

# **High-density Sustainability and Liveability— The Case of Hong Kong**

Prof. John NG<sup>1</sup>

Director, Hong Kong Green Building Council

---

<sup>1</sup> Corresponding Author E-mail: [john.ng@hkgbc.org.hk](mailto:john.ng@hkgbc.org.hk).

## **High-density Sustainability and Liveability— The Case of Hong Kong**

Prof. John NG

Director, Hong Kong Green Building Council

### **ABSTRACT**

*Hong Kong is renowned for its compact urban typology comprised of vibrant high-density development connected by an efficient public transport system. For years, the model serves Hong Kong well, giving rise to a thriving economy with a relatively low energy use per household. Like many other cities, it faces the immense risks of climate change and the universal quest for sustainable development. Hong Kong must strive for a transition to low-carbon living. Meanwhile the urban living environment of Hong Kong is facing multiple challenges: worsening air quality due to cross-boundary air pollution, marine and road-side air pollution, municipal solid waste, energy wastage, nature conservation and yet a shortage of housing supply, offices and quality public spaces. The multiplicity of these issues demonstrated that the sustainability of development is intricately connected with high-density liveability.*

*Examining reports on comparing sustainability and liveability across the world's major cities suggested that, while Hong Kong's strengths lie in its compactness, the low car ownership and bountiful natural environment, much remains to be done towards the other goals of social and environmental sustainability. In this regard, the building sector is of paramount importance for two major reasons: firstly, with the building sector consuming around 91% of the electricity of Hong Kong, the city simply cannot achieve low-carbon living without transforming this sector. Secondly, the built environment serves as topsoil for nurturing the much-needed liveable environment for the wellbeing of its people. A study of some of the highest-rating projects of BEAM Plus, the local green building labelling system, indicated that, while green building assessment encourages energy reduction and water saving practices, promotes excellent indoor environmental quality, as well as increases greenery coverage, there are a number of less explored areas. The roles and boundaries of green buildings must be readdressed to improve both sustainability and liveability in a high-density urban context.*

**Keywords:** BEAM Plus; Hong Kong; Liveability; Sustainability.

### **Biography**

*Prof. John NG is a professional Architect, Town Planner and Urban Designer. He has more than 30 years' experience in the planning, design, construction and project management of high-density housing and redevelopment projects. Awards of excellence were won by a number of these projects covering Architecture, Planning, Urban Design, Research and Green Building Design.*

*John has presented extensively in international and local conferences on sustainable communities, microclimate, high-density housing and community development. He is a Director of the Hong Kong Green Building Council, the Chairman of its Green Labelling Committee, Chairperson of the BEAM Society Limited, Honorary Secretary and Director of the Professional Green Building Council, and a Council Member of the Hong Kong Institute of Urban Design. He is Honorary Professor of the Department of Urban Planning and Design, University of Hong Kong, and Adjunct Professor of the School of Architecture, the Chinese University of Hong Kong. He is advisor and member of a number of government committees and NGOs, and an active volunteer in environmental protection, community development, green building and post-quake reconstruction.*

## **High-density Sustainability and Liveability— The Case of Hong Kong**

Prof. John NG

Director, Hong Kong Green Building Council

### **Introduction**

Located at the south-eastern tip of the mainland of China, at the mouth of the Pearl River Delta, Hong Kong is a small city with a total land area of 1,104 square kilometres. For years, Hong Kong develops itself into a thriving international financial centre with impressive economic development, while the city's stunning skyline continues to woo visitors around the world. With seven million inhabitants dwelling in this small city, Hong Kong is also one of the most densely developed cities with an average population density of 6,540 persons per square kilometre (HKSARG<sup>a</sup>, 2013). Mong Kok, one of the busiest districts in Hong Kong, hits the Guinness Book of Records as the most densely populated place on the planet, with over 130,000 people per square kilometre<sup>2</sup>. Adding to this immensity is the surging number of visitors to Hong Kong, which was almost 42 million in 2011 (Hong Kong Trade Development Council, 2012), and it is still on an increasing trend. How does Hong Kong attain sustainability and liveability commensurable to be Asia's world city in such high-density and compact urban environment?

This paper will focus mainly on the built environment and new buildings in particular. Firstly there will be a review in various international surveys on sustainability and liveability fronts, followed by an outline on the strengths and challenges faced by Hong Kong in its high-density development. In the second part, there will be an analysis of 57 building projects assessed by BEAM Plus, the local green building assessment tool between mid-2010 and mid-2013. The discussion will try to shed light on the role of buildings in driving high-density sustainability and improving liveability in Hong Kong. Finally, it will identify the less explored areas and indeed the roles and boundaries of green buildings which must be re-addressed to achieve both sustainability and liveability.

### **Positioning Hong Kong**

Comparing to other international cities, Hong Kong is considered economically vibrant and it continues to excel with its efficiency, vibrancy and diversity. On the sustainability front, the high energy consumption and higher levels of carbon emissions that come with it are the main concerns. Given the vast concentration of population and resources, the high energy consumption seems inevitable. Effective use of resources and energy is therefore particularly vital. Studies showed that high density development seemed to be a positive factor in reducing energy consumption (Norman et al, 2006). Earlier study by Newman and Kenworthy (1989) indicated that, population density had a negative relationship with fuel consumption per capita. As Figure 1 shows, comparing

---

<sup>2</sup> Source as adopted from blog post on <http://gohongkong.about.com/od/whattoseehk/ss/MongkokLadiesMa.htm>

to other major cities in the world, Hong Kong had extremely high population density with low average fuel consumption.

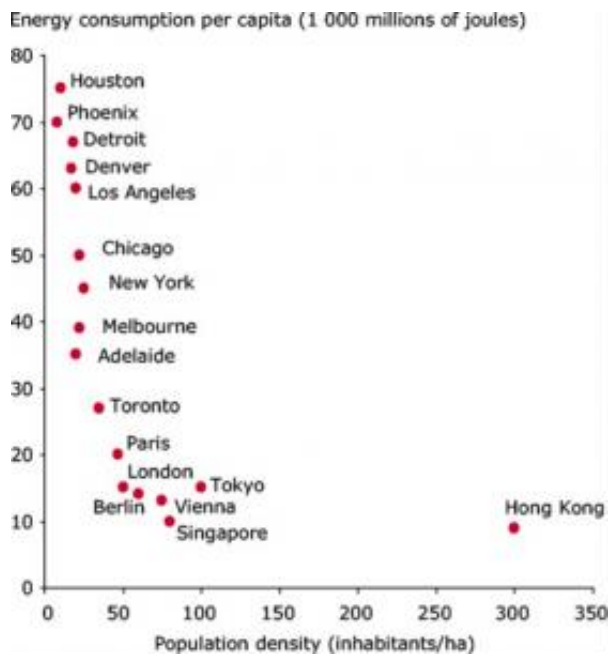


Fig 1. The relationship between energy consumption per capita and population density among major international cities <sup>3</sup>

While energy consumption and sustainability tops the urban agenda, the liveability of a city is getting increasing attention. The Centre of Liveable Cities and Urban Land Institute (2013) in Singapore examined the principles of achieving high liveability, particularly in high density setting. Figure 2 showed the distribution of world cities in terms of density and liveability, of which the latter is measured by Mercer's Quality of Living Survey (Centre for Liveable Cities and Urban Land Institute, 2013). Both Singapore and London achieved high liveability in a high density setting, while Hong Kong was falling behind in liveability. Likewise, in the world liveability survey conducted by the Economist Intelligence Unit (EIU) on international major cities in 2012, it measured parameters covering five categories, namely stability, healthcare, culture and environment, education and infrastructure. Hong Kong did not perform outstandingly in the survey (Economist Intelligence Unit <sup>a</sup>, 2012).

In a subsequent survey by EIU in 2012, Hong Kong was ranked the first as the Best Cities, based upon a new index, the spatially adjusted liveability index (Economist Intelligence Unit <sup>b</sup>, 2012). The new index is formed with an added category of spatial characteristics to the existing liveability index of EIU. As Hong Kong scored particularly well in spatial characteristics, which concern sprawl and natural assets, it got a substantial jump in the ranking to top the list, despite scoring in pollution and cultural assets were relatively low. The adjusted index sheds light on two important components of liveability - the provision of effective public transport and the access to the natural environment.

According to the latest population statistics, the birth rate of Hong Kong remains low, with the total fertility rate of 1,253 per 1,000 women, which is among one of the lowest of the world (HKSARG <sup>a</sup>, 2013). At the same time, with the longevity of the local

<sup>3</sup> Figure adopted from <http://parkwaycity.com/green-spaces/energy-vs-density-we-need-the-whole-story/>, the original graph is from Newman & Kenworthy, 1989).

population, of which male and female life expectancy is 80 and 87 respectively (HKSARG <sup>a</sup>, 2013), the population of Hong Kong is rapidly aging. The proportion of elderly people aged 65 comprised around 13% of the population in 2012, and it is expected to comprise 30% of population in Hong Kong by 2041 (HKSARG <sup>b</sup>, 2013). Considering liveability for elderly citizens furthers the meaning of liveability. The report by Stanford Center on Longevity (2013) states that “the concept of liveable communities calls attention to the ways the physical, social, and economic infrastructure of cities and towns can promote or hinder older residents’ ability to age in place”. While liveability in general applies to the quality of living of overall population, in practice, the population policy has to be taken into account including the steady growth of 150 daily individuals from the Mainland <sup>4</sup>. This is particularly relevant in view of tight housing supply and limited land resources, other services, amenities, etc. The liveability of Hong Kong has to take into account the changing demographic change and trend. This will not be discussed in this paper.

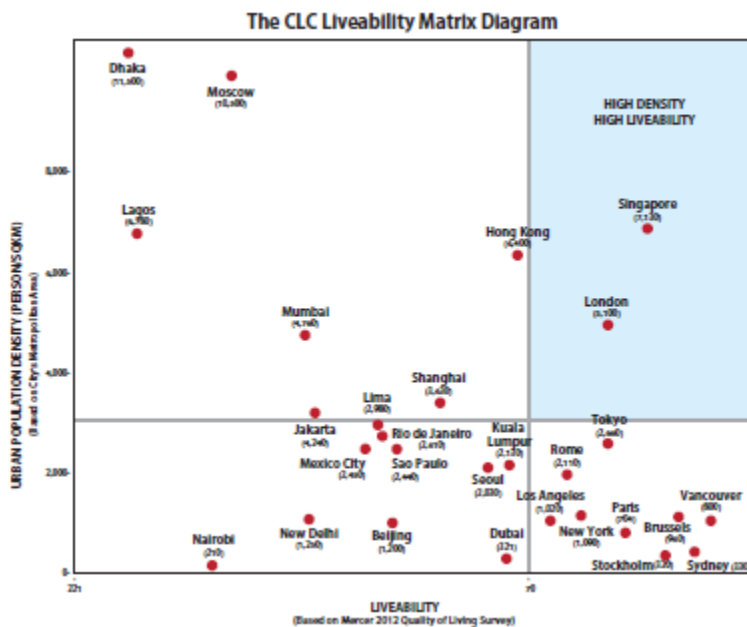


Fig. 2: The Liveability Matrix Diagram (Centre of Liveable Cities and Urban Land Institute, 2013)

### Wonders never cease

Almost twenty years ago, when visitors came to Hong Kong by plane, they would end up in one of the most “amazing” airport in the world, which was located exactly in the heart of a dense urban population. This explained why many visitors had an impression that Hong Kong was a dense concrete jungle. The high-rise compact urban development has an efficiently-run public transport system. The metro system in Hong Kong carries over 4 million passengers a day (MTRC, 2012), and the three major bus operators carry over 3 million passengers a day (HKSARG <sup>c</sup>, 2012). The extensive network of public transport ensures smooth flow of people from different locations with little reliance on private cars. According to the data of World Bank (2013), the number of passenger cars per population of 1,000 is 59 in Hong Kong, which is substantially lower than the world average of 124.3. From a sustainability point of view, the collective transport system reduces significantly the carbon footprint at an individual

<sup>4</sup> For additional information, please refer to [http://www.clc.org.hk/en/topics/immigration/for\\_non\\_residents/q1.shtml](http://www.clc.org.hk/en/topics/immigration/for_non_residents/q1.shtml)

level due to the low reliance on private mobility solutions. The well-developed transport system and infrastructure position the city favourably in a world calling for more collective mobility solutions.

With the operation of the new international airport at Chek Lap Kok, visitors now can have a peek of the beautiful countryside of Hong Kong upon their landing. Despite the dense urban inner city, about 75% of the territory is not developed and 40% of the land mass in Hong Kong is designated as country parks. Attributed to the enactment of Country Parks Ordinance in 1976, 24 country parks and 22 special areas, including marine reserves and the wetland park, were established for natural preservation, covering a wide land area of 44,239 hectares (HKSARG<sup>d</sup>, 2013). Above all, most of these country parks and natural reserves are easily accessible by public transport. They make the perfect hideaway for the city dwellers, and form a solid basis for long-term sustainability on ecology and biodiversity.

### **Pressing challenges**

Although Hong Kong has achieved remarkably in the areas of public transport and natural preservation, the city is also facing pressing environmental and social challenges.

Firstly, on the issue of air pollution, the health of the local population is put on a heavy toll with the deteriorating air quality in Hong Kong, most of which has to do with roadside pollution from outdated models of work vehicles as well as the often overlooked marine pollution. According to Clean Air Network (Hong Kong), a local NGO on fighting for clean air in Hong Kong, the mid-year Air Quality review on air quality showed that the local air pollution levels during the period of January to June 2012 exceeded the WHO's annual air quality guidelines, with only two exceptions (CAN, 2012). Great improvement has been found in 2013, with sulphur dioxide concentrations reduced by 25% on average comparing to 2011 levels, while roadside air pollution remains poor (SCMP<sup>a</sup>, 2013). Swift action is much needed. The Environment Bureau along with Transport and Housing Bureau, Food and Health Bureau, and Development Bureau issued in early 2013 a "Clean Air Plan for Hong Kong". It is intended to develop a comprehensive plan entailing solutions on roadside air quality, marine emissions, power generation and non-road mobile machinery. Diesel commercial vehicles (DCV) are the main sources of roadside pollution. A new DCV replacement programme aims at replacing the pre-Euro 4 DCV to Euro 5 model, along with other initiatives like urban greening, pilot green transport fund and regional fuel switch at berth for tackling marine emissions (HKSARG<sup>e</sup>, 2013).

Secondly, another inconvenient truth is waste management. At present, there are 13,458 tonnes of wastes disposed to landfills every day, of which majority is municipal solid waste (Environmental Protection Department, 2012). With limited land resources and the associated negative environmental impacts, landfilling is not an effective long-term solution for waste management. Subsequently, "Hong Kong Blueprint for Sustainable Use of Resources 2013—2022" was produced by Environment Bureau in May 2013 (Environment Bureau, 2013). It gives an overview on key actions the government would spearhead, including driving behavioural change through policies and legislative measures, mobilizing communities for waste recycling and reduction, as well as investing in needed infrastructures like organic waste treatment facilities. Specific targets include setting the target of reducing 40% of municipal solid waste (MSW) on a per capita basis by 2022, to transform the waste management structure by 2022 through recycling, incineration and landfilling; and to invest in organic waste

treatment facilities, waste-to-energy MSW treatment and landfill extensions. These proposals had been criticized heavily by some green groups and local citizens (SCMP<sup>b</sup>, 2013). Tackling the waste problem needs concerted efforts from the government, business community and the public, in particular, soliciting support from the public remains critical. The issue of the Blueprint report is a decisive first step in addressing the issue.

Thirdly, the building sector accounts for about 90% of the electricity consumption and more than 60% of GHG emissions (HKGBC, 2012). The city simply cannot achieve low-carbon living without transforming this sector. The built environment also serves as topsoil for nurturing the much-needed liveable environment for the wellbeing of its people. Therefore green building remains on the top of the agenda and takes a pivotal role to reduce energy consumption and respond to climate change. Apart from developing Kowloon East into a low-carbon community, an inter-departmental steering committee, under the lead of the Secretary for the Environment, was formed to promote green building. The committee will strengthen the co-ordination among government departments to formulate implementation strategies and action plans, while maintaining close dialogue and co-operation with relevant sectors and stakeholders (HKSARG<sup>f</sup>, 2013). This paper will focus on green building and its immediate built environment.

Fourthly, the preservation and conservation of nature, and the related ecological issues stay high in the public agenda and attract significant debates in most Environmental Impact Assessments relating to major developments, such as North East New Territories New Development Areas<sup>5</sup>, Lok Ma Chau Loop<sup>6</sup>, etc. With the extensive land mass dedicated as natural reserves, Hong Kong is blessed with rich biodiversity of flora and fauna, and all kinds of animals. Almost 3,000 kinds of flowering plants, more than 2,000 moths, 110 dragonflies and 230 butterfly species turn Hong Kong to their home (HKSARG<sup>g</sup>, 2013). More than one third of total bird species in China can be found in Hong Kong. The Mai Po Marshes was established as a restricted area for it is a major stopover point of Asia's migration routes for birds (HKSARG<sup>h</sup>, 2013). The wide range of species finding Hong Kong as their homes indicates that, the city is striking a delicate balance between its urban and economic development and that of natural preservation. Hong Kong, in response to China as one of the 193 contracting parties of the UN Convention on Biological Diversity since 2011, is now in the course of developing its Biodiversity Strategy and Action Plan before 2015 (AFCD, 2013).

Another critical challenge facing Hong Kong is the under-supply of housing, in particular affordable housing. With the limited land supply in Hong Kong, for years, the Hong Kong housing market has been criticised for its speculative activities. In recent years, the housing issue is again under the spotlight as there is a rising number of people living in substandard homes, including those notorious 'caged homes' and subdivided flats, which often lack basic amenities and are in poor hygiene and safety conditions. The Hong Kong Long Term Housing Strategy Steering Committee was formed in September 2012 to review and devise long-term housing strategy in Hong Kong (HKSARG<sup>i</sup>, 2012). The Consultation Document was released in early September 2013. It will be a supply-led approach with government taking a proactive role in the provision of public and subsidised housing. The overall housing supply target proposed is 470,000 in the next 10 years (HKSARG<sup>j</sup>, 2013), while the figure will be examined annually; priorities for housing would be given to elderly and people living in inadequate housing, including sub-divided units (HKSARG<sup>k</sup>, 2013). The issue of housing is particularly pertinent to the liveability of Hong Kong, if well planned and

---

<sup>5</sup> For information, please refer to <http://www.nentnda.gov.hk/eng/index.html>

<sup>6</sup> For information, please refer to <http://www.lmclloop.gov.hk/eng/study.html>

designed, the challenge may be a great opportunity to uplift overall liveability, attractiveness and sustainability of the built environment.

Adding to the under-supply of housing is the demand for office spaces. As the traditional central business district areas are approaching their full capacity, the shortage of office space is increasingly prominent. This can potentially hamper the vibrant business activities. The Financial Secretary announced a steady and adequate supply of Grade A Office in early 2011 (HKSARG<sup>1</sup>, 2013). Government is consolidating the existing CBD in Central and developing new office nodes outside the CBD, such as Kowloon East, Quarry Bay, Wong Chuk Hang, etc. The revitalization plan for the Kowloon East district posed a rare opportunity to address the issue. With the old industrial buildings no longer in use, many buildings are turned into commercial or hotel use through wholesale conversion and major retrofitting. The Government established a specialised office, 'Energizing Kowloon East Office', to oversee various visionary initiatives in the district to turn it into a second CBD as well as a low carbon and sustainable community. The estimated total supply of 5.4 million square metres of office space alone will double the existing stock in Central. It is expected that with the revitalization of the district, not only there will be an increase in the much needed office space, but also a vibrant and sustainable community with high quality public spaces (Development Bureau, 2013). The massive building supply and the transformation of the public realm pose challenges to our wisdom in urban development as well as some rare opportunities in creating low carbon urban living and making Hong Kong's second CBD more sustainable and liveable.

How do we address these multiple challenges? It is instrumental to adopt a holistic and integrated approach. The high density of population and buildings, intensity of activities, shortage of land supply, public objections will add on the complexity of the challenges. These challenges are all impacting on the liveability and sustainability of Hong Kong to varying degrees. A closer look into these issues indicated that many of these issues interact with one another. For instance seeking new land may be in contrast to the goals of nature preservation; building more homes and offices may shoot up electricity use; supporting local recycling often requires large plots of land, etc. A holistic approach in examining the liveability and sustainability is needed to embrace the complexity of the issues.

### **Liveability and sustainability**

Liveability attains to the "Quality of life is often tied to the opportunities available to people to the meaning and purposes they attached to their lives and to the extent to which they enjoy the possibilities available to them." (UN-Habitat, 2013). While Nobel Laureate Amartya Sen attributed "Quality of life is essential for any city to prosper (UN-Habitat, 2013)."

According to the Hague Centre for Strategic Studies, "urban liveability consists in the development of attributes and resources that help make the city pleasant to live in, and attractive for people, visitors and business (Chivot, 2011). The Hague Centre also raised that "sustainability" for the overloaded urban ecosystem is often the focal point of many environmental problems that influence global sustainability. The sustainability agendas and liveability initiatives often meet the same environmental, equity and economic goals; as a result, their definitions overlap substantially. It is considered that one of the conditions for improved urban liveability is actually sustainability (Chivot, 2011).



While achieving liveability in cities is desirable and perhaps necessary, the goal is sometimes in conflict with the burning issues facing sustainability. Peter Newton (2012) explored the liveability and sustainability of Australian cities, while many achieved a high standard in liveability, most of them also fell short to a high level of resource consumption—through both the inputs into the built environments and households. The Global Footprint Network (2012) states, “the global effort for sustainability will be won, or lost, in the world cities, where urban design may influence over 70% of people’s ecological footprint”. With the concentration of population, economic activities and buildings, it is of no surprise that cities and buildings are at the forefront to achieve sustainability.

The prominent role of cities in achieving sustainability can be demonstrated in a number of ways. As the report of WWF (2013) points out, 80% cities are responsible for as much as 80% of global greenhouse gas emissions. Taking the case of Hong Kong, according to the latest report by WWF (2013), it has an average per person Ecological Footprint of a 4.7 gha, which is much more than double of the 1.8 gha of the average global bio-capacity. In terms of categories of consumption, food and goods are major drivers for ecological footprint of Hong Kong, as it is substantially dependent on imports for all kinds of goods and food. In addition, a major portion of ecological footprint is carbon footprint. Being a city without major manufacturing industries, buildings account for about 90% of total electricity consumption in Hong Kong (HKGBC, 2012). The building sector is critically vital in steering Hong Kong towards a city of greater sustainability.

Before delving deep into sustainability issues on buildings, it is crucial to realize the intricate relationship between buildings and its surroundings. This is particularly valid for Hong Kong, the development of compact high-rise built environment coupled with narrow street structures largely upsets the air circulation in the city and creates an unpleasant walking environment in the city. A study by Planning Department points out “large built-up areas divorce themselves in a climatic sense from their surrounding landscape...contributing to the production of a separate urban climate lie in the far-reaching alteration of the heat budget and the local wind field<sup>7</sup>”. The study by the Planning Department in 2011 showed that the urban heat island effect in Hong Kong was intensifying, indicating that the temperature in urban areas was substantially higher than that in rural areas, as a result of the compact built environment and urban activities including vehicular emissions (Planning Department, 2011). Such urban heat island effect reduces thermal comfort and increase energy consumption in the urban areas. This will also discourage social activities at street level and the choice of natural ventilation of nearby buildings.

More importantly, as activities take place and humans interacts in buildings and in the areas between, the social impact of the built environment must be factored into the equation of urban liveability. As Jan Gehl’s famous work “Life Between Buildings” (Jan Gehl, 2011) pointed out, “Life between buildings offers an opportunity to be with others in a relaxed and undemanding way..., in public spaces the individual himself is present, participating in a modest way, but most definitely participating.” Research worldwide indicates the importance of streets for the community and also public health. The report by Civic Exchange titled Walkable City, Living Streets (Ng and Lau, et al, 2012) pointed out that Hong Kong streetscape is often characterised as a layered city where pedestrians travel along the elevated, street and underground level, such development is in opposition to good walkability and sense of community.” The report also emphasised that improved walkability is crucial for richer social life and social justice.

---

<sup>7</sup> Climatic booklet for urban development, as cited from Planning Department: Urban Climatic Map and Standards for Wind environment—feasibility Study  
[http://www.pland.gov.hk/pland\\_en/p\\_study/prog\\_s/ucmapweb/ucmap\\_project/content/reports/wp1a.pdf](http://www.pland.gov.hk/pland_en/p_study/prog_s/ucmapweb/ucmap_project/content/reports/wp1a.pdf)

## Green building as a solution

Buildings, as an infill to the urban fabric, affect not only the behaviour of their occupants, but also the physical attributes of the urban landscape and the sense of community. Of the 91% of the total electricity consumption, commercial buildings take the lead (65 %), followed by residential buildings (26%) (EMSD, 2012). Buildings and their users are therefore the source of the high levels of carbon emission, and yet a solution to reduce carbon emission also lies within them. If well thought out and designed, buildings can offer its residents a very high quality of life, use high density to their advantage, and reduce energy consumption effectively.

Items	% of projects achieved full scores
<b>A. Liveability Related</b>	
1. Meeting at least 50% of Hong Kong's Urban Design Guidelines, e.g. massing and intensity, height profile, view corridor, air circulation, streetscape character, circulation route, parking facilities, etc.* <sup>1</sup>	100%
2. Good security provisions that engender a feeling of wellbeing amongst building users	100%
3. Achieving good interior lighting quality	100%
4. Assurance of Indoor Air Quality (IAQ), e.g. meeting Good Class of IAQ Certification Scheme, reduction of odour from refuse collection chambers, providing adequate ventilation in car parks	94% to 100%
5. Enhancing the provision of facilities for persons with a disability	94%
6. Providing amenity features that enhance the quality of life and improve operation and maintenance	81%
<b>B. High Density Related</b>	
1. Good control of noise from building equipment such as fans and cooling towers	100%
2. Healthy drainage and air-conditioning system design to prevent transmission of diseases within high-rise buildings	100%
3. Good pollution management during construction including establishment of management plan and proper control of noise, dust and waste water	94% to 100%
4. Maintain neighbourhood daylight access	88%
5. Mitigation of vibration from building services and external sources	88%
<b>C. Resource/ Environment Related</b>	
1. Use of water-efficient appliances to reduce effluent discharge	100%
2. Provision of adequate metering, adoption of proper commissioning procedures and provision of adequate manuals and training to facilitate energy use reduction	88% to 100%
3. At least 20% of materials are manufactured within 800km	94%
4. Reducing the use of ozone depleting substances	88%
5. At least 50% of timber used is from sustainable source	81%

Table 1 – High Score Areas of the Platinum Projects

Hong Kong Green Building Council was established in 2009 to promote green building practices in Hong Kong. The Hong-Kong-based green building assessment system, BEAM Plus, offers a comprehensive assessment for buildings and embraces a wide

range of sustainability standards. Since its major overhaul in 2010, from mid-2010 to mid-2013, about 400 buildings have been registered for assessments. An analysis of the scoring patterns of the first 57 assessed projects including 16 highest-score Platinum projects was conducted. The scoring patterns of these 16 Platinum projects are also analysed separately to review the performance of the best performers. These 57 projects came from a fair spectrum consisting of commercial, residential, government, institution and community projects. For the ease of understanding, their different credit scores are divided into three categories: liveability related, high density related, and resource/environment related. Table 1 shows the common high-score areas of the 16 Platinum green buildings under these three categories.

On issues related to liveability, it can be seen that BEAM Plus has led to the creation of more liveable buildings with good amenities, environmental quality, good interior lighting and sense of security. The buildings are also socially more responsible as reflected by the enhancement of universal access. In relation to the high-density urban context, the designers and builders of green buildings are particularly conscious in minimising adverse environmental impacts including daylight blockage, equipment noise and vibration, and good pollution management during construction. Healthy design of drainage and air-conditioning systems in high-rise buildings are also emphasized, possibly due to lessons learnt from SARS and earlier incidents of Legionnaires' disease<sup>8</sup>.

In terms of resource and environmental impact reduction, the Platinum buildings commonly performed well in the reduction of peak electricity demand and energy management through metering, commissioning and training. They are also good at reducing effluent discharge, utilisation of locally manufactured materials, sustainable timber sources and reduced use of ozone depleting substances.

Rating achieved	% of projects got the rating	Average % of annual energy reduction
Platinum	28	30
Gold	21	23
Silver	10	17
Bronze	23	14
Unclassified	18	N/A

Table 2 – Energy Use Reduction among Different Classes of BEAM Plus Buildings

When the analysis is extended to all the 57 BEAM Plus assessed projects, it is found that the common high score areas are similar to the Platinum projects except that high scores are not commonly achieved in the top 2 to 3 items: amenity features, facilities for the disabled, interior lighting quality, neighbourhood daylight access, vibration mitigation, reduction of peak electricity demand, local manufacturing and sustainable timber source. These represent potential areas for enhancement.

In terms of annual energy use reduction, less than 25% of these 57 projects scored full marks. On average, the annual energy consumption of projects was lower than the baseline (i.e. building energy code) by 30%, 23%, 17% and 15% respectively for the Platinum, gold, silver and bronze projects (refer to Table 2). Substantial use of renewable energy is not yet common for buildings in Hong Kong, though currently there are some initiatives on using PV panels and bio-ethanol from waste cooking oil<sup>9</sup>. It may take some time before a wider adoption could take place.

<sup>8</sup> Further information can be obtained [http://www.news.gov.hk/en/categories/health/html/2013/05/20130531\\_195313.shtml](http://www.news.gov.hk/en/categories/health/html/2013/05/20130531_195313.shtml)

<sup>9</sup> For initiatives on renewable energy in Hong Kong, an example can be referred from Zero Carbon Building, <http://zcb.hkic.org/Eng/Features/renewenergy.aspx>

A report by Greenpeace on the role of BEAM Plus in reducing the average peak demand for electricity found that BEAM Plus would be a feasible solution for reducing electricity consumption (Chung, 2012). The study echoes the policy paper prepared by Hong Kong Green Building Council in 2012, "HK3030—A vision for a low-carbon sustainable built environment in Hong Kong by 2030", which proposes an absolute reduction of 30% electricity use in buildings by 2030 as compared to 2005 levels.

Items	% of projects achieved full scores
<b>A. Liveability Related</b>	
1. Enhancing microclimate around buildings, including air ventilation study, vegetation roof and light-coloured non-roof surfaces	2%
2. Adequate (40%) greenery on site and use of pervious materials for half of the hard landscaped areas	7%
3. Conserve and protect cultural heritage	9%
4. Achieving comfort through natural lighting and natural ventilation	7% to 16%
<b>B. High Density Related</b>	
1. Impact noise isolation between floors meets IIC52 for residential buildings	0%
2. Energy efficient building form, layout and orientation	9%
<b>C. Resource/ Environment Related</b>	
1. Adopting both rainwater harvesting and grey water recycling, each leading to at least 5% of fresh water saving	0%
2. Adequate use of rapidly renewable materials (2.5% minimum)	0%
3. Adequate use of renewable energy (2.5% of energy use or 100% of building footprint)	4%
4. Adequate use of recycled content (10% minimum) in exterior works, structures and interior components	5%
5. Adequate use of prefabrication (40% minimum)	5%
6. Reuse existing buildings	8%
7. Minimising embodied energy in structural materials	11%
8. Local transport, i.e. discourage the use of private vehicles	16%

Table 3 – Credits Less Commonly Achieved in the 57 Projects

### Opportunities for enhancement

Despite the encouraging results of high scoring areas of the Platinum projects, the analysis of the 57 projects also identified some areas in need of improvements i.e. full credits were less commonly achieved. From Table 3, for liveability related issues, there is room for improvement in enhancing microclimate around buildings and provision of adequate greenery on site, preserving cultural heritage, reusing existing buildings and achieving comfort through natural lighting and natural ventilation. Issues related to high density includes noise isolation between floors, passive design, energy efficient building form, layout and orientation. For credits related to resource and environment, there is room for improvement in the use of renewable energy, grey water recycling and low-energy structural materials. The high-rise nature and small footprint of Hong Kong's buildings could be one important barrier to the latter three aspects. Other pinch points of the projects include inadequate discouragement to private vehicles, recycled content in building materials, use of prefabrication and rapidly renewable materials.

Although these can be viewed as challenges to the building professionals, they also represent good opportunities for achieving greener buildings and enhancing the built environment.

When the analysis is restricted to the 16 Platinum projects, it is found that their pinch points are similar to the whole population of 57 projects, except that the percentages of projects achieving the credits are a bit higher. For example, in terms of greenery on site, the percentage of projects achieving the scores is 25% for Platinum, compared to 7% in the 57 projects.

### **Green community and neighbourhood development**

The analysis of the assessed projects suggested that, the performance of some aspects, like microclimate, greenery, cultural heritage, energy efficient layout and orientation, natural lighting, natural ventilation and local transport, depend not only on the design of buildings, but also the neighbourhood within which they are located. For instance, to improve the microclimate conditions and to ease the urban heat island effect, Air Ventilation Assessment (AVA) may be carried out to address the potential impact of buildings on air ventilation in the macro wind environment<sup>10</sup>. The low scoring in microclimate suggested that the issue deserves more attention. More importantly, as microclimate around buildings is impacted by more than one single building, the urban typology needs to be considered for a genuine improvement in the surrounding area. The crux of issues lies beyond a single building, thus the area around a particular building project has to be factored in. Other issues may be the amenity provisions, urban design and quality of the public realm, and the wider social-economic factors of the whole community.

As such, a stand-alone “green building” may not be necessarily green for the environment as a whole; a mere collection of “green buildings” may not result in a truly sustainable community either. HKGBC is now in the process of developing a new rating tool which embraces the high-density urban community and neighbourhood elements. One of the possible enhancements includes extending the assessment boundary beyond that of buildings to the surrounding area, so as to incorporate holistic thinking in the public realm and to place more emphasis on the open/public spaces in multi-block developments. The new tool will place emphasis on sense of place and community attributes and elements that bring building developments together into a community and relate it to the larger regional landscape. It will create a label, as well as a tool to quantify the quality of open space and urban design in a number of tangible criteria. It will serve and incentivize the creation of low-carbon sustainable communities environmentally and socially. It will encompass thoughtful neighbourhood planning which will limit the need for cars, improve connectivity and walkability, improve land use patterns, revitalise existing districts and improve neighbourhood quality, thereby creating more liveable and sustainable communities for the people of Hong Kong.

### **The existing building stock**

So far much of the focus of the discussion in this paper has been on driving sustainability in new building developments. However, the majority of building stocks in

---

<sup>10</sup> The Technical Circular is available at [http://www.devb.gov.hk/filemanager/en/content\\_679/hplb-etwb-tc-01-06.pdf](http://www.devb.gov.hk/filemanager/en/content_679/hplb-etwb-tc-01-06.pdf)

Hong Kong are existing buildings. Improving energy efficiency and environmental performance of existing buildings will be a crucial step in making significant changes to address issues on energy reduction. From December 2012 to May 2013, the HKGBC conducted a preliminary study on the major issues of its green assessment tool BEAM Plus EB (existing buildings). Based on 14 case studies of existing buildings, the study identified those credit items that might require modification as well as a number of opinions that stakeholders expressed concerning the scheme. These issues include: an overwhelming emphasis on buildings' inherent characteristics, occupants' areas outside applicant's control, too much reliance on scientific analysis, disturbance to building operation during re-commissioning, inadequate scope of coverage, and the required standards not achievable for aged buildings.

In response to the study, HKGBC builds on the results of this study and would commission a further consultancy to revamp the BEAM Plus EB. It is expected that the new tool may embrace an alternative path through which stepwise improvement efforts of aged buildings could be recognised. This would help the gradual transformation of Hong Kong to a greener and liveable city. There are also benefits from retrofitting existing buildings as opposed to pulling them down. Retrofitting older buildings can avoid the tremendous demolition waste and conserves the embodied energy within them. This can be viewed as a great improvement over the current weaker performance as shown in Items C6 and C7 of Table 3, i.e. building reuse and embodied energy in materials.

## **Conclusion**

Like many other world cities, high-density development and living are inevitable for Hong Kong. High density has its downsides for urban liveability; it also offers opportunities for sustainability. The case of Hong Kong shows how it strikes a balance between goals of sustainability and goals of liveability in urban development. If well thought out, planned and designed, the city can use its high density to its advantage and provides its residents with high sustainability as well as liveability. The high-density compact development model of Hong Kong provides a vital learning lesson for rapidly developing Asian cities, which are facing similar challenges in economic and social development.

While Hong Kong has derived high liveability from an efficient public transport system and bountiful natural assets, the city needs to strengthen its efforts in tackling air pollution, waste management, energy consumption in buildings, nature preservation, and provision of affordable housing and a steady supply of office space. While these issues are not wholly under the ambit of buildings, many issues are interconnected with them. Green building is a solution. Indeed, as indicated in the analysis of BEAM Plus assessed projects, green building assessment is useful in promoting energy efficiency. The results showed that, on average, the platinum buildings achieved an annual energy reduction of 30% as compared to code requirement. Enhancing energy efficiency and passive design in buildings can contribute to lower carbon emissions and steer Hong Kong towards sustainability. However, the substantial use of renewable energy has yet to be popularized for buildings in Hong Kong.

The BEAM Plus assessment scheme has led to the creation of greener, healthier and more liveable buildings. The impact is particularly strong in regard to pollution management and indoor environmental quality. The management of pollution is of particular relevance to a high-density urban environment where construction works are often carried out in close proximity to existing buildings. Regarding indoor environmental quality, good performance is common in IAQ and security provisions,

both of which enhance the liveability of the city. In particular, for Platinum projects, indoor environmental quality is also good in terms of interior lighting, provision of amenity facilities and special facilities for persons with disability. Another aspect that Hong Kong buildings commonly perform well is the control of noise from building equipment and the healthy design of drainage and air-conditioning systems.

The analysis also identified less explored areas and potentials for improvements, including the use of grey water recycling, improvement of microclimate around buildings, increased greenery on site, preserving cultural heritage, discouraging the use of private cars, use of rapidly renewable materials, energy efficient building form, recycling building materials, use of prefabrication, low-energy structural materials, reusing existing buildings, impact noise isolation between floors and achieving comfort through natural lighting and natural ventilation. All these improvements can be achieved through effective promulgation of green building assessment schemes and provision of sufficient market incentives for the key players to adopt the new building practices.

BEAM Plus has its own limitations because of its parametric constraints. There is a calling to go beyond itself to embrace the public realm, the wider community and neighbourhood development. Indeed the roles and boundaries of green building must be readdressed to facilitate a more holistic and integrated approach towards both sustainability and liveability in a high-density urban context. At the same time, reducing energy consumption and raising the liveability of the large stock of existing buildings remain an onerous task. HKGBC has now embarked on these two fronts with research and development works. Together with its ambitious HK3030 Campaign and many other community programmes, HKGBC will work together with all its stakeholders - the government, both private and public sectors towards the creation of a greener, more sustainable and liveable Hong Kong.

### **Acknowledgements**

The author would like to thank the Secretariats of the HKGBC for providing data. Particular thanks are extended to Ms Flora Lim and Ir Eddy Lau of HKGBC for their assistance in compiling the paper and presentation. The author would also like to thank the efforts of members of the task force on BEAM Plus Community/Neighbourhood Feasibility Study led by Mr. Larry Poon, members of the task force on Existing Building led by Mr. K M So, Prof Joseph M Chan for his valuable advice and the project owners for the use of their project information in the study and analysis.

## References

Agriculture, Fisheries and Conservation Department (AFCD), 2013. Introduction—The Convention on Biological Diversity [Online]. Available at [http://www.afcd.gov.hk/english/conservation/con\\_bsap/bsap\\_intro/bsap\\_intro.html](http://www.afcd.gov.hk/english/conservation/con_bsap/bsap_intro/bsap_intro.html) [Accessed 21 August 2013].

Centre of Liveable Cities and Urban Land Institute (2013). 10 Principles for Liveable High-Density Cities—Lessons from Singapore [online]. Available from <http://www.uli.org/press-release/10-principles-singapore/> [Accessed 15 August 2013]

Chivot, E., 2011. Livability and sustainability in large urban regions. Hague: The Hague Centre for Strategic Studies (HCSS) and TNO.

Chung, W., 2012, A feasibility study of the use of BEAM Plus to reduce electricity consumption and peak demands in Hong Kong [Online]. Available from [http://www.greenpeace.org/hk/Global/hk/publications/climate/2013\\_green\\_building\\_report\\_eng.pdf](http://www.greenpeace.org/hk/Global/hk/publications/climate/2013_green_building_report_eng.pdf) [Accessed on 18 July 2013].

Clean Air Network (CAN), 2012. Air pollutant level recorded in all monitoring stations exceeding WHO's standards [Online]. Available from <http://www.hongkongcan.org/eng/2012/07/air-pollutant-levels-recorded-in-all-monitoring-stations-exceeded-whos-standards%e2%80%8f/> [Accessed 15 June 2013]

Development Bureau, 2013. Legacy—To continue our successful story [Online]. Available from <http://www.ekeo.gov.hk/en/vision/legacy/index.html> [Accessed on 20 July 2013].

Economist Intelligence Unit <sup>a</sup>, 2012. A summary of the liveability ranking and overview—August 2012. [online] Available from [https://www.eiu.com/public/topical\\_report.aspx?campaignid=Liveability2012](https://www.eiu.com/public/topical_report.aspx?campaignid=Liveability2012) [Accessed 15 June 2013]

Economist Intelligence Unit <sup>b</sup>, 2012. Best cities ranking and report—A special report from the Economist Intelligence Unit [online]. Available from [http://pages.eiu.com/rs/eiu2/images/EIU\\_BestCities.pdf](http://pages.eiu.com/rs/eiu2/images/EIU_BestCities.pdf) [Accessed 15 June 2013]

Electrical & Mechanical Services Department, 2012. Hong Kong energy end-use data 2012 [Online]. Available from [http://www.emsd.gov.hk/emsd/e\\_download/pee/HKEEUD2012.pdf](http://www.emsd.gov.hk/emsd/e_download/pee/HKEEUD2012.pdf) [Accessed on 16 July 2013].

Environment Bureau, 2013. Hong Kong blueprint for sustainable use of resources 2013-2022 [Online], available from <http://www.enb.gov.hk/en/files/WastePlan-E.pdf> [Accessed 10 July 2013]

Environmental Protection Department, 2011, Urban Climatic Map and Standards for Wind Environment—Feasibility Study [Online]. Available from [http://www.epd.gov.hk/epd/english/boards/advisory\\_council/files/ACE\\_Paper\\_Annex2\\_3\\_2012.pdf](http://www.epd.gov.hk/epd/english/boards/advisory_council/files/ACE_Paper_Annex2_3_2012.pdf) [Accessed 10 July 2013]



Environmental Protection Department 2012. Monitoring of solid waste in Hong Kong—Waste statistics for 2011 [Online], available from <https://www.wastereduction.gov.hk/en/materials/info/msw2011.pdf> [Accessed 8 July 2013]

Gehl, J., 2011, Life between buildings: Using public space. Washington DC: Island Press.

Global Footprint Network, 2012, Footprint for cities [Online]. Available from [http://www.footprintnetwork.org/pt/index.php/GFN/page/footprint\\_for\\_cities/](http://www.footprintnetwork.org/pt/index.php/GFN/page/footprint_for_cities/) [Accessed on 10 July 2013].

Hong Kong Green Building Council (2012). HK3030—A vision for a low-carbon sustainable built environment in Hong Kong by 2030 [Online], available at [http://www.hkgbc.org.hk/upload/HK3030/Home/HK3030-Paper---Final-\(Version-1.0\).pdf](http://www.hkgbc.org.hk/upload/HK3030/Home/HK3030-Paper---Final-(Version-1.0).pdf) [Accessed 1 July 2013].

Hong Kong Special Administrative Region Government (HKSARG) <sup>a</sup>, 2013, Factsheet—Population [online]. Available from <http://www.gov.hk/en/about/abouthk/factsheets/docs/population.pdf> [Accessed 15 July 2013].

Hong Kong Special Administrative Region Government (HKSARG) <sup>b</sup>, 2013, Budget Speech 2013-2014—Embracing the challenges ahead [online]. Available from: <http://www.gov.hk/en/about/abouthk/factsheets/docs/population.pdf> [Accessed 20 July 2013]

Hong Kong Special Administrative Region Government (HKSARG) <sup>c</sup>, 2012, Factsheet—Transport [Online]. Available from <http://www.gov.hk/en/about/abouthk/factsheets/docs/transport.pdf> Accessed 15 August 2013]

Hong Kong Special Administrative Region Government (HKSARG) <sup>d</sup>, 2013, Fact Sheet—Country Parks and Conservation [Online] [http://www.gov.hk/en/about/abouthk/factsheets/docs/country\\_parks.pdf](http://www.gov.hk/en/about/abouthk/factsheets/docs/country_parks.pdf) [Accessed 18 July 2013]

Hong Kong Special Administrative Region Government (HKSARG) <sup>e</sup>, 2013, A clean air plan for Hong Kong [Online]. Available from [http://www.enb.gov.hk/en/files/New\\_Air\\_Plan\\_en.pdf](http://www.enb.gov.hk/en/files/New_Air_Plan_en.pdf) [Accessed 21 July 2013].

Hong Kong Special Administrative Region Government (HKSARG) <sup>f</sup>, 2013, Policy Address—Green Building [Online], Available from <http://www.policyaddress.gov.hk/2013/eng/p145.html> [Accessed 8 July 2013].

Hong Kong Special Administrative Region Government (HKSARG) <sup>g</sup>, 2013. The natural environment, plants & animals in Hong Kong [Online]. Available from <http://www.gov.hk/en/residents/environment/conservation/naturalenvplantsanimals.htm> [Accessed 12 July 2013].

Hong Kong Special Administrative Region Government (HKSARG) <sup>h</sup>, 2013. Factsheet—Country parks and conservation [Online]. Available from [http://www.gov.hk/en/about/abouthk/factsheets/docs/country\\_parks.pdf](http://www.gov.hk/en/about/abouthk/factsheets/docs/country_parks.pdf) [Accessed 20 July 2013]

Hong Kong Special Administrative Region Government (HKSARG) <sup>i</sup>, 2012. Composition of Long Term Housing Strategy Steering Committee Announced [Online]. Available from <http://www.info.gov.hk/gia/general/201209/13/P201209130427.htm> [Accessed 21 July 2013]

Hong Kong Special Administrative Region Government (HKSARG) <sup>j</sup>, 2012. Supply-led approach long term housing strategy [Online]. Available from [http://www.news.gov.hk/en/categories/infrastructure/html/2013/07/20130725\\_145730.shtml](http://www.news.gov.hk/en/categories/infrastructure/html/2013/07/20130725_145730.shtml) [Accessed 1 August 2013]

Hong Kong Special Administrative Region Government (HKSARG) <sup>k</sup>, 2012. Higher housing target tabled [Online]. Available from [http://www.news.gov.hk/en/categories/infrastructure/html/2013/08/20130807\\_141057.shtml](http://www.news.gov.hk/en/categories/infrastructure/html/2013/08/20130807_141057.shtml) [Accessed 15 August 2013]

Hong Kong Special Administrative Region Government (HKSARG) <sup>l</sup>, 2011. Speech by FS at seminar on office development [Online]. Available from <http://www.info.gov.hk/gia/general/201103/12/P201103120090.htm> [Accessed 16 August 2013].

Hong Kong Trade Development Council, 2012. Economic and Trade Information on Hong Kong [online]. Available from <http://www.hktdc.com/info/mi/etihk/en/> [Accessed 19 July 2013]

MTRC, 2012. Annual Report 2012—Key Figures [Online]. Available from [http://www.mtr.com.hk/eng/investrelation/2012frpt\\_e/E109.pdf](http://www.mtr.com.hk/eng/investrelation/2012frpt_e/E109.pdf) [Accessed 15 July 2013]  
Newman, P., & Kenworthy, J., 1989. Cities and Automobile Dependence: An International Sourcebook. Gower, Aldershot.

Newton, P. 2012, Liveable and Sustainable? Socio-technical challenges for twenty-first-century cities, *Journal of Urban Technology*, 39(1), 81-102.

Ng, S., Lau, W., Brown, F., Tam, E., Lao, M. and Booth, V., 2012, Walkable city, living streets [Online]. Available from [http://www.civic-exchange.org/wp/wp-content/uploads/2013/04/201210walkability\\_en.pdf](http://www.civic-exchange.org/wp/wp-content/uploads/2013/04/201210walkability_en.pdf) [Accessed on 12 July 2013].

Norman, J., MacLean, H., and Kennedy, C., 2006. Comparing high and low residential density: life-cycle analysis of energy use and greenhouse gas emissions. *Journal of Urban Planning Development*, 132(1), 10-21.

South China Morning Post <sup>a</sup> (SCMP), 2013. Delta air quality improves, but roadside pollution worse in Hong Kong [Online], available from <http://www.scmp.com/news/hong-kong/article/1226266/pearl-river-delta-air-quality-improves-roadside-pollution-worse-hong> [Accessed 12 July 2013]

South China Morning Post <sup>b</sup> (SCMP), 2013. Chief Secretary takes cases for landfill expansion to Tuen Mun Councillors [Online], available from <http://www.scmp.com/news/hong-kong/article/1280402/chief-secretary-takes-case-landfill-expansion-tuen-mun-councillors> [Accessed 29 July 2013]

Stanford Center on Longevity, 2013. Livable Community Indicators for sustainable aging in place. Available from <http://longevity3.stanford.edu/wp-content/uploads/2013/03/mmi-livable-communities-study.pdf> [Accessed 20 July 2013]

United Nations Human Settlements Programme (UN-Habitat), 2013, State of the World's Cities 2012/2013 [Online]. Available from <http://www.unhabitat.org/pmss/listItemDetails.aspx?publicationID=3387> [Accessed 16 July 2013]

World Bank, 2013. Data—Passenger Cars per 1,000 people [Online]. Available from <http://data.worldbank.org/indicator/IS.VEH.PCAR.P3> [Accessed 16 July 2013]

World Wide Fund for Nature (WWF), 2013. Hong Kong Ecological Footprint Report 2013 [Online]. Available from [http://awsassets.wwfhk.panda.org/downloads/hong\\_kong\\_ecological\\_footprint\\_report\\_2013.pdf](http://awsassets.wwfhk.panda.org/downloads/hong_kong_ecological_footprint_report_2013.pdf) [Accessed 3 September 2013]