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ABBREVIATIONS

CCAP – CLIMATE CHANGE AWARENESS PROGRAMM
EPD – ENVIRONMENTAL PROTECTION DEPARTMENT
ERP – ELECTRONIC ROAD PRICING
ESI – ENVIRONMENTAL SUSTAINABILITY INDEX
EXCO – THE EXECUTIVE COUNCIL OF HONG KONG
GDP – GROSS DOMESTIC PRODUCT
GVR – GREEN VEHICLE REBATE
HKPSG – HONG KONG PLANNING STANDARDS AND GUIDELINES
HK SAR – HONG KONG SPECIAL ADMINISTRATIVE REGION
MEWR - MINISTRY OF ENVIRONMENT AND WATER RESOURCES
MILU – MULTIPLE AND INTENSIVE LAND USE
MND - MINISTRY OF NATIONAL DEVELOPMENT
MOT – MINISTRY OF TRANSPORT
MRT – MASS RAPID TRANSIT
MSW – MUNICIPAL SOLID WASTE
MTI - MINISTRY FOR TRADE AND INDUSTRY
MTR – MASS TRANSIT RAILWAY
NEA – NATIONAL ENVIRONMENT AGENCY
NENT – NORTH EAST NEW TERRITORIES LANDFILL
NGOS – NON-GOVERNMENTAL ORGANIZATIONS
NUS – NATIONAL UNIVERSITY OF SINGAPORE
OECD - ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT
RQ – RESEARCH QUESTION
SA – SUSTAINABILITY ASSESSMENT
SENT – SOUTH EAST NEW TERRITORIES LANDFILL
SDGs – SUSTAINABLE DEVELOPMENT GOALS
SDI – SUSTAINABLE DEVELOPMENT INDICATORS
SEC – SINGAPORE ENVIRONMENT COUNCIL
SUD – SUSTAINABLE URBAN DEVELOPMENT
UGS – URBAN GREEN SPACES
UNDESA – UNITED NATIONS DEPARTMENT OF ECONOMIC AND SOCIAL AFFAIRS
UNDP – UNITED NATIONS DEVELOPMENT PROGRAMME
UNFCCC – UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE

URA – URBAN REDEVELOPMENT AUTHORITY SINGAPORE

VQS – VEHICLE QUOTA SYSTEM

WBCSD – THE WORLD BUSINESS COUNCIL FOR SUSTAINABLE DEVELOPMENT

WCED – WORLD COMMISSION ON ENVIRONMENT AND DEVELOPMENT

WENT – WEST NEW TERRITORIES LANDFILL

WTA – WASTE-TO-ENERGY

INTRODUCTION

The rapid growth of cities worldwide has profound consequences for the environment. At the same time, urbanization plays a crucial role in promoting prosperity, social, cultural and economic development. Recent studies predict that the world is set to face a drastic change by the year 2050, by which 70% of all population is expected to relocate from rural to metropolitan areas, with worldwide population growth reaching 9.7 billion people (United Nations Department of Economic and Social Affairs, 2017). According to the United Nations Development Programme (UNDP) (2017), cities only cover 1% of the world's surface, but their economic and ecological footprints are much more profound. Precisely speaking, cities currently account for over 70% of the world's greenhouse gas emissions and use around 80% of the world's energy (UNDP, 2017). At the same time, the ratification of the COP21 Paris agreement, which holds the temperature rise of the global average to below 2C degrees entered into force on 4 November, 2016. The Sustainable Development Goals (SDGs) were introduced in 2015, with an aspiration of "Transforming our World: the 2030 Agenda for Sustainable Development", the 11th goal of which aims to make cities and human settlements "inclusive, safe, resilient and sustainable" (Sustainable Development Knowledge Platform, 2017). In this context, embedded by policy implementation, uncertainty, population increase, urban growth, economic prosperity and sustainability discourse, two coastal city-states of the Republic of Singapore and Hong Kong Special Administrative Region (HK SAR) will be compared.

In order to better facilitate understanding of sustainable urban development (SUD), this thesis will solely concentrate on key urban development areas only. Through a thorough literature review, observations from the media sources, Non-governmental Organizations (NGOs) and first-hand dialogues with researchers in related fields, a selection of issues was identified to be addressed in this research. As such, aspects related to waste management, land use and transportation, thus further defined as infrastructure, have been specifically chosen for this study. With regard to

sustainability measurement, the author sees evident to create a precise dimension of sustainability assessment, for a detailed study of this topic. Hence, the above-mentioned fields of infrastructure will be evaluated from the perspective of comparing policy documents and their implication with regard to urban sustainability. This research will, therefore, concentrate on the current trends of policy implication with regard to waste, land and transportation development. As such, this paper aims to investigate current issues by looking at similarities, differences and possible future scenarios in the sphere of a city's environmental approaches.

Concluding from the above, the following Research Question (RQ) will be predominant throughout this study:

- *With reference to Hong Kong and Singapore, what are the differences and similarities between sustainable infrastructure policies?*

Study Limitations

Due to the scope of this paper, only the coastal city-states of Hong Kong and Singapore have been selected for this study and for the following reasons. Hong Kong, being a major financial, post-colonial harbour city with a population of over seven million people on a limited land, is one of the most densely populated cities in the world (Government of Hong Kong, 2017). As such, the growing population here would immensely contribute to the already existing environmental issues such as air pollution, energy consumption, transportation, water security and waste management. At the same time, it would undoubtedly bring cultural and life-style changes to the inhabitants. The current sustainable city development program has been greatly discussed with some projects being on the way, however more is expected from the government – whose decisions are highly dependent on the approval of the Communist Party of China. Thus, the comparison of policy documents directly related to sustainable development will shed light on the present, past and future scenarios.

Singapore, on the other hand, has been selected as a comparison as the most progressive, innovative and green city-state of the region, with recent projects setting an overall example of innovation, prosperity and environmental regulations in South East Asia. With a population of over five million residents within an area of 682.7 square kilometres, Singapore also ranks as one of the most densely populated regions of the world (Tan, 2006). However, its history, its independence and transition from a fishing village to a global city differs to that of Hong Kong. At the same time, its vegetation and tropical climate has played a greater impact in the process of city transformation, bearing in mind its green belt network. Both Hong Kong and Singapore are most vulnerable in the case of population increase in relation to space allocation. Hence, population growth and urbanization phases will play a crucial role in foreseeing solution network for sustainable urbanization processes.

Structure of the thesis

The following paper is divided into three chapters. The first chapter introduces the objectives of the research, the state of the art, theoretical frameworks and methodology for the chosen subject. The second chapter analyses current trends in sustainable infrastructure policies of Hong Kong and Singapore by evaluating problems, solutions and possible outcomes in the fields of waste management, green space allocation, transportation and land reclamation. Finally, the concluding chapter analyses the results of the research, assesses empirical evidence in relation to the research question and proposes further ways of exploration of the topic.

Primary Definitions

As this paper aims to look into various aspects and discourses of urban development and its implications, it is necessary to provide certain definitions for the purpose of clarity of the research. The more precise explanation of each definition and its relevance to the analysis will be provided in the subsequent chapter.

Firstly, it is evident to provide a definition for urban development followed by a definition of infrastructure and most importantly, sustainability. Subsequently, an interpretation of policy and its precise purpose in this paper shall further enrich the objective of this research.

Urban Development

As defined by Yang, Xu and Shi (2016), urban development can be associated with development processes of natural environment. More precisely, it concentrates on the “performance at improving the national standard of living”, and represents “a sign of the country’s development in terms of economy and comprehensive national strength” (Yang, Xu, Shi, 2016:869), while also involving the movement and settlement of people. Frank (1999), on the other hand, associates urban development with “strategies to foster changes in land use patterns” (p. 6), while also focusing on certain aspects of land use category, such as, for instance, ‘residential’, ‘transportation’, ‘recreational’ or otherwise.

Infrastructure

For the purpose of this paper, the study of infrastructure will be identified as a sub-division of urban development, thus a crucial component of urbanization processes. As identified by Beeferman and Wain (2012) from the University of Harvard, infrastructure can be defined as a set of “facilities, structures, equipment or similar assets [...] that are vitally important, if not absolutely essential, to people having the capabilities to thrive as individuals and participate in social, economic, political, civic or communal, household or familial, and other roles critical to their own well-being” (p. 15). In particular, infrastructure plays a crucial role in the functioning of urban environments, supporting technical structures and providing water, roads and the like. Thus, the discourse on infrastructure has been chosen in order to put a mere perspective on urban development, to narrow down the aspects of this research and to find out specific controversies for each field.

Sustainability

The most common definition of sustainability (used precisely with reference to sustainable development) and the one which will be predominant throughout this research, is taken from 'Our Common Future' published by the United Nations World Commission on Environment and Development (WCED), (1987), and refers to:

"development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (p. 54). And further: "the concept of 'needs', in particular the essential needs of the world's poor, to which overriding priority should be given; and the idea of limitations imposed by the state of technology and social organization on the environment's ability to meet present and future needs" (United Nations, WCED 1987:54). As such, sustainability advocates economic, social and governmental factors, in an effort to obtain sustainable outcomes for future generations. The goals of social and economic development shall, therefore, form from the general consensus of sustainability as a foundation factor of all development.

Policy

As characterized by Francesch-Huidobro (2014), policy (and subsequently, in its process – *polycymaking*), can be defined as a mechanism of providing solutions to current concerns by means of identifying knowledge and experiences to current problems and particular situations. More precisely and in relation to policy documents, the attribution of policy can be viewed as a specific institutional response or stance or procedure to a defined situation. As such, and with a particular emphasis on policy documents, this paper categorises any document published by an institutional body or an organization referring to sustainability as a *sustainability policy*. In doing so, this paper therefore, strives to draw conclusions by comparing different policy documents related to (but not limited by) the sustainable infrastructure.

CHAPTER I

1.1 Urban Form, Cities and the Environment

“In a period of intensifying globalization, urban life draws people into zones of intense interconnectivity. Cities are places of passion, hopes and dreams. However, they are entering an epoch of protracted crisis” (James, 2015:3).

Sustainable urban development has been researched and analysed by numerous scholars, however, a full understanding of the exact patterns of urban growth and its practice in relation to sustainability is yet to be finalised. Notably, the most prominent environmental concern within the framework of sustainable urban development amongst various scholars, has been concentrated around inefficient land use with potentially harmful consequences to future generations. However, this concept can also be extended to a city's infrastructure efficiency such as waste management, transportation and other necessary activities concentrated within a given city. Therefore, in an attempt to understand sustainable urban development, it is first necessary to look at the bigger picture and determine what urbanization and urban development processes consist of.



Figure 1. Comparison of different urban forms and settlements between London (United Kingdom) and Hong Kong SAR. Source: LSE Cities, 2017.

In defining human settlements and analysing the characteristics in which we create conditions for safety and prosperity, urban form plays a significant fundamental

configuration identified by built-up areas, density and boundary (including shape) as indicated in Figure 1. As defined by Oliveira (2016), urban forms are the physical elements of our cities, incorporating the more complex elements of buildings, streets, open space structures and their inhabitants. Urban forms, in relation to urban development as a whole, are a representation of human activity within its natural context, whereby water supply, geographical conditions, land relief and natural occurring conditions all play a significant role. Urban form is, hence, an essential component in the overall understanding of urban development, as it helps to identify the patterns in which cities continue to grow and urbanize (Oliveira, 2016).

The study of spatial distribution of people (or people density) is especially interesting in the overall study of urban form, development and cities for the purpose of analysing sustainability networks. Mike Jenks and Colin Jones (2010) argue that the dimensions of a sustainable city can be defined under densely populated regions. They state that it is precisely these features that contribute heavily to sustainability and create more coherent urban developments. At the same time, these are not necessarily favourable from the perception of the inhabitants, as density creates problems such as overcrowding, traffic congestion and increased amount of waste, subsequently creating a general discomfort. The authors bring examples of 'eco-cities' from around the world, emphasizing the idea of creating an eco-city within a bigger perimeter of a city in order to test their hypothesis. However, the danger of this solution lies within the concentration of ideas associated with an eco-city only, whereby the bigger city may neglect the proposed solutions and continue its development under a *business as usual* scenario. At the same time, the authors argue that the city's environment is unlikely to be able to formulate a single spatial or physical solution for sustainability, but instead is dependent on the context it is applied within (Jenks, Jones, 2010).

The developer of the Garden City concept – Ebenezer Howard, has been praised as the most influential city planner, whose concepts are still relevant to the present day's urban development. His ideal urban landscape, as analysed in "To-morrow" (published in 1898), noted the development of long term urban growth, which

would be “contained within slumless, smokeless cities” (Freestone, 2002:71). In his studies, Howard emphasized that the urban development should concentrate on the greenery (i.e. gardens, arable land and parks) outside of the city, thereby creating a tight urban boundary between cities. With such vision, Howard aimed to re-create a harmonious nature consisting of an equilibrium between urban form and humankind. However, this vision may have been neglected in the shadows of population growth and the necessity to shelter growing populations. On the other hand, the recent re-developments of Singapore gardens and green spaces can be very much attributed to this planning.

Throughout the process of defining urban development, it has become evident to also draw the line of where urban development meets rural surroundings. Bob Giddings et al. (2005), discuss the transformations of cities in the last centuries, from the rather contained forms of the past, to the widespread urban sprawl of the present day. They argue that as industrialization took place, cities developed a new pattern of suburban migration from city centres to surrounding towns and rural areas. At the same time, as cities became more mobile, transportation between rural and central areas became more accessible, thus the borders of a city becoming more difficult to define (Giddings et al. 2005). In the context of Hong Kong and Singapore, however, the urban and rural borders are easier to define, as both areas are constrained within land scarcity as well as geographic borders (Hong Kong with the Chinese border and Singapore with the Malaysian border). As such, in this paper Hong Kong and Singapore will be defined under the category of a *compact city*, which will be analysed in more detail further along this thesis.

Interestingly, the notion of a compact city (Jenks, Burgess, 2000) has been of significant debate towards sustainable urban development in recent studies. It introduces the concept of a ‘short distances’ urban design idea, whereby points of interest can be easily reached via public transport, walking or cycling, which as a result, reduce energy use and pollution. The idea of a compact city also encourages a certain layout of urban density. In both Hong Kong and Singapore, the attribute of a

compact city is easily noticeable as their density and space allocation fall under the category of tall buildings, mixed land uses and relatively short distances.

The concept of Multiple and Intensive Land Use (MILU) as discussed by Lau et al. (2005) has been associated with the principles of a compact city, yet it analyses the particular use of land resources of dense populations. Specifically, “the central theme of MILU is to intensify the use of land resources within single sites through high residential densities and mixed land uses, supported by public transport and pedestrian-based facilities” (Lau et al., 2005:153). The study is attributed by the ‘city within a city’ concept, whereby a mixed land use plays a crucial role. The main characteristics here are examples of skyscrapers with “sophisticated mixing of various uses” (Lau et al., 2005:155) of residential, office, social, institutional and transportation purposes. Within this context, the human flow as well as transportation movement creates a healthy and equal distribution of city dwellers on horizontal as well as vertical levels. This, according to the scholars, creates a practical alternative to urban sprawl, optimizing land resources and thus creating a more sustainable urban form (Lau et al., 2005).

Hugh Millward (2006) discusses the differences between various growth management approaches within cities. The variety of so-called ‘containment’ within cities can vary from compact to dispersed, with various degrees of bound (as illustrated in Figure 2). The author demonstrates how strict restrictions on city development can influence bounding between the inner and the outer belt, by creating longer commutes, more dispersed communities and segregated access to amenities. By decreasing the management control over development boundary (as indicated in options C and D; Figure 2), the size of the bound increases, with the final stage (as illustrated in option E, Figure 2) reaching a chaotic pattern, whereby infrastructure, housing and countryside areas become affected. This illustration can be thus applicable to the development of both Hong Kong and Singapore and may also be relevant to describe the policy adjustments of certain dispersed or compact city approaches, in relation to the development phases of the above-mentioned city-states.

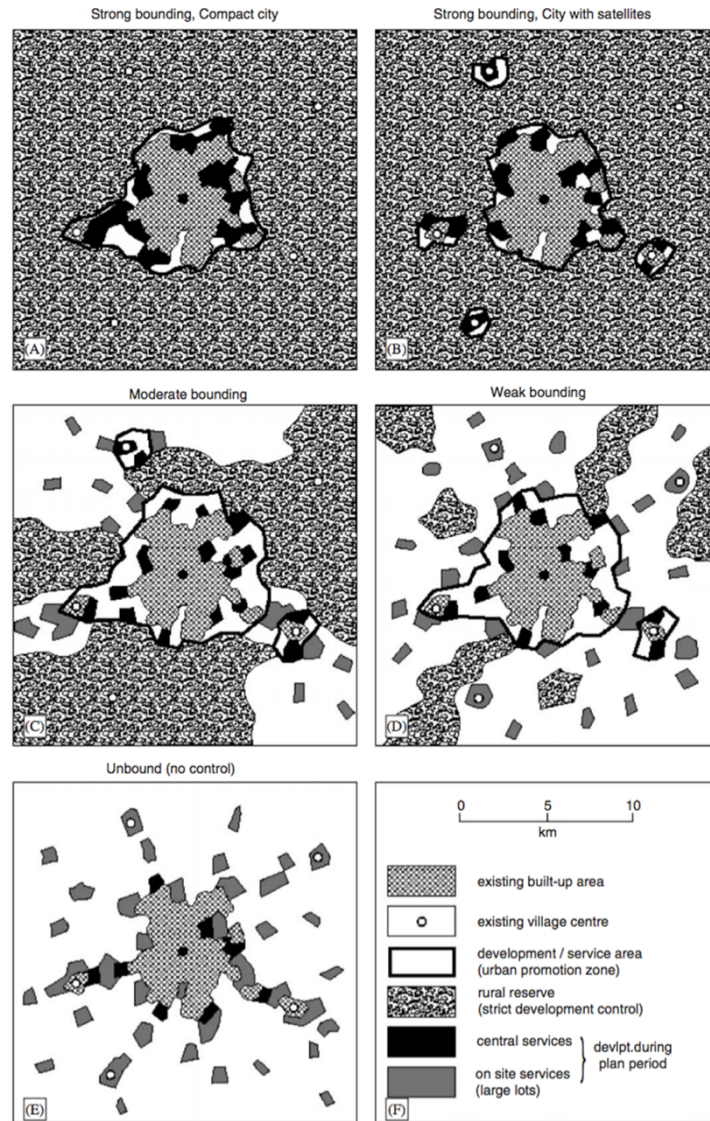


Figure 2. Five strategic options for urban containment: conceptual patterns for a medium-sized metropolis. Source: Millward, 2006:475.

The policies of a compact city, as underlined by an Organisation for Economic Co-operation and Development (OECD) report titled ‘Compact City Policies: A Comparative Assessment’ (2012) concentrates on the green growth of urban areas, while still practicing regional economic growth and prevention of environmental degradation. Thus, the three indicators which define ‘compact cities’ in the document fall under the following categorization:

1. “dense and proximate development patterns;
2. urban areas linked by public transport systems;
3. accessibility to local services and jobs” (OECD, 2012:27-28).

Concluding from the above, Singapore and Hong Kong can thus both fall under the category of a compact city (however, different circumstances need to also be taken into consideration), the benefits, disadvantages and the degree of sustainability of which, are crucial to address in this paper.

It can be argued that urban policies defined for the concepts of compact cities go hand-in-hand together. In this respect, the “Compact City Policies: A comparative assessment” (OECD, 2012) presents a thorough assessment of multi-dimensional policy approaches within the context of urban sustainability. The document argues that “it is crucial for policy makers at the national level to understand the potential of compact city policies and include them as appropriate in national urban policies” (OECD, 2012:20). Thus, the concept of a compact city may be reflected in policy implementation at a national level. At the same time, it is crucial to note that compact cities are more vulnerable to natural disasters and need to be made resilient to those risks. More so, the notion of a compact city, as argued in the report, is largely underestimated at present and needs to be considered when looking into sustainability assessment methods and must be reflected in the policy assessment practice.

Chan and Yung (2004) from the Polytechnic University of Hong Kong, have conducted questionnaire-based research on the concepts of a compact city and dense urban development in Hong Kong. The research consisted of an analysis of natural resources, social infrastructure, cultural vibrancy, environmental quality and mobility with an emphasis on provision of adequate living and open spaces, public transport, cultural vibrancy in a dense city environment - as considered sustainable - by the scholars. In addition, the legal system and the policies in relation to the above-mentioned issues of urban development have been established. The results of the questionnaire identified gaps in sustainable approaches to legal provisions and administrative measures. Specifically, the Building Department, the Planning Department and the Lands Department of the Government of Hong Kong Special Administrative Region tend to overlap in their development control mechanisms, which in return, create confusion and disparity in relation to planning regulations

(Chan, Yung, 2004). In addition, the scholars conclude that there is a missing link between land use policy and its implementation between different departments, which shows that administrative innovations are critical with respect to the sustainable dense development of Hong Kong.

Sustainable urban development, however, does not solely concentrate on the city's design structure, its compactness, form and density, but also on the aspects of infrastructure, whereby providing adequate facilities in relation to economic prosperity. As such, "adequate infrastructure includes provisions related to both physical infrastructure, such as water supply, sanitation facilities, drainage, roads, solid waste disposal facilities as well as land management" (Pinderhughes, 2008:9).

In his study, Raquel Pinderhughes (2008) argues that "infrastructure services are essential to economic activities, coping with density and population growth, improving living standards, reducing poverty, raising productivity, protecting the environment, and promoting social and environmental equity" (p. 9). Badly managed infrastructure services, on the other hand, would lead to environmental degradation and despair. Notably, the scholar states that from the historical perspective urban infrastructure has been designed and run with very little understanding of the environmental and social impacts, and thus mainly remains relying on the non-renewable and contaminating sources to the present day.

Admittedly, it is crucial to point out that infrastructural and economic development in the context of sustainable urban development are interdependent, with wealthy and industrialized cities consuming vast amounts of resources (often being imported) and producing vast amounts of waste (often being exported), due to higher consumption rates (Pinderhughes, 2008). Hence, urban development can often rely on problematic, unsustainable models of infrastructure, whereby creating unsustainable urbanization processes. With a high emphasis on waste management as one of the biggest components of sustainability measurement in infrastructure and hence, sustainable urban development, it is evident to emphasize the importance of reuse and recycle scheme, by encouraging policies which stress

material exchange and promote careful consideration of waste production. By doing so, as many examples and scholars show, the idea of sustainable development will become less vulnerable, creating public awareness and material utilization processes.

André Sorensen (2004) analyses the importance of mixed land use, transportation and policy implementation with regard to sustainable infrastructure. In his research, he points out to the importance of strict restrictions on gasoline car purchases in relation to investment in automobile infrastructure. He argues that the automobile industry promotes creation of a bigger urban sprawl, which allows scattered, as opposed to compact, land development. In such instances, the extensive development of land outside of the city advocates dispersed metropolitan growth away from rail links, hospitals, schools, offices and retail, whereby promoting longer and less sustainable commute as well as air pollution. Sorensen's view, however, can also be applied to other infrastructure related policies, such as waste management, energy consumption, water distribution and so on.

In an effort to better understand the current issues of sustainable infrastructure in the selected regions, a selection of recent studies conducted by the graduate students of the National University of Singapore (NUS) have been looked into in order to facilitate first-hand information and identify predominant issues from the graduates in the related field. Cheow and Heng (2014) identify problems of waste management with a specific emphasis on recycling in the region of Singapore. Currently, there remains only one landfill (contradictory to Hong Kong currently operating four landfills), which is expected to be filled by the year 2040, given the current waste management rate. The research thus concluded that there is still room for a better facilitation of waste management in Singapore, with a specific emphasis on food recycling, packaging agreement (and the lack thereof), recycling payment schemes and better integration of recycling opportunities for high-rise housing blocks (Cheow, Heng, 2014).

Khian and Ming (2014) develop a study on coastal green spaces of Singapore with an emphasis on infrastructural, ecological, physical and social impacts and the general

management strategies of the selected parks. The research was predominately conducted to find out the current issues associated with the areas, specifically in relation to banner campaigns and signage placement throughout the greenery network. The results showed that legislation campaigns such as non-smoking and nature conservation tactics seem to work well, whereas littering seems to still be a predominant issue throughout the green areas. At the same time, the authors suggest that complementing and educative enforcements in relation to environmental banners would be considered much more friendly, communicative and rewarding as opposed to strict fines, and would in turn enhance affirmative behaviour and positive environmental attitude from the park visitors (Khian, Ming, 2014).

A relatively recent article published by The Economist (2015) discusses the issues of land reclamation in relation to cross-border political and legal complications. Unsurprisingly, the article addresses environmental consequences as a result of dredging and its effects on local biodiversity. In addition, the criticism in the field of sand purchases from neighbouring countries and the environmental consequences those countries will now face is immense, with a 2003 legal United Nations Convention on the Law of the Sea addressed from Malaysia (The Economist, 2015). In Hong Kong, a similar situation can be observed, with Victoria harbour being filled due to the shortage of land, which as a result has been squeezed to less than half of its original width and is predominantly under construction projects affecting the nearby environment.

At the same time, introduction of such actions as policies and regulations have also been implemented and are expected to succeed in the years to come. With regard to sustainability scheme, Singapore is introducing tougher vehicle pollution regulations and “mandatory air suction waste systems” (Koh, 2017). With this scheme in place, future residents of private apartment blocks will be able to use chutes for recyclable and non-recyclable waste and will encourage the general recycling awareness campaign. In Hong Kong, on the other hand, the waste disposal payment, which is

expected to be implemented by the year 2019, is set to meet a target of a 40 per cent reduction in household waste by the year 2022 (Kao, 2017).

Paul Zimmerman, an elected councillor of the Southern District representing the Pokfulam constituency in Hong Kong, is a predominant figure in environmental concerns. As a CEO of 'Designing Hong Kong' and a Director of 'Civic Exchange' - a public policy think-tank, Zimmerman has published numerous investigations and reports stating his current concerns with regard to sustainable urban development of Hong Kong. His current advocacy concentrates in the areas of waste management, traffic regulations and controls, greening advocacy, air pollution and public housing developments. In this regard, 'Civic Exchange' has been contacted by the author of this paper to get first hand opinions and reports on the issues of sustainable infrastructure and will be further included in the empirical part of this research.

1.2 Theoretical framework

“Sustainable development is development that improves the long-term health of human and ecological systems” while “sustainable urban development improves the long-term social and ecological health of cities and towns” (Sorensen et al., 2004:4).

On the basis of various theoretical ideas and frameworks put forward by a diverse range of scholars, this section of the paper will thrive to create a set of criteria under which the SUD can be defined, with a certain emphasis on policy implementation. Subsequently, the methodological framework criteria deriving from those theories will be used in order to analyse and compare sustainable infrastructure policies of Hong Kong and Singapore and subsequently answer the RQ of this thesis.

1.2.1 Sustainability

It is generally argued that the idea of sustainability is a relatively new phenomenon, with the first mention of sustainability presented in a report by the UN WCED under the title 'Our Common Future' (1987) as mentioned in the previous section.

Subsequently, the concept of sustainable cities was introduced at the Rio de Janeiro Earth Summit in 1992 (Brand, Thomas, 2005). Furthermore, the consecutive implementation of Agenda 21 (United Nations Conference on Environment and Development) created local adaptations of sustainability assessments by urban authorities in major developed countries. In return, the local authorities, businesses and NGOs were challenged with the new concept of an interdepartmental cooperation in an attempt to address the challenging concept of urban development in relation to sustainability.

Sustainability relates to a variety of processes but most importantly - the behavioural aspects - as all activities reflected in the processes of urban development are, in fact, initiated by human progress. The use of land, the design, the resources and the infrastructure of our cities are all a reflection of how far we've come in relation to development. It is in this respect that we need to learn how to use our resources sustainably and how to approach the ability to sustain, support and prosper without compromising the future generations. Urban development should thus reflect a vision of sustainable behavioural patterns with recycling, reduced consumption, mixed-land use, green transport and interconnected green spaces.

1.2.2 Urban Development

As mentioned formerly, there are many definitions of 'sustainability' and the ways in which the concept of sustainability can be interpreted. Even more so, the definition combined with the words 'urban' and 'development' implies many more integrities and assumptions. With this in mind, Jabareen's (2008) ethical paradox of sustainable development brings valuable objectives in a broad attempt to define theoretical frameworks of sustainable development. In particular, the scholar argues that the concept of 'sustainability' gains a brand-new categorization when the idea of 'development' or 'urbanization' is added. With this in mind, the underlying concepts of development and urbanization trigger certain aspects of intervention and imply the use of additional natural and economic resources, energy as well as man-power.

As such, the concept should in addition concentrate on the ideals of society and the capital economy accordingly (Jabareen, 2008).

Urban development, as identified by Vreeker, Nijkamp and Munda (2007), covers a wide range of land use rehabilitation activities such as urban land use, transport systems, energy management, architecture and even the urban cultures and behaviours. In its essence, urban development has existed for hundreds of years, with the first settlements arranged in a very simple and transparent way. Nowadays, urban development is associated with designing urban futures where infrastructure, human needs and development meet the appropriate resource allocation and prosper without any prolonged consequences to the environment.

1.2.3 Sustainable Urban Development Around the Globe

Andr  Sorensen, Peter Marcotullio and Jill Grant (2004) present a very thorough visual diagram on the main differences between the Asian, European and the U.S.A. sustainable urban development patterns as indicated in Figure 3. The scholars very clearly reflect the projection of the GDP per capita, car use per capita, roads, urban density and the total percentage per passenger in kilometres transit from the European (cities chosen for the experiment: Frankfurt, Amsterdam, Zurich, Brussels, Munich, Stockholm, Vienna, Hamburg, Copenhagen, London and Paris); U.S.A. (states chosen for the experiment: Phoenix, Denver, Boston, Houston, Washington, San Francisco, Detroit, Chicago, Los Angeles and New York) and Asian (places chosen: Singapore, Tokyo, and Hong Kong) cities and states. As can be seen from the diagram, the patterns of urban development are very different and do not fall under the same trajectory. On the contrary, it shows how a different approach needs to be taken into consideration when dealing with sustainable urban development from different continents, development stages, cultural advances and economic stance. In addition, the consideration of previously adapted development stages needs to also be taken into account.

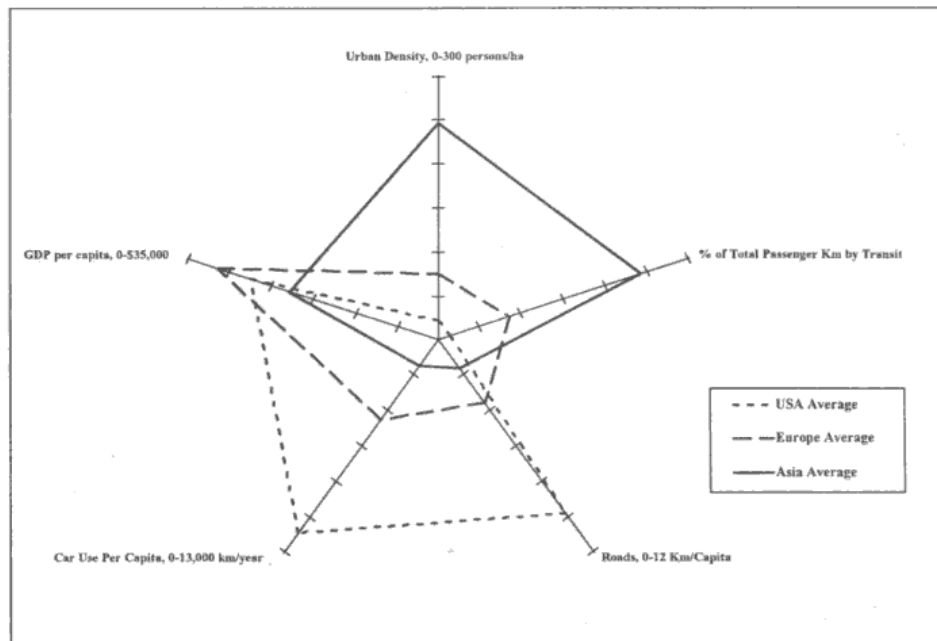


Figure 3. "The three worlds of sustainable urban development." Source: Sorensen et al., 2004:15.

As can be concluded from Figure 3, the European, Asian and the US urban development patterns differ drastically in the above-mentioned criteria. The main differences shown are the density, commute, car use per capita and the total road length. As the results show, these differences derive not only from the land and natural resources availability, but also from the previously adopted policies. Consequently, the coordination and integration of the strict manner at which the policies and integrations have been accepted or neglected, as well as the level of urban containment are also crucial when analysing urban development patterns. In this regard, the theoretical frameworks of sustainable urban development must indulge in acquiring understanding of European, American and Asian urban developments.

1.2.4 Sustainable Urban Development in the Context of Asian Environments

Many Asian cities have emerged on an immense scale and very often on a scarce land with difficult weather and natural disaster conditions and continuous dense populations. From the historic point of view, the development of Asian cities has undergone slower patterns of infrastructure development, specifically in the areas of water supply and waste management systems. In this regard, the rapid urbanization

patterns in Asia often times, face many problems at once. Some of these can be attributed to population increase, which consequently leads to a lack of urban infrastructure to attain the growing population, shortfall of housing, adequate transportation and access to amenities. In most Western cities, on the other hand, patterns of infrastructure development, educational establishments and population growth develop more gradually and in response to urbanization. Asian cities, however, tend to straggle with multiple environmental development issues simultaneously due to a more rapid urbanization patterns and population growth, and are arguably struggling to provide solutions.

In order to facilitate an understanding of sustainable urban development in the context of Asian environments specifically, a nearly complete theoretical framework criterion under which sustainable urban development can be defined needs to be constructed. Hence, a wide variety of strategies and detailed understanding of local issues as well as regional, socio-economic, technological and political visions need to be taken into account. With an emphasis on Asian experience and its rapid growth, the certain aspects of economic development and the compact city phenomena mitigate from the general consensus on sustainable urban development. In this respect, one needs to take into account the fact that certain patterns of development can be considered sustainable, whereas others cannot. With this respect, the notion of a compact city has been seen as a predominant factor of urban development within the context of Southeast Asian environmental approach.

1.2.5 Sustainability in the Context of a Compact City

The notion of a compact city, with a predominant occupation of this research, derives from the essence of a solution network to dense populations, transportation systems, infrastructure policies and mixed-land use. Its main goals in achieving shorter distances travelled by the occupants and more intense usability of building and housing units provides solutions to problems such as air pollution and energy use, and may thus be considered environmentally friendly and viable. However, can

this theory be really attributed to being sustainable solution for development and urbanization processes?

Nowadays, the idea of a compact city is prevalent throughout city planning, urbanization and sustainable development approach. It is predominant in the world of architecture and city planning literature and is openly criticised, appraised and, at the same time, acclaimed by city planners, scholars and the like. And while the concept of a compact city may appear imperative in the instance of rapid population growth, urbanization and sustainability approach, its complexity and actualization may prove otherwise. At the same time, the contemporary compact city approaches can indeed prove to be sustainable in certain aspects of infrastructure. But many questions remain unanswered, while the urgency for sustainable urban development becomes more critical.

It is evident that the notion of a compact city implies shorter travel distances and more compactness in relation to the theory of a wide sprawl. However, compact city approach thus far proved to bring issues such as air pollution, waste management and cultural difficulties of inhabitants, due to a close proximity of living. In the instance of Hong Kong and Singapore, however, the compact household approach has been predominant since the early stages of urbanization in those areas, hence, the social perspective of living in denser spaces is less troublesome than in that of the urban sprawl.

As highlighted by Burgess (2000), the predominant interest in the compact city achievement over the past decade has been specifically European, with developed countries (such as the U.S.A., Europe, Japan and Australia) being considered under the compact city development policies. Many of the countries located in the region of Asia, on the other hand, have little or insufficient documentation of a compact city approach, due to their economic development stages. Hence, the documentation of a compact city policy approach in the region of South East Asia is relatively new, and contains less accountability and reliability (Burgess, 2000).

It is hence, not surprising that the European Commission has been the strongest advocate for the compact city policies realisation in the region of Europe and has been conducting numerous analyses of the study. One of the latest reports on the compact city strategies has concluded that even though many European cities have successfully adopted some aspects of the compact city policies, it is yet too soon to assume the overall success of the scheme. On the contrary, many aspects of the European approach to the compact city development may not be compliant to the regions outside of Europe; neither do they prove to be sustainable. As such, the concept should remain open, flexible and adaptable (Science for Environment Policy, 2012).

While the region of South East Asia may seem to have an ideal preliminary for compact city realisation due to a close relationship between compact urban form and the notion of sustainability, not all factors central for a sustainable urban development are included. Gugger and Kerschbaumer (N.d.) argue that there is little proof for the compact city policy development and implementation to be favourable towards more vulnerable classes of society and lower income groups. From the economic and development stance, those groups already experience dense living conditions, which showcase ecological and social problems and are nowhere near to being sustainable.

In the instance of a middle-class group, however, the scholars prove an opposing theory, in which case the CO₂ emissions saved due to the compactness of the city (which, in its essence, minimizes the travel bound), will be spent elsewhere, i.e. for leisure travel and weekend getaways. In this particular case, the emissions saved due to the compactness of the city, will instead appear elsewhere outside or within the same city premises (Gugger, Kerschbaumer, N.d.).

1.2.6 Urban Modelling

It appears evident that sustainability factors and the ecologic footprint of a given city remain largely influenced and mainly the product of the urban population increase

within the given city and its economic output. Henceforth, the economic, social and ecologic sustainability are crucial elements of what characterises 'sustainable urban development', and are predominant factors of this definition. Within the framework of this paper, however, the aim of which is to study sustainable infrastructure policies of Hong Kong and Singapore from the perspectives of waste management, green space allocation, land reclamation and transportation, the socio-economic and environmental factors are hence crucial within the theoretical section of this research.

However, the question arises: how can sustainability be measured in order to be assessed? In an attempt to analyse the degree of sustainable growth, a number of factors have been developed by a range of scholars, including modelling of urban sustainability assessment and indicators. In 1995, Mitchell, May and McDonald introduced a methodological framework on various modelling techniques in the field of sustainable development. Inspired by the 1992 United Nations Conference on Environment and Development in Rio de Janeiro, the scholars stress the need of indicators that measure sustainable urban development based on the communication, demonstration and desirable outcome of data (Mitchell et al., 1995). Specifically, the questions tackled along the complexity of development processes with respect to cities and urbanization prioritised the need for a modelling scheme. At the same time, bearing in mind the sustainability concept alongside the specific problems of spatial scale (precisely, the scholar raises questions such as: "what is a city?" and "how are city activities related to impacts beyond their boundary?" (Mitchell, 2007:114)) remain part of a complex debate.

Furthermore, urban modelling, as argued by Mitchell (2007) is a relevant process in defining sustainable development, especially in the field of city development, its infrastructure and urbanism. The process, however, also implies relationships between various elements, interactions between space, people and land-use policies. Thus, "assessing the long-term impact of policy instruments on city sustainability is a significant challenge, but one that is greatly assisted by a systematic approach in which modelling is employed as a key approach to handling system complexity"

(Mitchell, 2007: 115). The initial steps, in the process of model implementation, must, however, derive from a 'kit-bag' (Mitchell, 2007) of policy tools "comprising of numerous specific instruments in the broad areas of strategic planning, legislation, economic instruments, technology and education" (p. 114). With this in mind, the author presents "Instruments for sustainable development" (as displayed in Table A) with a precise formulation of various policy objectives and examples of application. The below listed instruments are thus especially relevant in relation to constructing a set criteria for defining sustainable urban development and further applying some of the aspects of this criteria to define the SUD in order to subsequently answer the RQ of this paper.

<i>Policy instrument</i>	<i>Example application in energy sector</i>
Strategic planning is the co-ordination of key urban functions at local and regional level. It often addresses land-use planning to manage competing economic, social and environmental needs. It also seeks to provide the appropriate infrastructure required to address identified needs, and deliver key services. Infrastructure may include transport and utility networks, public buildings housing key services (schools, hospitals) and central functions such as waste disposal facilities.	• Land-use control to locate energy source near use point to reduce transmission loss (e.g. district heating schemes). • Land-use control to reduce travel demand. • Provision of facilities to recover energy from waste (digesters, landfill biogas collection, incinerators). • Development and exploitation of renewable energy sources. • Public transport infrastructure provision.
Technology Technological solutions to development problems have often merely created new problems of shifted the costs of development elsewhere, often impacting on the environment or populations that gain no direct benefit from the development. Nevertheless, there is a role for technology in promoting sustainable development, particularly through clean technologies and those that promote the efficient use of resources, and exploitation of renewable energy.	• Efficiency in production of energy. • Design and construction of energy-efficient buildings (insulation, passive energy use, heat exchangers). • Energy-efficient processes (e.g. reuse of breaking energy in vehicles, thermostatic controls). • Renewable energy sources; solar, bio-gas, wind and waves. • Telematics to reduce travel demand.
Economic instruments are increasingly been seen as powerful tools with which to promote sustainable development, and may take several forms, including direct manipulation of price (e.g. pollution charges, resource use taxes); indirect alteration of price or cost using subsidies; and market creation (e.g. tradable permits).	• Subsidies for energy conservation measures. • Demand management through price control. • Internalisation of environmental and social costs in charges, • Public transport subsidy. • Carbon taxes.
Legislative controls involve the establishment and policing of minimum standards. Often the prevailing social, economic or cultural circumstances mean that such standards are routinely ignored.	• Implement and police emission standards. • Implement and police energy-efficiency standards • Mandatory purchase by power companies of energy supplied derived from non-fossil fuel sources.

Education and awareness-raising is required so that individuals and organisations are better able to make informed decisions about their activities which have sustainability implications.	• Energy efficiency advice. • Driver advice for fuel economy. • Encourage attitudinal change through education (e.g. feedback and costs/impacts of energy use).
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Table A. Instruments of sustainable development. Source: Mitchell, 2007:114.

The table presented above (A) is seen especially favourable in the fields of strategic planning and economic instruments, whereby the scholar presents possible policy decision for co-ordination of key urban elements such as spatial planning, infrastructure (specifically, waste management and transportation) and land-use at local and regional level. With regard to economic instruments, an investigation into resource use taxation, pollution charges and direct manipulation of price seems evident in the process of comparing infrastructure related policies of Hong Kong and Singapore. Henceforth, the model of application (in this instance in energy sector), is evident in relation to infrastructure sectors and will be divided amongst the transportation, green space allocation, waste management and land reclamation policies.

1.2.7 The Role of Indicators

Even though the success of modelling in assessing sustainability is undoubtedly large, the so-called Sustainable Development Indicators (SDI) seem to be more prominent in the determination processes of urban sustainability. Constructed specifically to indicate certain aspects of decision-making, progresses or failures, in the above-mentioned field, indicators have been one of the major holistic ways of understanding the depths of sustainable development.

An indicator can be considered as an “operational representation of an attribute (quality, characteristic, property) of a system” (Waas et al., 2014:5520), whereby a system represents elements of achievement in a broader context. This set of criteria is then applied within a certain more specific context to conclude or analyse a certain process. In this respect, Waas et al., (2014), propose a great number of

theories for the purpose of sustainability measurement, with a certain emphasis on the indicator framework. Specifically, the scholars look into the aspects of complexity and compromise within the field, in an attempt to present the results of the sustainable development to policy-makers and the general public.

Henderson's (1991) view on sustainability indicators (as cited in Bell and Morse, 2003), portrays a good example of the importance of selection processes of indicators for policy implementation. In particular, the author stresses that "only transparent and tangible indicators that people can readily understand and visualise and relate to their own lives will provide the desired political constituency for needed governmental policy" (Henderson, 1991:176 as cited in Bell, Morse, 2003:44). Otherwise, the scholar fears, the lack of transparency and coherence in communication levels will result in certain aspects of neglecting and demotivating phases in response to a given issue.

However, empirical implementation and analysis of data contains preliminary stages of research and does not merely rely on statistics. For this objective sustainability diagrams and indices are indeed helpful in selecting and processing various sources of information. For this reason, "the relationships between indicators, data and information" (Bell, Morse, 2003:46) plays an important role in constructing measurement criteria for sustainability approach. The below Figure (4) represents the initial stages of data processing for the purpose of information realisation as conducted by Braat, 1991 (cited in Bell, Morse, 2003).

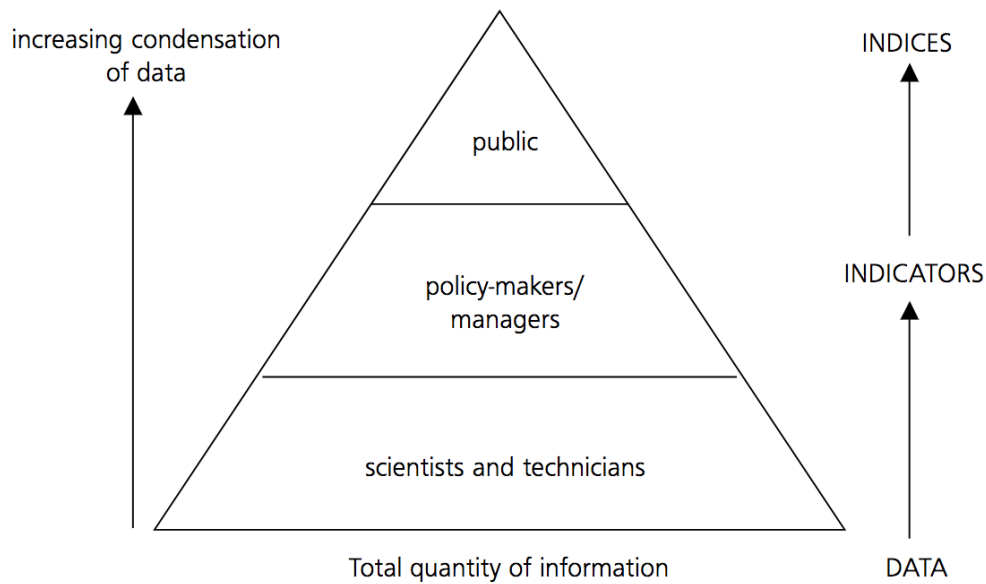


Figure 4. “Relationships between indicators, data and information’ based on the OECD pyramid of indicator sets.” Source: Braat 1991, as cited in Bell, Morse, 2003:46.

As such Figure 4, identified as ‘The pyramid of indicators sets’ portrays a relationship process between data collection and accountability to presentation and interpretation. As one moves from the top level (where the highly characterised and specific set of indicators would be located), to the lower level, the indicators become increasingly complex and less specific. In this instance, the figure represents the importance of selecting the right set and quantity of information and processing it in accordance with the given objective in order to achieve the right set of indicators for the assessment of sustainability processes.

The main aspects in acquiring a precise set of indicators for sustainability measurement lies in the essence of asserting targets for stakeholder and decision-makers and creating reference system for a certain group of advocates. In this respect, the main purpose of the sustainability indicators lies in policy planning processes and communication tools. Consequently, the aim of the indicators should also portray an understanding of the linkage between the economic, social and environmental systems and to help identify ways in which those connections can and should be improved. The use of SDI, as concluded by various scholars, should then alert the decision-makers to formulate policy documents accordingly and to foster a necessary action with reference to sustainable development. However, the

success of this implementation is still very much arguable to the present day, with a present debate concluding that there is a severe lack of communication between scientists and policy-makers on the local, national and international level, thus creating a great degree of disparity between science and policy.

In this context, “those working with the concept in a policy-making context ought to consider that assistance to development, which does not take into account environmental protection issues, is criticized as bureaucratic, subservient to vested interests, unresponsive to people’s needs, and generally failing in its objectives” (Francesch, 2004:142). As such, policy documents need to address the issues of sustainability from a much broader and a more accepting point of view. However, to the present day, it may seem as the environmental concern has been largely intertwined between the institutional, rather than a community driven initiative (Brand, Thomas, 2005).

In the instance of sustainable urban development, governance encompasses a strategic form of social coordination, determining objectives, standards and ways forward. In this process, a set of necessary policy implications determines the degree of sustainability approaches and action-plans. The role of urban governance in relation to urban and spatial organization and social change is hence significant in establishing the necessary documents with relation to sustainability (Brand, Thomas, 2005).

It is worth mentioning that a certain degree of community involvement is also crucial in summarising on what is needed to define indicators for sustainable urban development. Social sustainability is an important aspect with respect to understanding people’s values, needs, concerns and expectations and should be reflected in the decision processes of policy formulation (Bell, Morse, 2003) and certainly also, vice versa. One of the many examples of social sustainability and involvement of cultural and social community aspects in understanding sustainability performance and indicator development is the Environmental Sustainability Index (ESI) published by the Yale University’s Center for Environmental Law and Policy and

Columbia University's Center for International Earth Science Information Network (CIESIN) in collaboration with the World Economic Forum and Joint Research Centre, European Commission (Esty et al., 2005). The document outlines the 21 indicators of environmental sustainability, in response to a wide range of issues related to community and human involvement, including the aspects of: "reduction of human vulnerability to environmental stresses" and the necessity of "societal and institutional capacity to respond to environmental challenges" (Esty et al., 2005:2). With regard to the sustainable urban development goals, the theoretical framework of social sustainability is also highly relevant, as both the human vulnerability and social and institutional capacity with regard to environmental challenges are also prominent.

A great example of the use of indicators in analysing sustainability levels of a given city is depicted in the 'Methodology and Indicator Calculation Method for Sustainable Urban Mobility' report (2014) from The World Business Council for Sustainable Development (WBCSD). A selection of 19 indicators was used in order to develop a comprehensive analysis of sustainable mobility within cities in order to implement new measures for mobility practices and policies (WBCSD, 2014). The report is targeted at transportation related issues and is aiming to be performed repeatedly in order to assess the best measures in the context of selecting and calculating the necessary indicators.

However, to this day, significant frauds and misinterpretations remain evident with regard to sustainable development indicators and their implication in real life scenarios. There are certainly severe challenges in analysing science, the environment, the human impact and the economic development, their relationship and the ways in which sustainability can be measured. Additionally, there seems to be a significant misinterpretation between theoretical and scientific discoveries and the ways in which those are being presented by institutions.

Concluding from the above, sustainability indicators are a well-established tool for sustainability assessment of a given city, region or a particular area of expertise or a

system. However, most of the SDIs do not necessarily reflect other aspects of sustainability such as economic or social, as they mostly rely on assessments of environmental responses and physical attributes of a given framework. Therefore, in attempting to analyse certain progress of a sustainable urban development, it is crucial to establish an assessment which would cover most attributes and reflect fairly on the overall sustainability assessment.

1.2.8 Relevance of Policy Documents on the Study

As defined in the introductory part of this research, a selection of governmental documents will be used in order to analyse infrastructure related policies of Hong Kong and Singapore. In this respect, Maria Francesch (2004) argues that the concept behind policy making can be attributed to three main tenets such as: 1) futurity; 2) welfare and 3) equity. Futurity, must address the future scenarios and look at the commitment to resources that may only show beneficial results in the future. Welfare, on the other hand, should not be limited to addressing the GDP but also take the “meaning of development in terms of quality of life and the carrying capacity of the environment upon which economies rest” (Francesch, 2004:142). Finally, equity, should look into a fair and equal allocation of resources and that their production is aimed at long-term endurance and prosperity of economies. In their essence, the three concepts should challenge the policy-makers in the process of decision making and address the ideals of identifying the criteria between the “what we need” and “what we get” (Girard et al., 2007).

In this context, “those working with the concept in a policy-making context ought to consider that assistance to development, which does not take into account environmental protection issues, is criticized as bureaucratic, subservient to vested interests, unresponsive to people’s needs, and generally failing in its objectives” (Francesch, 2004:142). As such, policy documents need to address the issues of sustainability from a much broader and a more accepting point of view. However, to the present day, it may seem as the environmental concern has been largely

intertwined between the institutional, rather than the community driven initiative (Brand, Thomas, 2005).

In the instance of sustainable urban development, governance encompasses a strategic form of social coordination, determining objectives, standards and ways forward. In this process, a set of necessary policy implications determines the degree of sustainability approaches and action-plans. The role of urban governance in relation to urban and spatial organization and social change is hence significant in establishing the necessary documents with relation to sustainability (Brand, Thomas, 2005).

Within the framework of urban sustainability, the role of institutions and governance in the process of policy composition should predominantly concentrate on working together in an effort to establish a connection between various institutional sectors. In addition, the sustainability actions in citizens need to be fully supported and initiated by ways of local governance, whereby creating new sustainable behavioural patterns becomes a norm. As such “urban sustainability polic[ies] require active cooperation of citizens on the practical level of everyday behaviour” (Brand, Thomas, 2005:20). In doing so, a distinctive pattern of governmental and citizen interaction with particular set of objectives should emerge (i.e. policies), in an attempt to achieve sustainability processes of urban life.

1.3 Methodology

“If urban regions are to develop sustainably, we do not have time to wait for a full understanding of urban processes. Rather, we must apply the available tools, and work towards their more effective application as our understanding of cities grows”
(Mitchell, 2007:114).

As cities around the globe progressively introduce various sustainable urban development plans with an aim to a more secure and desirable urbanization process,

the concept of sustainability measurement remains open to much of a debate amongst scholars and the like. The question of sustainability varies between country-to-country depending on its development stage, GDP, population growth and its size. And while some countries are advancing towards general consensus on accepting sustainable development in their daily agendas, others remain in initial stages of sustainability acknowledgment. Currently, one can underline that there are many sustainability plans for cities, but a selection of issues being targeted at each city's unique needs and capabilities is at times missing. The frameworks developed by the United Nations and other international organizations, which broadly address sustainability goals, are briefly addressed in this paper. For the purpose of this study, however, both Hong Kong and Singapore are attributed towards developed city-states, hence will be analysed from the overall acceptance and desire towards sustainable development.

But what is meant under sustainable urban development and how can it be analysed? The physical urban space – i.e. the city – can be analysed from its size, population number, land use and its ability, transportation network, housing and the like. However, the overall sustainability issue and its measurement factors have to also include social, economic and policy implementation scenarios. With this in mind, the case study method will be used in order to address, compare and analyse the research question of differences and similarities of sustainable infrastructure policies of Hong Kong and Singapore.

1.3.1 Research Design

“Compared to other methods, the strength of the case study method is its ability to examine, in-depth, a “case” within its “real-life” context” (R. Yin, 2003:1).

According to Alexander L. George and Andrew Bennett (2005), the case study research consists of three crucial phases: phase one, where the objectives, design, and structure of the research is being formulated; phase two consists of case studies

being carried out in accordance with the design method, followed by phase three, where “the researcher draws upon the findings of the case studies and assesses their contribution to achieve the research objective of the study” (George, Bennett, 2005:73).

For the purpose of this thesis, Robert Yin’s (2009) approach to case study research has been taken as a research design of the empirical evidence. The scholar examines case study methods for research purposes under three categories such as: (a) exploratory, (b) descriptive and (c) explanatory. It is, therefore, argued that the method used for the study depends on the type of the proposed question, the degree of influence the researcher has on the events, as well as the contemporary versus historical approach (Yin, 2009). And while descriptive methods look into portraying various situations or events, the exploratory methods explore the actual event with the emphasis of explanatory method establishing the relationship between certain variables (Yin, 2009). At the same time, the type of the research question plays a crucial role in defining the condition of a case study. In this case, as the aim of the paper is to compare sustainable infrastructure policies of Hong Kong and Singapore, with the research question of what are the differences between the two city-states, the approach of this research will be exploratory and descriptive.

The case study method has been selected as a research method of this paper for the following reasons. Most importantly, it has been chosen in order to specify and compare sustainable infrastructure policies and develop a sufficient number of operational measures to collect and assess the data. Secondly, it has been selected to critically observe the types of changes occurring in the sustainable infrastructure policies. And thirdly, it has been considered assistive to look into the processes of differences and similarities within the given case studies, using multiple sources of evidence. Furthermore, the sources to be used for this particular case study will consist of policy related documents and reports.

“The emphasis of a case study, the central tendency among all types of case study, is that it tries to illuminate a decision or set of decisions: why they were taken, how

they were implemented, and with what result” (Yin, 2003:12). With such vision, the case study method will further investigate the set of decisions, and most importantly the background reasoning of the sustainable infrastructure policies of Hong Kong and Singapore. In addition, Yin describes case studies as an empirical enquiry, that:

- investigates a contemporary phenomenon within its real-life context, especially when
- the boundaries between phenomenon and context are not clearly evident (Yin, 2003:13).

In other words, the case study method in this instance covers the conditions of a real-life phenomenon, it being the sustainable infrastructure, within an investigation of its context and contextual conditions (Yin, 2003:12). Furthermore, the methodology of a case study method for the following research consists of the following implications:

1. to explain the presumed casual links in real-life interventions that are too complex for the survey or experimental strategies;
2. to describe an intervention and the real-life context in which it occurred;
3. to illustrate certain topics within an evaluation, again in a descriptive mode;
4. to explore the situations in which the intervention being evaluated has no clear, single set of outcomes;
5. to be used as a metaevaluation – such as a study of an evaluation study (Yin, 2003:15).

Furthermore, case studies can be limited to quantitative approach only, or be a mix of quantitative and qualitative evidence (Yin, 2009). As this study will concentrate on the comparative aspect, it is expected that both qualitative and quantitative methods will be the predominant methods of this paper. Thus, concluding from the above, the case study method will reveal the differences and similarities of sustainable infrastructure policies of Hong Kong and Singapore.

1.3.2 Research Method

As the purpose of this paper is to analyse sustainable urban development of Hong Kong and Singapore, with the research question tackling the problem of differences

and similarities between sustainable infrastructure policies - the specific structural analysis for both city-states needs to be carefully developed.

As characterized by Mitchell (2007) in defining instruments for sustainable development, the complexity of a task might indeed be challenging. While some urban processes are well understood and can be measured, the sustainability effort is difficult to record, due to the lack of a framework for the analysis. As such, the author sees evident to construct the analytical framework based on the collected literature.

The basic principle for analysing the characteristics of sustainable urban development, and further on, sustainable infrastructure policies, is taken from Robert Goodland's (1994) concept of sustainability. In his study, he compares the social, economic and environmental sustainability with overall development and, further on, the growth of a given country. The concept was then further developed by Peter Nijkamp (2007), and is realised in the below diagram (Figure 5). This diagram will, therefore, be used as a basis of an analytical framework of: firstly, comparing the current stance of Hong Kong's and Singapore's sustainable urban development and secondly, as a basis for further analysis of the sustainable infrastructure policies.

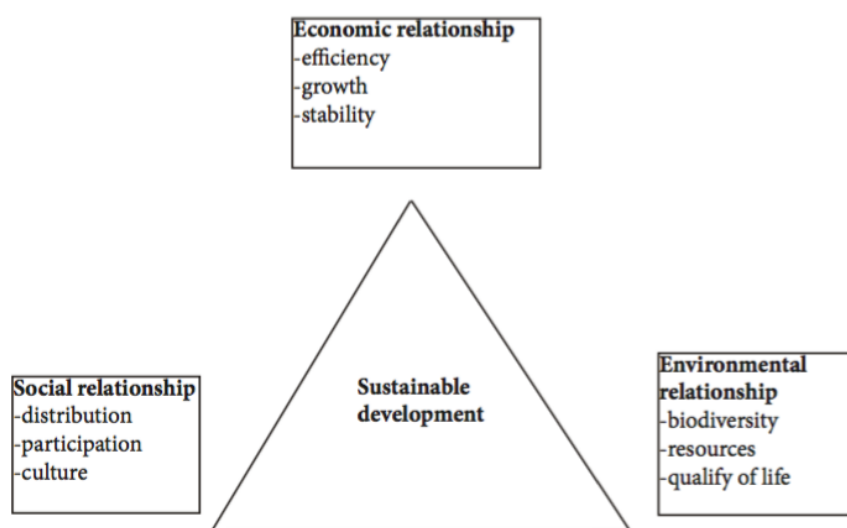


Figure 5. Description of social, economic and environmental sustainability.
Source: Nijkamp, 2007:99.

Based on the above diagram by Nijkamp (2007) on social, economic and environmental sustainability (Figure 5), a further scheme to investigate the current economic, social and environmental trends of urban sustainability efforts needs to be identified. As such, both city-states of Hong Kong and Singapore will be analysed from the more-precise categories as indicated further, in order to create a thorough understanding of the current trends and differences in social, economic and environmental areas.

1.3.3 Criteria for Policy Assessment and Comparison

For the purpose of the assessment of this research, the author of this paper created a sustainable urban development criteria based on the theories and assumptions mentioned in this chapter as presented in Table B. This criterion strives to include most of the above-mentioned theoretical frameworks in order to analyse the sustainable infrastructure policies of Hong Kong and Singapore. To its ability, it includes the economic, social, environmental and governmental indicators from the perception of a compact city development.

In its essence, Table B introduces components of the SUD criteria mainly based on Sorensen et al., (2004); Yosef Jabareen (2008), Miller (2004) and takes a limited approach to sustainability indicators as defined by Bell and Morse (2003). The analysis has been put forward based on Bell and Morse's (2003) *Systematic Sustainability Analysis* represented through four infrastructure related activities. The comparison method has been constructed based on the following stages (in order of relevance):

- to define the boundaries of each pillar, characteristic and dimension;
- to identify the indicators and represent them including the actors who control them;
- to define the number of indicators;
- to validate each indicator over a certain period of time;
- to identify the external context in term of various influences (Bell, Morse, 2003).

Thus, the SUD criterion has been constructed based on the above mentioned systematic analysis, with the following method.

Firstly, the characteristics emphasising urban development such as the annual GDP growth, population growth, density, mobility, land use, community involvement, accessibility and conservation have been identified. Secondly, the characteristics have been divided under dimensions such as *economic*, *environmental*, *political/governance* and *social* with a *concluding statement* summarising each and every dimension and its characteristic. Thirdly, the *processes* and *outcomes* of each characteristic have been identified based on the sustainable development indicators. And lastly, the *policy index* was composed using the supporting questions for the identification of degree of sustainability.

1.3.3.1 Economic Development

According to Goodland (1994), “when environmental sustainability is the goal, sustainable development can be part of the means to approach that goal” (p. 278), hence the *economic development* of a given place is vastly responsible for the achievement of a strategic task. In accordance with Nijkamp’s (2007) chart (Figure 5) the economic objectives display economic growth, efficiency and stability amongst other factors. However, those factors have to be taken into consideration from the waste management, transportation, green space allocation and land reclamation perspectives. Hence, what are the tendencies which can reflect both, the development and the infrastructure?

In accordance with Jabareen (2008), “development involves a progressive transformation of economy and society” (p. 182), thus the characteristics of *annual GDP growth* aim to reflect the development stage of a given place. Here, one can identify the amount of goods and services produced by an economy and reflect upon the stability of a given region. By identifying those means, the sustainability index

can be detected as *prominent* or not. The development factor, however, also identifies *consumption*, and may be evident for the *population growth* factors. With an emphasis on the core pillars of infrastructure selected for this study, the economic development can thus be characterised under *volume of solid waste generated* (due to the *consumption* factors), *mobility* (with an emphasis on adequate public transportation and green travel), as well as *land use* (with an emphasis on the budget allocated for green space allocation, cost of land reclamation and allocation of open space per citizen per square meter).

Sorensen et al., (2004) identify the idea of a sustainable city with respect to infrastructure through the following goals: safe water and sanitary conditions, rubbish collection and disposal, including “effective systems of solid waste reuse and recycling resulting in radically lower levels of final waste production per capita” (p.4). Thus, the reflection of economic prosperity with respect to the waste management infrastructure can be identified through the *domestic waste generated and disposed of at landfills*, the amount of waste being *recycled*, the amount of waste *incinerated* as well as the amount of waste being used for *energy production*.

With respect to Asian cities and their development, Sorensen et al., (2004) point out to the serious problems associated with *mobility* such as traffic congestion and a rapid spread of *private automobile and motorcycle ownership* due to poorly designed and developed public transit systems (p.13). Here, the indicators for *private automobile and motorcycle ownership* and the *allocated budget for transportation improvement* shall further enrich the criteria for comparison related purposes.

In the process of identifying *land use* and the precise meaning of SUD, the study has been concentrating on the *green space allocation and land reclamation* tactics. Here, the *allocation of open space per resident per square meter* plays an indicative role in analysing urban and housing density. The *cost of land reclamation* and the *allocated budget for green space allocation* would define the land use policies from the stance of the economic development.

1.3.3.2 Environmental Development

The *environmental development* dimension addresses the resource allocation and ecological concerns with respect to contribution of a healthy environment for the current and future generations. Miller (2004) conducted a study on assessing and monitoring countywide planning policies, with an aim to assess whether the policies were actually achieving the intended outcomes (p.119). The overall study included 45 indicators for comparison and performance identification with “each operationally stated indicator related to an outcome, defined in a goal or objective” (Miller, 2004:119). As mentioned formerly, the goal of the overall *environmental development* dimension is to address ecological concerns, thus the *conservation* aspect has been chosen by the author to identify the overall *protection and enhancement of natural ecosystems and biodiversity* stance. This indicator was also chosen due to the geographical positions of Hong Kong and Singapore, their diverse ecosystems and the sub-tropical climates.

With respect to *waste management*, the indicator here should portray the environmental aspects of managing waste and thus, concentrates on the *environmental reuse of waste* factor. As such, the documents will be compared from the identification of waste management factors in reference to ‘*waste as a resource*’ viewpoint.

The indicators for the transportation and land use linkage have been identified as per Miller’s (2004) set of indicators, with a “percentage of residents who commute one way within 30 minutes” and “percentage of residents who walk or use transit, bicycles, carpools” (p. 120) framework. This indicator has been rephrased slightly, in order to fit to the comparison criteria from a broader perspective to: *commute time from home to occupation*. Further, the indicators have been characterised as *effective and environmentally friendly transportation systems, percentage of walking and mode of transportation and free bicycle scheme and/or other modes of transportation*.

With reference to Bell and Morse (2003) and the measurement of sustainability, one of the processes in identifying the conceptual model includes the “identification of conflicting resource uses and issues” (p. 102) in creating the sustainability assessment. As such, the *land use* characteristic in the field of *environmental development* dimension has been identified under environmental allocation, which in this case would identify under *encouragement of land use in urban rather than rural areas, mixed-use settlement patterns and recreational spaces, green facilities, diversity and efficiency of land use*. These indicators have been selected from a variety of land use sources in order to compare the *green space allocation* and *land reclamation* policies.

1.3.3.3 Political / Governance Dimension

In many ways, the urban environmentalism reflects the shift of political systems, their arrangements and ways of approaching environmental concerns. As argued by Jabareen (2008), “the prevailing systems for decision-making in many countries tend to separate economic, social and environmental factors at the policy, planning and management levels, influencing the actions of all groups in society and affecting the efficiency and sustainability of development. Therefore, it proposed integrated systems of management to ensure that environmental, social and economic factors are considered together in a framework for SD [Sustainable Development]” (p. 186). As such, the *political* and *governance* dimension, as has been identified above, generates as part of the *economic, environmental and social* (to be identified further) dimension, and should incorporate *accountable and transparent governance*, with respect to the overall sustainability approach. With an emphasis to *waste disposal* the indicator has been identified under *waste unit pricing* implementation as it would determine certain governmental approaches in tackling waste management concerns.

In the pillar of *transportation*, the documents will be compared from the point of view of *promotion of public transportation* and its advocacy in policy implications.

This comparison, should indicate the degree of public transportation advancement and should further complement the advancement of *green transportation* and effectiveness of the overall transportation network.

1.3.3.4 Social Dimension

The *social* dimension contributes to the social well-being of the citizens, their involvement and contribution. As indicated previously, social factors contribute greatly to the general framework of sustainable development alongside the environmental, economic and governance. The comparative indicators here will mostly concentrate on the *community involvement* in the overall SUD criteria. The comparison will hence concentrate on the *educational awareness* and *citizen participation* factors (are there educational campaigns to further educate the citizens on sustainable ways of living? Are the citizens being involved in sustainable development projects?). Furthermore, the importance of SUD in private sector will be identified through *opportunities*, playing a vital role in the social cohesion, cultural and community fellowship.

1.3.3.5 Concluding Statements

Finally, the *concluding statements* were designed to put a closing remark on the comparison assessment by combining the main characteristics from the economic, environmental, political and social points of view. The *provision of healthy living and working environment for the inhabitants* is a crucial characteristic of development and governance management, and shall by no means be neglected. The *encouragement of liveable, diverse communities* is a direct reflection of equality and a diverse and fair government, where each member of a given community should feel welcome and safe. The *economic growth without compromising the ability of future environments to flourish* as well as the *sustainable outlook for the present and*

future infrastructure use as identified in the Brundtland Report (1987), should further augment the comparison criteria and demonstrate the differences and similarities of the documents.

As shown above, Table B has been constructed by using a vast amount of literature in the field of sustainability, but does not necessarily define SUD absolutely. The criteria used in the table is quite limited and has been selected in order to answer the predominant research question of this paper only. With respect to understanding the concept of urbanisation, population growth and limited availability of natural resources, the table's aim is to give a rather superficial, yet an introductory point of investigation. Due to the scope of this paper, the author had to limit the criteria to the most crucial components only, while the additional criterion indicated as *concluding statements* was included with an aim for a clearer comparison of infrastructure related policies.

In order to create a fair comparison system, the below table will be used further along this paper to evaluate the differences and similarities of the documents chosen for this study. In its essence, each category will be carefully evaluated in accordance with the document with a concluding 'yes' or 'no' score. When such evaluations are not applicable, a 'to a certain extent' criteria may be applied. The aim of this analysis is to evaluate and compare different policies, while to also identify the environmental, economic and social concerns. However, the framework should not be considered universal, as it was created for the purpose of this research only and thrives to add a general input in the research area of sustainable urban development.

Sustainable Urban Development (SUD)

Criteria for comparison of SUD in policy-related documents

Core Pillars	Characteristics	Processes and Outcomes	Policy Index
Economic Development			
Infrastructure services	Annual GDP growth	Natural resource management	<i>Has the country/city-state reached a certain stage at which sustainability is prominent?</i>
		Development stage at which sustainability is prominent	
		Employment in sustainability sector	<i>Do policies include employment opportunities in sustainability sector?</i>
	Population growth and density	Safe water, drains, sanitary conditions and waste disposal	<i>Inclusion of factors indicating safe water, drainage and waste disposal.</i>
	Consumption	Domestic waste production	<i>Inclusion of waste reduction schemes.</i>
	Volume of solid waste generated	Recycling	<i>Introduction of easy recycling facilities and information on how to recycle and where.</i>
		Solid waste production exceeding capacity of landfill sites	<i>Solution for landfill demands.</i>
		Accumulation of large quantities of certain types of waste and facilitating recycling mechanisms	<i>Recycling schemes for certain types of waste.</i>
		Domestic waste (in tonnes): · ...disposed of at landfills · ...recycled · ...for incineration · ...for energy production	<i>Policy on waste management and recycling schemes.</i>

Infrastructure services	Mobility	Allocated budget for transportation improvement	<i>Policies on sustainable transportation.</i>
		Private automobile and motorcycle ownership	<i>Policy on private vehicle ownership.</i>
	Land use	Allocated budget for green space allocation	<i>Policy implementation on green space conservation.</i>
		Housing density, allocation of open space per resident per square meter	<i>Policy implementation on allocation of open space per resident</i>
		Cost of land reclamation	<i>Policy implementation on land reclamation.</i>
	Environmental Development		
	Conservation	Protection and enhancement of natural ecosystems and biodiversity	<i>Protection and inclusion of natural ecosystems policies. Protection and inclusion of biodiversity policies.</i>
	Volume of solid waste generated	Environmental reuse of waste	<i>Waste as a resource?</i>
Infrastructure services	Green travel	Effective and environmentally friendly transportation systems Commute time from home to occupation	<i>Green vehicle scheme.</i>
		Percentage of walking and cycling as mode of transportation	<i>Development of cycling paths, easy access to points of destination.</i>
		Development of certain areas to reduce travel need	<i>Policy on land development schemes.</i>
		Free bicycle scheme/ other modes of transportation	<i>Provision of green transport, car sharing and/or free bicycle schemes. Provision of public transportation within easy access from home.</i>

Infrastructure services	Land use	Encouragement of land use in urban rather than rural areas	<i>Policy implementation for land use.</i>
		Mixed-use settlement patterns	
		Recreational spaces, green facilities, diversity and efficiency of land use	<i>Policy implementation on mixed-use land settlements.</i>
	Political / Governance		
	Accountable and transparent governance	Sustainability urgency	<i>Do the policies reflect fairly in accounting for sustainability factors?</i>
	Waste disposal	Waste unit pricing	<i>Waste generation policy implementation.</i>
	Accessibility	Promotion of public transportation	<i>Policy implementation on transportation and private vehicle control.</i>
Infrastructure services	Land use	Encouragement of recreational land use	<i>Policy implementation for land use (from the political/governance stance).</i>
	Social		
	Community involvement	Educational awareness	<i>Do the policies include community awareness factors?</i>
		Citizen participation	<i>Do the policies include community involvement in respect to urban sustainability?</i>
	Sustainable development in private sector	Opportunities	<i>Do the policies mention sustainable development in private sector?</i>
	Sustainable behavioural patterns	Awareness	<i>Are there noticeable behavioural patterns in relation to sustainability?</i>

	Concluding statements	
	Provision of healthy living and working environments for the inhabitants	<i>Does the overall policy document indicate provision of healthy living and working environments for the specific country/city-state?</i>
	Encouragement of livable, diverse communities	<i>Overall factor.</i>
	Economic growth without compromising the ability of future environments to flourish	<i>Overall factor.</i>
	Sustainable outlook for the present and future infrastructure use	<i>Overall factor.</i>

Table B. Sustainable Urban Development comparison criteria for policy-related documents.
Source: own drawing, adopted from Sorensen et al. (2004); Jabareen (2008); Miller (2004).

Emerging from a diverse range of theories and within the context of multilevel governance and policy changes with regard to infrastructure and sustainable urban development, city-states of Hong Kong and Singapore will be analysed from their recent policies as identified in Table B. The sustainability policies will be investigated in terms of their background, institutional, functional and aspirational practices and will be further analysed in relation to the differences and similarities of the two city-states. A detailed description of each policy will thus address economic, environmental, social and governance related implication. The chosen matrix will be further applied in the empirical part of this paper in order to compare and analyse the findings to be presented in the following chapter.

CHAPTER II

2.1 The Sustainability Vision of Hong Kong

As a city-state with a population of over 7 million and a density of 6,760 people per square kilometre (Government of Hong Kong, 2017), Hong Kong is highly exposed to environmental challenges and is expected to face greater risks as it reaches the year 2050. Its neighbouring and constituent position with People's Republic of China delivers an even greater concern in tackling environmental challenges, and a great degree of collaboration in certain spheres of sustainable urban development, such as air pollution, is certainly needed. Admittedly, Hong Kong has established a recent history of sustainable urban approaches and is tackling some of its issues to a certain degree. With respect to sustainable development and infrastructure policies specifically, Hong Kong has certainly achieved some level of accomplishment, nevertheless, a lot more is expected in this regard.

In order to analyse certain aspects of infrastructure related policies with respect to sustainable development, it is necessary to also understand the general structure of Hong Kong's decision-making bodies and the hierarchy within the structure. To this day, the main council of Hong Kong, the Executive Council (ExCo) and its advisors are the main policy-making and administrative body of Hong Kong's government. The advisors report directly to the Chief Executive (currently Mrs. Carrie Lam) and have much control over the political agenda. Moreover, the government secretariat, formed by the Offices of the Chief Secretary and the Financial Secretary, of the government of Hong Kong, currently consist of three main bureaux, which deal with urban sustainability and related policies. Those are (in order of relevance): The Environment Bureau; The Transport and Housing Bureau and the Development Bureau (Government of Hong Kong, 2017a). Furthermore, the Environment Bureau consists of the Environmental Protection Department (EPD), established in 1986, which liaises on environmental protection issues. The Planning Department, established under the Development Bureau of Hong Kong, takes a dominant role in

city's development, while also seeking to "formulate sustainable development strategies and plans" and "facilitate suitable development and redevelopment" as well as "encouraging community involvement and support" in Hong Kong (Planning Department, 2017). In achieving sustainability, the government of Hong Kong has in addition established the Sustainable Development Unit within the government's structure and an independent Council as advisory body, which published its first environmental strategy in 2005.

Historically, Hong Kong's government based its policies on the 'positive non-intervention' principle (Francesch, 2004) with the main focus concentrating on the development and financial growth of the past few decades. The governmental top down approach with respect to sustainable development has grown out of a broad and complex range of approaches, which arguably did not necessarily address and prevent the source of the problem, but rather controlled the statistics. The first White Paper, which addressed environmental issues in Hong Kong was published in 1989, with a subsequent revision in the year 1998 (Francesch, 2004). Since then, a vast number of documents and sustainability measurement systems have been created with the most recent document addressing the vision of Hong Kong's ways of sustainability towards the future. In 2001 the government of Hong Kong has adopted a Sustainability Assessment (SA) system, which evolved from the Sustainable Development for the 21st Century in Hong Kong (SUSDEV 21), which takes into account the environmental, social and economic issues of the future development of Hong Kong (Shen et al, 2011:21). At the same time, one of the initial reports along the series of "Hong Kong 2030" documents (one of which will be assessed further along in this paper), looks into three main categories associated with overall sustainability concerns with the categories addressing the issues of:

1. providing a quality living environment;
2. enhancing economic competitiveness;
3. strengthening links with the Mainland (Hong Kong 2030, N.d.).

With reference to the above, it is evident that Hong Kong's urban sustainability achievements have been largely dependent on governmental approval, the degree

of which is often unpredictable. However, it is interesting to observe the ambition as summarized above and will be illustrative to analyse the extent of the above statement further along this paper.

For the purpose of this research however, the following number of policy documents with regard to issues of sustainable infrastructure have been selected. The selection aims to portray the sustainability efforts of a given city-state, with the intention to answer the RQ of this thesis. The policies have been selected with the objective of reflecting a variety of different sources as well as representing different departments and governmental bureaux of Hong Kong. The reason behind choosing governmental documents only is significant for comparison purposes as well as accuracy of the results of this research.

Selection of Policy Related Documents, Hong Kong					
Institution Department Year	Title	Waste Management	Land reclamation	Green space allocation	Transportation
Sustainable Development Unit, Office of the Chief Secretary for Administration, The Government of the Hong Kong Special Administrative Region (2005)	"A First Sustainable Development Strategy for Hong Kong"	✓		✓	✓
Planning Department, Development Bureau; The Government of Hong Kong Special Administrative Region (2014)	Chapter 9 of Hong Kong Planning Standards and Guidelines	✓		✓	✓
Planning Department, Development Bureau; The Government of Hong Kong Special Administrative Region (2016)	"Hong Kong 2030: Towards a planning vision and Strategy Transcending 2030"	✓		✓	✓

Table C. Selected policy related documents for the study of Hong Kong. Source: own drawing.

The above Table (C) lists the names of the chosen documents, their official titles, and publication year. The variety of publication years has been picked specifically for the comparison of the 'before' and 'after' purposes, and in order to document significant changes (or the lack thereof) between the years. The ticked or un-ticked boxes of the columns indicate the relevance of the policy document to the area of infrastructure-related concern, which will be addressed further along the paper.

2.1.1 Waste Management: The Case of Hong Kong

2.1.1.1 Background

The first major argument associated with the general discourse on sustainable urban development will be addressing the issues of waste management and, subsequently, analysing the policy documents associated herein. An efficient waste scheme is set to determine the sustainability of a given city in many ways and reflects communal involvement in achieving sustainable urban development in the long-term. Waste management in Hong Kong, on the other hand, is a major environmental concern and has been raising alarm for the past few decades. Currently, the three operational landfills (South East New Territories Landfill (SENT); West New Territories Landfill (WENT); and North East New Territories Landfill (NENT)) located in the New Territories of Hong Kong, were all due to be filled by the year 2018 - 2019 with no precise action plan in place. In addition, 13 no-longer-operational landfills are already filled and are used as parks, golf courses and other multi-purpose outdoor facilities (EPD, 2017).

In this section of the chapter, it will be argued that the current consensus on the waste management plan of Hong Kong has many faults. Firstly, its main concentration lies within the landfill extension projects, rather than a selection of alternative measures such as, for instance, overall waste reduction, strict recycling schemes, introduction of waste payments and, furthermore, food waste

regeneration projects such as biofuel production. This is partially reflected as the result of waste management policy trends as will be discussed further. Following the methodological framework, this section will evaluate current trends, analyse governmental approaches in the sphere of waste management and, subsequently bring up argumentation on whether it is sufficient to conclude that there are indeed specific gaps in the field of policy implementation on material recovery facilities and recycling schemes in Hong Kong SAR.

2.1.1.2 Data Description and Analytical Interpretation

As presented in Figure 6, the current procedure for waste management in Hong Kong is rather complex and consists of various stages. These can be attributed to five main phases such as: pickup from city's locations, delivery, assortment, distribution and elimination. The waste is delivered to a sorting facility where the main attributes of solid waste are qualified as: 1) Municipal Solid Waste (MSW); 2) Overall Construction Waste and 3) Special Waste. Furthermore, the Municipal Solid Waste gets divided into: a) Domestic Waste; b) Commercial Waste and c) Industrial Waste. The detailed categorisation is thus a crucial component of the waste collection and elimination procedure, with a high emphasis reflected on the grouping and sorting. The process of waste collection goes through two main stages of collection and classification, after which the waste is disposed of either at one of the landfills or recycled for further use. In the year 2015 alone, around 2.03 million tonnes of municipal waste were recovered in Hong Kong, out of which only 2% was recycled locally and 98% was exported to the Mainland and other countries for further conversion (EPD, 2017).

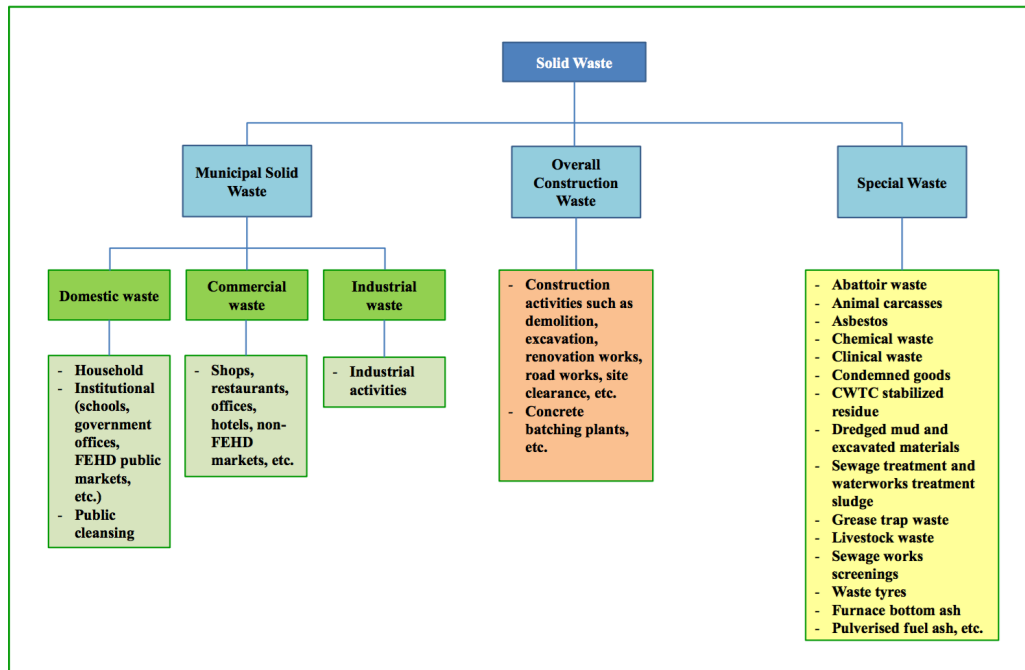


Figure 6. Current classification of solid waste in Hong Kong. Source: Monitoring of Solid Waste in Hong Kong, 2014.

Since the 1970's Hong Kong has seen a major transformation, converting from light industry to a major financial centre. With GDP reaching 320.9 billion (in USD) and a population of 7.347 million (as presented in Figure 7) it is not surprising that Hong Kong has produced enormous economic wealth, followed by an excessive amount of waste. Interestingly, however, the overall amount of waste generated annually has seen a brief decrease in the past decade, from 8,656 million tonnes generated in the year 2010 to 7,233 million tonnes in the year 2013, as indicated in Figure 8. However, the fluctuation becomes evident when comparing the figures from the year 2000-2016. Here, the total amount of waste has noticeably increased to 7,545 million tonnes in the year 2015 with the total amount of waste disposed of at landfills increasing to an overall of 5,512 million tonnes with only 2,032.8 million tonnes being recycled. The major difference in the amount of waste generated in the past decade is, however, significant in the year 2007 and 2008 with the overall amount reaching its lowest point of 7,892 million tonnes in the year 2007. The total number of recovered (i.e. recycled) waste for this year is also significantly high, reaching nearly 35% with the remaining 60% being disposed of at landfills.

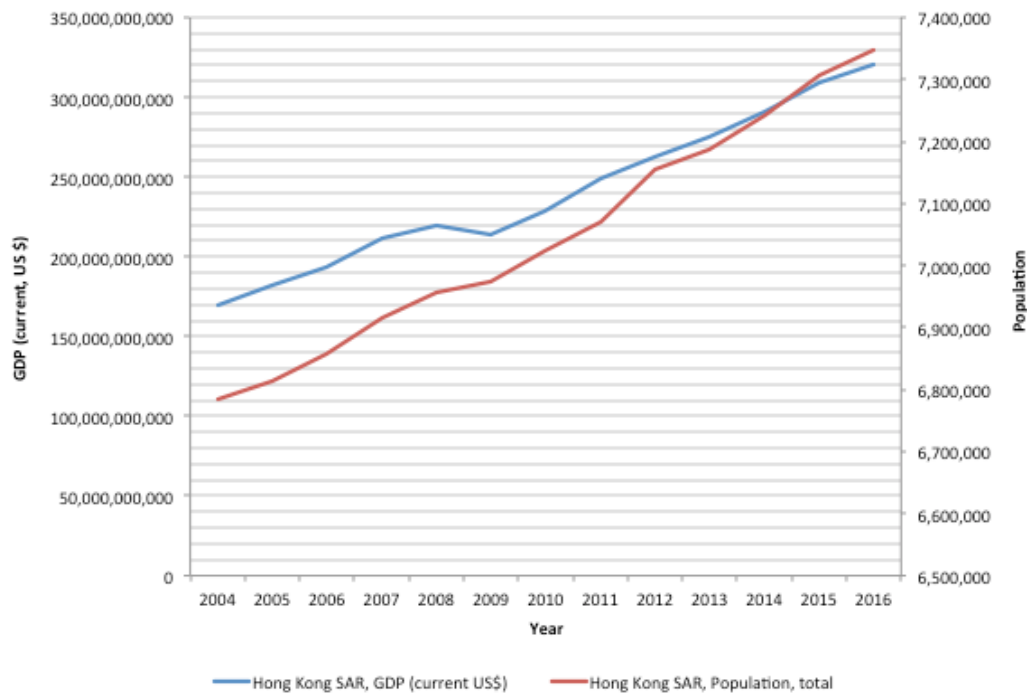


Figure 7. Population growth and GDP (current, in USD) of the Hong Kong Special Administrative Region. Source: constructed by the author, data obtained from The World Bank Open Data, 2017a,b.

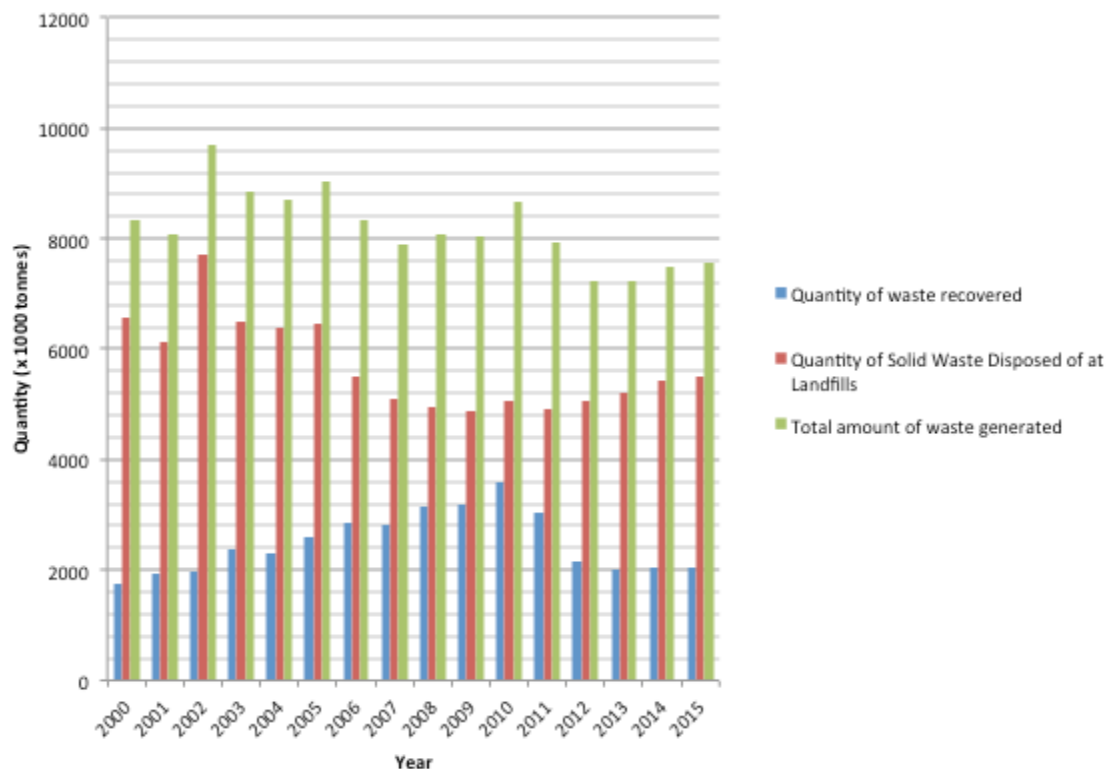


Figure 8. Statistics for the Municipal Solid Waste of Hong Kong for the years 2000-2015. Source: graph constructed by the author using data from EPD, 2017b.

Figure 9, on the other hand, demonstrates the current trend of MSW generated in Hong Kong for the years 2004 to 2005 and 2009 to 2015 respectively (no data was obtained for the years 2006-2008). The current tendency reflects the average amount of MSW generated per day (in tonnes), categorized by the type of waste generated. As such, the overall production of MSW has indeed decreased when compared with the previous decade (especially evident for the year 2005: 17,679 tonnes; and the year 2009 with an average number of 13,326 tonnes). However, when analysing the trend for the years 2014 - 2015, the rise of the overall waste generated is rather evident, with a 3.8% increase for the year 2014 and a further 1.6% increase for the year 2015. In addition, overall construction waste increased from 3,591 tonnes in the year 2013 to 4,200 tonnes in the year 2015. The amount categorized as special waste, on the other hand, saw a slight decrease, from 1,135 tonnes in the year 2014 to 740 tonnes in the year 2015.

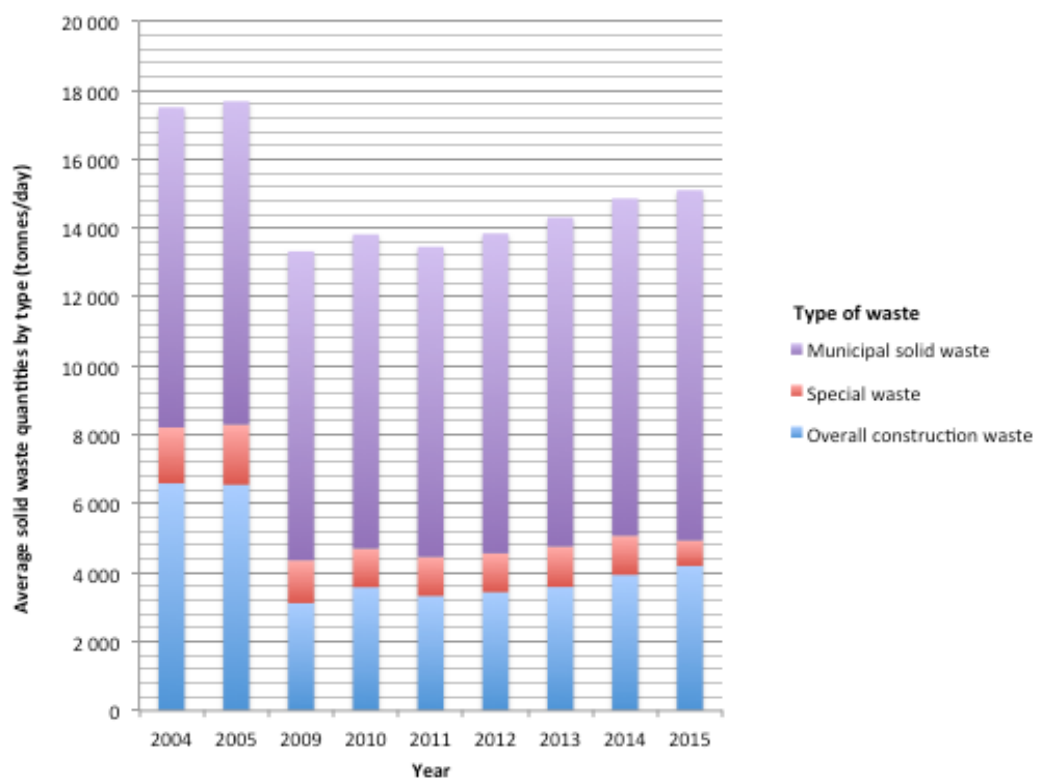


Figure 9. Average solid waste quantity generated daily by type of waste for the years 2004, 2005, 2009-2015 in Hong Kong. Source: graph constructed by the author, data obtained from EPD, 2017b.

Even though the idea of recycling is not new in Hong Kong's territories, the percentage of inhabitants actually following the scheme is extremely low. As such, most of the waste being delivered to the sorting stations must undergo a sorting procedure, whereby recovered materials are passed on for further recycling. Henceforth, Figure 10 shows the amount of recovered MSW (in tonnes) for the years 2004-2005 and 2009-2015, whereas Figure 11 demonstrates the amount of waste being disposed of at landfills (for the same years). Looking at Figure 10 and as indicated in Figure 8 previously, it is noticeable how the overall recycling rate is seen to have gone down with the overall recovery rate of 2,030 tonnes in 2015 in comparison to 3,603 tonnes in the year 2010. Here, a significant reduction in the recovery of plastics is specifically evident, as it has decreased from 1,577 tonnes in the year 2010 to 90 tonnes in the year 2015.

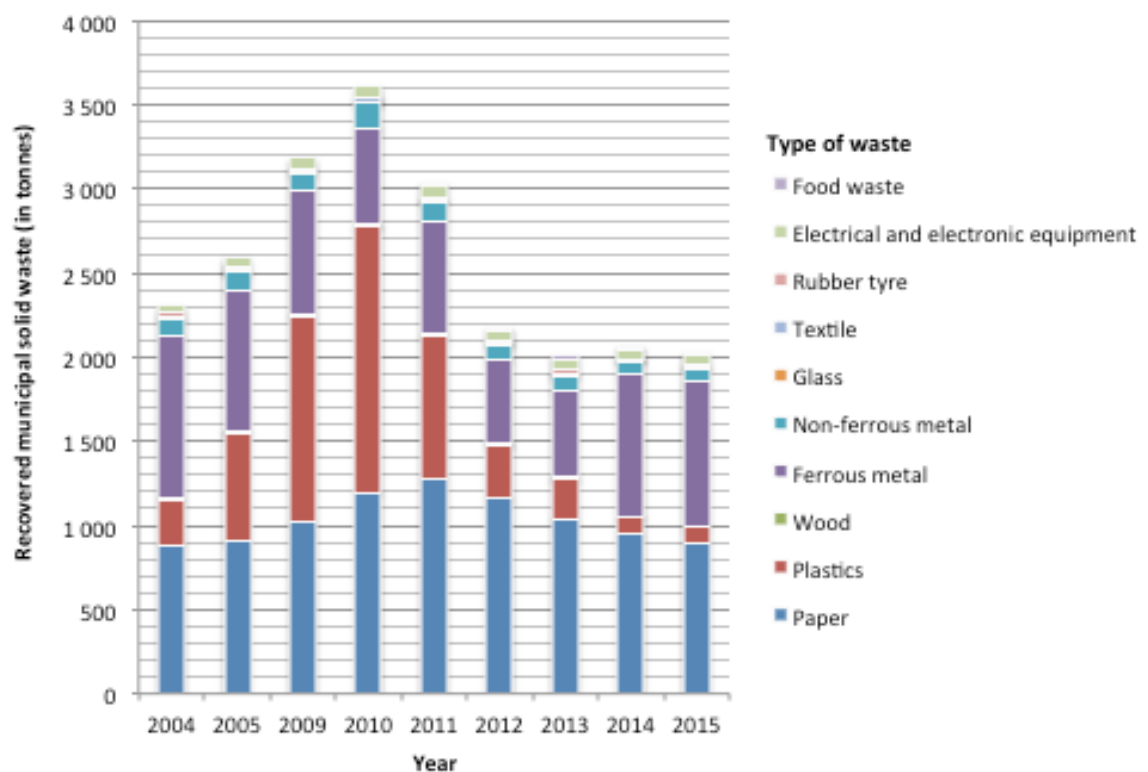


Figure 10. Statistics of Municipal Solid Waste Recovered for the years 2004, 2005, 2009-2015.
Source: graph constructed by the author using statistics obtained from the EPD, 2017c.

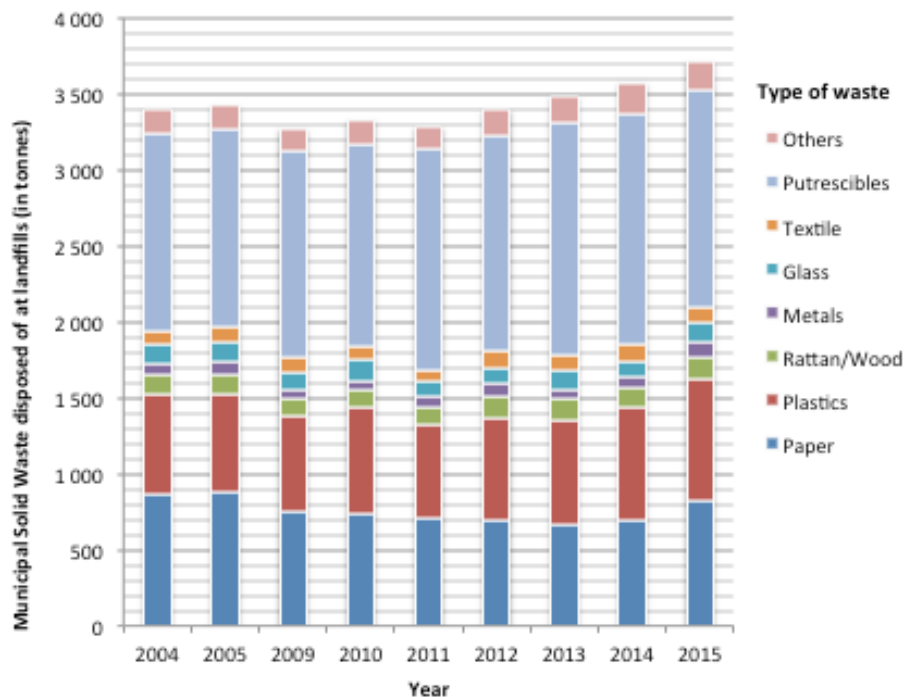


Figure 11. Composition of Municipal Solid Waste disposed of at landfills for the years 2004, 2005, 2009-2015. Source: graph constructed by the author using statistics obtained from EPD, 2017c.

Within the context of Hong Kong's relatively recent economic development, wealth and population increase (as represented in Figure 7), the city-state has overall witnessed an alarming level of waste generation on a scarce piece of land within a short period of time. With the landfills due to be filled in less than a decade, an immediate realization of sustainable approaches to waste management must occur. As a result, the concept of promoting sustainable development and a circular use of materials must include resource efficiency considerations. In this respect, recycling and the reuse of materials plays an important role which additionally promotes the reduction of overall waste at source. However, reducing, recycling and reusing also requires a specific change in the behavioural patterns of the inhabitants, in order to promote the necessary measures in any waste reduction plan (Yau, 2010:2440).

In order to address waste management in Hong Kong, the government proposed to build incinerator facilities in the years 2010 and 2011, which triggered public protests due to the environmental consequences (Friends of the Earth, 2011). As

such, the incinerator project was rejected with the main reasoning of it failing to solve the waste problem, but rather leading to a creation of new ones in the future. Additionally, the overall expenses, the social, environmental and biodiversity impacts have all pointed out to the negative effects of burning techniques. Thus, while seeking for alternatives, the proposed SENT landfill extension plan was submitted to the Finance Committee by the Legislative Council of Hong Kong in 2014, containing an action plan for the extension of current facilities. The plan was approved, however the current landfill SENT is already expected to be full by the year 2020, with an estimated of 1,4kg waste generated daily by the average Hongkonger. At present, the SENT landfill only receives construction waste, with NENT and WENT landfills receiving the remaining municipal solid waste. Arguably, by buying time and extending current landfills, Hong Kong is evidently delaying the development of a concrete action plan for waste-related implementation schemes.

Thus, as can be observed, the main characteristics deriving from the data displayed in Figures 7-11 can be attributed to the following: 1) overall fluctuation of waste quantities throughout the period of 2000-2015; 2) increase of quantity of waste at landfills; 3) decrease in the amount of plastics for recovery purposes, yet increase for elimination at landfills; 4) problematic amount associated with various metals attributes to a high level of recovery and dispose of at landfills; 5) an obvious trend of a high volume of putrescible waste generated throughout the study period; 6) the only material with a high disposal and reuse rate appears to be paper. However, there are also some noticeable changes with respect to overall waste production in the year 2002 with the highest amount of waste generated throughout the study, and in the year 2012 with the lowest amount of the overall waste. The overall amount of plastics and paper, however, has been going up through the years 2005-2010 with a noticeable decline in recycling of plastics for the years 2011-2015.

2.1.1.3 Analysis

With this in mind, the policy documents chosen for this study are analysed in order to acquire a specific pattern in the overall waste infrastructure with an emphasis on

policy implementation and integration for the given timeframe. The first document chosen for this study, titled “A First Sustainable Development Strategy for Hong Kong” published in the year 2005 by the Sustainable Development Unit, sets out an overall community and stakeholder involvement in a broad attempt to achieve sustainable development of Hong Kong in the sphere of waste management, energy and urban living space. Its bottom-up approach reflects the importance of involving society members and sets examples of civic engagement in the sphere of sustainable city approaches. Specifically, the document highlights that “achieving long-term sustainable solutions in the area of solid waste management will require the entire community to help us meet the challenges that we now face” and further, “whilst the Government can take initial steps in many areas – and can set a good example through its own practices – it is essential that the wider community also plays its part” (Sustainable Development Unit, 2005:8-9).

Further, the document sets strategic objectives with respect to waste management, which define the future vision of the council for sustainable development with the following intentions:

1. to make every effort to avoid generating waste and to reduce the amount of solid waste that needs final disposal, by adopting measures to facilitate the separation of discarded material, the recovery and reuse of material and the recycling of non-reusable material.
2. To apply the ‘user pays’ principle as a means of reducing volumes of waste for disposal
3. To adopt advanced technologies and practices to treat waste requiring final disposal and create new economic opportunities (Sustainable Development Unit, 2005:11).

In addition, the document sets out targets, following action plans in the field of sustainable development and with respect to MSW with the following initiatives for the year 2014:

- a) to reduce the amount of municipal solid waste generated in Hong Kong by 1% per annum up the year 2014, based on the 2003 levels.
- b) To increase the recovery rate of municipal solid waste to 45% by 2009 and 50% by 2014.

- c) To reduce the total municipal solid waste disposed of in landfills to less than 25% by 2014 (Sustainable Development Unit, 2005:11).

As a concluding remark, “A First Sustainable Development Strategy for Hong Kong” (2005) document sets out a ‘Plan of Action’ consisting of 15 key initiatives, seven of which are related to waste management with the following aims:

1. to embark on educational programmes to reduce waste generation.
2. To introduce community programmes to encourage territory-wide separation of waste at source and introduce measures to facilitate household participation.
3. To step up implementation of the polluter-pays principle through the introduction of fiscal measures such as product responsibility schemes and green tax.
4. To develop a policy to promote the recycling industry.
5. To establish a EcoPark exclusively for the environmental industry.
6. To examine the introduction of charges for municipal solid waste.
7. To consult the public on the introduction of advanced technologies for the bulk treatment of solid waste (Sustainable Development Unit, 2005:14).

Alternatively, Chapter 9 of the ‘Hong Kong Planning Standards and Guidelines’ (HKPSG) document outlines guidance in the area of building environment, developed for public and private enterprises, with an emphasis on environmental considerations and concerns. Published by the Planning Department, the Government of the Hong Kong in 2014, the document varies quite significantly to the Strategy Plan as it concentrates on the sustainable land use. As such, it outlines the following objectives with respect to waste management:

1. promotion of sustainable approach to waste management, in which we produce less waste and reuse or recover value from waste;
2. adequate provision of facilities for cost-effective and environmentally satisfactory disposal of all wastes; and
3. the availability of and proper enforcement of legislation on storage, collection, transport, treatment and disposal of wastes to safeguard the health and welfare of the community from any adverse environmental effects (Planning Department, 2014:59).

Further, the document outlines waste collection and disposal opportunities for construction management facilities, refuse collection points in private, domestic and non-domestic industrial building developments and constructions sites.

The third document, 'Hong Kong 2030 – Towards a Planning Vision and Strategy Transcending 2030', (or 'Hong Kong 2030+'), likewise published by the Planning Department in 2016, addresses pragmatic and action-driven strategic plans for Hong Kong, with an aim to enhance liveability in a high-dense compact city, focusing on infrastructure and on “embrace[ment] of economic challenges and opportunities” while “creating capacity for sustainable growth” (Planning Department, 2016:i). Overall, the document “represents the Government’s vision, policy and strategy for the territorial development of Hong Kong beyond 2030” through a “focused public dialogue” and “action-orientated approach” (Planning Department, 2016:1). Unlike the first document, however, the main focus here remains on the waste-to-energy conversion with no mention of either recycling or waste taxation policies specified in previous documents. Alternately, the document mentions the overall reduction of waste whereby introducing the ‘Integrated Waste Management Facilities’ as well as “a network of regional Organic Waste Facilities and the extension of the three existing strategic landfills” (Planning Department, 2016:13).

Summarising from the above figures and documents, it is evident that the issue of waste management has been of a concern for a number of years. Yet, the documents and the figures do not reflect a general strategic outcome to the problems raised, neither do they reflect a straight-forward consensus. For instance, the three strategic plans set out for the year 2014 were the following: a) “to reduce the amount of municipal solid waste generated in Hong Kong by 1% per annum up the year 2014, based on the 2003 levels”; b) “to increase the recovery rate of municipal solid waste to 45% by 2009 and 50% by 2014”; and c) “to reduce the total municipal solid waste disposed of in landfills to less than 25% by 2014” (Sustainable Development Unit, 2005:11). With respect to item a) - the amount of MSW has not decreased since the year 2014 (the statistics for the year 2016 still pending), however, the total amount of MSW as based on the year 2003 levels (6,480,000

tonnes) has indeed been decreasing slightly. With respect to item b) – the recovery rate did not reach 45% in the year 2009, neither did it reach 50% in the year 2014 (with only 2,053,100 tonnes recovered and 7,476,000 tonnes produced). With respect to item c) – a total of 5,423,000 tonnes has been disposed of in the year 2014 alone which exceeds the 25% target.

Despite the unreach targets, it is however evident that a lot has been done with respect to policy implementation to achieve certain targets. With an overall domestic recovery rate, for instance, the Hong Kong Government has set out a ten-year implementation programme, as outlined in the 'Policy Framework for the Management of Municipal Solid Waste' published by the EPD (2003). The main target here was to increase the recovery rate up to 26% by the year 2012, and upon success, to further introduce a recovery scheme program to participate in recycling schemes by 2010. The EPD has thus aimed to set up waste separation facilities on each floor of residential buildings. The trail scheme has been set up in various locations, however, has not been rolled out in the majority of residential buildings yet.

As mentioned previously, the majority of the documents associated with waste management of Hong Kong, concentrate on community and stakeholder engagement in recycling, waste reduction and a draft law on MSW charging due to the alarming landfill usage. However, without a comprehensive understanding and implementation of policies, any attempt to promote the necessary targets results with zero success. With this in mind, 'Civic Exchange' - a Hong Kong independent policy think-tank, has been continuously addressing the issue, with a specific emphasis on the plastic waste accumulation crisis. In response, the think-tank has published a thorough report on plastic bottle consumption and general attitudes towards recycling based on a public opinion survey and a focus group. The report looks at the overall consumption of bottled beverages, the general understanding and willingness towards recycling, the demographic profiles and income attributes as well as a general consensus on the government's involvement with the issue. As such, the report conveys general concerns in plastics accumulation with an overall

80% of respondents qualifying it under 'serious' or 'very serious' and a general understanding that the government needs to set a priority on the plastic waste problem – with a total of 32.4% on classifying it as a 'top' problem and a total of 51.5% as a 'medium' problem. The satisfaction of recycling arrangements for plastic, however, resulted with only 38.1% satisfied and a further 37.2% dissatisfied (Man-lei, Lai, 2015).

As concluded in the report, opinions on regulations and imposing plastic waste taxation appears generally favourable, with a proposed collaboration between Hong Kong and overseas governments “to set up universal standards for regulating beverage packaging” (Man-lei, Lai, 2015:84). Further, the participants agreed that a commonplace agreement could foresee a deposit and return scheme, whereby a small deposit upon purchasing a plastic bottle would also encourage its return in the future.

With respect to the methodological framework developed for this paper, the volume of solid waste generated has been identified, along with the recycling (recovery) rate at landfills. The percentage of Hong Kong's population with access to an adequate sewage system is equal to about 93% at present (Planning Department, 2016), with an actual percentage of city's population recycling remaining unknown due to the lack of recycling facilities installed in households, as identified previously.

With cities such as Seoul and Taipei generating significantly less waste due to their recent policies on recycling and waste payment, Hong Kong has admittedly a long way to go, yet a possible scenario with a specific and urgent action-plan set in stone is progressively appearing. By analysing three policy-related documents and acquiring local think-tank reports, the general picture of Hong Kong's current waste management scheme is bleak. With very little land, severe pollutant threads and 52% of local waste being sent to landfills (EPD, 2013), the policies examined in this study do not appear to take immediate action in the field of waste management, as an overall concern towards sustainable urban development of the city.

2.1.2 Urban Transportation: The Case of Hong Kong

2.1.2.1 Background

The following section of the paper is dedicated to the field of transportation as part of the investigation of the sustainable infrastructure policies and is therefore noting that due to the scope of this paper, the research related to the field of transportation in relation to sustainable urban development will be looked at from the perspective of land transportation only and will not cover air or water traffic statistics. Hence, this research will exclusively concentrate on the land vehicle (such as buses and cars), bicycle and walking as modes of transportation. The rail transportation attributed to rapid rail systems such as underground will be discussed with reference to statistical observations only.

Hong Kong has one of the most advanced transportation networks in the world carrying up to 12.6 million passenger journeys per day (Transport Department, 2017). Most of the journeys are made using public transportation systems such as the Mass Transit Railway (MTR), trams, buses, minibuses, ferries and taxis. At present, Hong Kong still stands as 'low' in a world-wide comparison with respect to car ownership, with the total licensed and registered private cars corresponding to around 544,000 as of May 2017 (Transport Department, 2017). By international standards, Hong Kong's car ownership in comparison to other megapolises' norm is still low, but is directly affected by Hong Kong's overall area and type of vehicle. The major problems related to the overland transportation issues thus correspond to congestion, noise, emissions, land scarcity for parking and road construction.

Sustainable transportation has long been regarded as a major precondition for sustainable urban development. Air pollution, traffic congestion, noise and illegal parking are all related to the use of land vehicles and are crucial to be addressed throughout the process of environmental development. Yet, transportation is a key element in infrastructural development directly linked to prosperity of its citizens. In

various studies, the purchase of private cars has been directly linked to wealth and hence symbolises the overall economic prosperity of a given region.

2.1.2.2 Data Description and Analytical Interpretation

As indicated in Figure 12, the relationship between the number of private cars purchased between the years 2011-2016 is in direct correlation with the overall growth of GDP. As such, policy implementations directly linked to car ownership and purchase are believed to reduce private vehicle appeal, yet are not proven to be successful. With a city-state like Hong Kong, where a private car fleet has reached 500,000 despite the excellent public transportation networks, the relationship between wealth, urban sustainability and governmental approach can be clearly identified.

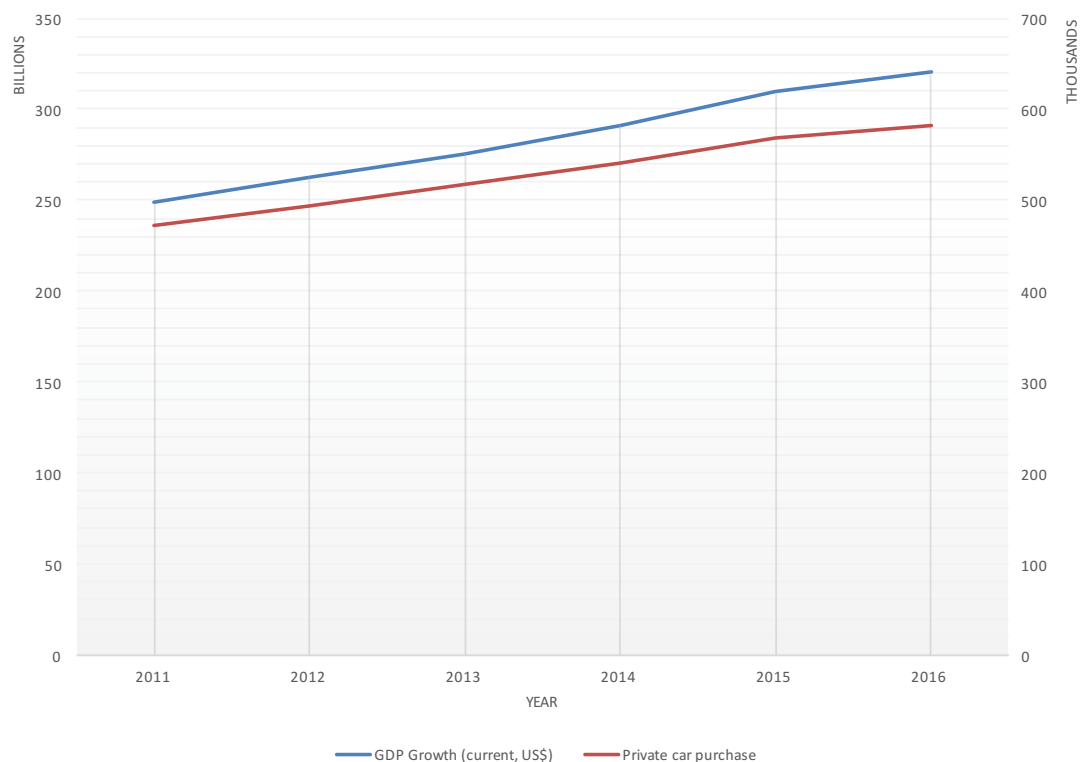


Figure 12. Relationship between private car purchase and GDP growth (current, USD) of Hong Kong. Source: graph constructed by the author using data obtained from Transport Department, 2017a, The World Bank Open Data 2017a.

Hong Kong's key public transportation network operates largely underground and provides transportation links between the main urban areas including the New Territories. Travel behaviour, as indicated in Figures 13, largely corresponds to MTR and franchised buses as the main modes of transportation for the majority of trips in Hong Kong. Interestingly, franchised buses transported more passengers yearly than the MTR between the years 1999 and 2003, which subsequently changed presumably due to the extension of the MTR services to the New Territories and Hong Kong Island. From the year 2005, the total number of railway passengers started its increase from 1,400,056 (in 2004) to 1,478,567 with the number of passengers taking public buses decreasing to 1,430,144 from 1,493,644 (in 2004).

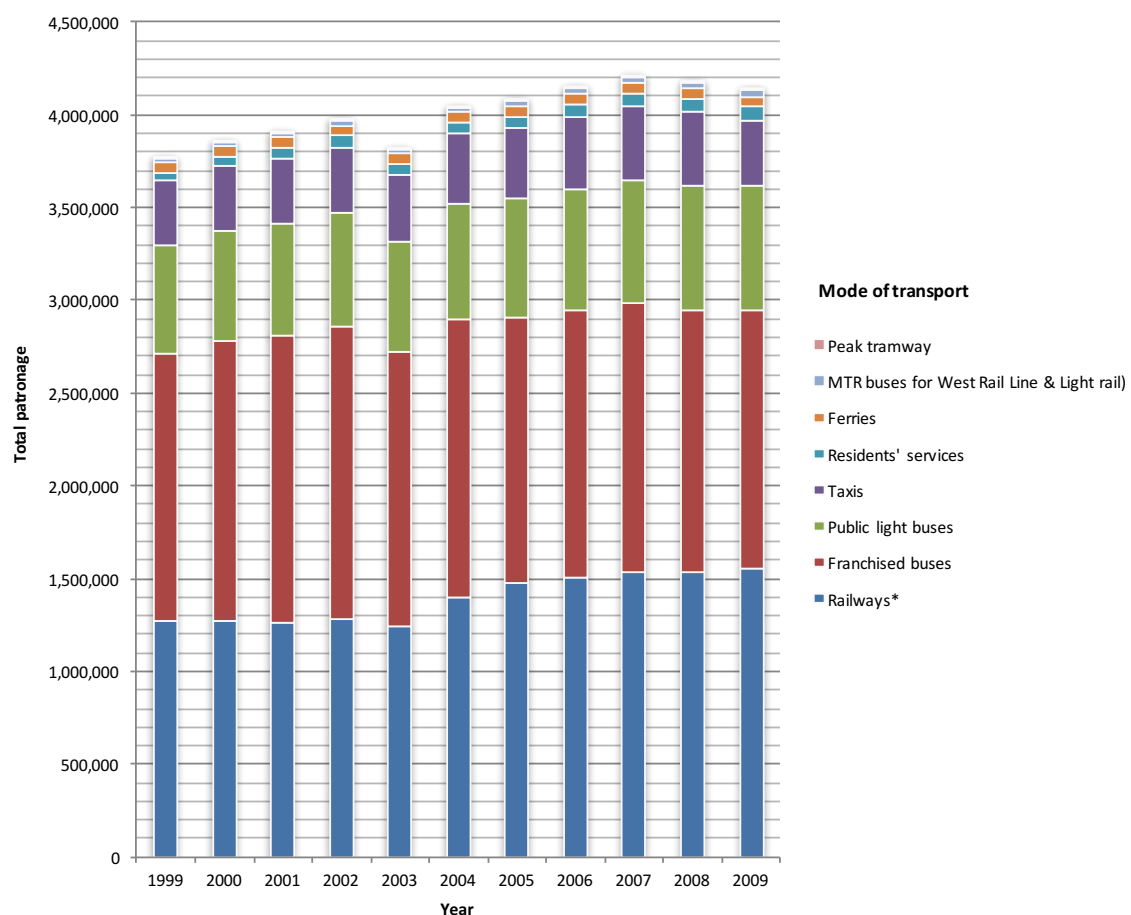


Figure 13. Public transport patronage by mode of transportation for the years 1999-2009.
Source: graph constructed by the author using data from Transport Department, 2017a.

*Railways include: MTR, KCR, Airport Express and Light rail.

The average daily passenger's mode of transportation, on the other hand, corresponds largely to railways (43%); buses (32%); and minibuses (exclusively known in Hong Kong as “公共小巴” or “public small bus”) at 14%, with taxis corresponding to 7% as obtained for the statistical observations for December 2016 (Figure 14). The remaining attributes correspond to ferries (1%) and residents' services (2%). Due to the absence of information on the number of private cars used for daily transportation to/from occupation, the following section will emit statistical observations on the use of private cars for destination travel but will base its observations on assumptions and statistical observations from other sources.

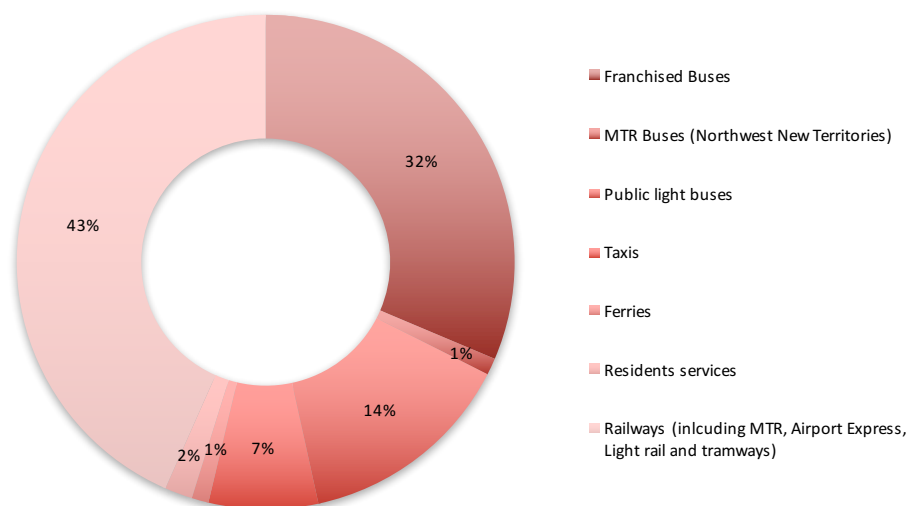


Figure 14. Distribution of average daily public transport passengers in Hong Kong by mode of transportation in December 2016. Source: own drawing constructed with the data from Transport Department, 2017a.

Figure 15, on the other hand, represents a correlation between total number of private cars, registrations and deregistration of vehicles for Hong Kong for the years 2011-2016. Interestingly, as the total number of purchases increases, the registrations of new cars has decreased from 50,332 to 41,182 in the year 2016 alone, with a total number of deregistrations declining from 2,399 in the year 2012 to 781 in the year 2016. Concluding from this figure, a distinct pattern of an increase

in the overall number of vehicles in Hong Kong is evident. With the deregistration of cars going down and the purchase going up, an increase in the number of cars per household may also be evident. The year 2015 is noticeable as it had seen the largest number of registration of cars with a total number of 50,322 registrations. Overall, the cumulative number of private cars is at a steady rise, also corresponding to an increasing population and a GDP rise.

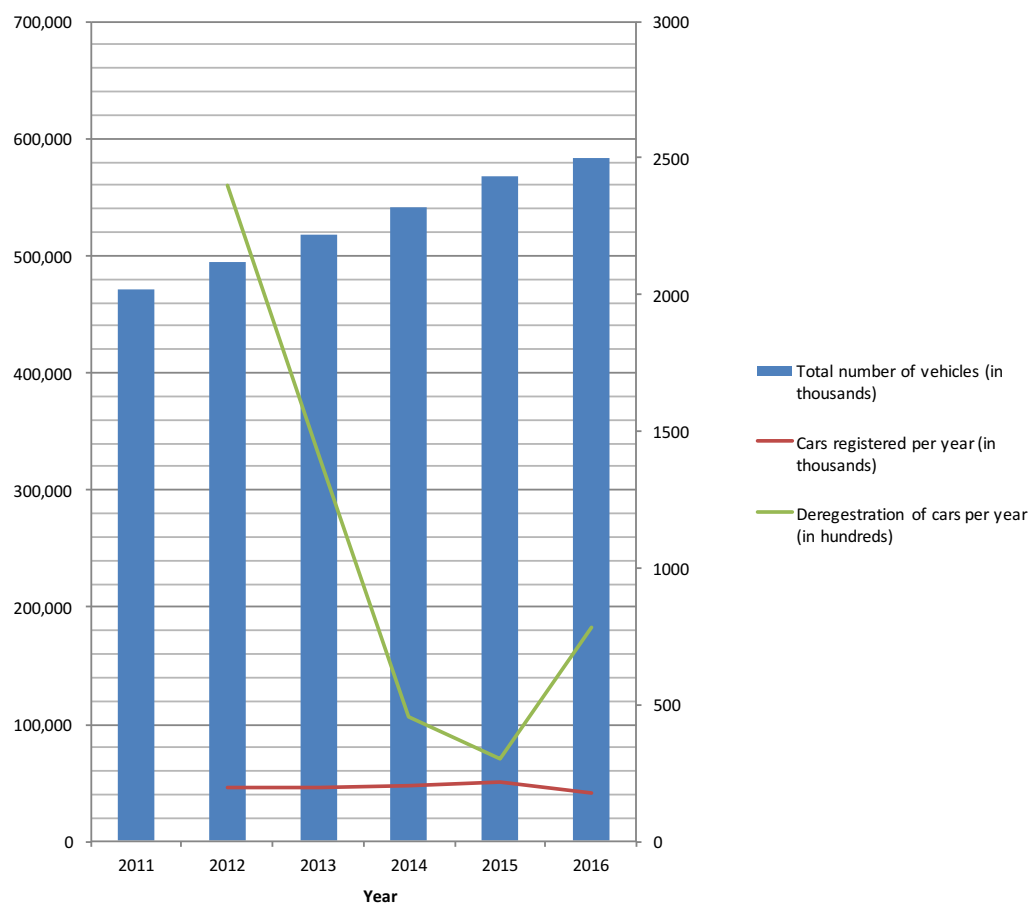


Figure 15. Relationship between total number of motor vehicles, registered vehicles and deregistration of old vehicles in Hong Kong for the years 2011-2016. Source: graph constructed using data obtained from Transport Department, 2017a, Statista Portal for Statistics, 2017.

According to the study conducted by Sharon Cullinane from the University of Hong Kong and Kevin Cullinane from the Hong Kong Polytechnic University (2003), car dependence and ownership in Hong Kong is mostly attributed to convenience, not necessity, but develops an essential purpose once it becomes part of a life-style. In the survey conducted by the scholars, the majority of the car owners attributed their

car purchase to easing shopping and ‘carrying things’, whereby demonstrating the excellence of public transportation and its convenience, but disclosing car purchases as a status of wealth. With respect to policy implications, the restricted supply of car parking spaces and increased charges for parking can thus be proposed.

With respect to private vehicle ownership, The Legislative Council Panel on Transport has recently issued a ‘Parking Policy’ (2017) document which was put forward for discussion in May 2017. Its purpose is to brief the Members on the Government on the current policy on provision of parking spaces in Hong Kong and thus, the document summarises the concerns associated with private vehicles as follows: 1) the increase in private car purchases; 2) limited parking spaces and 3) on-street parking. Specifically, on issue 1 the Legislative Council emphasises the following:

the Government’s transport policy is to encourage the use of public transport as far as possible, and to expand the public transport capacity as well as enhancing services as necessary in accordance with the demand of the public and pace of development of each district. Our aim is to facilitate the public to use the public transport system. [...] We nevertheless understand that some members of the public choose to commute by private car for various reasons. The Government will provide an appropriate number of parking spaces for private cars if the overall development permits, but at the same time not attract passengers to opt for private cars in lieu of public transport, thereby aggravating the road traffic congestion (Legislative Council Panel on Transport, 2017:12).

As such, fiscal proposals to control the increasing number of private cars, as identified in the Parking Policy document are to “increase the first registration tax and annual license fee for private cars” (Legislative Council Panel on Transport, 2017:12). However, no other particular measures could be identified.

Furthermore, with regard to issue 2) on limited parking spaces, the document emphasises that:

the Government’s current policy in the provision of parking spaces is to accord priority to considering and meeting the parking demand of commercial vehicles. To

address the shortage of parking spaces for commercial vehicles, the Government has actively rolled out various immediate measures in order to provide more parking spaces as soon as possible (Legislative Council Panel on Transport, 2017:8).

And further, to address issue 3), the concern over street parking has been identified as the following:

the Government's existing policy is to provide parking spaces in development projects as far as possible in order to reduce the possible traffic impact brought about by the designation of on-street parking spaces. However, for individual locations with parking demand, we will consider providing on-street parking spaces to cater for drivers' short-term parking needs (Parking Policy, 2017:6).

Concluding from the above, the document promotes the use of public transport, in emphasising the particularly excellent and high use of the network, as identified already to as much as 90% (Legislative Council Panel on Transport, 2017) however, does not necessarily introduce certain limitations in car purchases. As such, the document looks into possibilities of extending car parking areas, redeveloping certain aspects of existing areas and to provide solutions and immediate measures in the near future.

2.1.2.3 Analysis

With reference to the chosen documents for this study and as indicated in Table C, 'A First Sustainable Development Strategy for Hong Kong' (2005) report unfortunately does not include any policies in relation to transportation; neither does it mention transportation as part of the overall sustainable development strategy of Hong Kong. It does, however mention the "provision of more pedestrian-oriented" (Sustainable Development Unit, 2005:10) spaces for residents and visitors, but with no indication as to how this will be achieved.

With respect to built environment and land use, 'Hong Kong Planning Standards and Guidelines' (2014) concentrates on transportation from the point of view of territory

use and focuses on the development of transportation with an emphasis on noise, air and other factors related to land use planning. In this regard, the document's guidelines in relation to land transportation are as follows:

1. promote balanced land uses to minimize the need to travel, hence the traffic volume.
2. Avoid road alignments that would create excessive noise levels at adjacent noise sensitive uses (Planning Department, 2014:4).

Further, the document looks into pollution and noise causes with respect to highways. As such, it also emphasises the importance of walking and cycling as a means of transportation, in particular stating: "there are considerable environmental advantages in the use of mass transportation systems, walking and, wherever appropriate, bicycling in the metropolitan area as well as in the topographically-confined areas. With regard to mass transportation systems, the use of electrically powered underground railways, particularly in high density development corridors, is environmentally preferable" (Planning Department, 2014:22).

The aspects of noise reduction in connection with transportation and land use planning, as specified in the Government's policy recommendation are as follows:

- a) providing distance separation between the noise receiver and the vehicles;
- b) traffic composition and volume, i.e. using traffic planning and management to control vehicle movements and type of vehicles at different times of the day;
- c) line-of-sight, i.e. using noise-tolerant buildings to reduce the angle of view of received on road traffic; and
- d) shieldings, i.e. using barriers, road enclosures or road decking and the like (Planning Department, 2014:33).

Overall, general considerations in land use planning with an emphasis on transportation can be attributed to the following: 1) overall traffic and vehicle control in order to minimize environmental concerns such as air pollution; and 2) to develop a land use pattern in a certain way to "minimise the demand for road traffic and facilitate the development of railway network so that the vehicle emissions can be kept to the minimum" (Planning Department, 2014:15).

‘Hong Kong 2030+’ addresses the issue of transportation with a new infrastructure proposal as a mean to reduce the 3% annual growth in vehicle purchases. In this respect, private vehicle purchase must be defeated by a development and expansion of public transport networks. As an example, the document examines the development of The New Territories region of Hong Kong, which houses about 41% of the population but on the contrary, only provides 24% of the jobs. If this remains, the travel between New Territories to other parts of Hong Kong will continue the trend of private vehicle purchases.

As a compact city, Hong Kong believes to have established its pre-eminence at its core. In this respect, the document proposes to “continue to underscore a compact development model with railway transportation as the backbone, complemented by other modes of public transport and good pedestrian networks” (Planning Department, 2016:26). In order to integrate a successful transportation network, the document proposes the following key actions with regard to urban mobility:

- a) to enhance connectivity within the urban areas and with the surrounding rural areas, countryside and harbour front.
- b) To support mass transit with better pedestrian and feeder connection for seamless connectivity and better use of mass transit.
- c) To promote smart travel choices by providing better information to pedestrians and road users.
- d) To embrace to concept of walkability in the planning and design of the built environment and pedestrian network.
- e) To identify schemes to promote walk-able streets.
- f) To foster a ‘bicycle-friendly’ environment in new towns and new development areas through smart and innovative measures.
- g) To pursue the conceptual framework of accessibility to promote easy access to public transport, public amenities, neighbourhood facilities, jobs, recreational opportunities, nature, etc. (Planning Department, 2016:27).

In connection with ‘Hong Kong Planning Guidelines’ (2014) the document also emphasises the importance of strategic land development in order to minimise

vehicle-based commutes. Furthermore, “population and economic activities should be planned with the catchments of public transport nodes” with “more employment-related land uses designated outside of the traditional CBD [Central Business District] area to address the spatial mismatch of homes and jobs” (Planning Department, 2016:52). In an attempt to foster smart and eco-friendly mobility, the document mentions the integrated intelligent transport system and a low carbon mobility with the following key actions:

1. to continue with the policy of railway transportation as the backbone of the public transport system, complemented by other public transport modes.
2. To manage car growth and use.
3. To optimize road-based public transport.
4. To promote low-carbon, low-emission transport modes.
5. To promote smart urban growth with jobs closer to home, and walking and cycling to reduce travel needs.
6. To designate more employment-related land uses in new development areas and outside of the traditional CBD [Central Business District] area (Planning Department, 2016:60).

In planning a high-density city, the budgetary implications of environmental funding may indicate the transparency of the given project and its urgency. With this in mind, ‘Hong Kong 2030+’ extends its vision of certain environmental proposals by integrating budgetary allowances. With respect to transportation, the document states that “the current level of provision in existing and planned communities, shortages and estimates from relevant bureaus and departments on major specialised facilities are taken into account when deriving a ballpark estimate” (Planning Department, 2016:46).

The above presented background information on the current and provisional tendencies of Hong Kong’s transportation emphasises a particular problematic trend in the current private car purchases (it must be noted though, that many other aspects exist, but have not been taken for this study due to the limitations of this research and relevance of the study). As such, an aspect of related policies has been analysed with a concluding remark on the parking space allocation. With this in mind,

the policy think-tank 'Civic Exchange', which has been contacted for the findings of this research, has presented a report to the Legislative Council Secretariat of the HK SAR directly related to the issues of transportation, with a call to "increase penalties for traffic and parking-related offenses due to illegal parking which add to roadside emissions and air pollution, which causes health problems like asthma and lung disease" (Civic Exchange, 2016). The document also states that roadside parking causes a severe inconvenience to pedestrians and "discourages healthy activities like walking [...] in a city that is already polluted and crowded" (Civic Exchange, 2016:1).

The document presented by Civic Exchange (2016) proposes a strict penalty fee for illegal offload of passengers, such as car towing, instead of the current fine ranging between HK\$320-HK\$450 (USD 41-USD 57 at the time of this research). Further, the concluding remarks with respect to the government's decision on low penalties on illegal parking and confident provision of parking spots may seem provocative towards illegal parking and indifferent towards further vehicle purchases. In this regard, the documents lack an effective and environmentally-friendly approach towards private vehicles as well as alternative schemes such as cycling and walking.

With respect to the methodological framework of this paper, the current section has briefly addressed the main concerns of transportation-related issues with respect to the overall sustainable urban development of Hong Kong. As indicated in the selected documents, the overall promotion of environmental transportation is somewhat evident, with an additional consolidation with respect to adequate land use. With this in mind, budgetary concerns with respect to transportation improvement have been identified. The accessibility of public transportation is also evident with a high number of Hongkongers (90%) using public transportation on a daily basis. In addressing the 'distance travelled from home to occupation' an adequate figure has not been identified due to the unavailability of the data.

Overall, the public transportation network of Hong Kong is highly ranked. However, more can be achieved in respect to its environmental levels and private vehicle

allowances. In addition, allocation of projects towards green vehicles (including public transportation) and urban access regulations are noted to be missing.

2.1.3 Green Space Allocation and Land Reclamation of Hong Kong

2.1.3.1 Background

In order to further analyse the degree of sustainable urban development of Hong Kong and Singapore and to answer the RQ of this research paper, the process of land development with a special emphasis on green space allocation (occasionally also addressed as 'natural environment') and land reclamation will be evaluated. The study of those two areas will be discussed simultaneously due to their interdependence, similarity of origin and correlation. The discussion on green space allocation will be attributed to the general development and re-development of urban space with limited approaches associated with construction practices. The green space allocation will also be considered as an area for recreational purposes.

As discussed in the previous chapter of this paper, the notion of a compact city has been attributed to an urban form for both Hong Kong and Singapore but has been questionable in respect to its assumption to sustainability. In its concept, compact cities may be limited to green space allocation due to the proximities of built-up areas and the necessity of citizen allocation. However, the importance of green spaces in a city setting is assertively high with respect to sustainability as no city can be considered sustainable without a certain allocation of parks and recreational areas for not only health benefits, but also absorption of air pollutants. In this respect, Tian, Jim and Tao (2012) attribute the importance of Urban Green Spaces (UGS) to the quality of life including: a) ecosystem benefits; b) psychological and physical benefits to the citizens; and c) social and economic benefits of integration and revenue. Further, the importance of UGS contributes to the ideals of garden cities and are considered important factors of sustainability to development, redevelopment and expansion phases (Tian et al., 2012).

2.1.3.2 Data Description and Analytical Interpretation

As mentioned previously, in the case of Hong Kong, only about 24% of the land is considered developed, nevertheless, the UGS attributes contribute to country parks, open spaces, green spaces and conservation areas. As indicated in Figure 15, the layout of greenery corresponds to a large proportion of the island, with a relatively little allocation for residential purposes.

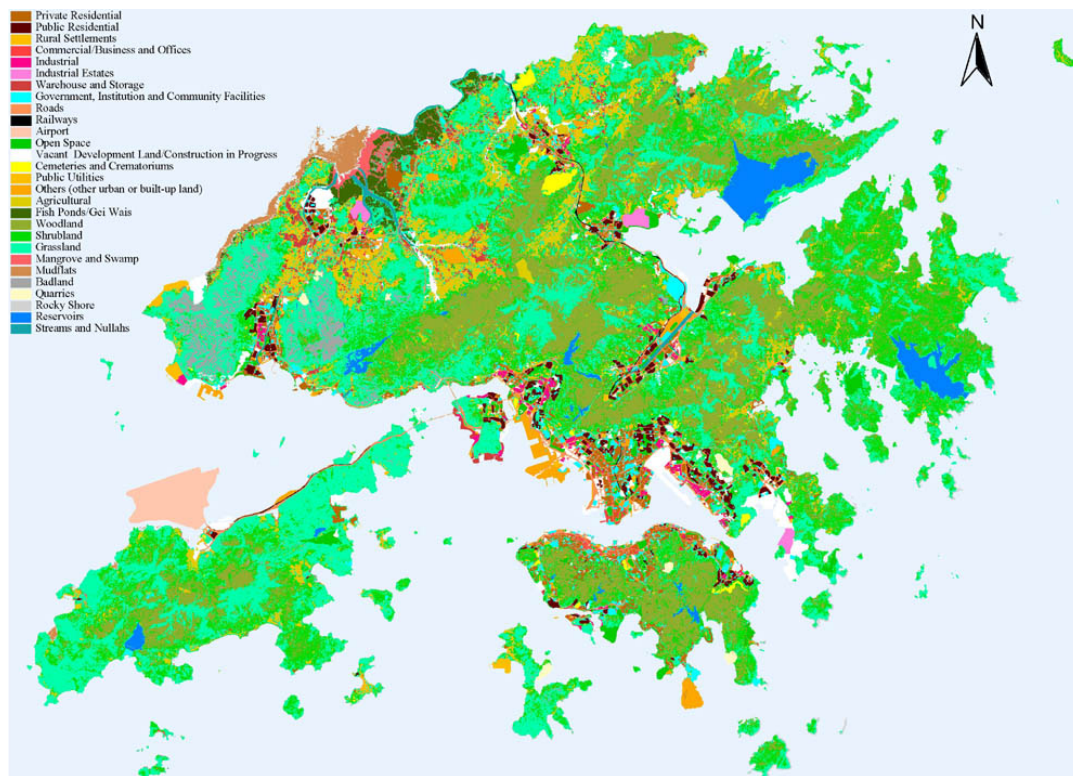


Figure 16. Land utilization plan of Hong Kong as developed by the Planning Department, the Government of the HK SAR.

Source: Department of Geography, The Chinese University of Hong Kong, 2001.

As can be observed from the above Figure (16), the current distribution of green and open spaces in Hong Kong form an interesting pattern, whereby most of the coastal and border areas are used for residential purposes, with the middle group mostly attributed to greenery (which is also due to the topography formed around the perimeter of the island). The largest allocation of greenery attributes to the New Territories and the Sai Kung area located on the east side, where the attribution to green cover generates to almost 100% (Tian et al., 2012).

With an emphasis on governmental measures to improve the green space allocation conditions of Hong Kong, numerous amplifications can be noted. These include:

- 1) preserving and implementing UGS on the hillslopes;
- 2) establishing country parks and special areas to preserve natural resources and beautify the territory;
- 3) constructing community centres or small playgrounds in almost every residential area;
- 4) setting up street playgrounds and outdoor sitting areas to provide additional green spaces for residents (Tian et al., 2012).

In this respect, the projects also include participation of community members and district dwellers.

Despite this, the distribution of green spaces in the built-up area of Hong Kong is rather problematic and lacks a comprehensive greenery plan. As such, Tian et al. (2012) further emphasise the concerns of urban compactness to distribution, planting and survival of greenery in high-density. In this respect, the problems attribute to:

- a) extremely limited ground-level spaces that can be allocated for green cover;
- b) the numerous cables, pipes, large chunks of concrete, and rocks in the topsoil as a result of underground facilities;
- c) the poor urban soil, which is characterised as 'stony' or 'sandy; with a 'poor structure', 'heavy compaction' and plenty of rubble;
- d) increased levels of air, noise, and water pollution as a result of rapid urbanization (Tian, 2012:104).

In addition, and due to Hong Kong's complex and rugged topography, the planting of trees is restricted in some areas due to the complexity of the soil.

As portrayed in various studies, the lack of social participation in prospering green spaces in Hong Kong is evident through a rather obvious neglect of the topic. Hong Kong is a financial business district, where economic prosperity is often reflected through its high paced environment. As such, the desire for convenience rather than

urban greenery often overrides the aspiration. It occurs quite often that spaces which could have been used for greenery are subject to development of shopping malls, entertainment facilities, eateries or transportation services such as MTR instead.

On the other hand, Hong Kong's Nature Conservation policy is quite unique in its ability to regulate and manage natural resources. To this day, there are "24 country parks, 22 special areas with a total area of about 44,300 hectares, and five marine parks and one marine reserve" (EPD, 2017a) which are subject to development controls. Overall, around 43% of Hong Kong's land area is under protection, with the following policy objectives with an emphasis on biodiversity and community involvement:

1. to promote the protection of ecosystems and important habitats, and the maintenance of viable populations of species in natural surroundings;
2. to promote public awareness;
3. to collaborate with, the private sector, including the business community, non-governmental organizations and the academia, to promote nature conservation, and to conduct research and surveys as well as to manage ecologically important sites for such purpose (Agriculture, Fisheries and Conservation Department, 2017).

Due to the above-mentioned reasons, land scarcity and land policy protection, Hong Kong's main solution for rapid population increase has been concentrating around land reclamation for hundreds of years. In this way, Hong Kong's response to urbanization is to be able to expand and house its growing population on large-scale reclaimed land areas. As such, reclamation can be seen as the main strategic outcome in increasing land use. At present, the overall land area of Hong Kong is approximately 1,106.3km² as indicted in Table E below. As noted, the overall land area has not actually significantly increased in the last years, despite major land reclamation projects such as the construction of the Hong Kong International Airport, which is now part of the Lantau Island (completed in 1998), and the Central and Wan Chai reclamation project launched in the 1990's (EPD, 2017). However, the history of reclamation and the change to the overall topography of Hong Kong is rather significant, as displayed in Figure 17.

Land area of Hong Kong								
	Sq. km							
Year	1985	1990	2005	2009	2010	2011	2015	2016
Hong Kong Island	n/a	n/a	80.5	80.6	80.6	80.6	80.7	80.7
Kowloon	n/a	n/a	46.9	46.9	46.9	46.9	46.9	46.9
New Territories and Islands	n/a	n/a	976.6	976.9	976.9	976.9	978.1	978.7
Total	1,064.00	1,074.00	1,104.00	1,104.00	1,104.40	1,104.40	1,105.70	1,106.30

Table D. Land area of Hong Kong and its territories for the years 1985, 1990, 2005, 2009, 2010, 2011, 2015 and 2016.

Source: own drawing, constructed using data from the Census and Statistics Department, 2017.

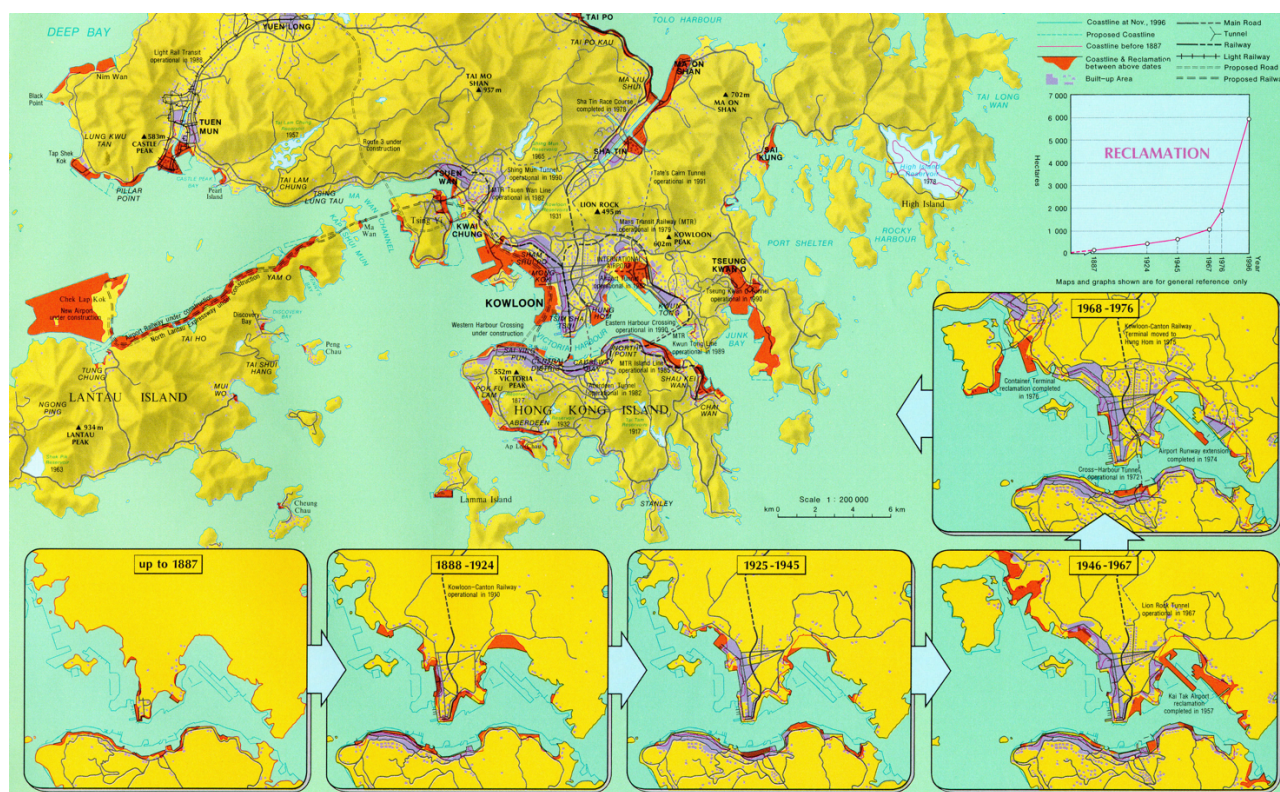


Figure 17. Reclamation development phases of Hong Kong. Source: Cartography by Survey & Mapping Office, 2017.

Hong Kong's ongoing urbanization and population rate is increasing at the rate of 0.75%-0.85% annually (Wong et al., 2017) subsequently producing an extremely high density. As such, proposed reclamation plans are mainly concentrating within the Central Business District and Victoria Harbour boundary as indicated in Figure 17 – from the historical perspective, and in Figures 18-19 – from the most recent development. As indicated in the study area on the maps, the majority of the land is used for 1) residential use; 2) other specified use; 3) commercial / office / hotels use; and 4) open space. Interestingly, the boundary on both sides of the study area is surrounded by green belt / parkland dedicated to presumably preserve the area.

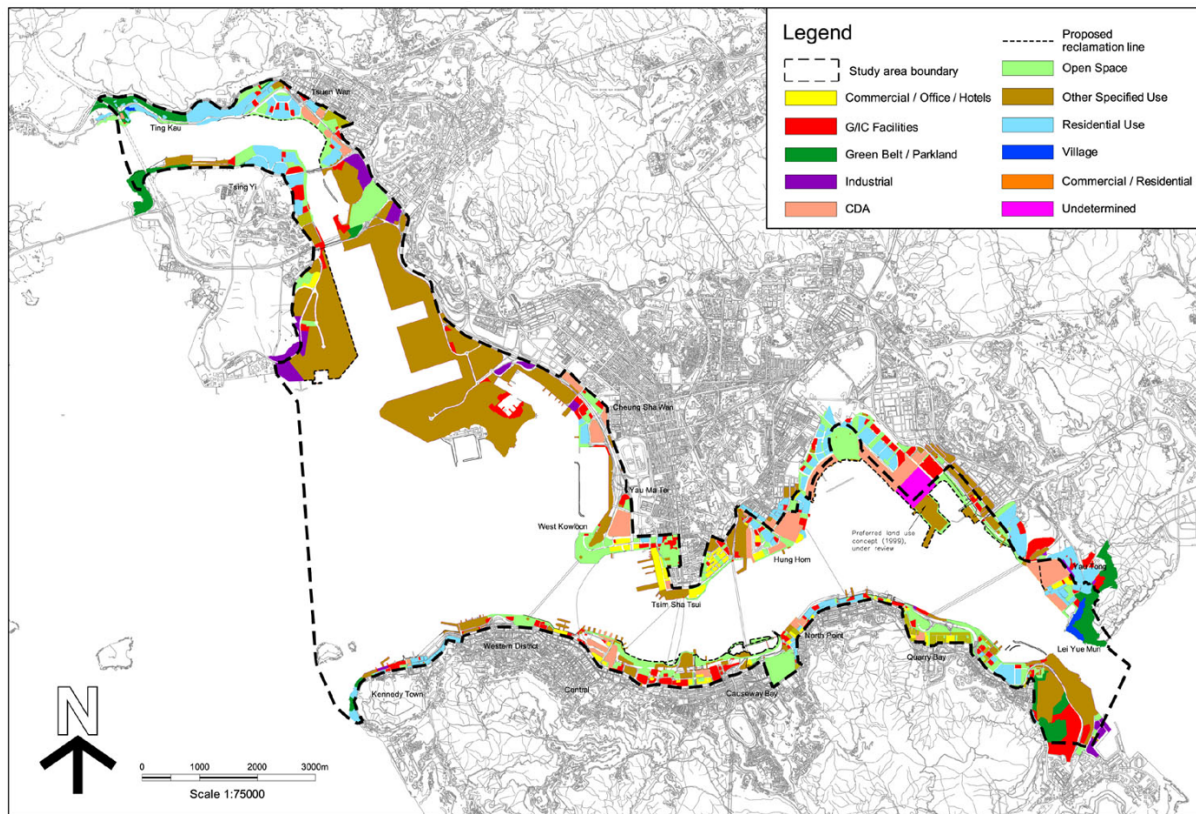


Figure 18. 'Existing land use zonings' as identified by the Planning Department, the Government of the HKSAR. Source: Planning Department, 2002.

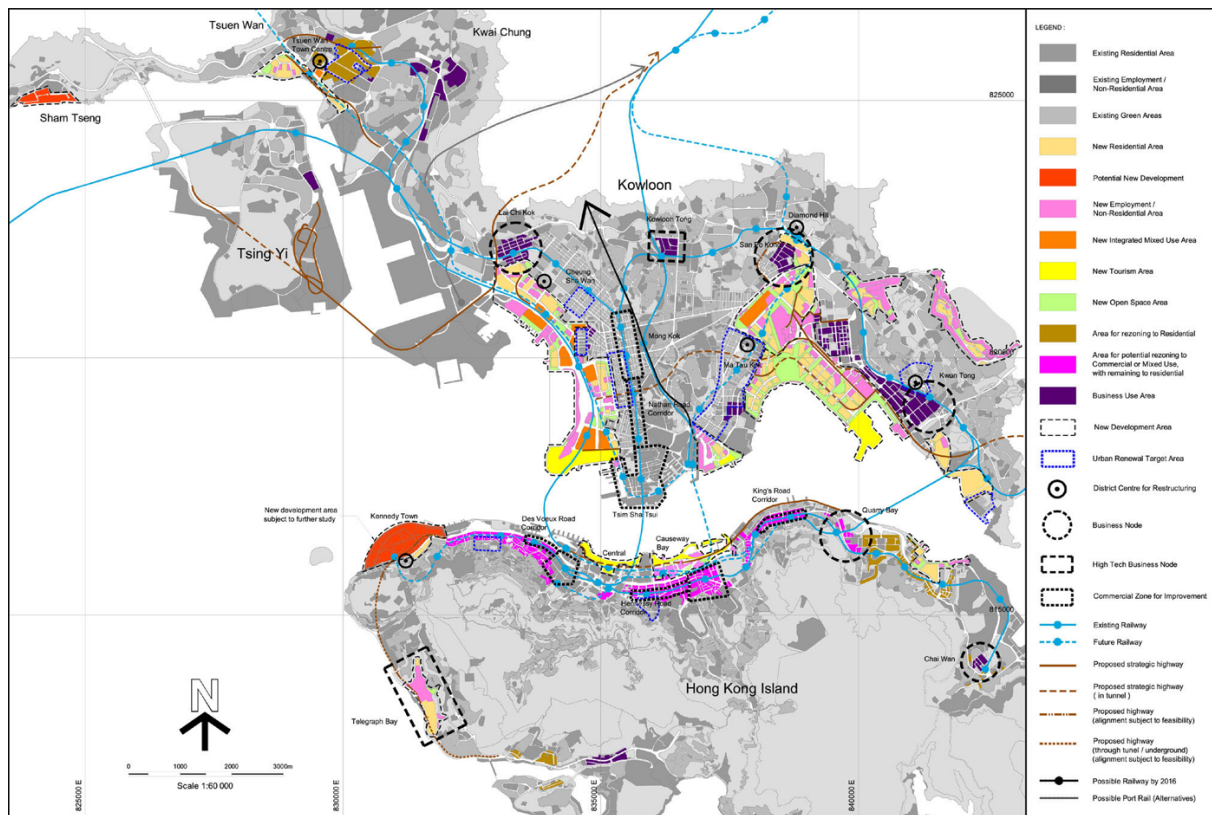


Figure 19. Land use and infrastructural (including transport) proposals as identified by the Planning Department, The Government of the HKSAR. Source: Planning Department, 2002a.

As displayed in Figure 17 – the Praya Reclamation Scheme was one of the earliest reclamation projects in Hong Kong starting as early as the 1860's and setting a continuous reformation to the present day. With many projects still on the way and as can be observed from the above diagrams, the current representation of green space allocation and land reclamation represents the following pattern: a) the total land area of Hong Kong accounts to approximately 1,106km²; b) 76% of the non-built-up land of Hong Kong corresponds to agricultural land (8%), water bodies (4%) and woodland/shrubland/grassland (87%) with barren land accounting to 1%; c) the largest amount of land was reclaimed prior to 1980's (approx.. 670 ha) followed by a significant decline with approximately 131 ha being developed in the year 2015 (Statistical Highlights, 2016).

2.1.3.3 Analysis

As previously mentioned, another area that is currently undergoing major transformations is located in the New Territories. As already detailed in the section addressing transportation, the re-development of New Territories in Hong Kong stands as a major concern in relation to commute and at the same time, as a contributor of green environment of Hong Kong. Due to the fact that Hong Kong's built-up area attributing to as little as 24% of its land, the allocation of green space within commuter and central districts is scarce. As such, 'A First Sustainable Development Strategy for Hong Kong' (2005) identifies certain strategies in the field of green space allocation with the following objectives:

1. to speed up improvements to the environment of older urban areas through a 'people-oriented' approach and the flexible deployment of the '4R' strategy - redevelopment, rehabilitation, preservation and revitalisation.
2. To plan and further develop the New Territories, taking account of stakeholder concerns on sustainability issues such as the need to protect the natural environment and cultural characteristics of rural areas, while having regard to Hong Kong's long-term socio-economic needs.

3. To promote sustainable urban planning and design practices that will ensure that Hong Kong will be an attractive and enjoyable place in which to live and work.
4. To regenerate older urban districts by taking full account of the need for economic viability whilst emphasizing the importance of open space provision and retaining local socio-cultural characteristics and heritage buildings (Sustainable Development Unit, 2005:13).

With reference to HKPSG (2014) which is directly associated with land use planning provision and incorporation of environmental considerations, the Government of Hong Kong has agreed on the following policy objective:

- i. to avoid creating new environmental problems by ensuring the consequences for the environment are properly taken into account in site selection, planning and design of all new developments;
- ii. to seize opportunities for environmental improvement as they arise in the course of urban redevelopment (Planning Department, 2014:9).

Further, with an emphasis on land reclamation, HKPSG (2014) states the following:

reclamation and watercourse training projects, and extraction of marine sand as a source of fill involve extensive dredging activities. As dredging, produces considerable disturbance in the environment, the necessary measures to minimise adverse effects include the avoidance of dredging; the carrying out of assessment studies prior to the commencement of operations; the selection of management strategies, dredging method and machinery to minimize the impact on aquatic life, particularly in the vicinity of commercial fisheries and aquaculture operations; the control over the timing of the operations to prevent interruption of the sensitive uses in affected areas; and the monitoring of water quality prior to and during dredging activities (Planning Department, 2014:53).

Currently 443km² of Hong Kong's area is dedicated to country parks and the so-called special green areas. With 24km² permitted for marine parks and marine reserves and 76km² assessed as sites of special scientific interest, conservation areas of coastal protection areas. According to 'Hong Kong 2030+' study, 85% of Hong Kong's population lives within a 3km vicinity of a country park with 90% of population within a 400m bound of a park. Within this vision, 18.8M trees have been

planted by the Government between the years 2001-2011, with a ‘Greening, Landscape and Tree Management’ Section established in 2010 as part of the Development Bureau, The Government of the Hong Kong SAR. The aim of the section is to mainly reinforce the vegetation and preservation of trees whereby providing a green and sustainable environment with a target of brining “noticeable improvements in urban greenery” and “to enhance existing greened areas [...] during the planning and development of public works projects” (Greening, Landscape and Tree Management Section, 2017).

As presented in Table E, the current total built-up area of Hong Kong is 1,106.3 km², which is a result of a 42,3km² land reclamation increase in the past 30 years. In accordance with ‘Hong Kong 2030+’ document, the built-up area takes up around 268km² and will be further expanded to 311km². The remaining 72% of land area consists of hilly terrain, natural assets and ecological areas. Therefore, the key actions for planning a ‘liveable high-density city’ address the following enforcement strategies with regard to open space and greenery allocation as documented in the ‘Hong Kong 2030+’ (2016) document:

- a) to embrace active design in promoting physical activities and health through urban design and building design.
- b) To appropriately increase open space provision.
- c) To promote accessibility to recreational facilities (e.g. country parks and sports facilities).
- d) To provide a comfortable walking and cycling environment (Planning Departments, 2016:29).

Further, the document also addresses living conditions and well-being of the citizens through the establishment of green spaces with the following strategies:

in a compact city such as Hong Kong, natural assets of green and blue spaces should be leveraged in planning the city to provide a quality living environment. We propose to establish a coherent conceptual framework for a territory-wide green and water space plan with associated key strategic directions and actions. These will help achieve a sustainable living environment for public enjoyment and well-being (Planning Department, 2016:30).

As such, the key actions as identified in Hong Kong 2030+ (2016) with respect to green space allocation are as following:

- 1) to develop better country park access and facilities and to promote greater use and appreciation.
- 2) To designate / upgrade flagship parks, open spaces and public spaces.
- 3) To identify projects for community gardens, gardens in home / office / schools and urban farm, and encourage communal open spaces in development at multiple scales and levels.
- 4) To identify urban farming opportunities and to review the provision and guidelines for urban farming.
- 5) To develop and implement an urban forestry strategy and management plan.
- 6) To develop a street planting improvement plan.
- 7) To conduct a review of the existing policies, guidance, functions, quality, designs, accessibility, provision and management of public space including public parks and public streets, with a view to embracing public space as a key element of providing a quality living environment (Planning Department, 2016:30-31).

And further with respect to land uses:

- a) to relocate uses requiring less prime sites.
- b) To increase development intensity where planning terms permit.
- c) To explore more topside development to optimise use of land.
- d) To conserve and enhance natural environment of high environmental and ecological value and to identify sites with low conservation value and public enjoyment value for more productive uses.
- e) To explore reclamations on an appropriate scale outside of Victoria Harbour.
- f) To explore more rock cavern, underground space and topside developments (Planning Department, 2016:60).

Further on, an emphasis on green space and liveability of Hong Kong's land development has been established, with the following determination:

- i. urban and design measures to retrofit congested old urban areas and create smart, green and resilient new development areas.
- ii. The green and blue assets and urban-rural-countryside-nature continuum concepts will be adopted to bring nature closer to people (Planning Department, 2016:63).

In addition, the future 'open space per person provision target' has been established to set to a minimum of 2.5m² per person, facing an increase of 0.5m² from the previous years (Planning Department, 2016).

With respect to land reclamation projects and as identified in the 'Hong Kong 2030+' (2016) document, the main concentration of land development will concentrate around East Lantau Metropolis in order to "create artificial islands by reclamations in the waters near Kau Yi Chau and the Hei Ling Chau Typhoon Shelter, and to make better use of the underutilised land in Mui Wo" (Planning Department, 2016:73). Overall the project aims to develop around 1,000 hectares of land mainly through reclamation. The economic benefits of this aim to connect the facilities with Central Business District in Hong Kong, as well as to provide access to the surrounding areas. Interestingly, however, the social impact of this project has been graded as 'low' in accordance with the document as the reclamation processes does not involve existing development, but arguably destroys the existing biodiversity.

In the New Territories, the reclamation will concentrate on the development of The New Territories North project, which aims to "provide land for building new communities and developing modern industries and industries preferring a boundary location while improving the living environment of the existing area" (Planning Department, 2016:73). This project aims to develop around 720 hectares of land, in mainly abandoned cultivation areas. The economic benefits of this projects are mainly concentrating on the use of land for industrial uses primarily concentrating on accessibility.

As defined in the methodology part of this paper, the proportion of green space and reclaimed land in comparison to the city area has been identified. In addition, the policies on land preservation and community involvement have also been determined. The percentage of the green space coverage in relation to the overall land area has also been established and it certainly appears much larger than many other metropolitan areas. The percentage of the reclaimed land used for green-space purposes is, unfortunately, not applicable in this instance as Hong Kong's

reclamation projects are mostly associated with built-up activities due to the scarcity and land conservation policies.

Nevertheless, problems occur when analysing Hong Kong's greenery in relation to its density and the lack of green spaces in the proximity of buildings. Compared with many Western cities, Hong Kong also lacks allocation of trees in the vicinity of roadsides and high-ways. In this regard, Hong Kong is also lagging behind with respect to vertical greenery, such as introduction of sky-scraper farms, rooftop gardening and sky gardens.

In response to the problematic consensus of open space in Hong Kong, 'Civic Exchange' has published a paper on 'Mapping Equitable Availability of Open Space in Hong Kong' (Lai, 2017) in order to study the unique set up of Hong Kong's urban areas. The report concentrates on the allocation and provision of open space being set to 2.5m² (as indicated previously), which is significantly lower than in the cities such as Tokyo, Seoul, Shanghai or Singapore (Lai, 2017). In addition, it is argued that the open space is unevenly distributed, with more than half of Hong Kong's population living with much less than the distribution of 2m² of open area, yet alone greenery. In these cases, mostly the elderly population is affected, with a higher likelihood of living in denser populated areas.

Another issue associated with allocation of green spaces in Hong Kong is the underdevelopment of existing recreational spaces, which would involve the assessment of private ownership of some areas. In this respect, funding proposals and financial commitment for redevelopment would signify the sincerity of the projects and allocate specific improvement and maintenance of open zones and boost Hong Kong's sustainability awareness. The reclaimed land in this respect, should also include more greenery and open space allocations.

In the overall assessment review of the policy recommendations, the Government of Hong Kong lacks on reporting the overall open space distribution by the district. While the overall numbers are set to the provision of 2.5m², a large number of Hong

Kong districts is so dense that the increase of the open space target seems unrealistic. In those districts in particular, a set priority should include regeneration projects to include more greenery and introduce better space allocations. In addition, little has been found in relation to provision of green playground areas for children in the documents studied.

With respect to the development of the New Territories as identified in 'Hong Kong 2030+' the planned projects would put Hong Kong on the path of sustainable growth and a better living environment. Specifically, "the territorial spatial planning framework could also help redress the existing unbalanced spatial distribution of homes and jobs for the territory by creating more jobs in the New Territories" (Planning Department, 2016:77), bringing more jobs and better infrastructure and facilities in the area, however, also affecting its greenery.

Despite the constraints mentioned above, it is evident that Hong Kong has the opportunities from the financial and the community perspective with regard to better use and development of land. It's strong economic background should make an impact in relation to urban greenery, its use and a careful consideration of reclaimed land. With reference to compact city analysis, Hong Kong needs to implement strategies to optimize greenery above ground level, with a lack of such reference in the documents studied. With respect to Governmental policies on a set sum of an open space provision, it became clear that very limited information is actually available to prove these findings, with a more transparent approach clearly needed to be established.

2.2 The Sustainability Vision of Singapore

With a population of 5,607 million and the land size of 719.1km², the city-state of Singapore has a long and profound climate change and sustainability awareness scheme dating back to 1997 when the city-state ratified the United Nations Framework Convention on Climate Change (UNFCCC), as well as accepted the Kyoto Protocol in the year 2006 (Putra, Koh, 2014). Further, the Singapore Environment Council (SEC), supported by the National Environment Agency (NEA), introduced the Climate Change Awareness Programm (CCAP) likewise in the year 2006, with an intention of raising public awareness in the sphere of climate change and environmental concerns (Naon, 2014). Subsequently, the Singapore's National Climate Change Secretariat (NCCS) was allocated to the Prime Minister's Office in the year 2010, which is now headed by a Permanent Secretary (Putra, Koh, 2014). To the present day, NCCS acts as a "dedicated unit under the Prime Minister's Office to provide coordination at the highest level for Singapore's domestic and international policies, plans and actions on climate change" and sustainability related issues (Naon, 2014:2).

With respect to the publishing bodies and the reports on sustainable development issues, the NCCS has published a document 'A lively and Liveable Singapore: Strategies for Sustainable Growth' to assess and develop the national sustainable development strategy for Singapore which looks into the future development and sustainability network of Singapore as it highlights the visions and goals of Singapore's future from the perspective of "A City of Garden and Water" (Sustainable Singapore Blueprint, 2014). In addition, Urban Redevelopment Authority of Singapore (URA) summarises the past, current and future plans of Singapore in their reports annually.

At present, the Government of Singapore indwells on four ministries engaged in sustainability-driven research. These Ministries are: the Ministry of Environment and Water Resources (MEWR); the Ministry for Trade and Industry (MTI); the Ministry of National Development (MND) and the Ministry of Transport (MOT). In addition, the

National Environment Agency (NEA), run under the MEWR, is the leading organization of Singapore dealing with the waste management, recycling and waste collection scheme.

In the last decade, the Singaporean Government has produced a significant number of national policy reports and documents in relation to sustainability and climate change adaptation. In this respect, Singapore portrays an example of policy publication outlining national strategies and policy recommendation significance, with respect to public education campaign. At the same time, the majority of the documents have been produced with an intention of public awareness and education in the field, as well as the overall acknowledgement of national strategies and responses in relation to sustainability and climate change (Naon, 2014). In addition, the governmental documents have been considered as significant indicators of a country's proposed plans in various fields, their ways of achievement and encouragement, and have been widely used and shared between stakeholders, policy makers, academics and the like.

For the purpose of this research, and in a similar way as with Hong Kong, a number of policy documents has been selected in order to address the sustainability efforts of a given city-state, as well as with an intention of answering the RQ of this thesis. As such, Table 9 presents the chosen policy related documents from Singapore. In an effort to compare the differences and similarities of policy documents, the chosen documents portray different strategic outcomes of the city-state and have been selected from various years: 2006, 2007 and 2014 respectively. The reports have been carefully selected in order to reflect a variety of different issues and compare them as accurately as possible to the ones of Hong Kong.

Selection of Policy Related Documents, Singapore					
Institution Department Year	Title	Waste Management	Land reclamation	Green space allocation	Transportation
Ministry for the Environment and Water Resources, Republic of Singapore (2002)	"The Singapore Green Plan 2012"	✓	✓	✓	✓
Ministry for Trade and Industry, Republic of Singapore (2007)	"Energy for Growth" National Energy Policy Report	✓	✓	✓	✓
Ministry for the Environment and Water Resources; Ministry of National Development Republic of Singapore (2014)	"Our Home, Our Environment, Our future" Sustainable Singapore Blueprint	✓	✓	✓	✓

Table E. Selected policy related documents for the study of Singapore. Source: own drawing.

In the same way as with the selected documents of Hong Kong, the above Table (E) lists the names of the chosen documents, publishing institutions, and the publication year. The variety of publication years has been picked specifically for the comparison of the “before” and “after” purposes, and in order to reflect on the significant changes between the years. Unlike with Hong Kong, the policy documents of Singapore seem to cover a wider range of topics and address most of the issues being tackled in this paper.

2.2.1 Waste Management: The Case of Singapore

2.2.1.1 Background

Singapore has long established its name under shining-clean outdoor spaces. And while littering is at its lowest, waste management, on the other hand, is an important component with respect to sustainability and urbanization processes.

Distinctively from Hong Kong, Singapore's current issues concentrate around the field of municipal food waste.

In the last decade, Singapore has followed the 'Singapore Green Plan 2012', which outlines zero landfill targets and promotes recycling and sustainable management of waste. With recycling urgency emerging in the early 2000's when Singapore began to produce over 7,600 tonnes of waste a day - an increase of nearly six times in comparison to the 1970's - the population of Singapore along with its government had to urgently concentrate on the new recycling schemes (Yep, 2015). Currently, only around 2% of the waste generated annually is sent to the one operating landfill, with the remaining waste being recycled or burned for energy production (NEA, 2017). At present, Singapore operates four Waste-to-Energy (WTE) incineration plants, with a fifth plant under way, expected to be operational by the year 2018-2019. Currently, the energy derived from the WTE plants provides less than 3% of the electricity needed for the island, however with the overall amount of waste generated annually still increasing (Eco-Business, 2013). The proposed fifth WTE plant will aim to process 3,600 tonnes of waste per day, producing 120 megawatt of renewable electricity (NEA, 2017).

2.2.1.2 Data Description and Analytical Interpretation

The following graph (Figure 20) represents the amount of waste generated in Singapore throughout the years 2003-2016. Very differently to Hong Kong, there appears to be a steady increase in the amount of waste being generated yearly with an exception for the year 2013, where an exceptional of 7,851,500 tonnes of waste was produced. As can be noted, the largest amount of waste generated falls under the category of: 1) paper/cardboard; 2) construction debris; 3) ferrous metal; 4) plastics; and increasingly more so in the recent years – 5) biodegradable waste. Overall, the amount of waste generated has increased from 4,730,000 tonnes in the year 2003 to approximately 7,900,000 tonnes in the year 2016. Hence, the biggest

contributor to waste increase in the recent years falls under construction debris and ferrous metal, with the steadiest contributor remaining over the years as food.

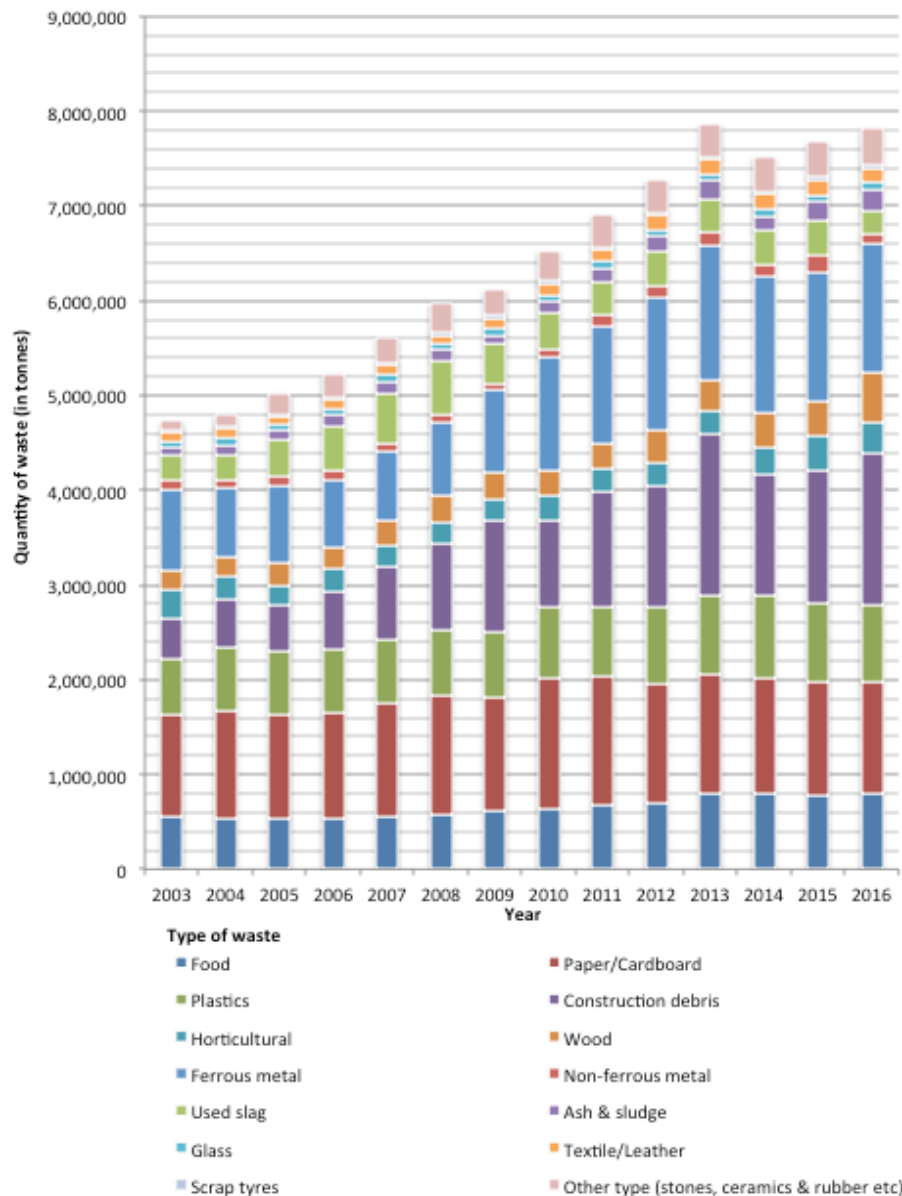


Figure 20. Waste statistics for Republic of Singapore for the years 2003-2016.
Source: own drawing constructed using the data from NEA, 2017a.

The following chart (Figure 21) represents the recycling rate in relation to waste generation of Singapore for the years 2003-2016. The trend represented in this graph clearly shows the increase in the overall waste production, followed by a steady but rather slow, advancement in recycling rate. As represented in the graph, the most recycled component from the overall waste in Singapore remains

accommodated to construction debris, followed by ferrous metal. The recycling rate for these components, however, remains steady between 90-99% throughout the years 2003-2016. The lowest recycling rate is attributed to textile and leather materials, which accumulate to an average of 1-4% recycling rate in the years 2003-2007, with an increase of 12% in the year 2008, followed by a slight decrease to 7% in the year 2016. Other types of waste, attributed to stones, ceramics and rubber, remain at the lowest (0-6%) recycling rate followed by a significant increase in glass recycling (from 6% in 2005 to 20% in 2016). Overall, the recycling rate remains quite steady, with the lowest overall number in 2003 (47%) and the highest (61%) in the years 2013, 2015 and 2016 respectively.

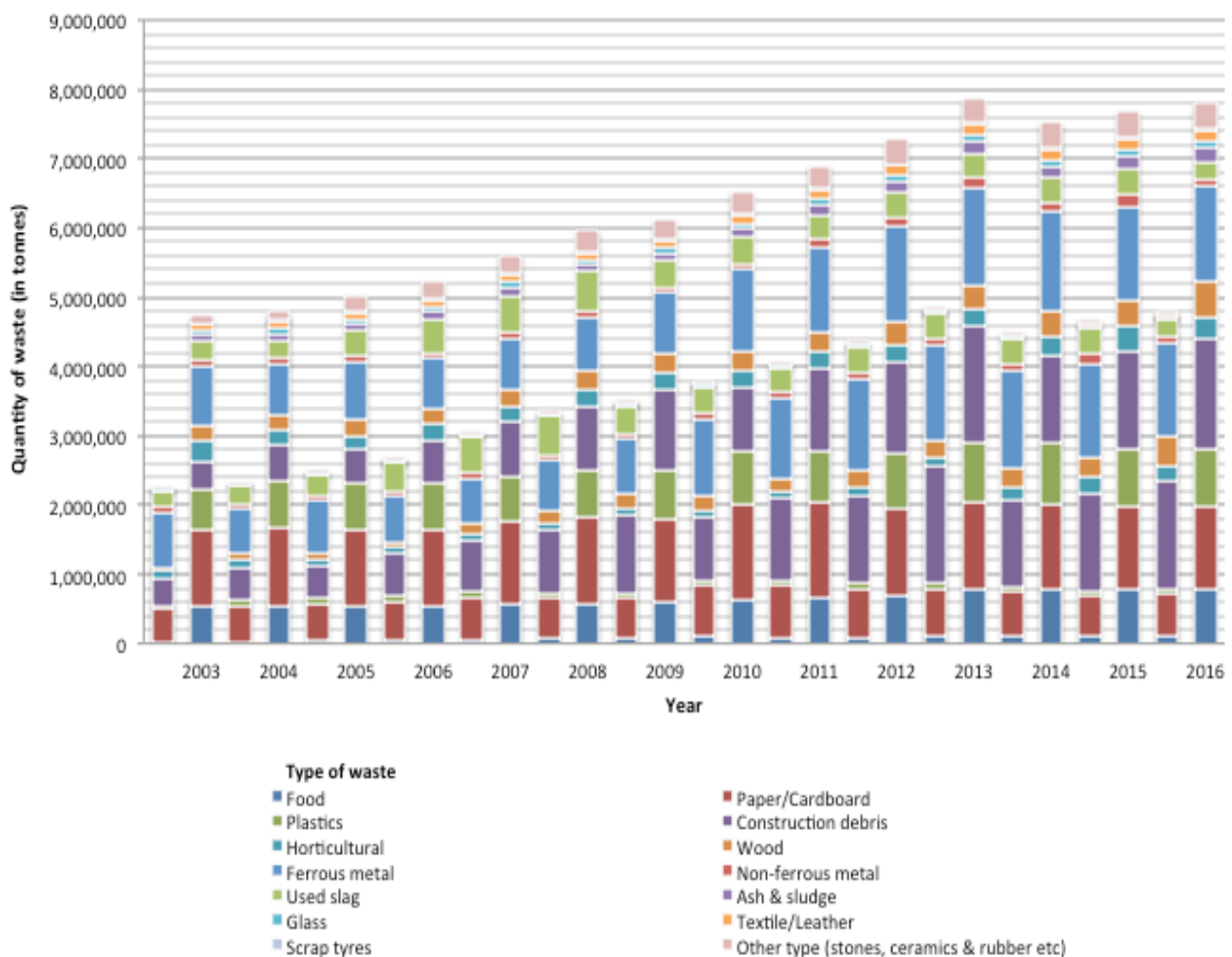


Figure 21. Total waste generated vs. total waste recycled of Republic of Singapore for the years 2003-2016. Source: own drawing constructed using the data from NEA, 2017a.

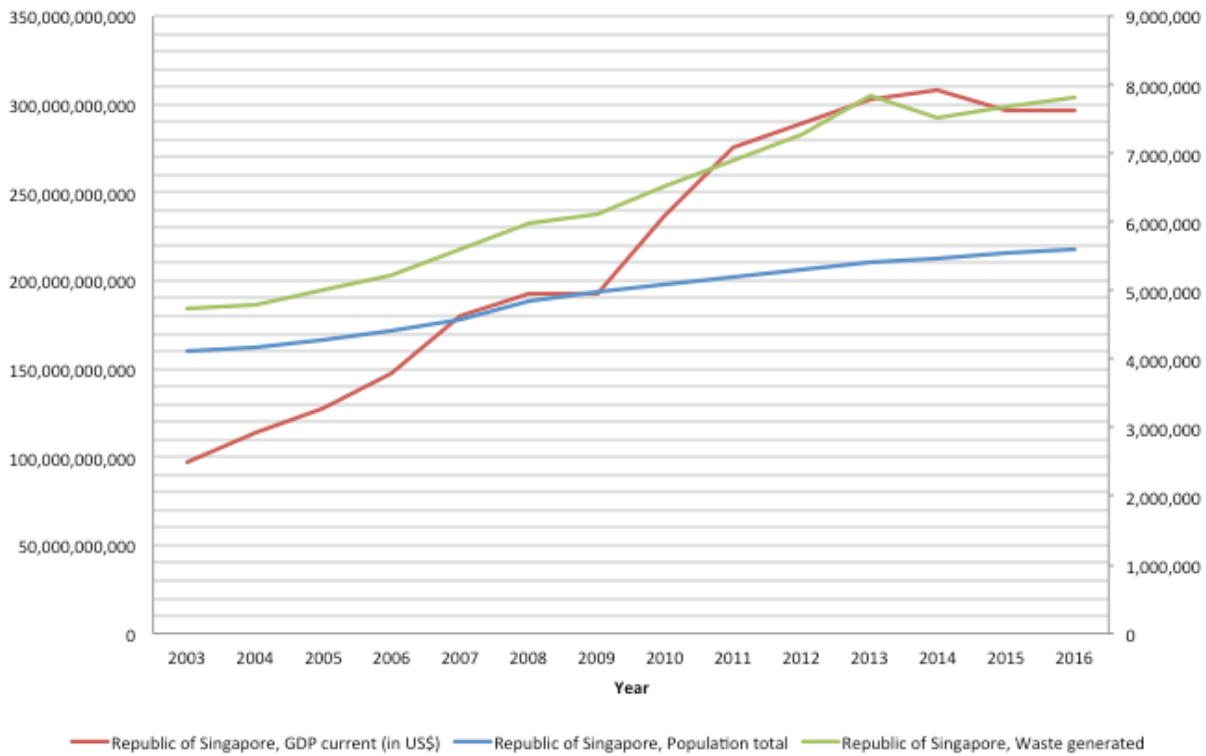


Figure 22. Relationship between GDP, population growth and waste generation in Republic of Singapore for the years 2003-2016. Source: graph constructed by the author using data from The World Bank Open Data, 2017c, 2017d, NEA, 2017a.

As stated in the previous chapter of this paper, population growth is directly linked to the establishment of sustainable development and hence, plays a major role in forming sustainable patterns of production, consumption and waste generation chain. The above graph (Figure 22) presents the relationship between the population growth (currently 5,535 million), GDP (current, 293 billion in USD), and waste production (in millions, measured in tonnes) in Singapore throughout the years 2003-2016. The predominant factors here are directly linked to the population growth as the production of waste increases, with an exception of the years 2013-2014 when the overall waste production dropped to 7,515,000 tonnes. The GDP factor reflects the general pattern of prosperity and economic growth, with a correspondent but less drastic increase in the annual waste production. Currently, an increase of waste is still evident with the overall number estimated to increase for the current year.

2.2.1.3 Analysis

Whilst the recycling and WTE plants seem to be operating under quite a successful scheme in Singapore, the land and resource scarcity, alongside the on-site recycling restriction still pose problems. With the help of the following documents, the waste management of Singapore will be analysed from the perspective of policy implementation.

‘The Singapore Green Plan 2012’ published in the year 2002 by the Ministry for the Environment, Republic of Singapore, addresses the following with respect to sustainable development and waste management, in particular: “Singapore’s policy towards waste management covers the entire spectrum from generation to recycling to disposal. Because of [our] limited land – [only 719.1 km²] – we aim to ‘zero landfill’, by minimising the amount of waste generated and recycling as much as feasible” (Ministry for the Environment, 2002:3).

From the above presented, it is evident that the general statistics for the year 2001 reflect the recycling rate of 44% for the year 2001. The targets set to be achieved by the year 2012 are, subsequently, the following:

- 1) raise the overall waste recycling rate from 44% to 60%.
- 2) Extend the lifespan of Semakau Landfill to 50 years, and strive towards ‘zero landfill’ needs.
- 3) Reduce the need for new incineration plants, from the current one every 5-7 years to one every 10-15 years (Ministry for the Environment, 2002:x).

The document titled “Energy for Growth”, on the other hand, published in the year 2007, looks into the use and reuse of energy sources and the environmental impact of energy consumption. Its aim is to generate a holistic national energy policy framework to approach environmental sustainability and economic competitiveness with an overall aim of the energy-related policies to secure economic growth. Its relation to waste management approach is very significant as incinerator plants in Singapore produce energy in return for waste. As such, the document mentions the

significance of using waste sources for generation of energy and to continue the overall concentration on the waste reduction scheme. In particular, the document states that “Singapore is one of the few countries in the world that incinerates almost all its waste, generating electricity in the process and minimising the amount of waste dumped into the landfills” (Ministry of Trade and Industry, 2007:51) as well as producing about 2-3% of the power supply. With this in mind, the next steps towards sustainable development are to continue securing energy through research and development for production of biofuels and distinguishing alternative sources for energy. “Our policies to reduce, reuse and recycle waste will further cap waste production” – summarises the document (Ministry of Trade and Industry, 2007:32).

“Our Home, Our Environment, Our Future” – “Sustainable Singapore Blueprint 2015”, published by the Ministry for the Environment and Waste Resources and the Ministry of National Development in 2014, is the second edition of the “Sustainable Singapore Blueprint” published in 2009. In terms of waste management, the document reports on the successful national recycling rate, increasing from 56% in the year 2008 to 61% in the year 2013 - which was noticeably the most successful year for recycling thus far and furthermore sets future targets to:

- a) introduce centralized chutes for recyclables in all HDB [Housing and Development Board] flats and facilitate recycling in private housing through better infrastructure support.
- b) Introduce Pneumatic Waste Conveyance Systems in more HDB towns to support convenient and hygienic waste disposal.
- c) Build an Integrated Waste Management Facility which will have the capacity to segregate recyclable from waste.
- d) Introduce more initiatives to reduce food waste in Food & Beverage businesses and to improve recycling of electrical and electronic waste (p. 16).

With regard to national recycling rate, the targets set for the year 2030 are 70%, with the current recycling rate being 61%. Supplementary, the domestic recycling rate is set to increase from 20% to 30% with a non-domestic recycling rate from 77% to 81% (Sustainable Singapore Blueprint, 2014). In addition, the plan corresponds to the pilot schemes of Singapore Packaging Agreement, Mandatory Waste Reporting

for Large Commercial Premises, Food Waste Recycling Initiatives and National Partnership Programme for Recycling E-Waste. The especially encouraging part about the document corresponds to the budgeting and stakeholder initiatives, which are not common to any of the other two documents, neither to the ones related to the study of Hong Kong. Specifically, the document sets a budget of National Environmental Agency of \$27 million funding in waste management technologies. In addition, it states that “in August 2014, \$25 million was also allocated under NRF’s (National Research Foundation) Energy National Innovation Challenge for research, development and demonstration in enhancing energy and resource recovery from municipal solid waste” (Sustainable Singapore Blueprint, 2014:70).

While the recycling and WTE plants seem to be operating under quite a successful scheme in Singapore, the land and resource scarcity, alongside the on-site recycling limitations still pose challenges with regard to MSW. In 2012 alone, Singapore generated 703,200 tonnes of food waste with only 12% of it being recycled. In this instance, the actual recycling rate for the mentioned year does not actually meet the target of 30%, as described in The Singapore Green Plan (2002). At present, only around 13% of food is being recycled with the second lowest recycling rate - despite the attempted regulations - being plastic. In response to the issue, the local NGO ‘Zero Waste Singapore’ published numerous reports in addressing the problems and initiating a further zero waste and circular economy network. Similarly to Hong Kong, the issue of plastic seems to pose a critical alert with 822,200 tonnes generated in 2016 and as low as 7% recycle rate.

‘Zero Waste SG’ (2016) addresses the challenges of plastic waste in Singapore by stating the overall increase (as displayed in Figure 20) from 579,000 tonnes in 2003 to 822,200 tonnes in 2016. Despite the overall target of recycle rate of 35% by the year 2012 as mentioned in the ‘Singapore Green Plan 2012’ by 2012, the actual recycle rate was 10% in the year 2012, which further dropped to 7% in the year 2015. In “Sustainable Singapore Blueprint 2015” on the other hand, the overall commitment to recycling is set to 70%, which is far higher than what has been actually achieved this far. In this respect, the NGO published a number of

recommendations for achieving a greater rate of recycling for plastics and an overall reduction of waste produced. Therefore, it strongly believes that in order to achieve sustainable waste management governments and businesses shall:

- a) provide information and guidelines to help companies and consumers make the right choice.
- b) Set up a committee to tackle plastic disposables holistically.
- c) Develop specific plans and targets to reduce or phase out certain plastic disposables over time.
- d) Implement a structured incentive scheme to help consumers switch to using reusables.
- e) Address challenges and funding needs for companies to switch to alternatives or reusables.
- f) Conduct research on mixing alternatives with food waste for recycling into biogas or fertilisers (Zero Waste SG, 2016).

In this respect, the document is particularly efficient in the efforts of producing alternative energy while using unneeded materials and focusing on the research of alternative solutions.

With reference to the methodological framework of this paper, this section has identified the volumes of solid waste generated, the recycling rates and domestic waste production overall. It has also looked into certain aspects of recycling facilities such as recycling chutes and the budgetary expenditure for certain waste related initiatives.

Concluding from the above, the recommendations proposed on a local level suggest a notion of an integrated waste management system, with a specific emphasis on tackling waste management sources at core. And while waste quantities are inexplicitly connected to economic activity, the overall waste accumulation and production may continue to rise. With an emphasis on three documents discussed in this section, the overall advance on waste management in Singapore concentrates on alternative recycling schemes and energy production while fostering economic prosperity. With two alarming sources of waste discussed here such as food and

plastic, Singapore may soon be targeting a zero landfill waste scheme with a 61% recycling scheme. Such vision, would set a great example for the neighbouring countries, however, few issues remain unclear. With a spectrum of laws and policies related to waste management, not everything is addressed and a long-term solution for especially problematic waste element such as plastic, is yet to be determined.

2.2.2 Urban Transportation: The Case of Singapore

2.2.2.1 Background

Singapore's transportation system is considered efficient and convenient. It consists of mostly over-ground networks with the Mass Rapid Transit (MRT) connecting the majority of the island's points of interest. In addition, buses, taxis and trams constitute as modes of public transportation. With respect to private car ownership, Singapore has long established control system over purchased vehicles, whereby also establishing a traffic congestion authority. The traffic utilisation system of Singapore has also been in place for a number of years and plays a major role in an attempt to achieve reduced pollution on the built environment. The transformation of Singapore's policies on transportation can be noted from the establishment of the 'Land Transport White Paper' published in 1996 followed by a 'Land Transport Master Plan' published in 2013 which will be discussed further along this section.

2.2.2.2 Data Description and Analytical Interpretation

As indicated in the below graphs, Singapore's land vehicle population mainly attributes to cars, rental cars, taxis, buses, motorcycles and scooters. Figure 23 demonstrates the main types of land vehicles operational in Singapore. As can be observed, the main characteristic about the graph is the almost steady increase in the number of vehicles between the years 2010 and 2016, a steady increase between the years 2003-2010, with an overall slight decrease in the year 2016. In

the year 2015 alone, the total number of motor vehicles on register was accounting to 957,246 with a slight decrease to that number in the year 2016.

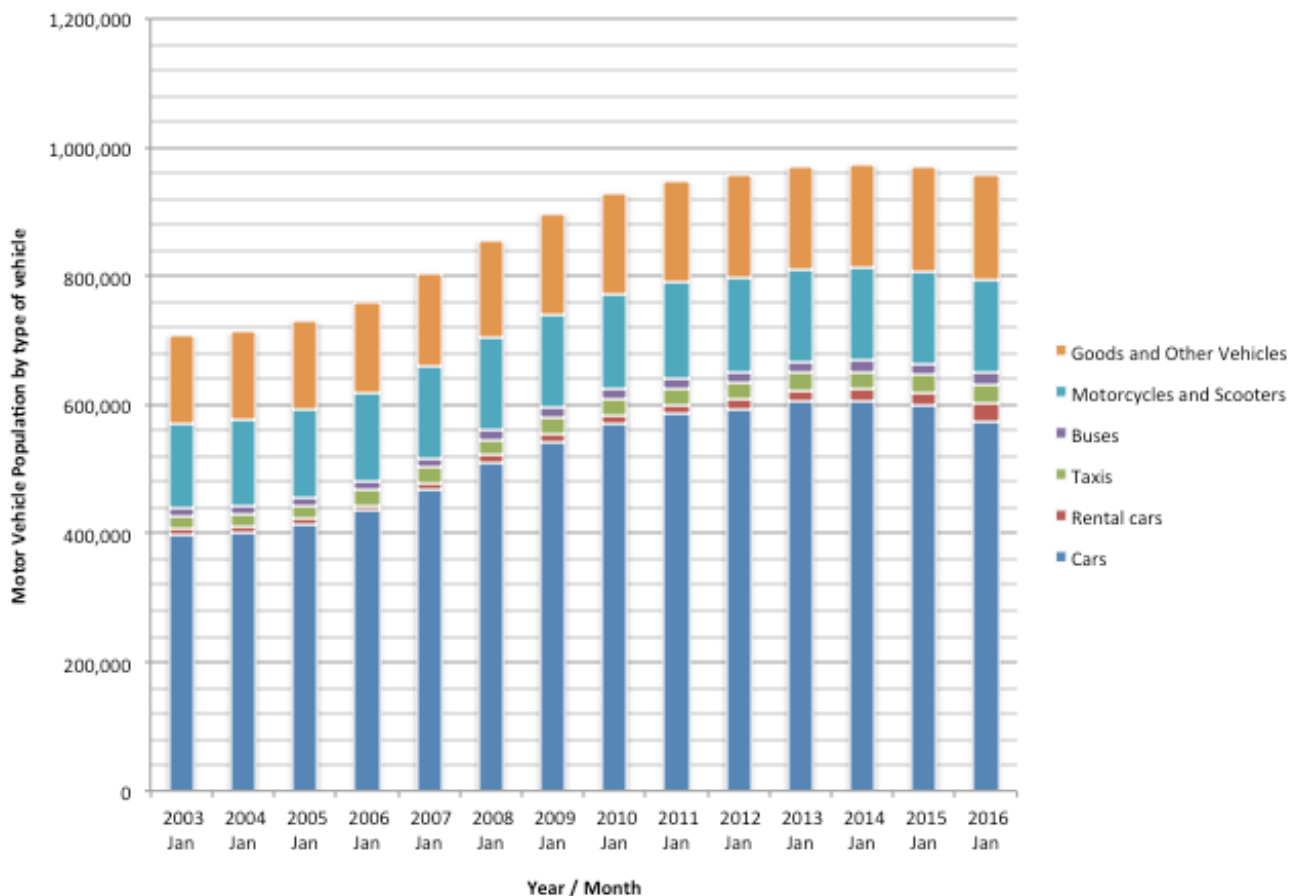


Figure 23. Land motor vehicle population of Republic of Singapore for the years 2003-2016.
Source: graph constructed by the author using data from the Land Transport Authority, 2017.

With an attribute to deregistration of vehicles in Singapore, however, the graph (Figure 23) presents an interesting pattern with a steep decrease in deregistration of vehicles for the years 2010, 2011 and 2012. As detected, land vehicles in Singapore must undergo annual inspections, which testify for usability of a given car. Here, it can be assumed that the decline of deregistration falls under a problematic processing rates of deregistered vehicles and a shortage of space in the 'Export Processing Zones' which process deregistered vehicles for further export (Lee, 2016). As deregistration can be pricey, many Singaporeans choose to refuse to deregister their vehicles, whereby strict fines and court orders are applicable. The problematic consensus of driving unsuitable cars further contributes to environmental concerns.

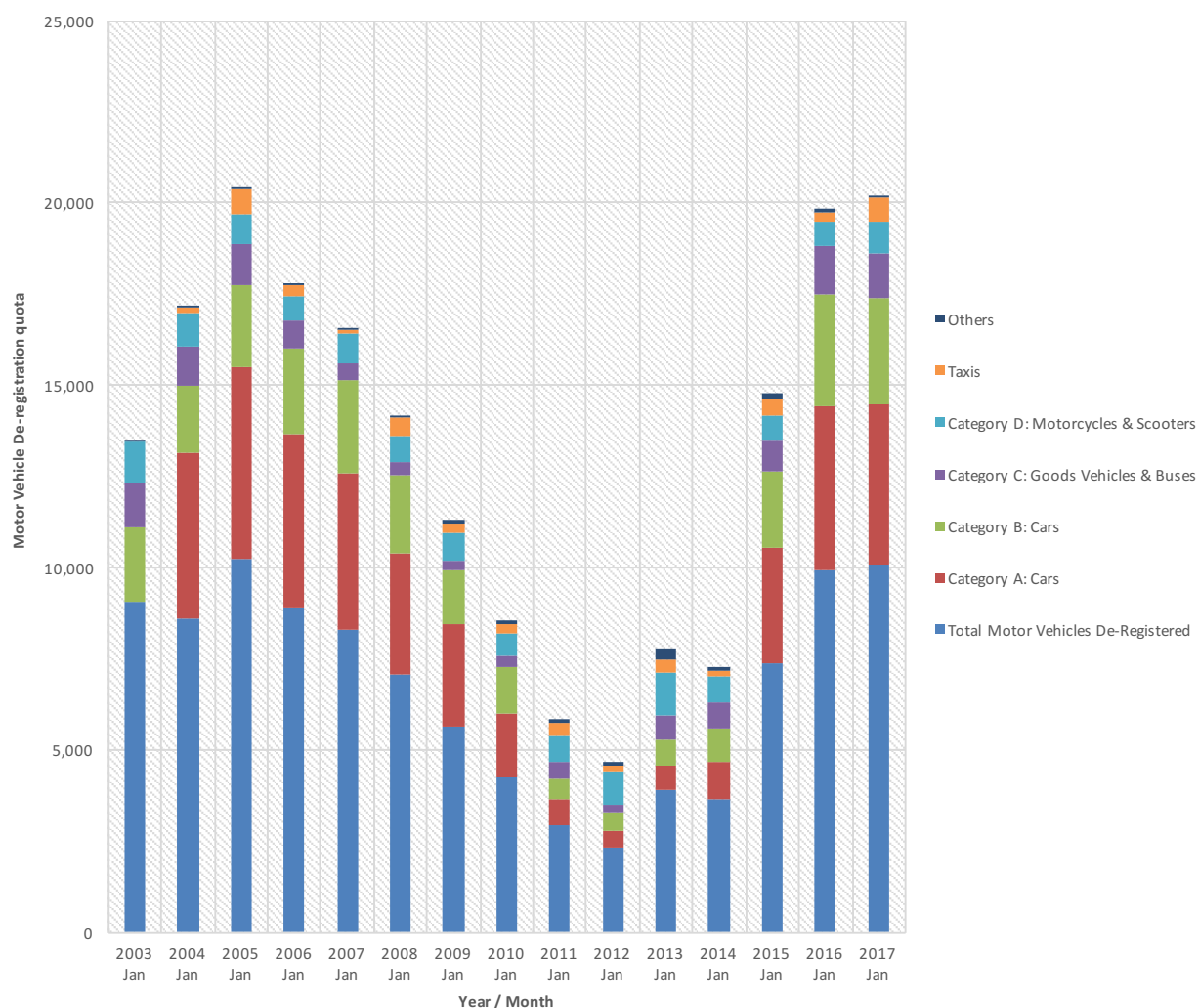


Figure 24. Land motor vehicle de-registration quota for the years 2003-2017.
Source: own drawing using the data from Land Transport Authority, 2017a.

With respect to economic growth and prosperity, the Singaporean government has certainly attempted to maintain a steady car ownership, with the total population of cars remaining at around 610,000 for the last six years (Table G). Its urban traffic and vehicle purchase restrictions have been introduced in the 1970's firstly with the 'Area Licensing Scheme', which aimed at restricting access to the central business district, followed by car ownership control such as 'Vehicle Quota System' as well as the 'Electronic Road Pricing' and congestion pricing (Fwa, Chua, 2007). However, the overall increase in car population is still evident as indicated in Table F with various fluctuations.

Car population in Singapore	
Year	Number of private cars registered
2006	474,717
2007	517,041
2008	552,846
2009	579,371
2010	597,746
2011	606,280
2012	620,011
2013	623,688
2014	619,023
2015	604,722
2016	603,763

Table F. Annual vehicle population of Singapore for the years 2006-2016.
Source: table constructed by the author using data from Data.gov.sg, 2017.

For this section of the paper, the author found applicable to also look into the patterns of transportation from household to occupation, as defined in Figures 25-27. As indicated in the methodological part of this paper, a distinct outline of key trends in transportation facilities with respect to access to underground lines within short distances and the overall distance travelled, will further enhance the analysis of this research.

As such, Figure 24 outlines the average main modes of transportation used for occupational trip purposes for the years 2013-2016. Interestingly, the data also contains characteristics for 'working from home' population, which is also assertive for this type of research. Concluding from the diagram, most of the trips were made by buses (29,27%), MRT (28,05%) and cars – including taxis (17,07%). Notably 'walking' contributes to 10,98% with 'motorbike' and 'working from home' attributing to 4,88% and 6,10% respectively. Cycling contributes to 2,44% with tram/streetcar attributing to 1,22%.

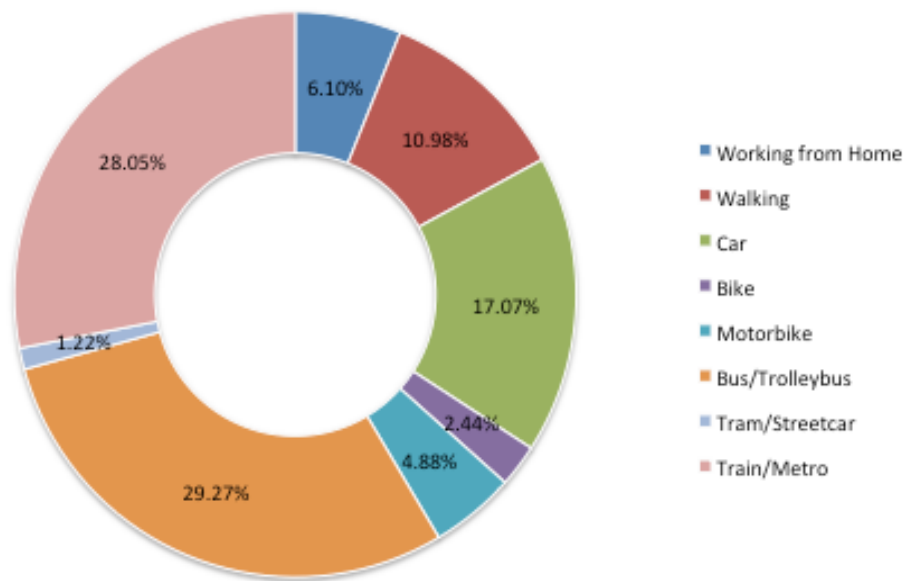


Figure 25. Means of transportation from home to occupation in Republic of Singapore. The average number was calculated based on the statistics from the last three years (2013-2016).
Source: chart constructed by the author using data from Numbeo Database, 2017.

Further, transportation patterns within the context of sustainability can be identified through time travel required from home to occupation whereby also identifying access to occupation within short distance. In this instance, Figure 25 identifies two scales of time travel, depended on the distance from home. Admittedly, most of the occupants (in this instances aged five and over) tend to live within 'up to 15min of travel' distance (37%) and require 'public bus only'. Further, the occupants rely on 'MRT and public bus only', 'car, and 'chartered bus' attributing to 14%. The remaining student occupants fall under 'MRT only' (7%), 'other combinations of MRT and public bus' (6%) and 'no transport required' (7%). The occupants whose travel requires 16-30min, however, fall under 'public bus only' (14%), 'car only' (16%) and 'no transport required' (58%). The chart, therefore, concludes that most students live within 'up to 15min' travel frame within Singapore.

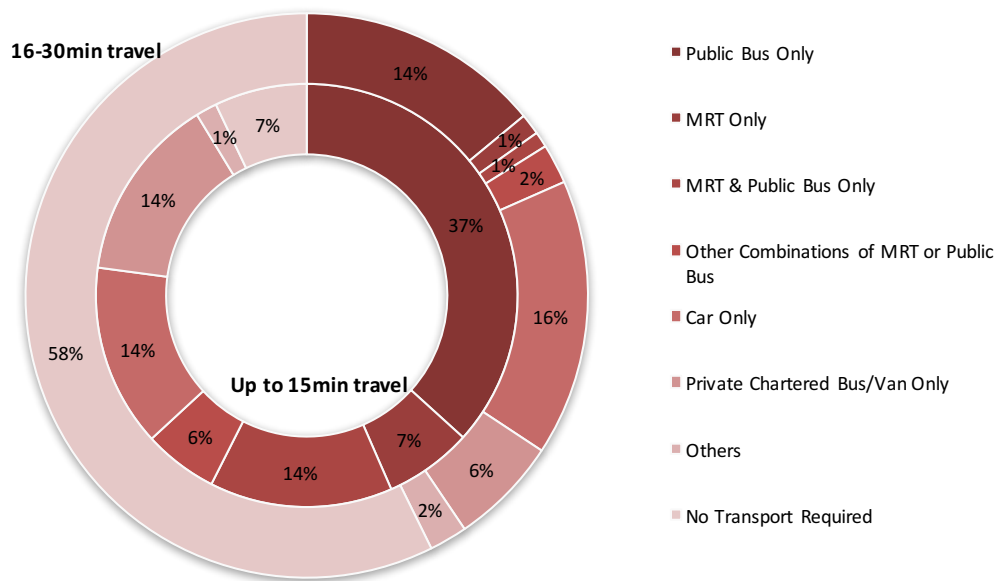


Figure 26. Residents aged five years and over travel time to occupation and mode of transport.
Source: chart created by the author using data from General Household Survey, 2015.

Figure 25 identifies a certain category of working class population of Singapore aged 15 and above within the time needed to travel to occupation. Here, most of the residents identify under '16-30min' travel with a total of 722,700 (19%) using 'public bus' only. The remaining occupants 89,800 (12%) require 'MRT and public bus only' with 255,400 (35%) travelling by 'car only'. The residents requiring up to 15min of travel time, on the other hand, tend to travel mostly by 'car only' (29% or 86,600) and 'public bus only' (13% or 38,800) with the remaining residents not requiring any transport (36% or 108,900).

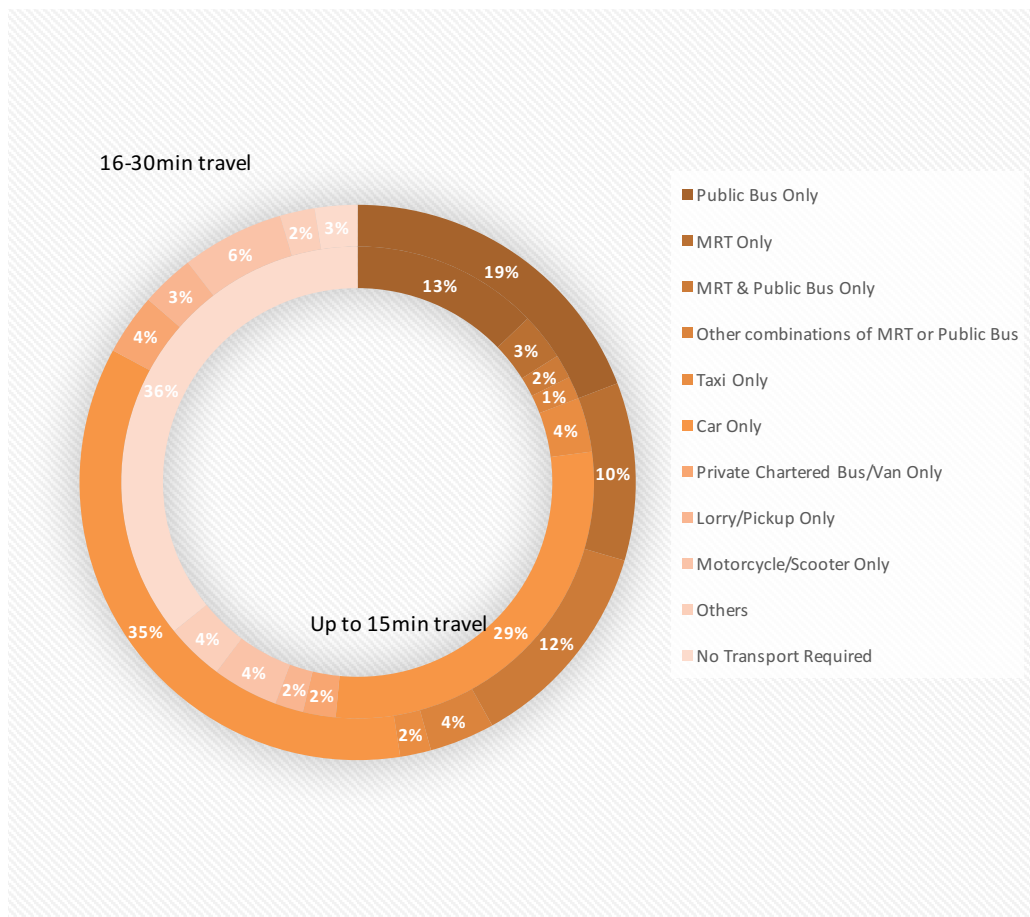


Figure 27. Working population aged 15 years of age and older by mode of transport and travelling time to work. Source: own drawing, constructed using data obtained from General Household Survey, 2015.

2.2.2.3 Analysis

Based on the above figures, the transportation patterns of Singapore within working and student classification can be attributed to the following: 1) the working population aged 15 and above requires longer transportation time to occupation and falls under the category of 'cars only' at 29% in order to have quick and easy access to occupation; 2) the younger population group has quick and easy access to occupation mostly categorised under 'public bus only'.

Within the framework of time required to travel to occupation and the modes of transportation used, the data identified in the above graphs may present certain characteristics of policy implication and transportation tactics. With this in mind, the

documents chosen for this study present the following information within the field of transportation for Singapore.

'The Singapore Green Plan 2012' (2002) sets the main targets related to transportation in the advocacy of natural gas in transportation beyond public buses and taxis and promotion of public transportation as an alternative to private vehicles, specifically: "to reduce fuel consumption, public transport will be enhanced further as an attractive alternative to private cars" (Ministry for the Environment, 2002:19), as well as the extension of the underground lines to cover more districts of Singapore. In addition, a National Energy Efficiency Committee was set up in 2001, in order to integrate a "more efficient use of energy by industries, homes, commercial buildings and vehicles" (Ministry for the Environment, 2002:19).

The 'Energy for Growth' (2007) document addresses transportation issue with an emphasis on energy production and consumption the Government's recognition in facilitating greater energy diversity and as indicated in the previous section, the mandatory vehicle inspections. In this respect, it states the following approach:

for land transport, our strategies of promoting the use of public transport and innovative policies to restrain car ownership and usage will help to address the energy challenges by encouraging energy efficiency and conservation. To safeguard public health and the environment, we have also put in place policies such as mandatory vehicle inspections, vehicular emission standards, and promotion of fuel efficient and green vehicles" (Ministry for Trade and Industry, 2007:7).

Notably, the document also mentions the Government's intention to introduce "mandatory fuel economy labelling, in addition to increasing public awareness of fuel efficient driving habits" (Ministry for Trade and Industry, 2007:7).

As mentioned previously, the above strategies in restraining car ownership and usage are set to be achieved through application of Vehicle Quota System (VQS) and Electronic Road Pricing (ERP). In addition, the Government has been involved in offering the Green Vehicle Rebate (GVR) programme to encourage the overall

consumption of hybrid cars. The production of second-generation of biofuels from sustainable sources is additionally presented as an alternative in the energy market, to promote energy security and balance (Ministry for Trade and Industry, 2007).

With a particular significance on sustainable land planning principles and transportation 'Sustainable Singapore Blueprint 2015' (2014) indicates to promote the following:

- a) the use of public transport by providing an extensive rail network and intensifying land use around rail stations;
- b) decentralise commercial centres to provide more jobs near homes, as well as to reduce the need to travel and peak hour traffic congestion (Sustainable Singapore Blueprint, 2014:11).

And further, the key points of the document are aiming to:

- 1) introduce innovative features and creative designs to towns to provide a better cycling and walking environment, starting with Ang Mo Kio.
- 2) Develop a comprehensive cycling network spanning more than 700km by 2030, with supporting infrastructure and a code of conduct to promote safe cycling within and across towns.
- 3) Create more car-free spaces in housing estates and the city, such as the Civic District, where roads are temporarily or permanently closed for public activities.
- 4) Introduce driverless vehicles on a larger scale in Singapore.
- 5) Pilot an electric car-sharing scheme to allow residents convenient access to electric cars without having to own one (Sustainable Singapore Blueprint, 2014:15).

It is important to mention that especially problematic for Singapore are the peak hours of commute for which the indicators related to mobility are aiming to increase the 'modal share of journeys during peak hours made via public transport' from 64% in 2013 to 75% by the year 2030. The length of the rail network is aiming for a 180km increase with a 'proportion of households within 10-min walk from train station' to an overall increase from 58.5% to 80% (Sustainable Singapore Blueprint, 2014).

With a relatively large proportion of Singapore residents taking public transport to work (almost six out of ten, (Lee, 2016)), the number of working class commuters preferring to travel by car remains relatively high. With an emphasis on Vehicle Quota System limitation, only one out of ten Singaporeans is able to buy a car, however, the 36% of labouring class commuters will travel to work with a private vehicle to shorten the trip and with the purpose of convenience. According to the School of Public Policy research on the 'Evolution of Public Transport Policies in Singapore' (2013), the main emphasis with respect to public transportation remains within the quality and affordability factors of the services. However, the question on sustainability factors, which targets economic, social and environmental factors must remain evident. By analysing the above policies three main factors occur: 1) an adequate supply of transport for the necessary demand; 2) affordability; 3) accessibility and excellence in planning. With respect to sustainability however, the open issues remain as follows: 1) travel during peak hours; 2) replacement of public transportation to green vehicles and 3) affordability for lower classes.

Concluding from the above, the following statements are drawn in relation to policy implications with respect to transportation in Singapore in accordance with the methodological approach used for the comparison.

- 1) The effectiveness of the transportation system is evident with the environmental friendly tendencies evident for the future.
- 2) There is clear evidence of Singaporeans to welcomingly using walking and cycling and modes of transportation.
- 3) Allocation of free transportation is not evident, but car sharing schemes are.
- 4) Allocation of budget for biofuel and other and green vehicle production is evident.
- 5) The allocation of train services within a 10min walk from occupation is set to increase from 58.5% to 80%.
- 6) The distance travelled from home to occupation appears to be larger for the working population with a preferred mode of transportation as car.

Overall, the transportation system of Singapore has come a long way in achieving a good connecting network and reliable services. With respect to sustainability concerns, it is also evident that new projects and objectives are set in stone. Thus,

promoting green transportation and viable alternatives to private vehicles must remain precise, open and evident.

2.2.3 Green Space Allocation and Land Reclamation of Singapore

2.2.3.1 Background

Urban greenery has acquired a very special significance in the overall image of Singapore, where 'Gardens by the Bay' – a nature park covering over 100 hectares of land built on reclaimed land – is a major tourist attraction and a compelling image of the city. Historically Singapore with a tropical rainforest climate, developed on the naturally occurring flora but due to the rapid urbanization has lost most of its original forests (Chua, 2015) and is recreating and preserving its habitat anew. As such, the National Parks Board has been created as part of the statutory board of the Government of Singapore, established in the 1960's with a mission to make Singapore a City in a Garden and is aiming to provide an enhancing green infrastructure and engage the community in various activities in park establishments and nature reserves (National Parks Board, 2017).

As discussed by Henderson (2013), the significant implications of green space development in Singapore has undergone various stages to achieve its current status. Up to the 1970's the urgency of housing and employment were considered a priority in the development, with the commitment to establish parks and places of leisure after the 1980's and a more profound commitment to create 'lush green experience' in 2000's (Henderson, 2013). As indicated in the study by Sieber, Fremgen and Pons (2015) Singapore has been establishing a great emphasis on the environmentally friendly urban development with around ten per cent of the country dedicated to green space as indicated in Figure 28. Further, park connectors, cycle paths and skyscraper greenery (as indicated in dark green dots) have been identified and constitute to allocation of green spaces in the city. In total, "the island state is home

to more than 2800 hectares of parks, 2656 hectares of roadside greenery and 3347 hectares of nature reserves” (Sieber et al., 2015:80).

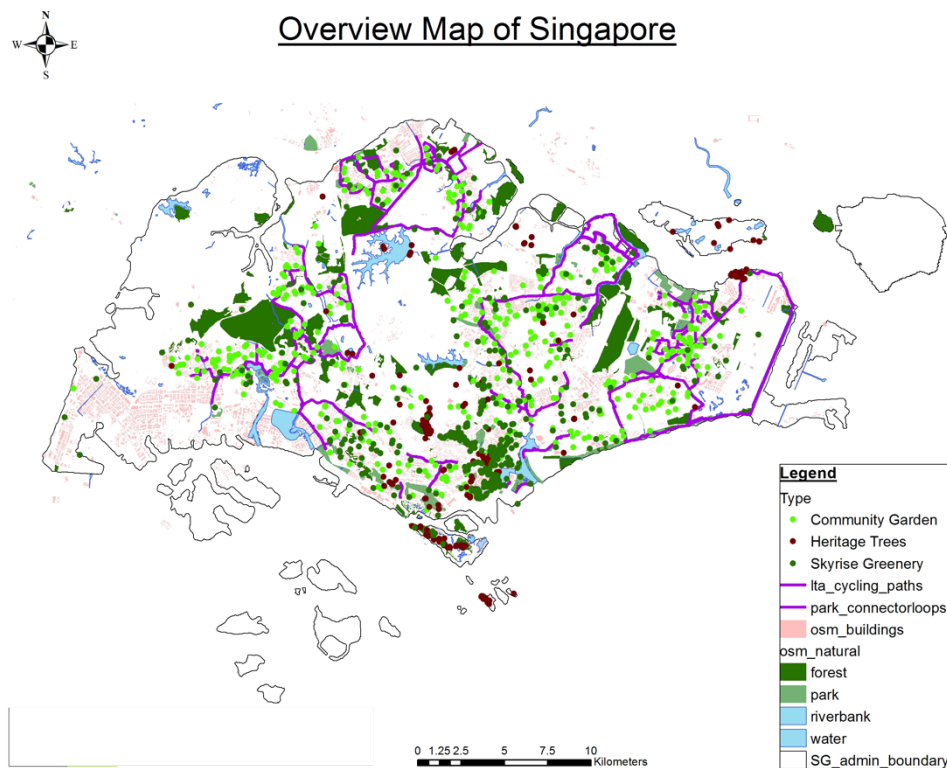


Figure 28. Overview map of Singapore identifying green urban areas. Source: Sieber et al., 2015:80.

2.2.3.2 Data Description and Analytical Interpretation

The planning urban greenery policies are mostly associated with the Ministry of National Development along with the ministerial schemes from the Housing and Development Board with a strong top-down model approach. In its leadership, a mix of democracy and authoritarianism is evident through the exclusion of certain plans and acceptance of others. As identified by Henderson (2013), it is evident that the government’s approach is somewhat preoccupied with the “unification of multi-ethnic population and securing economic growth which is believed to be pre-requisite of social stability and political continuity” (Henderson, 2013:216). In this respect, the physical developments of the island including its housing and urban

space allocation are believed to be the product of harsh manifestations of governmental powers.

Singapore's land reclamation projects, on the other hand, have been a fundamental contribution to its economic growth. As stated by The Economist (2015) the territorial expansion has increased by 22% since Singapore's independence in 1965- from 58,000 ha to 71,000 ha respectively. As also presented in Figure 29, the land area has been continuously increasing throughout the years 2000-2016. In this respect, the island has seen major changes and is expected to continue its expansion in the future. The reclaimed areas are contributing to the expansion of housing and creation of tourist attractions, boosting the island's economy. The worrying factors here, however, are associated with the import of sand from the neighbouring countries, dredging and the loss of biodiversity in the waters and surrounding areas. In this respect, Figures 30-31 indicate the current and future reclamation plans with the current land areas indicated in pink and the future reclamation plans defined in bright red (Figure 30). Further, Figure 31 identifies future reclamation projects by their land purpose and infrastructure in reference to the separate uses of the island.

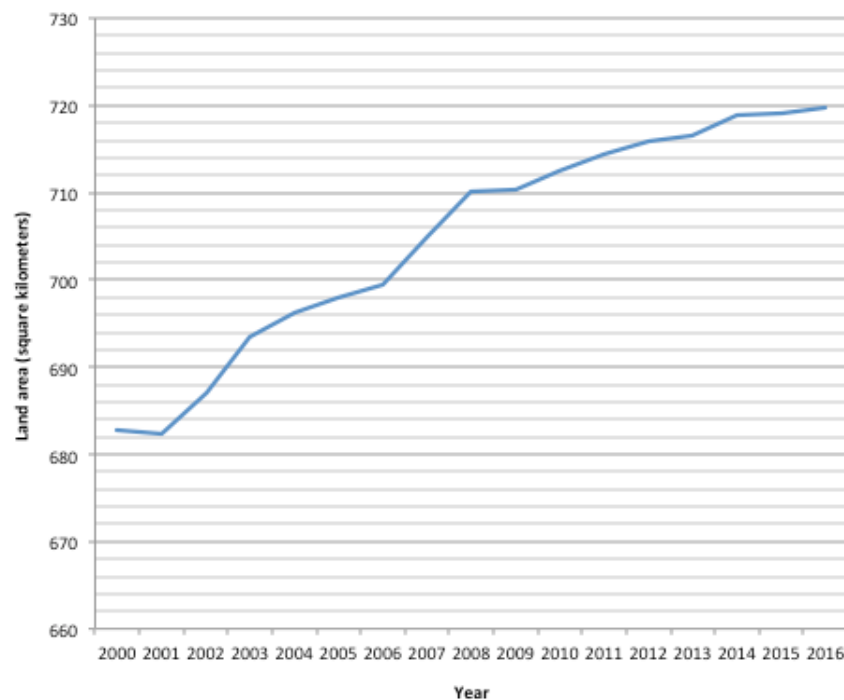


Figure 29. Total land area of Singapore (including off-shore islands) for the years 2000-2016. Source: graph constructed by the author using data obtained from the Singapore Land Authority, 2017.

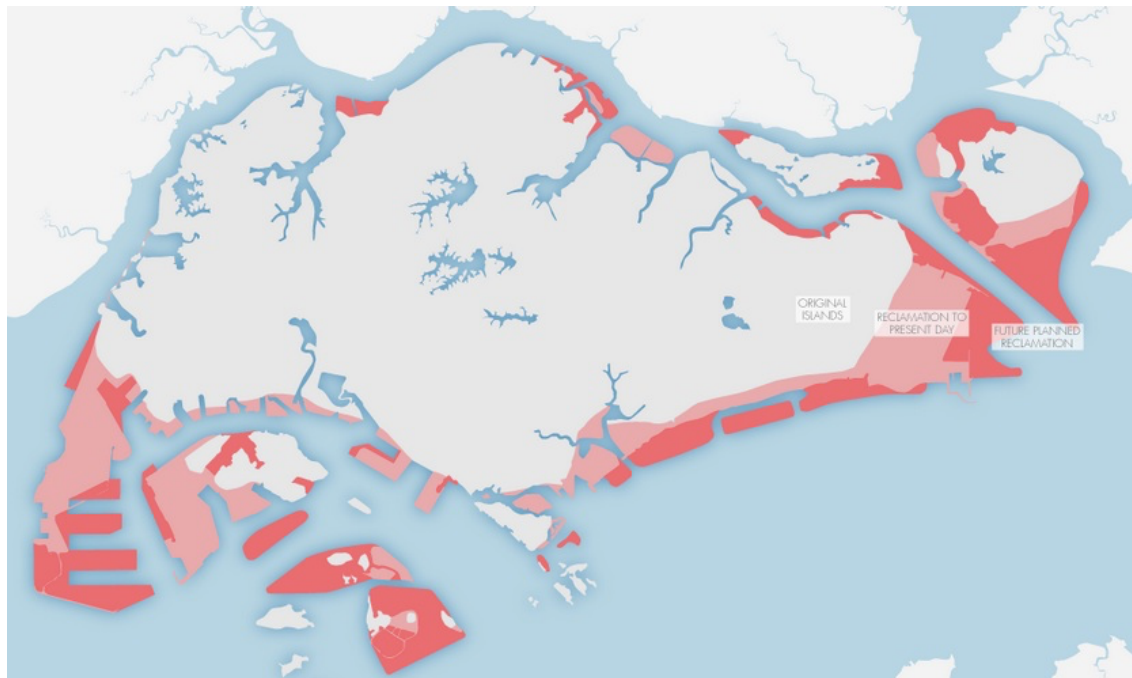


Figure 30. Land reclamation phases of Singapore. Source: Nanyang Technological University Singapore. 2017.

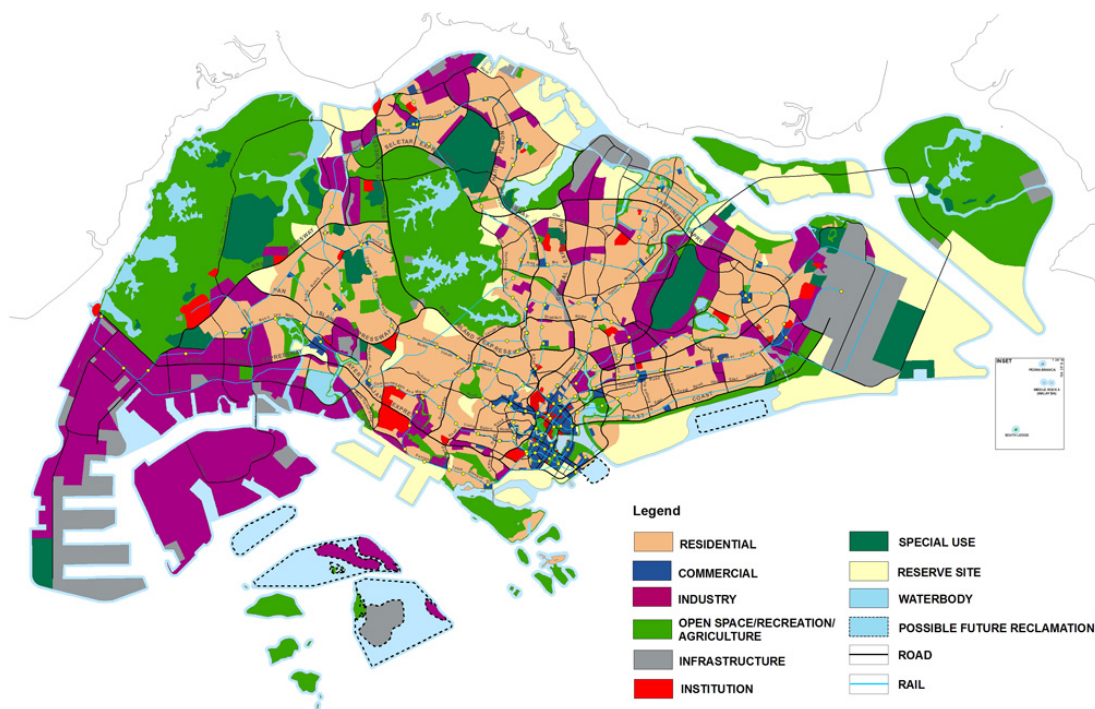


Figure 31. Future land reclamation projects of Singapore as defined by separate uses. Source: Ministry of National Development Singapore, 2017.

The main contributors to the reclamation activity, however, are identified in the graph below (32), with respect to the reclaimed area in total. As such, the main projects associated with land reclamation are the 'East Coast Phases 1-7' (ongoing, indicated in blue); the 'North Eastern Coast Phases 1-3' (ongoing, indicated in green); the 'Pulau Tekong' (started in 2015, indicated in grey) and Pasir Panjang (ongoing, indicated in red).

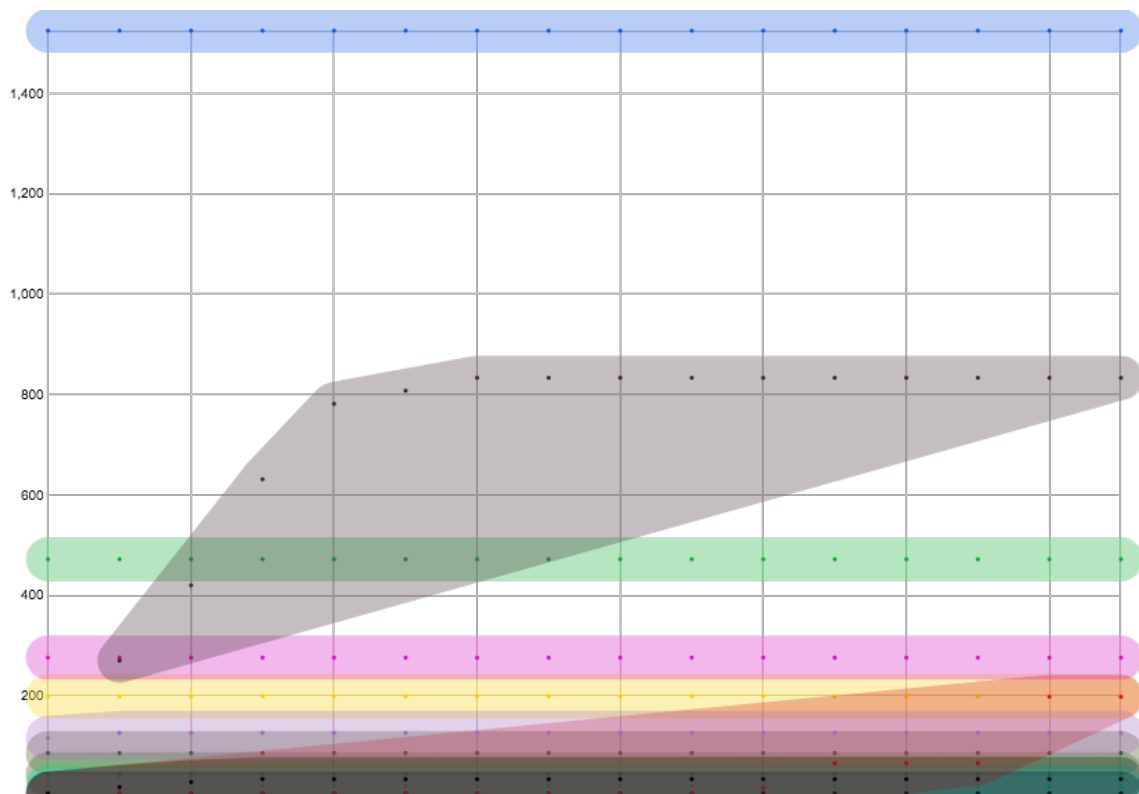


Figure 32. Cumulative area reclaimed in the region of Singapore for the years 2000 - 2015.
Source: graph constructed by the author, data obtained from Data.gov.sg 2017a.

With this in mind, the 'East Coast' reclamation project was mainly used to accommodate housing, schools, parks and 'other community facilities' (The Straits Times, 2015), followed by an estimation of 200,000 residents to be relocated to the area. In the North Eastern part of the island, a construction work of a 150km green trail connecting the historical, natural and cultural sites of Singapore is expected to be completed in the years to come. The network aims to create recreational spaces for cyclists and park goers when completed (The Straits Times, 2016) with an

interlinking connection of parks and green areas from the surrounding neighbourhoods.

With respect to land reclamation and green space allocation, the documents chosen for this study have been providing the following insights to the study. 'The Singapore Green plan 2012' (2002) emphasises the 'living in harmony with nature' concept at the very start and thrives to create a 'multi-prong approach' against the backdrop of "conserving [our] natural heritage in the context of an urbanised city-state" with a constant land preservation for "nature reserves, parks and park connections" (Ministry for the Environment, 2002:v). As such, the document states that "pivotal to our nature conservation efforts is the amicable partnership between government agencies, non-governmental organisations, the tertiary institutions, private organisations and numerous individuals" (Ministry for the Environment, 2002:v).

As such, the key targets related to green space allocation are presented as the following:

- 1) keep nature areas for as long as possible.
- 2) Put in place new parks and park connections.
- 3) Set up a National Biodiversity Reference Centre" (Ministry for the Environment, 2002:x).

With respect to nature conservation and greening plan, the document emphasises the importance of a multi-agency approach, hence partnering with the Environment Council, the National Parks Board, the Nature Society Singapore and other organisations to seek the following balance of: "land use needs with its environmental inheritance through careful planning" and to "ensure that Singaporeans will have enough green space for rest and recreation purposes, even in the midst of [our] urban city-state setting" (Ministry for the Environment, 2002:8).

As stated previously, Singapore has been associated with the Garden City concept for a long time and as response, a project on parks has been emphasised with the following amendments to connect the designated areas on the island with an establishment of "a network of park connectors in a long-term project that aims to

link up all the major parks in Singapore. It will enable people to jog or cycle all round the island. It may also function as a green corridor for wildlife” (Ministry for the Environment, 2002:10).

‘Energy for Growth’ (2007) on the other hand, does not necessarily emphasise the concept of green space allocation within the premises of energy for growth concept, as the energy sector is not directly linked with neither green space allocation nor land reclamation policies per se, however, the following can be noted with relevance:

- a) The National Research Foundation Singapore aims to provide competitive grants scheme for clean energy projects undertaken by both the public and private sectors;
- b) It aims to provide support in clean energy, innovation and other centers of excellence;
- c) It aims to provide innovations in clean energy research in building and outdoors facilities and governmental agencies;
- d) It aims to keep promoting energy efficient technology and measures in building capability and expertise in energy management;
- e) The National Environment Agency aims to develop and implement the relevant agencies to design energy efficiency programs in the sectors of power generation, industry, transport, construction, households and outdoor spaces;
- f) By providing sustainable energy approach to a city environment and applying strong technological knowledge in the spheres of transportation, power, industry and buildings, the overall aim is to create a holistic, flexible and forward-looking national energy policy framework to secure energy consumption in Singapore (Ministry for Trade and Industry, 2007).

The ‘Sustainable Singapore Blueprint 2015’ (2014) establishes the following principles with respect to sustainable land planning and civic engagement:

- a) develop and efficient city and adopt innovative ideas to improve our living environment and optimise land use.
- b) Foster community spirit through the provision of public spaces and by facilitating active civic participation in sustainable development (p. 11).

Notably, the document states that more than 80% of households are located within a 10-min walk of a park with an additional of 1/2 of new residential and 1/3 of

commercial buildings regenerated under the Landscaping of Urban Spaces and High Rises schemes 2009 with an additional of 110 existing buildings providing green areas through Skyrise Greenery Incentive Scheme. As such, the following amount of land has been dedicated to the overall green space including buildings up to the year 2013 (Table H) as also specified in the document.

Green space allocation, Singapore		
	2009	2013
Amount of skyrise greenery (ha)	10	61
Amount of green space (ha)	3,602	4,040
Length of park connectors (km)	113	216

Table G. Comparison of green space allocation in Singapore between the years 2009 and 2013.
Source: graph obtained from Sustainable Singapore Blueprint 2015, 2014:12.

In response to a greater green space allocation the targets listed in the ‘Sustainable Singapore Blue Print 2015’ (2014) are with the following allocation:

1. 9 in 10 homes to be within 10-min walk of a park.
2. 400km of Park Connectors.
3. Enhanced ecological connectivity with 180km of Nature Ways.
4. Over 100 potential ABC Waters projects identified for implementation island-wide.
5. 200 ha of skyrise greenery, equivalent to about 650 school fields (p. 20).

As indicated further in the document and as part of the sustainable housing project, the rooftop greenery will be included as part of the green space allocation defined for multistorey car parks with an aim to: “reduce urban heat, slow down water runoff and provide a pleasant environment for community activities” (Sustainable Singapore Blue Print, 2014:23). Overall, the document emphasises the necessity to include building blocks in a ‘quest to go greener’. As such, the incentive schemes also discuss the ‘Landscaping for Urban Spaces and High Rises’ programme, which in its essence encourages provision of green spaces at the ground and upper levels through provision of Gross Floor Area incentives. In addition, the Skyrise Greenery Incentive Scheme and the Landscape Excellence Assessment Framework have recognised and encouraged the development of greenery provision and

management. In total, these schemes have proven to provide more than 60 hectares of skyrise greenery as also identified in Table H (Sustainable Singapore Green Plan, 2014).

Furthermore, the 'Sustainable Singapore Green Plan' (2014) identifies the following strategic targets:

- a) to create more than 180km of Nature Ways by 2030.
- b) to have generous provision of spaces for playgrounds, fitness areas and community gardens (p. 39).

In addition, the following outlook for the year 2030 has been established:

- a) to increase the amount of skyrise greenery from 61ha to 200ha
- b) To increase the amount of land dedicated to parks from 4,040ha to a provision of 0.8ha/1,000 population
- c) To increase the length of park connectors for recreational activity from 216km to 400km
- d) To expand the length of Nature Ways from 21km to 180km
- e) To increase the proportion of households located within a 10min walk to the park from 80% to 90% (Sustainable Singapore Green Plan, 2014).

2.2.3.3 Analysis

With an emphasis on the land reclamation policies, the interesting development in the recent years has been provided by the NEA with an aim to explore ways to make use of the left-over incineration ash for construction purposes such as road surfacing and land reclamation. With this vision, the waste management and land reclamation projects are interconnected and may be profitable for one another, however are still questionable in terms of their exploitation.

Singapore's attempt in solving land scarcity and reintroduction of green spaces on the island can be considered remarkable in its attempt to reintroduce the biodiversity and at the same time provide housing for the growing population. Arguably, the development of green spaces, as indicated in the above studies, is

highly dependent from the economic, social and political contexts, whereby creating wealthy tourist attractions and entertainment locations in a form of green areas can be economically beneficial. At the same time, however, those areas are able to demonstrate sustainable urban development processes and encourage environmentally healthy behaviour. However, studies confirm that not all redevelopments are done sustainably, whereby land area mistreatments have been indicated previously. An example of this is the creation of the East Coast Park Singapore constructed on reclaimed land but where all its natural habitat was cleared out in order to create a clean, well-ordered open space contrary to its original environment.

At the same time, Singapore reflects a clear understanding of involving various stakeholders and community members in a vigorous attempt to create better environment for its inhabitants. Its policies clearly state commitment to an open feedback and are devoted to involving various organisations and individuals to the projects related to green infrastructure.

While this section has identified the percentage of reclaimed and green space allocation land, percentage of green space in relation to city area, the area identified for parks and communal use, it has not, however identified the exact cost associated with the reclamation projects. It is, however, evident that sand imports from neighbouring countries has not come at high enough prices while the land associated with reclamation has substantially higher real estate costs.

2.3 Concluding Remarks

This chapter has identified infrastructure related trends of Hong Kong and Singapore by evaluating their current tendencies, consumption, production and GDP levels. The sustainability factor, on the other hand, has been identified through an evaluation of the policy related documents and a comparison of application of sustainability related behaviours in different sectors. While it is indeed challenging to identify

sustainability levels, this chapter has nevertheless attempted to do so as presented herewith.

The waste management patterns of both Hong Kong and Singapore currently face a general increase in the overall production level. And while Singapore is managing its waste by incineration with 2% of the yearly waste being sent to landfills, Hong Kong, on the other hand, is sending most of its waste to landfills whereby following an unsustainable pattern. The waste management procedures as addressed in the policy related documents for the purpose of sustainability assessment, highlight the necessity of reuse, reduce and recycle behaviour and may address the user payment schemes in the future. At present, the attitude of waste management of Hong Kong is seen as unsustainable, while Singapore is approaching a more sustainable path.

With respect to transportation, both Hong Kong and Singapore are associated with an increased level of private car consumption. In this respect, the policy documents are not addressing private vehicle purchase per se, but promote the use of public transportation in a hope to achieve sustainable travel scheme for both Hong Kong and Singapore.

In the field of green space allocation Singapore is aiming to achieve a greater biodiversity and a better allocation of green space for its citizens via creation of sky gardens and using built-up area for allocation of greenery. Hong Kong, on the other hand is not seen to be constructing green spaces on its built-up areas yet. With respect to land reclamation, both city-states are addressing the issue of land scarcity through further reclamation of land, whereby the necessity to provide housing for the growing population is crucial. Overall, the documents studied do not provide enough information with reference to land reclamation elements.

While this chapter has covered the statistical observations, and presented the relevant information of the chosen documents, the following chapter will provide empirical results and will further investigate the SUD in order to answer the predominant RQ of this thesis.

CHAPTER III

3.1 Empirical Results and Analysis

In a mere attempt to critically analyse sustainable urban development of the Republic of Singapore and Hong Kong SAR, this paper has come across a large and complex network of interrelated challenges. Sustainability is an open issue which requires a substantial understanding of the current tendencies, abilities, behaviours and scientific factors alongside governmental, social and economic considerations. By focusing this research on infrastructure related issues and addressing secondary sources using a case study method, the empirical results of the study will be attributed to a 'yes' and 'no' evaluation, with a special emphasis on the policy related index. The attributes characterized as 'yes' reflect the similarity, whereas a 'no' would point out to a different approach hence show the difference. As was identified in the theoretical part of this paper, the criteria used for the SUD policy comparison will be used in order to compare the empirical results as identified in previous chapter. In doing so, the differences and similarities between policy related documents of the two city-states can be easily observed.

The following Tables I-J present the results of the study where a comparison of six different policy-related documents was involved. The evidence presented in the tables below strongly corresponds to the specific differences and similarities of the documents as determined by the RQ. Thus, with reference to Hong Kong and Singapore, the differences and similarities between sustainable infrastructure policies can be identified as the following.

The attributes characterized as a 'yes' for both the Hong Kong and Singapore documents fall under quite a few categories under the economic, social and environmental dimensions starting with the *natural resource management*, *development stage at which sustainability is prominent* and *safe water, drains, sanitary conditions and waste disposal*. Here, the similarity is rather obvious, as both

Hong Kong and Singapore have been chosen for the comparison due to their complementary stages of development.

With respect to *waste reduction schemes* both Hong Kong and Singapore also fall under the 'yes' category, nevertheless, with the reduction schemes only being introduced in the policy documents but not being realised in real life scenarios as of yet for Hong Kong. The *recycling schemes for certain types of waste* have been certainly introduced for both Hong Kong and Singapore, as indicated in the documents with certain types of waste being recycled for further use (such as paper, glass, wood, etc.) or sent to the mainland for further re-use scheme (in case of Hong Kong). In Singapore, the recycling schemes are being introduced with a more frequent rate and are implemented on a larger scale.

The *policy implementation on allocation of open space per resident* is definitely evident for both Hong Kong and Singapore documents as determined at a minimum of 2.5m² for Hong Kong and "more than 80% of households within 10-min walk of a park" (Sustainable Singapore Blueprint, 2014:12) for Singapore.

With respect to *policies on land development schemes*, the selected documents for both city-states present an evident plan for redevelopment projects as well as the *policy implementation for land use*. With specific emphasis on the *encouragement of land use in urban rather than rural areas* dimension both Hong Kong and Singapore fall under the category of 'yes' due to the factors such as land scarcity. In Hong Kong, only 24% of the land is considered developed, whereas only 14% of land of Singapore is used for housing with an aim to increase this number to 30% by the year 2030. As identified through the study of *land reclamation* policies, both Hong Kong and Singapore are engaged in the development of their land areas even further, with an intention to accommodate the growing population and provide more green areas in case of Singapore.

With respect to *mixed-use land settlement* pattern assessment, both Hong Kong and Singapore tend to fall under a 'yes' category with an evident approach of a compact

city urban design concept. It is thus evident that both city-states are working towards a resource utilization policy, mixed use settlements and sustainable build forms in an attempt to reach sustainable urban development patterns as demonstrated in the documents.

In the concluding statement which highlights the community awareness and community involvement, both Hong Kong and Singapore demonstrate a similar approach in engaging their citizens in sustainability awareness. This is especially evident in the most recently published documents as they lean towards a genuine involvement of private institutions, organisations and individuals in a 'We Welcome Your Views' manner and provide considerations for a better understanding and facilitation of communal needs through questionnaires and feedback sessions. However, the *economic growth without compromising the ability of future environments to flourish* and the *sustainable outlook for the present and future infrastructure use* has been graded as 'strong' for Hong Kong and 'very strong' for Singapore due to the overall sustainability encouragement factor as depicted from the documents.

On the other hand, the attributes characterized as a 'no', 'to a certain degree' or 'not identified', portray the differences between the sustainable infrastructure policies and thus demonstrate the liability gaps in terms of their approaches towards the SUD. In this respect, the *employment in sustainability sector* under the economic development dimension is especially evident. Here, Hong Kong tends to fall behind in its policies and fails to provide adequate evidence in employment opportunities in sustainability sector while Singapore promotes 'A Leading Green Economy' with jobs in cutting-edge businesses for sustainable development. However, this of course cannot be considered conclusive generally, as the study is limited to six documents only, whereby a different selection of documents could have proven otherwise. At the same time, for the comparison purposes of this paper in particular, the lack of evidence in this category is distinctive.

The waste management indicators, with an emphasis on *recycling* shows a 'to a certain degree' result for *introduction of easy recycling facilities and information on how to recycle and where* policy index. Here, Hong Kong portrays a 'to a certain degree' result as the information of recycling facilities in the documents studied is missing. Further, the *solution for landfill demands and policy on waste management and recycling scheme* is also not adequately represented for Hong Kong documents, hence the noted difference in the SUD.

The *policies on sustainable transportation* and *policy on green space conservation* further demonstrate the difference between the documents of Hong Kong and Singapore as the results demonstrate a 'to a certain degree' and 'yes' outcome respectively. The *protection and enhancement of natural ecosystems* and *protection of biodiversity* outcomes have been identified as a 'to a certain degree' for Hong Kong and as a 'yes' for Singapore. This characteristic is especially evident with a shortfall of information in this field and no mention of enhancement of ecosystems present for Hong Kong. Singapore, on the other hand, falls under a 'yes' for both fields as the documents provide many examples in this area such as protection of the biodiversity and enhancement of green growth.

With respect to *waste as a resource* and *green vehicle scheme* under environmental development dimension, Hong Kong demonstrates a 'no', 'not identified' and 'to a certain degree' result while Singapore falls under the 'yes' category mostly. With respect to *transportation* the *provision of green transport, car sharing and/or free bicycle schemes* are also not evident for Hong Kong.

In the social dimension, under the *educational awareness, community involvement* and *sustainable behavioural patterns* the attribute has been identified as 'not identified' and 'to a certain degree' for Hong Kong due to the lack of information to provide a full certainty. This is especially evident for the documents analysed for Hong Kong in their lack of waste management behaviour in the reuse, reduce and recycle scheme as identified in previous section. Singapore, on the other hand, has been identified as a 'yes'.

In the *concluding statements* category, the documents investigated for both Hong Kong and Singapore study have been scored identically, with an exception of *economic growth without compromising the ability of future environments to flourish* and the *sustainable outlook for the present and future infrastructure* section. This is due to the fact that the selected documents for the study of Hong Kong do not provide sufficient degree of sustainability outlook without the realisation of strong economic prosperity first.

While Tables I-J present the final analysis based on the analytical framework, their results are largely quantitative. And while the goal of this paper was to compare the similarities and differences between infrastructure related policies of Hong Kong and Singapore with an overall objective of understanding the sustainable urban development of the region, it does indeed do so in a comparative manner.

It is worth noting that the assumption by Sorensen et al., (2004) whose theories have largely contributed to the theoretical framework of this paper, with respect to mobility network and the increased number of private car purchases in the region of East Asia does not demonstrate to be due to the poor transportation networks, but instead, due to the increasing wealth and the necessity for 'comfort' in case of Hong Kong and Singapore. This paper has shown that the transportation networks of both city-states are outstanding with a majority of citizens using public transportation network on daily basis, yet, the number of private vehicles continues its increase yearly.

Concluding from the above, Hong Kong is evidentially standing out with respect to less positive and more negative responses in accordance with the comparative framework used for this paper. This is especially so in the areas of *waste management, sustainable transportation, protection of natural ecosystems* and *sustainable behavioural patterns*. Evidence suggests that there is a definite mention of sustainability related approaches, however, certain aspects related to crucial realisation in support of sustainable development are missing. As investigated in the

previous chapter of this paper, there are many concerns associated with sustainable urban development processes of Hong Kong, but these are very indirectly addressed and are likely to have limited effect without certain ways of collaboration. As evident from the study, urban sustainability is considered as a relatively low priority for the government, with pro-economic growth and revenue maximisation set as an overall message. And while policy documentation exists, many aspects of the initially set targets are not being achieved and are not legally enforceable.

Singapore, on the other hand, demonstrates a somewhat better way of addressing sustainable urban development issues, however, as evident from the findings elaborated on previously, it is also expected to perform at a higher level in all areas mentioned in this study. While the majority of the results are considered as a 'yes' factor, the realisation of certain policies and the governmental favourability remains predominately evident.

Sustainable Urban Development (SUD)

Comparison of SUD in policy-related documents of Hong Kong

Core Pillars		Characteristics	Processes and Outcomes	Applicability	Policy Index	Results
Economic Development						
Infrastructure services		Annual GDP growth	Natural resource management	Yes	<i>Has the country/city-state reached a certain stage at which sustainability is prominent?</i>	Yes
			Development stage at which sustainability is prominent	Yes		
			Employment in sustainability sector	Yes	<i>Do policies include employment opportunities in sustainability sector?</i>	No
	Waste management	Population growth and density	Safe water, drains, sanitary conditions and waste disposal	Yes	<i>Inclusion of factors indicating safe water, drainage and waste disposal.</i>	Yes
		Consumption	Domestic waste production	Yes	<i>Inclusion of waste reduction schemes.</i>	Yes
		Volume of solid waste generated	Recycling	To a certain degree	<i>Introduction of easy recycling facilities and information on how to recycle and where.</i>	To a certain degree
			Solid waste production exceeding capacity of landfill sites	Yes	<i>Solution for landfill demands.</i>	At present, the solution is to build more landfills
			Accumulation of large quantities of certain types of waste and facilitating recycling mechanisms	Yes	<i>Recycling schemes for certain types of waste.</i>	Yes

Infrastructure services	Waste management		Domestic waste (in tonnes): · ...disposed of at landfills · ...recycled · ...for incineration · ...for energy production	Identified	Policy on waste management and recycling schemes.	No
	Transportation	Mobility	Private automobile and motorcycle ownership	Yes (increase)	Policy on private vehicle ownership	No
			Allocated budget for transportation improvement	Yes	Policies on sustainable transportation.	To a certain degree
	Green space allocation and Land reclamation	Land use	Allocated budget for green space allocation	To a certain degree	Policy implementation on green space conservation.	To a certain degree
			Housing density, allocation of open space per resident per sq m	Yes	Policy implementation on allocation of open space per resident	Yes
			Cost of land reclamation	Not identified	Policy implementation on land reclamation.	No
	Environmental Development					
		Conservation	Protection and enhancement of natural ecosystems and biodiversity	To a certain degree	Protection and inclusion of natural ecosystems policies. Protection and inclusion of biodiversity policies.	To a certain degree
	Waste management	Volume of solid waste generated	Environmental reuse of waste	Not identified	Waste as a resource?	No
		Green travel	Effective and environmentally friendly transportation systems	Not identified	Green vehicle scheme.	To a certain degree

Infrastructure services	Transportation		Commute time from home to occupation	Not identified		To a certain degree
			Percentage of walking and cycling as mode of transportation	Not identified	Development of cycling paths, easy access to points of destination.	No
			Development of certain areas to reduce travel need	Yes	Policy on land development schemes.	Yes
			Free bicycle scheme/ other modes of transportation	Not identified	Provision of green transport, car sharing and/or free bicycle schemes. Provision of public transportation within easy access from home.	To a certain degree
	Green space allocation and land reclamation	Land use	Encouragement of land use in urban rather than rural areas	Yes	Policy implementation for land use.	
			Mixed-use settlement patterns	Yes		
			Recreational spaces, green facilities, diversity and efficiency of land use	Yes	Policy implementation on mixed-use land settlements.	Yes
	Political / Governance					
		Accountable and transparent governance	Sustainability urgency	To a certain degree	Do the policies reflect fairly in accounting for sustainability factors?	To a certain degree
	Waste management	Waste disposal	Waste unit pricing	No	Waste generation policy implementation.	No

Infrastructure services	Transport	Accessibility	Promotion of public transportation	Yes	Policy implementation on transportation and private vehicle control.	No
	Green space allocation	Land use	Encouragement of recreational land use	Not identified	Policy implementation for land use (from the political/governance stance).	To a certain degree
	Social					
	Community involvement	Educational awareness		Not identified	Do the policies include community awareness factors?	Yes
		Citizen participation		To a certain degree	Do the policies include community involvement in respect to urban sustainability?	No
	Sustainable development in private sector	Opportunities		Not identified	Do the policies mention sustainable development in private sector?	No
	Sustainable behavioural patterns	Awareness		To a certain degree	Are there noticeable behavioural patterns in relation to sustainability?	To a certain degree

	Concluding statements			
	Provision of healthy living and working environments for the inhabitants	Yes	<i>Does the overall policy document indicate provision of healthy living and working environments for the specific country/city-state?</i>	Yes
	Encouragement of livable, diverse communities	Yes	<i>Overall factor.</i>	Strong
	Economic growth without compromising the ability of future environments to flourish	Yes	<i>Overall factor.</i>	Strong
	Sustainable outlook for the present and future infrastructure use	To a certain degree	<i>Overall factor.</i>	Strong

Table H. Empirical results of the comparison of policy related documents of SUD in Hong Kong. Source: own drawing.

Sustainable Urban Development (SUD)

Comparison of SUD in policy-related documents of Singapore

Core Pillars		Characteristics	Processes and Outcomes	Applicability	Policy Index	Results
Economic Development						
Infrastructure services		Annual GDP growth	Natural resource management	Yes	<i>Has the country/city-state reached a certain stage at which sustainability is prominent?</i>	Yes
			Development stage at which sustainability is prominent	Yes		
			Employment in sustainability sector	Yes	<i>Do policies include employment opportunities in sustainability sector?</i>	Yes
	Waste management	Population growth and density	Safe water, drains, sanitary conditions and waste disposal	Yes	<i>Inclusion of factors indicating safe water, drainage and waste disposal.</i>	Yes
		Consumption	Domestic waste production	Yes	<i>Inclusion of waste reduction schemes.</i>	Yes
		Volume of solid waste generated	Recycling	Yes	<i>Introduction of easy recycling facilities and information on how to recycle and where.</i>	Yes
			Solid waste production exceeding capacity of landfill sites	No	<i>Solution for landfill demands.</i>	Yes
			Accumulation of large quantities of certain types of waste and facilitating recycling mechanisms	Yes	<i>Recycling schemes for certain types of waste.</i>	Yes

Infrastructure services	Waste management		Domestic waste (in tonnes): · ...disposed of at landfills · ...recycled · ...for incineration · ...for energy production	Identified	Policy on waste management and recycling schemes.	Yes
	Transportation	Mobility	Private automobile and motorcycle ownership	Yes (increase)	Policy on private vehicle ownership	No
			Allocated budget for transportation improvement	Yes	Policies on sustainable transportation.	Yes
	Green space allocation and Land reclamation	Land use	Allocated budget for green space allocation	To a certain degree	Policy implementation on green space conservation.	Yes
			Housing density, allocation of open space per resident per sq m	Yes	Policy implementation on allocation of open space per resident	Yes
			Cost of land reclamation	Not identified	Policy implementation on land reclamation.	No
	Environmental Development					
		Conservation	Protection and enhancement of natural ecosystems and biodiversity	Yes	Protection and inclusion of natural ecosystems policies. Protection and inclusion of biodiversity policies.	Yes

Infrastructure services	Waste management	Volume of solid waste generated	Environmental reuse of waste	Yes	Waste as a resource?	Yes
	Transportation	Green travel	Effective and environmentally friendly transportation systems	Yes	Green vehicle scheme.	Yes
			Commute time from home to occupation	Identified		
			Percentage of walking and cycling as mode of transportation	Identified	Development of cycling paths, easy access to points of destination.	Yes
			Development of certain areas to reduce travel need	Yes	Policy on land development schemes.	Yes
			Free bicycle scheme/ other modes of transportation	Yes	Provision of green transport, car sharing and/or free bicycle schemes. Provision of public transportation within easy access from home.	Yes
	Green space allocation and land reclamation	Land use	Encouragement of land use in urban rather than rural areas	Yes	Policy implementation for land use.	Yes
			Mixed-use settlement patterns	Yes		
			Recreational spaces, green facilities, diversity and efficiency of land use	Yes	Policy implementation on mixed-use land settlements.	Yes

Infrastructure services	Political / Governance					
		Accountable and transparent governance	Sustainability urgency	Yes	<i>Do the policies reflect fairly in accounting for sustainability factors?</i>	To a certain degree
	Waste management	Waste disposal	Waste unit pricing	To a certain degree	<i>Waste generation policy implementation.</i>	To a certain degree
	Transport	Accessibility	Promotion of public transportation	Yes	<i>Policy implementation on transportation and private vehicle control.</i>	No
	Green space allocation and Land reclamation	Land use	Encouragement of recreational land use	Yes	<i>Policy implementation for land use (from the political/governance stance).</i>	Yes
	Social					
	Community involvement		Educational awareness	Yes	<i>Do the policies include community awareness factors?</i>	Yes
			Citizen participation	Yes	<i>Do the policies include community involvement in respect to urban sustainability?</i>	To a certain degree
	Sustainable development in private sector		Opportunities	Yes	<i>Do the policies mention sustainable development in private sector?</i>	Yes

Infrastructure services	Sustainable behavioural patterns	Awareness		<i>Are there noticeable behavioural patterns in relation to sustainability?</i>	
			Yes		Yes
	Concluding statements				
	Provision of healthy living and working environments for the inhabitants		Yes	<i>Does the overall policy document indicate provision of healthy living and working environments for the specific country/city-state?</i>	Yes
	Encouragement of livable, diverse communities		Yes	<i>Overall factor.</i>	Strong
	Economic growth without compromising the ability of future environments to flourish		Yes	<i>Overall factor.</i>	Very strong
	Sustainable outlook for the present and future infrastructure use		Yes	<i>Overall factor.</i>	Very strong

Table I. Empirical results of the comparison of policy related documents of SUD in Singapore. Source: own drawing.

3.2 Further Research

While this paper has addressed a selection of infrastructure-related issues in an attempt to determine sustainable urban development of the region, the research was limited to six documents only, published by governmental institutions. As such, the presented results cannot comprise a complete picture of the sustainable urban development of Hong Kong and Singapore, but only a mere fraction of the field. In this case, further research would be extremely beneficial in order to compare more documents with a wider spectrum of issues. As this research was limited to waste management, transportation, land reclamation and green space allocation only, it would be constructive to also analyse other aspects in the fields of energy, ecology, the built environment as well as the SDGs, and involve field research in order to elaborate on different practices.

3.3 Conclusion

This paper attempted to present a study into sustainable urban development of Hong Kong and Singapore by analysing infrastructure-related policies. During this process, it has come across a variety of issues associated with human activities and impacts, reflected in an immense struggle of continuous urban growth. As such, sustainability becomes an issue, while the consumption of natural resources and continuous growth are evident. In this case cities are exceptionably vulnerable, as our energy, land, water and greenery supplies are not endless. At the same time, economic growth and increasing wealth result in greater consumption, an accumulation of private cars, the production of more waste, demands for bigger housing and a necessity for greenery inside the cities.

As has been presented, cities face greater pressures from the intensifying human activities and trends. Amongst the most immediate action plans, the need to accommodate but also to prosper, provide education, health, transportation and food - cities must also maintain environmental sustainability, provide governmental support, economic prosperity, equality and cultural diversity. Demands are shown to

constantly overgrow resources. And while we strive to innovate and progress, it becomes evident not to forget the direct consequences we bring to the environment, especially in the field of urban development. By providing a great degree of modernization and opportunities in the building, waste and transportation sector, the role of sustainability should attribute to a high priority.

In its efforts to address particular issues associated with urbanization, this paper has presented a specific approach to sustainability-related issues, in which a comparison of infrastructure-related policies was examined. In doing so, it has answered the RQ of this research by providing evidence of similarities and differences between infrastructure-related policies. By presenting the differences and similarities of these policies, this thesis has demonstrated various gaps in certain aspects of sustainability approach of both city-states. This is particularly relevant for not only identifying the areas of further development, but also for policymakers, scholars and the like, for engaging in further research and suggesting ways of improvement. The results have, therefore, demonstrated their relevance.

This work has been an introductory study of how the cities work, prosper, develop, communicate and engage. Most importantly, it has looked into ways of improvement by providing statistical observations of the chosen city-states. As became evident from this study, there are no policies that work consistently well and there is no evidence to show that we have reached a sustainable urban development path as of this moment. What may work well in the region of Southeast Asia may prove to not work anywhere else. This is particularly evident with an emphasis on the compact city study. The immediate solution here seems to revolve around finding the appropriate regional and local solutions for growth, economic balance and governance. However, without a certain involvement of all responsible actors and immediate, radical action, the prospect of sustainable urban development with a balanced ecosystem at all levels will not be possible to achieve.

REFERENCES

- Agriculture, Fisheries and Conservation Department. 2017. "Policy Objectives." Retrieved August 13, 2017 (http://www.afcd.gov.hk/english/conservation/con_nncp/con_nncp_po/con_nncp_po.htm).
- Beeferman, Larry, Allan Wain. 2012. "Infrastructure. Defining Matters." Harvard Law School, Harvard University. Retrieved July 9, 2017 (<http://www.law.harvard.edu/programs/lwp/pensions/publications/INFRASTRUCTURE%20DEFINING%20MATTERS%20FINAL.pdf>).
- Bell, Simon, and Stephen Morse. 2003. *Measuring Sustainability: Learning by Doing*. London: Earthscan.
- Brand, P. Charles, and Michael J. Thomas. 2005. *Urban Environmentalism: Global Change and The Mediation of Local Conflict*. London: Routledge.
- Burgess, Rod. 2000. "The compact city debate: A global perspective." Pp. 9-24 in *Compact cities: Sustainable urban forms for developing countries*, edited by Mike Jenks and Rod Burgess. London and New York: Spon Press.
- Cartography by Survey & Mapping Office. 2017. "Reclamation and Development in Hong Kong." Retrieved August 30, 2017 (http://www.landsd.gov.hk/mapping/en/download/download/map/ar9_4e.jpg).
- Census and Statistics Department. 2017. "Hong Kong in Figures." Retrieved July 10, 2017 (<http://www.censtatd.gov.hk/hkstat/hkif>).
- Chan, Edwin H. W., and Esther H. K. Yung. 2004. "Is the Development Control Legal Framework Conducive to a Sustainable Dense Urban Development in Hong Kong?" *Habitat International* 28(3):409–26.
- Cheow, Tan Puay, and Lye Lin Heng. 2014. "Recycling in Singapore the Singapore Model: Strategies and Ways to Improve." Pp. 75-101 in *Sustainability Matters: Asia's Green Challenges*, edited by Lye Lin-Heng, Victor R. Savage, Chou Loke Ming, Yu Liya E and Kua Harn-Wei. Singapore: World Scientific.
- Chua, Grace. 2015. "How Singapore makes biodiversity an important part of urban life." Citiscope.org. Retrieved August 15, 2017 (<http://citiscope.org/story/2015/how-singapore-makes-biodiversity-important-part-urban-life>).
- Civic Exchange. 2016. *Recommendation: Subcommittee on Two Proposed Resolutions under the Fixed Penalty (Traffic Contraventions) Ordinance and the Fixed Penalty (Criminal Proceedings) Ordinance*. Hong Kong: Civic Exchange.

Cullinane, Sharon and Kevin Cullinane. 2003. "Car dependence in a public transport dominated city: evidence from Hong Kong." *Transportation Research Part B* 37:129-138.
Data.gov.sg. 2017. "Annual Motor Vehicle Population." Retrieved June 28, 2017 (<https://data.gov.sg/dataset/annual-motor-vehicle-population-by-type-of-vehicles>).

Data.gov.sg. 2017. "Cumulative Area Reclaimed for Engineering Projects." Retrieved August 1, 2017 (<http://www.mnd.gov.sg/landuseplan>).

Department of Geography, The Chinese University of Hong Kong. 2001. "Consultancy Study to Analyse Broad Land Use Pattern of Hong Kong." Retrieved July 28, 2017 (http://www.pland.gov.hk/pland_en/p_study/comp_s/lup/index_e.htm).

Eco-Business. 2013. "Plans for the 5th incineration plant for solid waste." Retrieved July 18, 2017 (<http://www.eco-business.com/news/plans-5th-incineration-plant-solid-waste>).

EPD. 1998. "Waste Reduction Framework Plan Initiatives." Retrieved August 22, 2017 (http://www.epd.gov.hk/epd/english/environmentinhk/waste/prob_solutions/wrfp_doc.html).

EPD. 2003. "A Policy Framework for the Management of Municipal Solid Waste (2005-2014)." Retrieved August 22, 2017 (http://www.epd.gov.hk/epd/english/boards/advisory_council/files/30-2005-Annex-A.pdf).

EPD. 2013. "Waste Recycling Statistics." Government of Hong Kong. Retrieved July 10, 2017 (https://www.wastereduction.gov.hk/en/quickaccess/stat_recycle.htm).

EPD. 2017. "Waste." Retrieved July 21, 2017 (http://www.epd.gov.hk/epd/english/environmentinhk/waste/waste_maincontent.html).

EPD. 2017a. "Conservation. Environmental Protection Department." Retrieved July 28, 2017 (http://www.epd.gov.hk/epd/english/environmentinhk/conservation/conservation_maincontent.html).

EPD. 2017b. "Hong Kong Waste Treatment and Disposal Statistics." Retrieved June 27, 2017 (http://www.epd.gov.hk/epd/english/environmentinhk/waste/data/stat_treat.html).

EPD. 2017c. "Waste Data and Statistics." Retrieved June 27, 2017 (https://www.wastereduction.gov.hk/en/assistancewizard/waste_red_sat.htm).

- Esty, Daniel C., Marc Levy, Tanja Srebotnjak, Alexander de Sherbinin. 2005. "Environmental Sustainability Index: Benchmarking National Environmental Stewardship." New Haven: Yale Center for Environmental Law & Policy. Retrieved June 10, 2017 (http://archive.epi.yale.edu/files/2005_esi_report.pdf).
- Francesch-Huidobro, Maria. 2014. "Climate policy learning and change in cities: the case of Hong Kong and its modest achievements." *Asia Pacific Journal of Public Administration* 36(4):283-300.
- Francesch, Maria. 2004. "Sustainable Development and Public Policy." Pp. 139-175 in *Sustainable Development in Hong Kong*, edited by Terri Mottershead. Hong Kong: Hong Kong University Press.
- Frank I. Andrea. 1999. "A theoretical, Interdisciplinary Framework for Environmentally Sensitive Urban Land Use and Development." *Regional Analysis and Policy* 29(2)5:30.
- Freestone, Robert. 2002. "Greenbelts in city and regional planning." Pp. 67-99 in *From garden city to green city: the legacy of Ebenezer Howard*, edited by Kermit C. Parsons and David Schuyler. Baltimore, Md: Johns Hopkins University Press.
- Friends of the Earth. 2011. "Municipal Solid Waste Issue in Hong Kong." Retrieved June 10, 2017 (http://foe.org.hk/uploaded_files/municipal%20solid%20waste%20study/Municipal_Solid_Waste_Management_FOE%20_HK_Dec_2011.pdf).
- Fwa, T.F., G.K. Chua. 2007. "Passenger Car Travel Characteristics in Singapore." *IATSS Research* 31(2):48-55.
- General Household Survey. 2015. "General Household Survey, Department of Statistics." Retrieved June 10, 2017 (<http://www.singstat.gov.sg/publications/publications-and-papers/GHS/ghs2015content>).
- George, Alexander L., Andrew Bennett. 2005. *Case studies and Theory Development in the Social Sciences*. Cambridge, Mass: MIT Press.
- Giddings, Bob, Bill Hopwood, Mary Mellor and Geoff O'Brian. 2005. "Back to the City: A Route to Urban Sustainability." Pp. 13-30 in *Future Forms and Design for Sustainable Cities*, edited by Mike Jenks and Nicola Dempsey. Oxford: Elsevier.
- Girard, Luigi Fusco, Maria Cerreta, Pasquale De Toro and Fabiana Forte. 2007. "The Human Sustainable City: Values, Approaches and Evaluative Tools." Pp. 65-94 in *Sustainable Urban Development Volume 2: Environmental Assessment Methods*, edited by Mark Deakin, Gordon Mitchell, Peter Nijkamp, and Ron Vreeker. London: Routledge.

- Goodland, Robert. 1994. "Environmental Sustainability and The Power Sector." *Impact Assessment* 12(3):275-304.
- Government of Hong Kong. 2017. "GovHK: Hong Kong – the Facts." Retrieved April 20, 2017 (<https://www.gov.hk/en/about/abouthk/facts.htm>).
- Government of Hong Kong. 2017a. "Organisation Chart of the Government of the HKSAR." Retrieved July 21, 2017 (<https://www.gov.hk/en/about/govdirectory/govchart>).
- Greening, Landscape and Tree Management Section. 2017. "Development Bureau." Retrieved July 30, 2017 (http://www.greening.gov.hk/en/about_gltms/purpose_objectives.html).
- Gugger, Harry, and Gwendolyn Kerschbaumer. N.d. "The Compact City: Sustainable or Just Sustaining the Economy?" Retrieved June 1, 2017 (https://src.lafargeholcim-foundation.org/dnl/2dfc74b2-9b40-4875-84b4-a37d0e4c4b9f/F13_GreenWS_GuggerKerschbaumer.pdf).
- Hannah Koh. 2017. "Singapore Toughens Regulations to Meet Environment Goals." Eco-Business, Asia Pacific. Retrieved August 22, 2017 (<http://www.eco-business.com/news/singapore-toughens-regulations-to-meet-environment-goals>).
- Henderson, Joan C. 2013. "Urban Parks and Green Spaces in Singapore." *Managing Leisure* 18(3):213–25. Retrieved June 10, 2017 (<http://www.tandfonline.com/doi/abs/10.1080/13606719.2013.796181>).
- Hong Kong 2030. N.d. "Hong Kong 2030: Planning Vision and Strategy. Stage 3: Public Consultation." Retrieved August 22, 2017 (<http://www.legco.gov.hk/yr03-04/english/panels/plw/papers/plw1125cb1-447-e-scan.pdf>).
- Jabareen, Yosef. 2008. "A New Conceptual Framework for Sustainable Development." *Environment, Development and Sustainability* 10(2):179–92.
- James, Paul. 2015. *Urban Sustainability in Theory and Practice*. London and New York: Earthscan from Routledge.
- Jenks, Mike, and Colin Jones. 2010. *Dimensions of The Sustainable City*. Dordrecht: Springer.
- Jenks, Mike, and Rod Burgess. 2000. *Compact Cities: Sustainable Urban Forms for Developing Countries*. London and New York: Spon Press.
- Kao, Ernest. 2017. "Waste disposal charge will cost a typical Hong Kong family HK\$51 a month." South China Morning Post. Retrieved July 8, 2017 (<http://www.scmp.com/news/hong-kong/health-environment/article/2080508/11-cents-dump-1-litre-trash-hong-kong-government>).

Khian, Karen Lim Hui, and Chou Loke Ming. 2014. "The Management of Visitor Pressure on Coastal Parks of Singapore." Pp. 295-329 in *Sustainability Matters: Asia's Green Challenges*, edited by Lye Lin-Heng, Victor R. Savage, Chou Loke Ming, Yu Liya E and Kua Harn-Wei. Singapore: World Scientific.

Lai, Carine. 2017. *Unopened Space: Mapping Equitable Availability of Open Space in Hong Kong*. Hong Kong: Civic Exchange.

Land Transport Authority. 2017. "Motor Vehicle Population by Vehicle Type." Retrieved August 1, 2017 (https://www.lta.gov.sg/content/dam/ltaweb/corp/PublicationsResearch/files/FactsandFigures/MVP01-1_MVP_by_type.pdf).

Land Transport Authority. 2017a. "Motor Vehicles De-registration under Vehicle Quota System." Retrieved July 27, 2017 (https://www.lta.gov.sg/content/dam/ltaweb/corp/PublicationsResearch/files/FactsandFigures/MVP05-1_Dereg_by_COE.pdf).

Lau, Stephen, Jun Wang, R. Giridbaran, and S. Ganesan. 2005. "High-density, High-rise and Multiple and Intensive Land Use in Hong Kong: A Future City Form for the New Millennium." Pp. 153-167 in *Future Forms and Design for Sustainable Cities*, edited by Mike Jenks and Nicola Dempsey. Oxford: Elsevier.

Lee, Pearl. 2016. "More Singaporeans take bus, MRT to work: government survey." The Straits Times. Retrieved August 12, 2017 (<http://www.straitstimes.com/singapore/more-singaporeans-take-bus-mrt-to-work-government-survey>).

Legislative Council Panel on Transport. 2017. "Parking Policy." Government of Hong Kong. Retrieved August 10, 2017 (<http://www.legco.gov.hk/yr16-17/english/panels/tp/papers/tp20170519cb4-1021-9-e.pdf>).

LSE Cities. 2017. "Urban Morphology." Retrieved August 20, 2017 (<https://urbanage.lsecities.net/data/urban-morphology-london-notting-hill>).

Man-lei, Mandy Lao, and Carine Lai. 2015. *Reducing Plastic Waste in Hong Kong: Public Opinion Survey of Bottled Water Consumption and Attitudes Towards Plastic Waste*. Hong Kong: Civic Exchange, Wyng Foundation.

Miller, Donald. 2004. "Developing and Employing Sustainability Indicators as a Principle Strategy in Planning: Experiences in the Puget Sound Urban Region of Washington State." Pp. 112-131 in *Towards Sustainable Cities: East Asian, North American and European Perspectives on Managing Urban Regions*, edited by André Sorensen, Peter J. Marcotullio, Jill Grant. Aldershot: Ashgate.

- Millward, Hugh. 2006. "Urban Containment strategies: A case-study appraisal of plans and policies in Japanese, British, and Canadian cities." *Land Use Policy* 23(4):473-485.
- Ministry for the Environment. 2002. "The Singapore Greenplan 2012." Retrieved June 1, 2017 (<https://www.mewr.gov.sg/docs/default-source/default-document-library/grab-our-research/sgp2012.pdf>).
- Ministry of National Development Singapore. 2017. "Land Use Allocation Beyond 2030." Retrieved August 1, 2017 (<http://www.mnd.gov.sg/landuseplan>).
- Ministry of Trade and Industry. 2007. "Energy for Growth." Retrieved June 2, 2017 (<https://www.mti.gov.sg/ResearchRoom/Documents/app.mti.gov.sg/data/pages/885/doc/NEPR%202007.pdf>).
- Mitchell, G., A. May, and A. McDonald. 1995. "PICABUE: a methodological framework for the development of indicators of sustainable development." *International Journal of Sustainable Development & World Ecology* 2(2):104-23.
- Mitchell, Gordon. 2007. "The Role of Modelling in Urban Sustainability Assessment." Pp.110-138 in *Sustainable Urban Development, Volume 2: The Environmental Assessment Methods*, edited by Mark Deakin, Gordon Mitchell, Peter Nijkamp and Ron Vreeker. New York, London: Routledge.
- Monitoring of Solid Waste in Hong Kong. 2014. "Waste Statistics for 2014." Retrieved June 15, 2017 (<https://www.wastereduction.gov.hk/sites/default/files/msw2014.pdf>).
- Nanyang Technological University. 2017. "Map of Singapore showing original land, reclaimed land and future land reclamation plans." Retrieved August 1, 2017 (https://blogs.ntu.edu.sg/hp331-2014-10/?page_id=7).
- Naon, Katiohora. 2014. "National Climate Change Policies." Retrieved June 1, 2017 (<https://sustdev.unescap.org/Files/Singapore%20National%20Strategy%20Climate%20Change%20Policy.pdf>).
- National Parks Board. 2017. "National Parks Board." Government of Singapore. Retrieved August 22, 2017 (<https://www.nparks.gov.sg/about-us>).
- NEA. 2017. "Waste Management." Retrieved August 22, 2017 (<http://www.nea.gov.sg/energy-waste/waste-management>).
- NEA. 2017a. "Waste Statistics and Overall Recycling." Retrieved July 21, 2017 (<http://www.nea.gov.sg/energy-waste/waste-management/waste-statistics-and-overall-recycling>).

Nijkamp, Peter. 2007. "The Role of Evaluation in Supporting a Human Sustainable Development: A Cosmonomic Perspective." Pp. 94-109 in *Sustainable Urban Development Volume 2: Environmental Assessment Methods* edited by Mark Deakin, Gordon Mitchell, Peter Nijkamp, and Ron Vreeker. London: Routledge.

Numbeo Database. 2017. "Traffic in Singapore." Retrieved June 28, 2017 (<https://www.numbeo.com/traffic/in/Singapore>).

OECD. 2012. "Compact City Policies, A Comparative Assessment." *OECD Green Growth Studies*. Retrieved June 10, 2017 (<http://www.oecd.org/greengrowth/compact-city-policies-9789264167865-en.htm>).

Oliveira, Vítor. 2016. *Urban Morphology: An Introduction to the Study of the Physical Form of Cities*. Springer.

Pinderhughes, Raquel. 2008. "Alternative Urban Futures: Designing Urban Infrastructures that Prioritize Human Needs, are Less Damaging to the Natural Resource Base, and Produce Less Waste." Pp. 9-19 in *Local Sustainable Urban Development in a Globalized World*, edited by Susan M. Opp and Lauren C. Heberle. Aldershot: Ashgate.

Planning Department. 2002. "Existing Land Use Zonings." Retrieved August 30, 2017 (http://www.pland.gov.hk/pland_en/p_study/comp_s/harbour/harbour_finalreport/images/fig2_1.jpg).

Planning Department. 2002a. "Land Use-Transport Framework." Retrieved August 30, 2017 (http://www.pland.gov.hk/pland_en/p_study/comp_s/harbour/harbour_finalreport/images/fig2_1.jpg).

Planning Department. 2014. "Hong Kong Planning Standards and Guidelines: Chapter 9 Environment." Retrieved June 10, 2017 (http://www.pland.gov.hk/pland_en/tech_doc/hkpsg/full/ch9/pdf/ch9.pdf).

Planning Department. 2016. "Hong Kong 2030 – Towards Planning Vision and Strategy Transcending 2030." Development Bureau. Retrieved June 10, 2017 (http://www.hk2030plus.hk/document/2030+Booklet_Eng.pdf).

Planning Department. 2017. "Vision, Mission and Values." Retrieved July 17, 2017 (http://www.pland.gov.hk/pland_en/about_us/vmv/index.html).

Putra, Azha, and Nicholas Koh. 2014. "Singapore's Policy Response to Climate Change: Towards a Sustainable Future." Pp. 81-99 in *Government's Responses to Climate Change: Selected Examples from Asia Pacific*, edited by Nur Azha Putra and Eulalia Han. New York, London: Springer.

Science for Environment Policy. 2012. "Compact City Strategies in Europe Compared for Trade-Offs." *Science for Environment Policy* 309. Retrieved May 10, 2017 (http://ec.europa.eu/environment/integration/research/newsalert/pdf/309na2_en.pdf).

Shen Li-Yin, Ochoa, J. Jorge, Shah N. Mona, Zhang Xiaoling. 2011. "The application of urban sustainability indicators – A comparison between various practices." *Habitat International* 35(1):17-29.

Sieber, Jeannette, Leonie Fremgen, Manon Pons. 2015. "Assessment of Ecosystem Services for Urban Resilience - Case Study in Singapore." *Planet@Risk* 3(1). Retrieved August 22, 2017 (<https://planet-risk.org/index.php/pr/article/view/169/315>).

Singapore Land Authority. 2017. "Total Land Area of Singapore." Retrieved August 1, 2017 (<https://data.gov.sg/dataset/total-land-area-of-singapore>).

Sorensen, André, Peter J. Marcotullio, Jill Grant. 2004. "Towards Sustainable Cities." Pp. 3-23 in *Towards Sustainable Cities: East Asian, North American and European Perspectives on Managing Urban Regions*, edited by André Sorensen, Peter J. Marcotullio, Jill Grant. Aldershot: Ashgate.

Sorensen, André. 2004. "Major Issues of Land Management for Sustainable Urban Regions in Japan." Pp. 197-217 in *Towards Sustainable Cities: East Asian, North American and European Perspectives on Managing Urban Regions*, edited by André Sorensen, Peter J. Marcotullio, Jill Grant. Aldershot: Ashgate.

Statista Portal for Statistics. 2017. "Number of Passenger cars in Hong Kong." Retrieved June 3, 2017 (<https://www.statista.com/search/?statistics=1&forecasts=1&outlook=1&studies=1&industryReports=1&topics=1&infos=1&interval=0&category=0&subCategory=®ion=0&archive=1&q=hong+kong+cars&sortMethod=idrelevance&accuracy=and&subCategory=>).

Statistical Highlights. 2016. "Land Utilization in Hong Kong." Research Office, Legislative Council Secretariat. Retrieved August 14, 2017 (<http://www.legco.gov.hk/research-publications/english/1617issh04-land-utilization-in-hong-kong-20161024-e.pdf>).

Sustainable Development Knowledge Platform. 2017. "Goal 11." Retrieved April 19, 2017 (<https://sustainabledevelopment.un.org/sdg11>).

Sustainable Development Unit. 2005. "A First Sustainable Development Strategy for Hong Kong." Office of the Chief Secretary for Administration. Retrieved June 2, 2017 (http://www.epd.gov.hk/epd/sites/default/files/epd/english/environmentinhk/waste/prob_solutions/files/1stSDStrategyE.pdf).

Sustainable Singapore Blueprint. 2014. Ministry of the Environment and Water Resources, Ministry of National Development. Retrieved May 1, 2017 (https://sustainabledevelopment.un.org/content/documents/16253Sustainable_Singapore_Blueprint_2015.pdf).

Tan, Kiat W. 2006. "A greenway network for Singapore." *Landscape and Urban Planning* 76(1-4):45-66.

The Economist. 2015. "Such quantities of sand." Retrieved July 10, 2017 (<https://www.economist.com/news/asia/21645221-asias-mania-reclaiming-land-sea-spawns-mounting-problems-such-quantities-sand>).

The Straits Times. 2016. "Work to start on 150km Round Island Route green corridor." Retrieved August 16, 2017 (<http://www.straitstimes.com/singapore/transport/work-to-start-on-150km-round-island-route-green-corridor>).

The World Bank Open Data. 2017a. "GDP (current US\$) of Hong Kong SAR, China." Retrieved July 1, 2017 (<https://data.worldbank.org/indicator/NY.GDP.MKTP.CD?locations=HK>).

The World Bank Open Data. 2017b. "Population, total of Hong Kong SAR, China." Retrieved July 1, 2017 (<https://data.worldbank.org/indicator/SP.POP.TOTL?locations=HK>).

The World Bank Open Data. 2017c. "Population Total, Singapore." Retrieved July 1, 2017 (<https://data.worldbank.org/indicator/SP.POP.TOTL?locations=SG>).

The World Bank Open Data. 2017d. "GDP (current in US\$) Singapore." Retrieved July 1, 2017 (<https://data.worldbank.org/indicator/NY.GDP.MKTP.CD?locations=SG>).

Tian, Yuhong, C.Y. Jim, T. Tao. 2012. "Challenges and Strategies for Greening the Compact City of Hong Kong." *Journal of Urban Planning and Development* 138:101-109.

Transport Department. 2017. "Introduction." Retrieved July 21, 2017 (http://www.td.gov.hk/en/transport_in_hong_kong/public_transport/introduction/index.html).

Transport Department. 2017a. "Monthly Traffic and Transport Digest." Retrieved June 15, 2017 (http://www.td.gov.hk/en/transport_in_hong_kong/transport_figures/monthly_traffic_and_transport_digest/index.html).

United Nations Department of Economic and Social Affairs. 2017. "World Population Projected to Reach 9.7 Billion by 2050." UNDESA. Retrieved April 19, 2017 (<http://www.un.org/en/development/desa/news/population/2015-report.html>).

United Nations Development Program. 2017. "Sustainable Development in Cities Is Critical To Achieving Most Of The 2030 Agenda." UNDP. Retrieved April 10, 2017 (<http://www.undp.org/content/undp/en/home/presscenter/pressreleases/2016/10/17/sustainable-development-in-cities-is-critical-to-achieving-most-of-the-2030-agenda-.html>).

United Nations WCED. 1987. "Our Common Future." Retrieved June 10, 2017 (<http://www.un-documents.net/our-common-future.pdf>).

Vreeker, Ron, Peter Nijkamp, Giuseppe Munda. 2007. "Evaluation of Sustainable Urban Development: Cost-Benefit Analysis and Multicriteria Analysis." Pp. 142-157 in *Sustainable Urban Development Volume 2: The Environmental Assessment Methods*, edited by Mark Deakin, Gordon Mitchell, Peter Nijkamp and Ron Vreeker. New York, London: Routledge.

Waas, Tom, Jean Hugé, Thomas Block, Tarah Wright, Francisco Benitez-Capistros and Aviel Verbruggen. 2014. "Sustainability Assessment and Indicators: Tools in a Decision-Making Strategy for Sustainable Development." *Sustainability* 6(9):5512–34.

WBCSD. 2014. "Methodology and Indicator Calculation Method for Sustainable Urban Mobility." *WBCSD - World Business Council for Sustainable Development* 41(0):76.

Yau, Yung. 2010. "Domestic Waste Recycling, Collective Action and Economic Incentive: The Case in Hong Kong." *Waste Management* 30(12):2440–2447.

Yep, Eric. 2015. "Singapore's Innovative Waste-Disposal System." *The Wall Street Journal*. Retrieved July 19, 2017 (<https://www.wsj.com/articles/singapores-innovative-waste-disposal-system-1442197715>).

Yin, Robert K. 2003. *Case Study Research Design and Methods*. 3rd ed. California: Sage Publications.

Yin, Robert K. 2009. *Case Study Research Design and Methods*. 4th ed. California: Sage Publications.

Zero Waste SG. 2016. "Position Paper on the Reduction of Single-Use Plastic Disposables in Singapore." Retrieved June 15, 2017 (<http://www.zerowastesg.com/plasticdisposables>).

ABSTRACT

Today's cities are profound reflections of human achievements, activities, developments and prosperity. Yet, as evidenced by the climatic abnormalities, health problems, pollution, uneven allocation of resources, traffic congestion, loss of biodiversity and accumulation of waste within urban areas - cities tend to reflect an unwelcoming and unsustainable environment to live and prosper in. However, by familiarising ourselves with current tendencies, a profound solution on sustainable urban development can be achieved. The following paper seeks to contribute to the study of infrastructural development in the areas of waste management, transportation, green space allocation and land reclamation by analysing policy related documents of the Hong Kong Special Administrative Region and the Republic of Singapore through case study analysis. In time of high urbanization volatility, the aim of this research is to develop an analysis into urban development in relation to sustainability for the region of Southeast Asia. As such, it analyses certain aspects of urban planning by looking into factors contributing to major changes and attributes in the sphere of extremely dense metropolises. The results of the analysis present a continuous necessity for responsible attitudes and careful considerations in a hope to find prominent solutions for protecting our environment for future generations.

ZUSAMMENFASSUNG

Städte sind heutzutage Spiegelbilder menschlicher Errungenschaften, Aktivitäten, Entwicklungen und des Wohlstands. Wie aber klimatische Abweichungen, Gesundheitsprobleme, Umweltverschmutzung, ungleiche Ressourcenverteilung, Verkehrsstaus, der Verlust der Biodiversität und Müllanhäufungen in urbanen Gebieten beweisen, stellen Städte auch einen unwirtschaftlichen und nur bedingt nachhaltigen Lebensraum dar. Indem wir uns mit diesen aktuellen Tendenzen vertraut machen, kann jedoch eine tiefgreifende Lösung für nachhaltige Stadtentwicklung erreicht werden. Die vorliegende Arbeit möchte zur Forschung über infrastrukturelle Entwicklung in den Bereichen Abfallwirtschaft, Verkehrswesen, Grünflächenzuordnung und Landgewinnung beitragen, indem politische Dokumente der chinesischen Sonderverwaltungszone Hongkong und Fallstudien zur Republik Singapur analysiert werden. In Zeiten großer Schwankungen bei der Verstädterung ist es Ziel dieser Untersuchung, eine Analyse für die Stadtentwicklung in Bezug auf die Nachhaltigkeit der Region Südostasien zu entwickeln. Dabei werden jene Faktoren der Stadtplanung in Betracht gezogen, welche zu den großen Veränderungen und Eigenheiten im Bereich extrem dicht besiedelter Großstädte beitragen. Die Ergebnisse der Analyse zeigen den kontinuierlichen Bedarf verantwortungsvoller Einstellungen und achtsamer Herangehensweisen auf, in der Hoffnung Lösungen zu finden, um unsere Umwelt für zukünftige Generationen zu bewahren.