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HKGBC Guidebook for Sustainable Built Environment

About HKGBC

The Hong Kong Green Building Council Limited (HKGBC) is a non-profit, member led organisation established in 2009 and has become a public body under the Prevention of Bribery Ordinance since 2016. The HKGBC strives to promote the standards and developments of sustainable buildings in Hong Kong. The HKGBC also aims to raise green building awareness by engaging the public, the industry and the government, and to develop practical solutions for Hong Kong's unique, subtropical built environment of high-rise, high density urban area, leading Hong Kong to become a world's exemplar of green building development.

Our passion for a sustainable built environment is the motivating force to achieve our goals. The wide experience and deep insight of our members and experts is the underlying foundation for real results.

To learn more about the HKGBC, please visit www.hkgbc.org.hk.

Our Vision

To help save the planet and improve the wellbeing of the people of Hong Kong by transforming the city into a greener built environment.

Our Mission

To lead market transformation by advocating green policies to the Government; introducing green building practices to all stakeholders; setting design, construction and management standards for the building profession; and promoting green living to the people of Hong Kong.

Contents

Abbreviations

ArchSD	Architectural Services Department (Hong Kong)
BD	Buildings Department (Hong Kong)
BIPV	Building-integrated Photovoltaics
BSAP	Biodiversity Strategy and Action Plan
BEAM	Building Environmental Assessment Method
CAP 2050	Hong Kong Climate Action Plan 2050
CBD	Central Business District
CCHP	Combined Cooling, Heating and Power
CDA	Comprehensive Development Area
CO_2	Carbon Dioxide
CSGKC	China-Singapore Guangzhou Knowledge City
DEVB	Development Bureau (Hong Kong)
DSD	Drainage Services Department (Hong Kong)
EEB	Environment and Ecology Bureau (Hong Kong)
EF	Energy Foundation (China)
EPD	Environmental Protection Department (Hong Kong)
EV	Electric Vehicle
EU	European Union
F&B	Food and Beverage
FSD	Fire Services Department (Hong Kong)
GFA	Gross Floor Area
GHG	Greenhouse Gas
GIC	Government, Institution and Community
HDB	Housing and Development Board (Singapore)
HKEX	Hong Kong Exchanges and Clearing Limited
HKGBC	Hong Kong Green Building Council
HKPSG	Hong Kong Planning Standards and Guidelines
HKSAR	Hong Kong Special Administrative Region
ICT	Information and Communication Technology
IoT	Internet of Things
IPCC	Intergovernmental Panel on Climate Change
ITB	Innovation, Technology and Industry Bureau (Hong Kong)
IUCN	International Union for Conservation of Nature
LEED	Leadership in Energy and Environmental Design
MIC	Modular Integrated Construction
MIMEP	Multi-trade Integrated Mechanical, Electrical and Plumbing
NGO	Non-governmental Organisation
PlanD	Planning Department (Hong Kong)
PV	Photovoltaic
SBD	Sustainable Building Design
SCG	Site Coverage of Greenery
SDGs	United Nations Sustainable Development Goals
TOD	Transit-oriented Development
UHI	Urban Heat Island
UN	United Nations
URA	Urban Renewal Authority (Hong Kong)
UV	Ultra-violet

Message from Secretary for Environment and Ecology

Mr TSE Chin-wan, BBS, JP

Secretary for Environment and Ecology
The Government of the Hong Kong Special Administrative Region

Amid rapid urbanisation, concerted efforts to meet the sustainable development needs of Hong Kong have become increasingly important. In recent years, the Government has been driving a number of initiatives to support Hong Kong's sustainable growth. We announced Hong Kong's Climate Action Plan 2050 with four major decarbonisation strategies, namely "net-zero electricity generation", "energy saving and green buildings", "green transport" and "waste reduction". All these would lead Hong Kong towards the goal of carbon neutrality before 2050. I would like to congratulate the Hong Kong Green Building Council on their latest publication of the Guidebook for Sustainable Built Environment to catalyse the progress towards carbon neutrality and enhance the resilience and liveability of our city.

The Guidebook introduces design strategies that accelerate the sustainable development of precinct-scale projects with consideration of holistic benefits to the environment and its inhabitants. It provides practical recommendations that help minimise the environmental and societal impacts associated with various urban challenges, enabling new and re-development projects to be built in a more sustainable manner.

Notable examples of application of these strategies to the context of Hong Kong are climate resilient design such as porous pavements to effectively manage surface water runoff; flexible building design to extend usability of space, allowing multi-functional purposes; and application of mechanically assisted mobility to create a barrier-free environment. These have addressed unique challenges such as the city's changing climate, availability of developable land, ageing population and others. The Guidebook complements the Government's long-term goal of facilitating sustainable development and environmental protection in Hong Kong and contributes to our decarbonisation target. It also enhances the city's international competitiveness, well-being of individuals as well as economic, environmental and social sustainability.

I look forward to more successful applications of the Guidebook design strategies as well as more green and sustainable buildings in Hong Kong.

Foreword from HKGBC Chairman

Dr CHEUNG Tin-cheung, SBS

Chairman
Hong Kong Green Building Council

On behalf of the Hong Kong Green Building Council (HKGBC), we take great pleasure in presenting the Guidebook for Sustainable Built Environment in Hong Kong to facilitate the planning and design of more sustainable urban precincts.

The HKGBC is committed to promoting green building practices to building industry practitioners, developers, owners, operators and occupants. Increasingly, cities around the world are striving to become more sustainable. In addition to the United Nations Sustainable Development Goals which have been widely adopted on an international level, local targets and strategies such as those embedded in the Climate Action Plan 2050 also create opportunities for the development of a sustainable and resilient Hong Kong.

Throughout the Guidebook, 48 design strategies are recommended under 8 key themes: plan liveable precincts, integrative planning and governance, climate resilient and carbon neutral precincts, connected and circular precincts, urban biodiversity, inclusive and accessible communities, innovative sustainable design and technology and mitigation of health risks. International and regional best practice case studies, together with practical examples of the application of design strategies to Hong Kong are also presented.

We hope this guidebook provides useful information and inspiration for built environment professionals to consider, integrate and adapt strategies to address challenges in their projects and create precincts in Hong Kong that are sustainable, smart, liveable, resilient and people-oriented, ultimately contributing to the creation of a built environment that is beneficial to all.

We would like to take this opportunity to thank the valuable contribution from various industry stakeholders, including government departments, developers, consultants, professional bodies and universities to the development of the Guidebook. We would also like to express our gratitude to the Construction Industry Council for its funding support in the production of this Guidebook.

Foreword from SDC Chairman

Ir PAN Shu-jie

Chairman
Sustainable Development Committee

Director
Hong Kong Green Building Council

Rapid urbanisation and economic growth faced in Hong Kong have led to increasing rates of resource consumption, greenhouse gas emissions and waste production, ultimately causing challenges such as climate change, risks and hazards. In recent years, extreme weather changes have become more frequent, together with increasing temperatures.

Where demands are growing, there is a need to ensure that the development of built environments is sustainable. As such, HKGBC has formulated this Guidebook—targeting precinct scale developments. It provides a series of design strategies that facilitate the incorporation of sustainable considerations across different areas, such as that related to the environment, society and economy. In addition, the Guidebook also explores the application of such strategies in tackling Hong Kong-specific challenges, providing practical examples of how the strategies could be implemented by industry practitioners and work together in synergy to create not only environmental but broader social and economic impacts.

To support the changing needs and development of Hong Kong's built environment, the design strategies presented in this Guidebook may be updated or new strategies may be added in the future in response to industry and environmental changes.

I would like to express my heartfelt appreciation to all the industry stakeholders who have provided their valuable input during the development this Guidebook. We hope that this Guidebook will serve as a useful reference for the industry towards the development of a more sustainable city and that the industry would lend its support to the continual development of this Guidebook.

Message
About this Guidebook

Mr CHEUNG Hau-wai, SBS

Chairman
Steering Committee
Hong Kong Green Building Council

Hong Kong has seen a growing number of new and re-development projects being planned in recent and coming years. At the same time, the city is also striving towards greener and more sustainable goals, including the Government's announcement of Hong Kong's target to achieve carbon neutrality before 2050. As such, there is increasing need for a holistic consideration of sustainable design in the development of Hong Kong's urban fabric.

This Guidebook strives to provide recommendations that facilitate the development of sustainable built environments—with the aim to accelerate Hong Kong's progression towards carbon neutrality by 2050, the achievement of the United Nations Sustainable Development Goals, as well as Hong Kong's goal of becoming a world-class smart, green, resilient and liveable city. The sustainable design strategies presented are proposed with particular consideration of the specific conditions and context of Hong Kong. Among a broad spectrum of strategies presented, the Guidebook encourages readers to make the best use of natural resources, optimise building disposition and use of open spaces, adopt various forms of renewable energy, and effective waste management strategies which may be supported by green finance mechanisms.

I would like to thank the stakeholders and subject matter experts who participated in various engagement workshops through which valuable feedback was obtained in the shaping of the Guidebook. We hope that the Guidebook serves as a pragmatic resource for building and construction industry practitioners in the development of sustainable built environments in Hong Kong, now and in the future.

EXECUTIVE SUMMARY

Executive Summary

The HKGBC Guidebook for Sustainable Built Environment provides practical design strategies and recommendations for the development of precinct-scale sustainable built environments in Hong Kong

The introductory chapter of this Guidebook highlights the main urban challenges in Hong Kong and provides definitions of important concepts that pertain to the development of sustainable built environment. The core objectives that form the basis of the design strategies and recommendations of this guidebook are presented together with an overview of the target audience, types of projects to which design strategies apply, along with how the Guidebook can be best utilised by built environment professionals. The focus on precinct scale developments is specified.

The second chapter outlines a preliminary understanding of existing efforts that support the development of sustainable built environments, both in Hong Kong and abroad, setting a foundation for the design strategies and application examples presented in the subsequent chapters. Relevant policies and practices from local, regional and international governments are identified while best practice case studies are also selected from various cities to serve as inspiration. The applicability of relevant strategies implemented in these case studies to the context of Hong Kong is also explored.

Detailed design strategies for the development of a sustainable built environment are elaborated in the third chapter. These are categorised across eight themes and detailed on the following page. Illustrations are included together with reference guidelines in the appendix to facilitate further understanding. Select strategies from this chapter are then combined in the fourth chapter to demonstrate how they can be applied in synergy towards solving key urban challenges faced in Hong Kong. Readers may choose to refer to this chapter directly for a clear demonstration of how the strategies could be applied in a practical way to the unique context of Hong Kong. Where relevant, references from existing documents are provided to enhance understanding and to serve as further inspiration.

The final chapter concludes with potential challenges and opportunities, as well as recommendations in areas of public awareness and education, together with future development and studies. Overall, this Guidebook encourages the adoption of green and sustainable strategies in the conceptual stages of precinct design across Hong Kong's built environment.

Design Strategies at a Glance

The design strategies for the development of a sustainable built environment are categorised across eight themes.

Plan Liveable Precincts

Promoting wellness and liveability through nature-based precinct design that considers both greenery and water bodies, building disposition and site responsive design that enhances permeability and comfort, urban renewal, as well as sustainable master planning that focuses on polycentricity and mixed-use developments.

Integrative Planning and Governance

Strengthening governance through encouraging integrative planning and cross-sector partnerships, leveraging sustainable finance and business models in precinct development, as well as fostering community engagement and participation.

Climate Resilient and Carbon Neutral Precincts

Building climate resilience and accelerating the path towards carbon neutrality through strategies that aim to minimise energy consumption and carbon emissions and maximise the use of renewable energy.

Connected and Circular Precincts

Improving urban mobility and enhancing the efficiency of district wide systems through effective transit-oriented development, digital intervention, waste collection and management systems, as well as the integration of energy systems.

Urban Biodiversity

Minimising the adverse effects of urban development on existing natural habitats, through maximising conservation of biodiversity within the urban environment, supporting the growth of urban biodiversity, and reducing the damage caused by urbanisation on ecological resources.

Inclusive and Accessible Communities

Creating a safe and welcoming environment through improving social infrastructure, strengthening local engagement and sense of belonging within the community, ensuring access to core public facilities, as well as fostering inclusiveness and social cohesion.

Innovative Sustainable Design and Technology

Integrating technology and sustainability to foster the development of a smart green precinct through the adoption of intelligent systems, modern construction technologies, sustainable construction materials, as well as flexible building design.

Mitigation of Health Risks

Encouraging the adoption of health-conscious design and enhancing the quality of living through strategies that target to improve public hygiene and sanitation, air quality and circulation, public response to epidemics, self-sufficiency, and contact tracing.

Hong Kong's Key Urban Challenges at a Glance

The application of design strategies to tackle Hong Kong's urban challenges and to create a sustainable built environment are explored in Chapter 4.

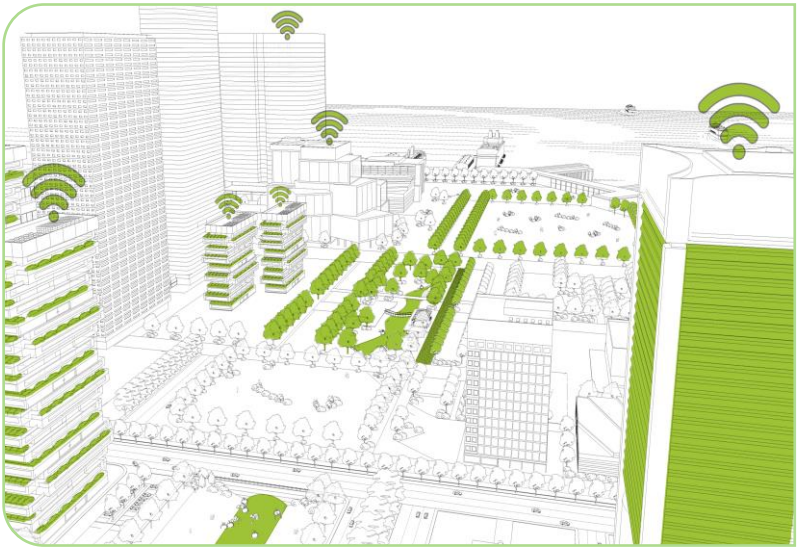
Hong Kong's High-Density Environment:

Hong Kong is often characterised by its combination of high population density and high-rise buildings. While there are various benefits to a high density environment, such as enhanced walkability and access to services, high density living may also lead to congestion issues, pollution, and lack of space. The application of sustainable design strategies that target building disposition, improved air flow, low-carbon transport and adequate access to facilities, may hence, work well together to tackle this urban challenge.

Hong Kong's Availability of Developable Land:

Hong Kong's mountainous topography results in physical constraints that limit the availability of developable land. The application of appropriate design strategies is therefore necessary to ensure that spaces remain accessible and useable, and that liveability and natural landscapes continue to be considered. These strategies may cover the design of barrier-free and sociable spaces, easily accessible infrastructure, flexible building design, and preservation of urban biodiversity, among others.

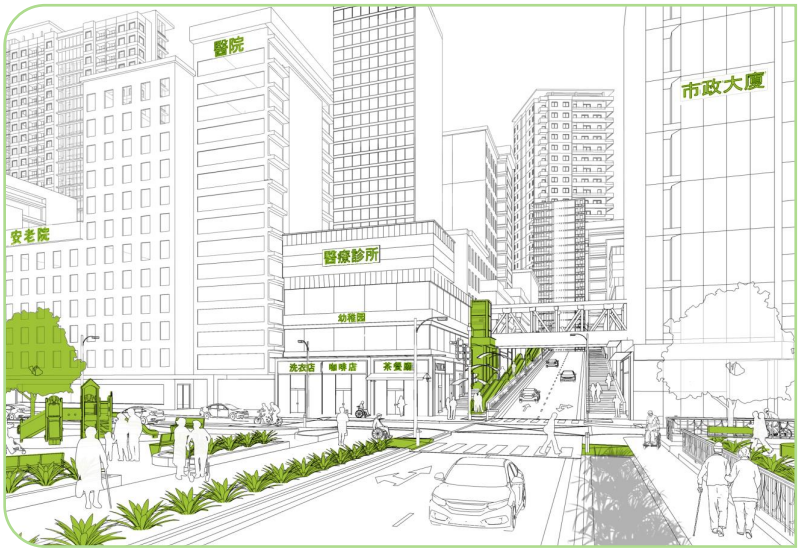
Hong Kong's Changing Climate:



Like many cities, Hong Kong has been experiencing increasing temperatures and more frequent extreme weather events, including severe typhoons and heavy rainfalls. The need to advance the path towards carbon neutrality and climate resilience to alleviate the impacts of Hong Kong's changing climate is prevalent. The combination of design strategies in the areas of climate resilient design, passive mechanisms and renewable energy may be especially beneficial in tackling such a challenge.

Hong Kong's Key Urban Challenges at a Glance

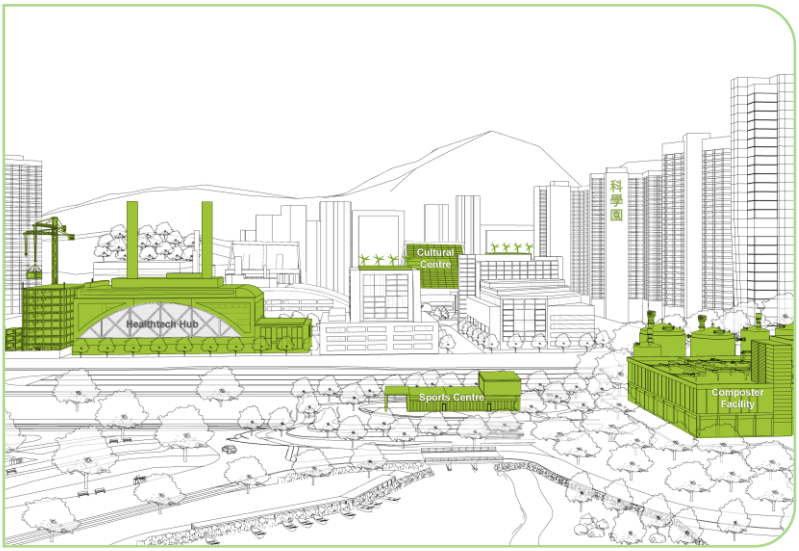
Hong Kong's Ageing Population:



The proportion of elderly persons in Hong Kong has continued to increase. Appropriate planning is needed to ensure that changing demographic needs are properly accommodated. Strategies targeting the development of physically and socially inclusive spaces, intergenerational activities, as well as easy-to-access facilities may be particularly useful in addressing this challenge.

Hong Kong's Rapid Economic Expansion:

Hong Kong's rapidly growing economy has led to increasing rates of resource and energy consumption that leads to environmental concerns such as heightened levels of waste generation and carbon emissions. Strategies targeting the areas of waste collection and management, sustainable finance and circular supply chains, as well as the preservation of natural habitats appear as essential in alleviating such a challenge.



CHAPTER 01

INTRODUCTION

CHAPTER 01

Introduction

1.1 Hong Kong and Global Sustainability Challenges

In the wake of rapid urbanisation, cities around the world have increasingly faced sustainability challenges, affecting not only the natural environment, but economic growth and social issues as well. As a global metropolis, Hong Kong, too, has been experiencing imminent challenges to its built environment. These challenges must be addressed to ensure that the needs of current and future generations can continue to be met.

Hong Kong's iconic dense urban landscape is a result of accommodating a large population within a tight geographical area. In face of the city's rapid urbanisation and economic expansion, an increasing number of new developments and revitalisation projects are being planned, such as reclamation works, the development of new towns/brownfield sites, and the re-development of ex-quarry areas. Such developments are also met with a series of challenges, such as topographical and spatial constraints, environmental impacts, as well as social and cultural issues that arise.

Nonetheless, amid these challenges, the Government has set its sight on developing Hong Kong into a more sustainable city through various initiatives, such as striving to achieve carbon neutrality before 2050, smart city development, enabling sustainable development through green financing measures, and more.

From an environmental perspective, it is worth highlighting that Hong Kong has been experiencing increasing levels of energy consumption that has resulted in high levels of carbon emissions [1]. The city's carbon emissions reached a peak in 2014 at an emission index of 6.2 tonnes per capita [2]. However, approximately two thirds of Hong Kong's carbon emissions in 2019 was due to electricity generation, signifying the importance of improving energy efficiency and maximising energy savings. 90% of Hong Kong's electricity consumption is attributable to buildings, while 60% of carbon emissions are caused by electricity generation for buildings, thus, reinforcing the impact that the built environment has on climate change. Additionally, 7% of the emissions in 2019 was also attributable to waste [2]. Given that construction expenditure in the coming decade is forecasted to increase, the impact of growing construction activity on construction waste levels is another sustainability challenge for the city [3].

The increasing amount of greenhouse gas emissions has resulted in greater risks of climate change. In the last century, Hong Kong's temperatures have continued to rise in accordance with the global trend. In addition, extreme weather events such as heavy rains have also occurred more frequently while the sea level at Victoria Harbour has continued to rise [4]. Located in a subtropical climate, Hong Kong experiences hot, humid, and rainy summers alongside relatively mild and dry winters. For most of the year, the region enjoys a temperate climate. Over the last century, the number of hot nights and hot days in Hong Kong have increased while the number of cold days has decreased [5]. These changes in temperatures can cause further environmental impacts, such as disruptions to urban biodiversity and ecological habitats in Hong Kong.

There is, hence, a consequential need for the city to build-up its climate resilience. Having dealt with a history of severe weather events, the city has garnered experience in strengthening its infrastructure in response to climate vulnerabilities [6].

To create a liveable environment, however, it is insufficient to solely rely on mitigation and adaptation strategies that simply focus on the city's hardware. Extending the focus to the social dimensions of the built environment is essential to the creation of a society that is inclusive of all communities. In this context, Hong Kong's challenge of double-ageing—the ageing of both the city's population and building stock is an important consideration. Additionally, the recent impacts of the COVID-19 pandemic have further exacerbated the need to consider individual health, well-being and behaviours, thus, further encouraging the need to develop a type of sustainable built environment that not only takes into consideration physical and natural environments, but social and economic dimensions as well.

To help address these challenges, this Guidebook aims to facilitate the development of a sustainable built environment in Hong Kong through the provision of design strategies that target precinct scale development projects.

1.2 Purpose of the Guidebook

'The HKGBC Guidebook for Sustainable Built Environment' identifies best practice strategies for the planning and design of sustainable urban quarters and precincts in Hong Kong.

The Guidebook is intended to assist project proponents, built environment professionals, community groups, NGOs, decision-makers and landowners to arrive at sustainable land use planning and design outcomes, now and in the future, and in ensuring that appropriate sustainable design best practices are considered in the process.

1.3 Key Objectives of the Guidebook

This Guidebook intends to provide sustainable design strategies that will: (1) facilitate Hong Kong's progression towards carbon neutrality by 2050; (2) accelerate the achievement of the United Nations Sustainable Development Goals (UN SDGs); and (3) facilitate the advancement towards smart, green and resilient city development.

The application of the design strategies provided in this Guidebook would not only help to solve urban challenges in Hong Kong in alignment with the objectives above but would also enable the city to achieve its vision of becoming a more liveable, competitive and sustainable international metropolis overall.

Facilitate Hong Kong's Progression Towards Carbon Neutrality before 2050

Achieving carbon neutrality requires extensive effort in significantly decreasing the amount of greenhouse gases released into the atmosphere across all industries and sectors of the economy. Likewise, the need for functions and activities in the built environment to take into consideration low carbon design and innovations will be crucial. With the vision of "Zero-carbon Emissions, Liveable City, Sustainable Development" in mind, the Hong Kong Government produced the Hong Kong Climate Action Plan 2050 (CAP 2050) with a pledge to achieve carbon neutrality by 2050. The Action Plan places a significant focus on the built environment, with its four decarbonisation strategies being net-zero electricity generation, energy saving and green buildings, green transport and waste reduction. While the strategies and targets presented in CAP 2050 largely cover the city as a whole, they can nonetheless be taken into consideration in the development of smaller-scale developments, i.e., at the precinct level.

Accelerate the Achievement of the United Nations Sustainable Development Goals

There are a total of 17 Sustainable Development Goals (SDGs) as part of the United Nation's (UN) 2030 Agenda for Sustainable Development. Adopted by all UN member states in 2015, the UN SDGs cover a wide range of issues, such as poverty, health, hunger, education, inequalities, economic growth and climate change among others. Some goals are more relevant than others for the purpose of this Guidebook, which primarily focuses on the design of the built environment. The table below summarises the relevant SDGs that help guide the development of design strategies presented in this Guidebook for precinct-scale developments.

Guidebook Relevance to UN SDGs

UN SDGs	Design Strategy Themes							
	Plan Liveable Precincts	Integrative Planning & Governance	Climate Resilient & Carbon Neutral Precincts	Connected and Circular Precincts	Urban Biodiversity	Inclusive & Accessible Communities	Innovative Sustainable Design and Technology	Mitigation of Health Risks
No Poverty						✔		
Zero Hunger	Not Applicable							
Good Health and Well-being	✔		✔		✔	✔		✔
Quality Education						✔		
Gender Equality						✔		
Clean Water and Sanitation			✔	✔				✔
Affordable and Clean Energy			✔	✔				
Decent Work and Economic Growth		✔				✔		
Industry, Innovation and Infrastructure	✔		✔	✔			✔	
Reduced Inequalities						✔		
Sustainable Cities and Communities	✔	✔	✔	✔	✔	✔	✔	✔
Responsible Consumption and Production	✔		✔	✔		✔		
Climate Action	✔	✔	✔	✔	✔		✔	
Life Below Water					✔			
Life On Land			✔		✔			
Peace, Justice and Strong Institutions		✔				✔		
Partnerships for the Goals		✔						

Table 1: Linkage between the UN SDGs and Design Strategies

Facilitate the Advancement Towards Smart, Green and Resilient City Development

Increasingly, cities around the world have accelerated their adoption of technology in tackling urban challenges. Smart green city development, which leverages innovation and technology to improve efficiency, elevate the quality of life and drive sustainable solutions, has also become a global trend in recent years. The Hong Kong government has actively encouraged the implementation of various smart city initiatives—many of which have been documented in the Hong Kong Smart City Blueprint [7].

In addition, to enhance liveability in a city that is constantly facing the challenges of climate change, it has also become important to strengthen resilience, such that urban systems and infrastructures are properly equipped to adapt to the environment and respond to climate risks, hazards and disasters.

Moreover, the Government's active promotion of green and sustainable finance initiatives can further act as an enabler to catalyse Hong Kong's development into a smarter, greener and resilient city. Examples of ongoing initiatives include the Government Green Bond Programme, funding schemes such as the Green and Sustainable Finance Grant Scheme and Pilot Green and Sustainable Finance Capacity Building Support Scheme, as well as cross-agency collaborations.

As such, the strategies provided in this guidebook will explore the integration and benefits of smart and green components in the design of precinct scale developments, and ultimately contribute to Hong Kong's path toward smart city development at large.

1.4 Scales and Types of Project

This Guidebook may be applied to development projects of various sizes and scales. However, it is not intended for application to individual buildings or single development sites, but rather to guide and mediate the sustainable design of and relationships between development sites and their surrounding public infrastructure (roads, open space, waterbodies, drainage, sewerage and GIC facilities, etc.), by providing inspiration and strategic recommendations that could be adopted and adapted by practitioners.

Some of the guidance could be adapted to larger "Comprehensive Development Area" or "CDA" sites (as defined in Outline Zoning Plans) and those within which are large enough to form precincts in their own right. But it is more specifically intended for use in more extensive comprehensive urban developments, which are often (but not always) in multiple ownership, or which are to be sold/leased to multiple owners and uses. Examples of projects of the scale in which the Guidebook addresses include the Hong Kong Science Park, Fairview Park, Cyberport, Taikoo Place, EcoPark or SkyCity, as well as certain precinct-scale urban renewal projects.

1.5 The Guidebook and the 'BEAM Plus Neighbourhood' Rating Tool

The guidance provided can be distinguished from the design principles set out in the credits of the HKGBC 'BEAM Plus Neighbourhood' sustainability rating tool in three important ways:

1) The Guidebook is orientated towards larger comprehensive urban development projects than the BEAM Plus Neighbourhood' rating tool.

2) Whereas in the rating tool there must necessarily be a focus on one lot or development site, which is the subject of the assessment, the planning and design guidance in this Guidebook aims to create a holistic, balanced and sustainable relationship between multiple land uses and built forms on numerous lots or development sites, as well as with the infrastructure that supports them and their communities.

3) Finally, because the objective of the Guidebook is design guidance rather than design assessment, it does not set out specific design parameters or performance targets in the same way as the BEAM Plus Neighbourhood rating tool.

However, it is important to note that, while addressing different scales and different objectives, 'The HKGBC Guidebook for Sustainable Built Environment' and the 'BEAM Plus Neighbourhood' sustainability rating tool are nonetheless entirely mutually compatible and mutually supporting tools for furthering and promoting sustainable built environment in Hong Kong.

1.6 Definition of Terms and Key Concepts

The key terms and concepts used throughout this Guidebook are summarised below:

Built Environment

A built environment is a man-made space that encompasses important structures that support all walks of life, such as the buildings that we live and work in, energy systems, transportation networks, as well as other public facilities, open space, waterbodies, stream courses and infrastructures.

Sustainability

Sustainability was defined by the United Nations Brundtland Commission in 1987 as the ability to "meet the needs of the present without compromising the ability of future generations to meet their own needs" [8]. In supporting continued growth, Hong Kong pursues sustainable development through striving to balance the environmental, social and economic considerations that impact its present and future generations [9].

Climate Resilience

Climate change has posed increasing challenges to cities around the world, affecting not only natural and built landscapes, but people and their ways of living as well. Climate resilience comprises strategies that enable the ability to adapt to climate change and to tackle the acute problems caused by it.

Carbon Neutrality

Carbon neutrality can be achieved through net-zero carbon dioxide emissions. It is reached when carbon dioxide emissions produced is balanced out by the amount that is removed. As a means of creating a more sustainable and competitive city with an increased range of opportunities, the government has pledged to achieve carbon neutrality by 2050 in Hong Kong's latest Climate Action Plan [2].

Urban Renewal

Urban renewal is carried out to improve the living conditions of older districts, decelerate urban decay and beautify the construction of existing neighbourhoods [9]. In Hong Kong, the Urban Renewal Authority (URA) is tasked, under the URA Ordinance and Urban Renewal Strategy, to conduct urban renewal through redevelopment, rehabilitation, preservation, revitalisation and retrofitting, via a "people-first, district-based, public participatory" approach [10].

Circular Economy

A circular economy is a regenerative system of production and consumption that targets to prolong the lifecycle of resources. It reduces the use of new materials and thus the generation of waste as well.

Smart City

Smart cities strive to maximise the benefits of information and communication technology (ICT) infrastructure and can use innovation to address issues and enhance urban processes, such as city governance and management, transport and mobility, built and natural environments, as well as overall liveability and individual needs. Smart city initiatives target to improve quality of life and enable sustainable growth [11].

Green Finance

Green finance encourages the shift of financial flows towards sustainable development initiatives, across public, private and not-for-profit sectors. Promotion of green finance can be carried out through different forms, such as changes in regulatory frameworks, investment in green technologies, and encouraging the use of green bonds, etc. [12].

Green Economy

In green economies, economic growth is stimulated by investment into activities that aim to reduce emissions of greenhouse gases, encourage resource efficiency, promote inclusive societies, and prevent the loss of urban biodiversity [12].

Urban Biodiversity

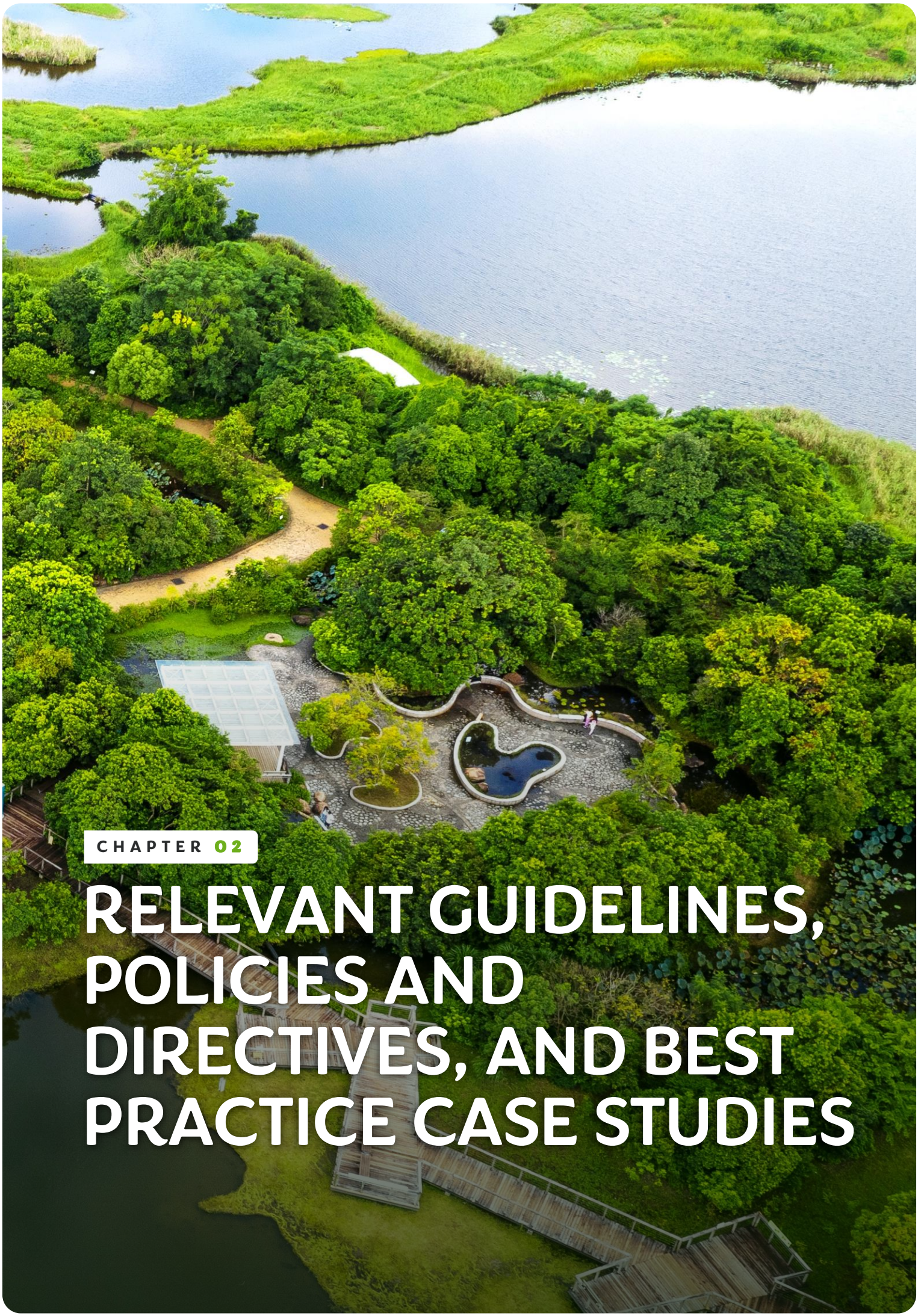
Urban biodiversity refers to the range of living organisms, including their genetic variations, as well as the types and diversity of natural habitats that can be found in urban environments [13].

Equitable Communities

The development of equitable communities considers the individual wellbeing of inhabitants across social, economic and environmental factors, as well as access to various services, amenities and welfare opportunities.

1.7 How to Approach the Guidebook

This Guidebook is broken down into several sections for ease of reference. While it is recommended that readers go through the Guidebook chronologically, readers may choose to focus on specific chapters depending on their interests. For example, those interested in existing guidelines, policies and relevant best practice case studies of sustainable built environments may refer to Chapter 2, while those interested in themed design strategies may refer to Chapter 3. Readers also have the option to refer directly to Chapter 4 to understand strategy combinations and applications in Hong Kong to address specific urban challenges prevalent for the city. A list of reference guidelines are also included in the Appendices of this Guidebook to enhance understanding and supplement any further studies.



CHAPTER 02

RELEVANT GUIDELINES, POLICIES AND DIRECTIVES, AND BEST PRACTICE CASE STUDIES

CHAPTER 02

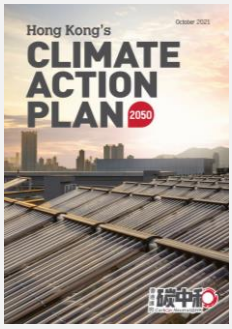
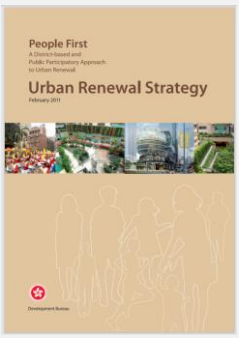
RELEVANT GUIDELINES, POLICIES AND DIRECTIVES, AND BEST PRACTICE CASE STUDIES

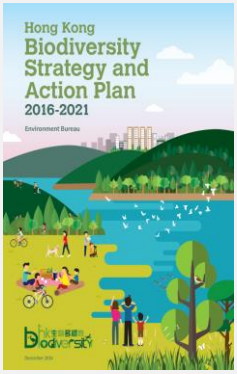
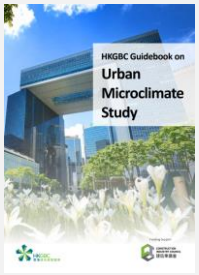
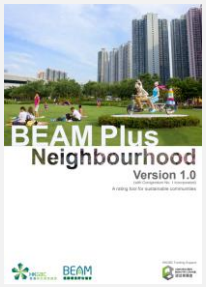
To address the three objectives identified in Chapter 1, this chapter will first explore existing guidelines, policies and practices from selected documents to identify key issues for Hong Kong. The chapter will be followed by international and regional case studies to identify best practice strategies that are potentially applicable to Hong Kong.

The tables below summarise key Guidelines, Policies and Practice Notes from local, regional and international governments and organisations which are of great relevance to the development of sustainable built environments in Hong Kong. Several key principles could be identified from existing guidelines as a foundation for the development of design strategies presented in this Guidebook. For example, the Hong Kong 2030+ sets out the territorial spatial development strategy for the city beyond 2030. The CAP 2050 sets overarching targets for carbon neutrality that should be considered in the development and application of relevant design strategies. The HKPSG also provides useful technical guidance that the Guidebook strategies could reference—where appropriate, relevant standards and guidelines are included in the Appendix. Moreover, the Smart City Blueprint could provide useful directives for strategies targeted at the development of intelligent infrastructure.

2.1 Hong Kong Guidelines and Policies

Document	Details
 [Link]	**Hong Kong 2030+ Towards a Planning Vision and Strategy Transcending 2030** **Author/Publisher:** Development Bureau (DEVB) and Planning Department (PlanD) ▪ A strategic spatial planning framework for the future planning, land and infrastructure development of Hong Kong, as well as the shaping of its built and natural environment beyond 2030. ▪ A set of quantitative guidelines on enhanced standards for living space, GIC facilities, transport infrastructure and open space provision are provided. ▪ Setting out strategic directions of 'Enhancing Liveability in a Compact High-density City' and 'Creating Capacity for Sustainable Growth'.

Document	Details
 [Link]	**Hong Kong's Climate Action Plan (CAP) 2050** **Author/Publisher:** Environment and Ecology Bureau (EEB) ▪ A major environmental policy plan setting out the vision of "Zero-carbon Emissions · Liveable City · Sustainable Development" and outlining the strategies and targets for combating climate change and achieving carbon neutrality by 2050. ▪ Four main strategies are outlined in the Action Plan – "net-zero electricity generation", "energy saving and green buildings", "green transport" and "waste reduction".
 [Link]	**Hong Kong Smart City Blueprint 2.0** **Author/Publisher:** Innovation, Technology and Industry Bureau (ITB) ▪ Blueprint 2.0 sets out initiatives under six smart areas, namely "Smart Mobility", "Smart Living", "Smart Environment", "Smart People", "Smart Government" and "Smart Economy".
 [Link]	**Hong Kong Planning Standards and Guidelines (HKPSG)** **Author/Publisher:** Government Manual ▪ A collection of general guidelines/parameters to ensure that adequate land will be reserved to facilitate social and economic development while providing appropriate public facilities to meet the needs of the public. ▪ Assist in regulating development by providing guidance on the scale, intensity and site requirements of various developments as well as the supporting facilities required. ▪ Chapters that are most relevant to the development of sustainable built environment are Chapters 3, 4, 5, 9, 10 and 11.
 [Link]	**Urban Renewal Strategy (URS)** **Author/Publisher**: Urban Renewal Authority (URA) ▪ A government urban renewal strategy to be implemented by the URA and other stakeholders. ▪ "Redevelopment" and "Rehabilitation" have been adopted as URA's core business under the strategy comprising redevelopment, rehabilitation, heritage preservation, revitalisation and retrofitting.

Document	Details
 [Link]	**Hong Kong Biodiversity Strategy and Action Plan (BSAP) 2016-2021** **Author/Publisher:** Environment Bureau (current EEB) ▪ Hong Kong's first city-level biodiversity strategy and action plan to conserve biodiversity and support sustainable development for future generations. ▪ Innovative initiatives on planning and design of the urban environment, including building design, urban parks, slope greening, greening master plans, "blue-green" infrastructures, and urban forestry promotion. ▪ Provides specific actions in promoting biodiversity in urban landscapes through increasing species diversity and promoting biodiversity appreciation.
 [Link]	**Hong Kong Smart Green Building Design Best Practice Guidebook** **Author/Publisher:** Hong Kong Green Building Council (HKGBC) ▪ Provides practical guidelines and inspiration for smart green building design and features. ▪ Comprises several key chapters, including definitions and trends, smart green strategies for new and existing buildings, and local and overseas best practice cases. ▪ References to policy adjustments and greater public awareness are made at the end of the Guidebook. Further details of the strategies are also provided in the Appendices.
 [Link]	**HKGBC Guidebook on Urban Microclimate Study** **Author/Publisher:** HKGBC ▪ Provides the knowledge and inspiration for urban microclimate design. The science and principles of urban microclimate studies are introduced, strategies to optimise microclimate conditions are stipulated, and good practices are reflected on. ▪ Recommendations on further studies and policy adjustments are made at the end of the Guidebook.
 [Link]	**BEAM Plus Neighbourhood Version 1.0** **Author/Publisher:** HKGBC ▪ BEAM Plus Neighbourhood is a comprehensive environmental assessment tool for neighbourhood scale development projects. ▪ The Guidebook defines best practices for a range of sustainability issues, providing a comprehensive set of performance standards, for use and reference by developers and owners.

Practice & Guidance Notes

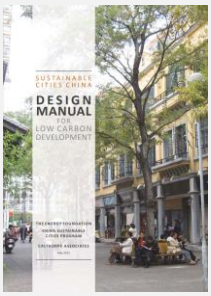
Document	Details
 [Link]	**PNAP APP-151 Building Design to Foster a Quality and Sustainable Built Environment** **Author/Publisher:** Buildings Department (BD) ▪ This practice note sets out a package of measures, covering the following major elements, to promote a quality and sustainable built environment: (a) sustainable building design guidelines (SBD Guidelines) on building separation, building set back and site coverage of greenery; (b) gross floor area (GFA) concessions; and (c) energy efficiency of buildings.
 [Link]	**PNAP APP-152 Sustainable Building Design (SBD) Guidelines** **Author/Publisher:** BD ▪ The Guidelines cover building separation, building setback and site coverage of greenery (SCG) requirements which will enhance the quality and sustainability of the built environment in Hong Kong. ▪ The Government has been applying SBD Guidelines to development projects by including requirements such as: (a) lease conditions; (b) advisory clauses in granting planning permission; and (c) pre-requisites for obtaining gross floor area concessions.
 [Link]	**GN 7/2010 Ecological Baseline Survey for Ecological Assessment*** **Author/Publisher:** Environmental Protection Department (EPD) ▪ These guidance notes provide detailed guidelines for conducting ecological surveys, including the duration, seasonality, and methodology.

Table 2: Relevant Hong Kong Guidelines and Policies

Remarks: **Contains mandatory requirements established by the Hong Kong Government*

2.2 Mainland China Guidelines and Policies

Document	Details



[Link]

Sustainable Cities China – Design Manual for Low Carbon Development

Author/Publisher: Energy Foundation, China Sustainable Cities Initiative, Calthorpe Associates

- Lays out principles and practices focused on making China's development patterns more sustainable, resilient, and energy efficient.
- Reframes critical elements of city development into mixed-use, walkable and transit-oriented districts to create areas with greater social and economic vitality.

[Link]

Guidelines for Low-Carbon Eco-City Planning & Construction in Guangdong Province of China

Author/Publisher: Department of Housing and Urban-Rural Development of Guangdong Province, Guangdong City Planning Association, Energy Foundation, Shenzhen LAY-OUT Planning Consultants Co. Ltd

- Summarises an effective method to implement low-carbon ecological development concepts in all cities of the Guangdong Province.
- Provides planning and design guidance for five macro-systems of low carbon development at the city level, and for six spatial elements at the district and community levels.

[Link]

Action Plan for Carbon Dioxide Peaking Before 2030

Author/Publisher: National Development and Reform Commission

- This Action Plan is formulated to advance actions on carbon dioxide peaking—to implement major strategic decisions by the Central Committee of the Communist Party of China and the State Council to peak carbon dioxide emissions and achieve carbon neutrality.

[Link]

推動綠色發展 實現雙碳目標——《"十四五"循環經濟發展規劃》解讀之三

Promoting Green Development to Achieve Dual-carbon Goals

Author/Publisher: National Development and Reform Commission

This paper provides a summary of the strategies for promoting green development to achieve dual-carbon goals under the 14th Five-Year Plan.

- The Plan aims to accelerate the green transformation of China's development model by realising the efficient use and recycling of resources and promoting carbon peaking and carbon neutrality.

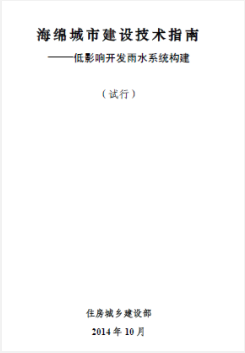
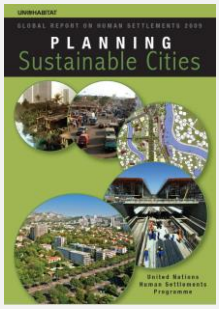
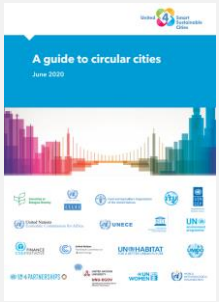
Document	Details
 [Link]	**明確方向、突出重點 促進循環經濟健康持續發展——《"十四五"循環經濟發展規劃》解讀之五** **Clear Direction and Focus to Promote Healthy and Sustainable Circular Economy Development** **Author/Publisher:** National Development and Reform Commission ▪ This paper provides a summary of the overall requirements for the development of a circular economy in China, including key tasks, key projects, actions, policy measures and organisational implementation.
 [Link]	**大力發展循環經濟 助力雙碳目標實現——《"十四五"循環經濟發展規劃》解讀之四** **Vigorous Development of Circular Economy to Achieve Dual-carbon Goal** **Author/Publisher:** National Development and Reform Commission ▪ This paper provides a summary of the 14th Five-Year Plan's three major initiatives: five major projects, six major actions and four safeguard policies. ▪ The initiatives ensure the security of China's national resources, supports the achievement of a carbon peak and carbon neutral targets, while building an ecological civilisation.
 [Link]	**海綿城市建設技術指南——低影響開發雨水系統構建** **Technical Guidelines of the Sponge City Development – Low Impact Development Systems for Storm Water** **Author/Publisher:** Ministry of Housing and Urban Rural Development ▪ Technical guidelines that set out general principles for planning, design, construction, maintenance and management of sponge cities and low-impact development system for stormwater. Contains six chapters including best practice case studies in China.

Table 3: Relevant Mainland China Guidelines and Policies

2.3 International Guidelines, Policies and Directives

Document	Details
 [Link]	**Planning Sustainable Cities: Global Report on Human Settlements 2009** **Author/Publisher:** UN Habitat ▪ The Report assesses the effectiveness of urban planning as a tool for dealing with the unprecedented challenges facing 21st-century cities and for enhancing sustainable urbanisation.
 [Link]	**The New Urban Agenda (The Quito Declaration on Sustainable Cities and Human Settlements for All)** **Author/Publisher:** UN Habitat ▪ Lays out standards and principles for the planning, construction, development, management, and improvement of urban areas along its five main pillars of implementation: national urban policies; urban legislation and regulations; urban planning and design; local economy and municipal finance; and local implementation.
 [Link]	**Transforming Our World: The 2030 Agenda for Sustainable Development** **Author/Publisher:** United Nations ▪ Comprehensive, far-reaching and people-centred set of universal and transformative goals and targets which seek to realise the human rights of all and to achieve gender equality. ▪ The Agenda disseminates for the first time the UN's 17 Sustainable Development Goals.
 [Link]	**The United for Smart Sustainable Cities (2020) A Guide to Circular Cities** **Author/Publisher:** United Nations Economic Commission for Europe ▪ This Guide to Circular Cities, which was developed within the United for Smart Sustainable Cities initiative, is a guide for cities to implement circular activities and to promote circularity and urban sustainability.

Document	Details
 [Link]	**URBES – Urban Biodiversity and Ecosystem Services Project (Factsheets)** **Author/Publisher:** Biodiversa + International Union for Conservation of Nature (IUCN) ▪ Proposes measurements for urban management and decision-makers to integrate natural environment and human needs. ▪ Addresses scientific knowledge gaps on urbanisation processes that are sustained by ecosystem services.
 [Link]	**Urban Protected Area Profiles and Best Practice Guidelines** **Author/Publisher:** IUCN ▪ This document provides detailed guidelines for setting up urban biodiversity areas, including guidelines on human activities and invasive species control and management, natural areas connections provision, protection effectiveness monitoring, and promotion of urban protected areas.
 [Link]	**Guidelines for Conserving Connectivity through Ecological Networks and Corridors** **Author/Publisher:** IUCN ▪ Consolidates the knowledge and best available practices of providing ecological connectivity. It provides tools and examples for applying ecological connectivity in protected areas. ▪ Regulate effective area-based conservation measures and develop ecological networks for conservation.

Table 4: Relevant International Guidelines and Policies

2.4 Role of the Guidebook in the Development of Sustainable Built Environments

Through examining various sustainability guidelines, policies and directives in sections 2.1 to 2.3, areas to which this Guidebook can contribute to assist built environment professionals and project proponents in the sustainable planning and design of precinct scale developments are elaborated below.

Holistic Guidance on Sustainability

This Guidebook aims to provide holistic guidance on sustainability issues pertinent to the planning and design of an urban precinct or quarter in an interconnected manner. In doing so, the Guidebook addresses the need for guidelines that consider the range of existing policy requirements, and to demonstrate their role and applicability in the design of urban precincts or quarters, together with other best practices developed in the guidebook.

Further Recommendations on Implementation and Practical Applications

This Guidebook takes inspiration from a diverse range of existing guidelines, serving different purposes, to further develop practical suggestions and methods of implementation for the design of sustainable precinct type developments. For example, recommendations on blue-green infrastructure and habitat conservation may complement the information provided in documents such as the BSAP.

Provide a Sustainability Focus to Complement Existing Urban Design Guidance

Existing guidance on urban design in Hong Kong (e.g., 'HKPSG Chapter 11 - Urban Design Guidelines' and the 'Harbour Planning Guidelines for Victoria Harbour and its Harbourfront Areas') addresses several sustainability issues, together with other general design features. This Guidebook supports existing urban design guidance by offering a core focus on sustainability, and by providing directions on how urban precincts or quarters could be planned and designed in ways which address climate change—as articulated by the UN IPCC and other authorities as a pressing issue, as well as other prevalent sustainability issues.

Consideration of an Urban Precinct or Quarter

Existing Urban design guidance such as the 'HKPSG Chapter 11 - Urban Design Guidelines' addresses various scales of urban development, while sustainability rating tools such as the 'BEAM Plus Neighbourhood Version 1.0' are applicable to 'a stand-alone high-rise tower, a large development with multiple towers, or a project with a couple of low-rise houses'. Some guidelines cater to the city at large, such as the Urban Protected Area Profiles and Best Practices Guide and Guidelines for Conserving Connectivity Through Ecological Networks and Corridors, which provides recommendations for urban biodiversity at the city scale. Building on existing guidance, this Guidebook gears towards the development of strategies specific to sustainable built environments at the scale of urban precincts or quarters.

Sustainability Guidance for Hong Kong's Geographic Location

Sustainability guidelines produced elsewhere in the world may offer useful assistance to built environment professionals and project proponents in Hong Kong when planning and designing urban precincts or quarters. However, many of these guidelines originate from cities or countries in climatic zones very different to that in which Hong Kong lies. The result is that certain design guidance may be more appropriate for e.g., temperate climates, rather than Hong Kong's sub-tropical climate, where high incidence of solar radiation, humidity and typhoons are key sustainability and urban resilience issues. Hong Kong could benefit from sustainable urban design guidance that specifically addresses its own climatic issues, which can be expected from this Guidebook.

Furtherance of the United Nations Sustainable Development Goals

Adopted by the UN in 2015, the seventeen SDGs form the cornerstone of global efforts to tackle climate change and ensure development worldwide is carried out in ways that will meet the needs of both current and future generations. More importantly, the SDGs are integrated—they recognise that action in one area will affect outcomes in others, and that development must balance social, economic and environmental sustainability. For Hong Kong to further the progress of SDGs, there is a need for the ongoing development of a set of planning and urban design guidelines that address all SDGs relevant to the built environment in a coordinated way.

2.5 Application and Use of Existing Guidelines and Policies

Application of Existing Guidelines and Policies

The guidelines, policies and directives outlined in sections 2.1-2.3 provide useful references for promoting sustainable built environments. The cited references can be used judiciously as no one document or assembly of documents will comprehensively address sustainability issues pertaining to all urban precincts that are subject to planning, development or regeneration.

Separate Functions of Guidelines and Policies

Some of the documents produced by various parties have been prepared to articulate specific planning or sustainability proposals and may not be specific to all urban precincts and quarters. However, such documents have an important role in propounding guidance on planning policies and government intentions that should be broadly considered in framing new developments and regeneration. The Hong Kong 2030+ strategy, for example, articulates a strategic vision for the direction and composition of development in Hong Kong. This high-level strategy allows for the layering of other proposals (e.g., approaches to sustainability that are outlined in other Hong Kong produced documents). The HKPSG provides guidelines to which reference can be made when addressing the planning of large- and small-scale developments.

Application of Mainland and International Approaches to Hong Kong

Relevant mainland and international documents can provide good reference points pertaining to sustainable development—in the context of urban precincts and quarters in Hong Kong. However, prevailing Hong Kong government requirements need to be considered. The use of specific sustainable materials for example, that may be acceptable in other international administrations, may require further study on if and how they can be appropriately applied in Hong Kong.

Reconciliation of the Old and the New

Creativity and innovation in sustainable development applications and approaches within urban precincts and quarters in Hong Kong require careful consideration. The approaches outlined in this Guidebook may differ to standard approaches and offer additional and new guidance moving forward. Requirements can be reviewed and applied creatively towards generating more liveable and sustainable living and working communities.

2.6 International and Regional Best Practice Case Studies

Many cities in the world have incorporated the concept of sustainability in their design and development to address their urban challenges while becoming greener and smarter. Sustainable precincts can act as building blocks to a sustainable city at large and have the potential to function as a unit that cumulatively facilitates the transition towards an overall sustainable environment. This section presents nine international case studies to highlight innovative practices adopted in various cities around the world. In particular, practices that could be applicable to Hong Kong are elaborated for each case.

The nine case studies include:

- Waterfront Toronto, Canada
- Songdo International Business District, South Korea
- Masdar City, Abu Dhabi, United Arab Emirates (UAE)
- Central Precinct Renewal Programme, Sydney, Australia
- Riverside Sunderland, Sunderland, England, United Kingdom
- Punggol Eco-town, Singapore
- China-Singapore-Guangzhou Knowledge City, Guangzhou, China
- Chenggong New Town, Yunnan, China
- Shenzhen, China

2.6.1

TORONTO, CANADA

Waterfront Toronto

Introduction

The Waterfront Toronto Revitalisation Corporation ("Waterfront Toronto"), a tri-government organisation, is tasked with overseeing and delivering the revitalisation of Toronto's waterfront. Waterfront Toronto delivers their projects in partnership with real estate developers and non-profit organisations and community groups. Its primary objective is to transform the area into sustainable mixed-use communities and dynamic spaces which can deliver key economic and social benefits. The project began in 2001 and is the largest urban redevelopment project currently underway in North America [14].

Community Engagement

Waterfront Toronto engages with the broader community in every revitalisation project they undertake. This is informed by the acknowledgement that engagement is an ongoing process of dialogue, dissent, consensus building and learning. They continuously evaluate their approaches, maintain a sustained dialogue with their partners and revisit their assumptions to ensure they are achieving their goals.

Figure 1: Public Amenities along Quayside

Mixed-use Development

West Don Lands was designed as a mixed-use neighbourhood, with approximately 6,000 residential units, ample employment and commercial space, at least one primary school, two child-care centres, and is surrounded by nearly 9.3 hectares of parks and public spaces [15]. Once developed, the Quayside community—one of the largest all-electric, zero-carbon master planned communities in Canada—will also deliver mixed-use development, including new market and affordable housing, recreational opportunities, parks and a new community centre.

Highly Efficient Buildings

Buildings are required to achieve specific Total Energy Use Intensity and Thermal Energy Demand Intensity requirements depending on building type [16]. As per Version 3 of Waterfront Toronto's Green Building Requirements, residential and commercial buildings must achieve a greenhouse gas intensity below 5kg CO_2e/m^2/year. Developer partners are encouraged to investigate the viability of low-carbon technologies to achieve this requirement. New buildings will be designed for zero-carbon operations, through using clean electricity.

Figure 2: Waterfront Innovation Centre – Leadership in Energy and Environmental Design (LEED) V4.1 Platinum Candidate

Mobility

Numerous bike paths and pedestrian links are constructed between the waterfront neighbourhoods and the rest of the city. Most residences are within 5 minutes' walk to a transit stop, reducing the need for private vehicles. Short blocks, cycling paths and pedestrian links improve connectivity and encourage walking and cycling [17].

Figure 3: Walking and Cycling Paths

Application to Hong Kong

Waterfront Toronto demonstrates a combination of green and environmental strategies, that are aligned with the objectives of this guidebook, particularly in the planning of neighbourhood designs.

When seeking to adopt the design strategies of Waterfront Toronto in Hong Kong, it is important to note that the two cities contain variations in road design and infrastructures. For example, roads in Hong Kong may be narrower with relatively higher traffic volumes when compared to Toronto. Introducing additional bike lanes to connect different precincts may place a burden on the transport network, further exacerbating the existing problem of traffic congestion in Hong Kong.

On the other hand, geographical and climatic variations may result in differences between Hong Kong and Toronto when planning for species of wildlife or aquatic habitats in waterfront areas.

Nevertheless, several approaches in Waterfront Toronto that look at social wellbeing, such as community engagement initiatives, the implementation of mixed-use development, and the construction of other social facilities, may demonstrate potential to be expanded in Hong Kong. For example, there is opportunity to adopt and adapt these features to cater for specific groups, including Hong Kong's ageing population.

Location	Toronto, Ontario, Canada	**Name of Delivery Agents**	Waterfront Toronto (backed by federal, provincial and municipal governments)
Project Area	8km^2	**Name of Developers**	Multiple – e.g., Quayside by Quayside Impact Limited Partnership, Waterfront Innovation Centre by Menkes Developments Inc. and Bentall GreenOak, Bayside by Hines, etc.
Project Start and Completion Date	2001 – present		

2.6.2

SEOUL, KOREA

Songdo International Business District

Introduction

Songdo International Business District is a new smart district development located in South Korea and is connected to Incheon International Airport by the 12.3km Incheon Bridge [18]. The development began in 2004 and covers 6km^2 of reclaimed land along Incheon's waterfront [19]. It is the first LEED certified city in Korea and is the largest project to be included in the LEED pilot programme outside the United States [20].

Waste Management

All buildings are equipped with pressurised chutes that transport waste to a central depository. Household waste is collected through a pneumatic waste conveyance system and sent to centralised sorting centres. In this area, waste is automatically sorted and recycled appropriately. Some valuable materials are moved on for reprocessing, others are incinerated to provide energy for the city [21]. 75% of waste is targeted to be recycled into biomass and heat generated by it will be redistributed throughout the city [22].

Figure 4: Waterfront Features at Songdo

Green Spaces and Mixed-Use Development

With residential neighbourhoods containing large green areas, and parking spaces designed to be below ground, green spaces take up to almost 40% of the total area in Songdo [23]. The city's masterplan included hundreds of acres of open space to encourage gatherings [24]. Designed with walkable streets and a mixed-use urban density that promotes active living, the city also strives to be pedestrian friendly. At the city's center is Central Park, which provides space for activities such as outdoor concerts, exhibitions, and sports [25].

IoT

Environment detecting sensors are installed in Songdo's parks, shopping avenues, schools, and housing areas to measure weather, atmospheric, and environmental conditions (e.g., wind velocity, humidity, fine particles concentration, sulphur oxides). They can also be found in residences and buildings to provide users with real-time usage information and suggestions for reducing energy consumption [26].

Green Buildings

Songdo is not only home to 118 LEED-certified buildings [27] but is also the first city to earn LEED for Communities Precertification, including LEED for Communities and LEED for Cities [20]. The entire district has around 22 million ft^2 of LEED-certified space [20]. During the construction phase, a carbon footprint analysis was conducted to help identify opportunities for greenhouse gas reduction [28]. 75% of the construction waste was also recycled in addition to the use of low volatile organic compound materials and 20% of ordinary cement was replaced with fly ash cement for construction [22].

Application to Hong Kong

Songdo International Business District showcases an array of smart green design strategies. It is important to consider differences in the topographic environment between projects when looking at the feasibility of applying aspects of Songdo's business district to Hong Kong. For example, the majority of Hong Kong's landscape consists of hills and undeveloped mountains which fall steeply to the coast. Thus, design strategies such as the pneumatic waste conveyance system which transports waste to a central depository through underground pipes, may be difficult to implement in certain areas of Hong Kong. In particular, the uneven terrain would present challenges during the construction phase when connecting a network of pipes to the various buildings. The cleaning of such waste systems would also pose difficulties for workers during maintenance.

On the other hand, well executed strategies such as the implementation of IoT that detects environmental conditions, the promotion of active living, and the large areas of green-certified spaces such as those certified by BEAM are approaches that Hong Kong can look to adopt.

Figure 5: Green Spaces Along the Canal

Figure 6: Large Open Space and Pedestrian-friendly Area

Location	Incheon, South Korea	**Name of Owners**	New Songdo International City Development (Joint venture of Gale International and POESCO E&C)
Project Area	5.77km^2		
Project Start and Completion Date	2003 – 2030	**Name of Developer**	New Songdo International City Development

2.6.3

ABU DHABI, UNITED ARAB EMIRATES (UAE)

Masdar City

Image Credit: Evaldas - stock.adobe.com

Introduction

Masdar City is a medium-to-large scale new city built in a semi-rural greenfield area close to Abu Dhabi International Airport. Located in an arid tropical climate, the 6km^2 Masdar City was built to fight and resist heat. It was designed to be one of the most energy efficient cities in the world by incorporating sustainability into its planning, design, transportation, and waste management.

Renewable Energy

Masdar City is completely powered by solar energy. The city is covered by a solar farm that consists of 10MW Solar Photovoltaic (PV) Plants and 1MW rooftop-type PV [29]. The plant produces around 17,500MWh of clean electricity annually and diverts 7,350 tonnes of carbon emissions per year [30].

Image Courtesy of: Evaldas - stock.adobe.com

Figure 7: PV Panels on Roofs

Figure 8: Masdar Institute Campus – Powered by Solar Energy

Building Design

Buildings are highly insulated, using reflective wall panels and angled facades to minimise heat and glare from the sun all the while optimising natural light. Recycled materials, including steel and aluminium, are used in the buildings' construction. Cushions of air designed within the walls for insulation and reflective wall panels, help reduce demand for air conditioning by 55%, and the naturally established temperature is 10°C cooler than the rest of Abu Dhabi [31].

Passive Cooling

Masdar City utilises passive cooling strategies such as integrating wind towers and wind gates into the urban design. For instance, the design of narrow streets receive shading from surrounding buildings and are complemented by dedicated street-level shades for residents' comfort. The city's masterplan concentrates on utilising passive design and inspiration from traditional housing designs in the Arab region to assist natural cooling in the city.

Water Use

Water can be a scarce resource in the harsh climate of the UAE. To combat this, the city aimed to reduce water consumption per person from 180 litres to 105 litres per day The city enhances water efficiency through the incorporation of water efficient fixtures, appliances, smart water meters, water tariffs, and highly efficient micro-irrigation to minimise evapotranspiration in vegetation throughout the city [32]. Furthermore, Masdar City also commissioned several pilot projects to explore the feasibility of seawater desalination.

Figure 9: Electric-powered and Automated Mobility Service

Transport

Carbon-free and electrically powered Light Rail Transit are linked to neighbouring communities and the international airport via existing road and rail routes [29]. With a maximum 200m distance to the nearest transit nodes, the city is designed to encourage walking [33]. Public transportation within the city is provided by electric buses and cars to reduce emissions. Bikeshare stations are also installed to encourage cycling.

Application to Hong Kong

The case study of Masdar City demonstrates a holistic approach to building a sustainable and low carbon city within the 6km^2 project.

Climatic differences may pose challenges in applying Masdar City's sustainable design strategies to Hong Kong. While the UAE is usually warm and dry year-round, Hong Kong experiences a subtropical climate with mild winter seasons. Hence, not all climate resilient strategies in Masdar City can be directly translated. For example, building insulation strategies can be applied to minimise heat gain in Hong Kong during the summer months to reduce the demand for space cooling. However, the level of building insulation required may nevertheless differ between both cities given that the UAE typically experiences warmer temperatures across all seasons.

Topographical and infrastructural constraints should be considered when adopting strategies. For example, if Hong Kong is to take inspiration from the bikeshare stations introduced in Masdar City to further promote cycling, one may need to beware of the city's hilly and uneven terrain, together with narrow and congested streets, outside of designated bicycle lanes.

Nonetheless, Masdar's approach to renewable energy and water conservation could be beneficial to Hong Kong. While spatial limitations in Hong Kong may restrict the installation of large-scale solar PV plants, solar energy could be leveraged through building-integrated photovoltaic (BIPV) panels which occupy less space.

Figure 10: Wind Tower

Water treatment and desalination techniques similar to the Tseung Kwan O Desalination Plant [34] could also be further explored to increase the share of potable water supply in Hong Kong's systems.

Location	Abu Dhabi, UAE	**Name of Owner**	Mubadala Investment Company
Project Area	6km^2	**Name of Developer**	Mubadala Investment Company
Project Start and Completion Date	2008 – 2030		

2.6.4

SYDNEY, NEW SOUTH WALES, AUSTRALIA

Central Precinct Renewal Programme

Introduction

The Central Precinct Renewal Programme is a commercial park-scale urban renewal project centered around Central Station in Sydney, Australia—the largest and busiest railway in Australia. Covering 0.24km^2 across 8 sub-precincts around Central Station, the project aims to transform the historical Sydney precinct into a vibrant central business district (CBD) destination with innovative and diverse businesses and high-quality public spaces [35]. The design embraces concepts of sustainability and connectivity, while celebrating the area's social and cultural heritage.

Figure 11: Prince Alfred Park and Belmore Park – Green Open Spaces

Heritage

The unique architectural and cultural heritage of Sydney's Central Precinct will be retained through conservation, adaptive reuse and interpretation [36]. For instance, adaptively reusing the Sydney Terminal building for retail, active or community uses. The rich Aboriginal culture of the area can also be presented through landscaping, built forms, public spaces, public art and interpretation [35].

Community Engagement

Community engagement has been vital in shaping the renewal of the Central Precinct. Since 2016, a series of stakeholder engagements (e.g., surveys, discussion forums) have been conducted with various stakeholders from the community, including customers, government departments and agencies, representative and advocacy groups, to co-create the vision and values for the renewal of the Central Precinct as well as seek feedback on key planning considerations, future character, and features they would like to see in the area [36].

Green Technology

The project utilises renewable energy such as solar lighting, and PV technologies to eliminate smell and noise from diesel-based portable light towers [37]. Dual plumbed water systems are provided to create a recycled water network for permitted non-potable uses (e.g., flushing, irrigation, fire-fighting and certain industrial purposes) and connect with district recycled water networks, where available [38].

Accessibility

The project implemented a green network of parks, plazas, streets and lanes to create diverse and walkable open space for different activities, whilst providing visual corridors to key heritage and other landmarks. The alignment of multiple cross-corridor linkages with the surrounding street network will enhance connectivity for pedestrians and cyclists [36].

Application to Hong Kong

Strategies used in the Central Precinct Renewal Programme demonstrate the strategic renewal of the Sydney train station. The integration of Central Station to enhance mobility within the city's central hub can be a major challenge in Hong Kong developments. While Sydney's Central Station is situated in a spacious open area, Hong Kong's central business districts are often highly urbanised and have limited space for blue/green infrastructure development. Consequently, the creation of 'green' assets or deep soil zones for groundwater recharge might be difficult in the context of Hong Kong.

Figure 12: Sydney Central Station

On the contrary, the heritage and cultural preservation aspects of the Central Precinct case study can provide great inspiration for Hong Kong. There are abundant historical and cultural sites throughout Hong Kong that could benefit from preservation. At the same time, it is also important to prevent the gentrification of such areas during the process of urbanisation.

Location	Sydney, New South Wales, Australia	**Name of Owner**	New South Wales Government
Project Area	0.24km^2	**Name of Developer**	Transport for New South Wales
Project Start and Completion Date	2016 - ongoing		

2.6.5

SUNDERLAND, ENGLAND, UNITED KINGDOM (UK)

Riverside Sunderland

Introduction

Led by the Sunderland City Council, Riverside Sunderland is a science park-scale project to revitalise 0.33km^2 of urban brownfield land on both sides of the River Wear in Sunderland, UK. The project aims to be the first carbon-neutral urban quarter in the UK and will incorporate 'ubiquitous' smart technology [40]. The masterplan is set out to create 1,000 homes for 2,500 people and 0.09km^2 of office developments for 8,000 to 10,000 employment opportunities [39].

Mixed-Use Development

The design of the riverside will promote active citizenship, wellbeing and concept of the 15-minute city where most routine and day-to-day needs can be met close to home. The mixed-use development includes commercial space, co-working space, retail, food and beverage (F&B), transport, healthcare facilities, educational institutions and other social infrastructure. Pedestrian will be given priority and streets will be designed to be car-free wherever possible, creating a safe and accessible environment for all [39].

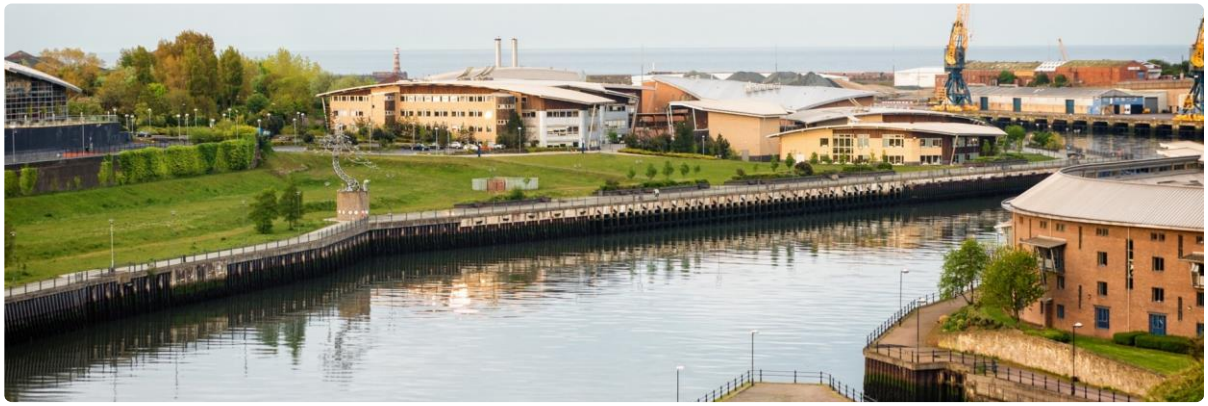


Figure 13: University Campuses — Mixed-Use Area

Biodiversity and Resilience

Riverside Sunderland aims to achieve a biodiversity net gain of more than 40% through a series of initiatives—including retaining existing dense vegetation and tree cover with targeted interventions to improve safety and enhance biodiversity; removing invasive non-native species and introducing new native species for better tree age profile; and managing the existing underperforming grassland areas to develop botanically-rich meadow habitats [39].

Figure 14: Trees and Green Spaces

Smart Neighbourhood

The riverside community features 1,000 new energy efficient and technology-enabled homes, super-connected to the city's 5G network. The city's smart and sustainable lighting system can illuminate key movement routes and facilities to enhance vibrancy, nightscape and safety. Furthermore, a one-stop-shop mobility hub will be created to offer various transport modes and supporting facilities, including cycle storage, showers and changing facilities, bike/e-bike/e-scooter hire, lockers, cycle repairs, and luggage storage [39].

Energy Efficient Design

1,000 new energy efficient homes will be developed with key considerations including building orientation and massing to balance daylight and solar gain, fossil fuel free heating and hot water generation. Developments will be designed to generate more energy than required, with surplus energy being shared with nearby properties through local power and heat networks [39].

Other energy efficiency measures include building fabric efficiency to reduce space heating demand, use of low-flow hot water outlets, utilisation of wastewater heat recovery systems, and ventilation to minimise overheating [39].

Sustainable Drainage Design

Water efficiency is maximised through appropriate drainage design to mitigate flood risk and management of surface and foul water [41]. A sustainable drainage strategy is also adopted to facilitate the creation of a climate resilient 'sponge city'.

Figure 15: Riverside Park

Application to Hong Kong

As a city prone to climate risks such as heavy rainfalls, flooding and typhoons, Hong Kong may take inspiration from the sustainable drainage design strategies adopted in Riverside Sunderland—targeted at mitigating flood risks and managing surface water. In doing so, geographical and climatic differences shall still be considered.

Additionally, the integration of mixed-use development and smart neighborhood design in Riverside Sunderland are elements that can be emulated in Hong Kong. For example, in addition to further integration of the 15-minute neighborhood concept, Hong Kong may also take inspiration from the one-stop-shop mobility hubs in supporting and enhancing the experience for transit users, especially given the city's existing variety of transit nodes and infrastructure. In doing so, the differences in modes of transportation between both cities should also be taken into consideration.

Location	City of Sunderland, England, UK	**Name of Owner**	Sunderland City Council, England
Project Area	0.332km^2	**Name of Developer**	Sunderland City Council, England
Project Start and Completion Date	2019 – 2040		

2.6.6

SINGAPORE

Punggol Eco-Town

Introduction

Developed by the Housing and Development Board (HDB) and with construction work starting in 2010, Punggol is Singapore's first eco-town, accounting for 9km^2 in land space. The project area is home to a variety of sustainable initiatives and infrastructure, including eco-friendly apartments, a manmade water-way, a 40km cycling network, among others. Over the years, the town has earned several awards and accolades, such as Building and Construction Authority's Green Mark Platinum Award in 2021, the Gold Award (Public Amenities and Infrastructure) at the FIABCI Prix d' Excellence Awards in 2013, and the Urban Land Institute Asia Pacific Award for Excellence 2021.

Blue-Green Infrastructure

Stretching 4.2km in length across the Punggol Eco-Town, the Punggol Waterway is the first man-made waterway developed by the HDB in Singapore [42]. Together with the integration of blue space, it provides communal areas along the promenade for residents, which contribute to the creation of a 'sustainable waterfront town'. The waterway is further equipped with features that foster urban biodiversity, such as aerators, freshwater tolerant mangroves and floating wetlands.

The Punggol Waterway was certified as an Active Beautiful, and Clean (ABC) Waters project in 2010—an initiative that targets to improve water quality through maximising the potential of water infrastructure in Singapore.

Figure 16: Punggol Waterway

Sustainable Homes

Also situated along the waterway is the Treelodge@Punggol, an eco-precinct made up of 7 residential blocks that actively promote a sustainable lifestyle [43]. It adopts various passive design strategies—for example, buildings are

oriented in directions that optimise natural cross-ventilation, and windows are positioned to provide natural lighting whilst reducing direct solar radiation. Energy and water efficient features are also adopted, such as on-demand lighting, solar photovoltaics, rainwater harvesting system, and water saving devices, which together reduce electricity and water consumption, and carbon emissions [44]. Furthermore, the residential blocks are built with a podium carpark that spaces out buildings to improve cross-ventilation and is sheltered by an eco-deck which acts as a green spine that stretches across the estate, providing space for recreational amenities, such as a playground, fitness centre and community garden [45].

Figure 17: Promenade and Communal Spaces

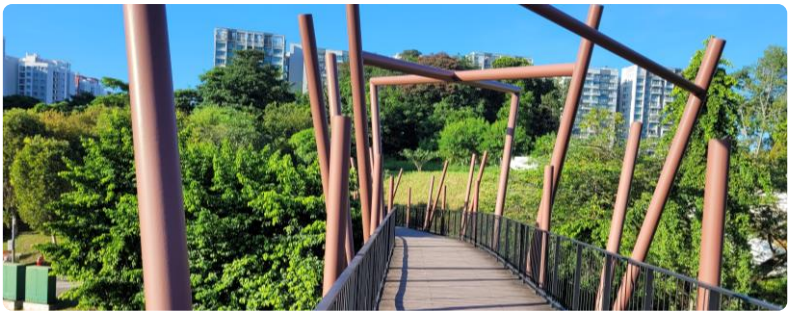


Figure 18: Infrastructure Enabling Strengthened Interaction With Nature

Figure 19: Barrier-free Car Park Entrances

Smart City Development

There have been increasing efforts to transform Punggol into a smart district. Built in the northern side of the project area, the Punggol Digital District most notably comprises the Singapore Institute of Technology campus and the Jurong Town Corporation (JTC) Business Park—bringing together technology and innovation while creating a sustainable living environment for local communities. The district will contain smart green infrastructure and services, such as an open digital platform that facilitates building management through a single estate system, a centralised logistics hub, district cooling system, pneumatic waste collection system and a smart energy grid [46].

Application to Hong Kong

The development of Punggol demonstrates the application of a wide range of green and smart strategies which align with the main objectives of this Guidebook.

However, It is important to note the differences between the scale of this project and that of this Guidebook's focus, which is noticeably smaller. Design strategies that involve larger scale transformations, such as the manmade waterway, for example, may not be applicable to the projects that this Guidebook targets to enhance.

Differences in climate should also be taken into consideration when inspiration is taken from Punggol, such as the suitability of urban biodiversity for example. While Singapore is situated in a tropical climate, Hong Kong's climate is mainly subtropical, which may cater certain plant species more than others. Nevertheless, several strategies have great potential for further development in Hong Kong, such as energy and water efficient features in residential units, green spaces above carparks, and partnerships with academic and business sectors to foster digitalisation.

Location	Punggol, Singapore	**Name of Owner**	Housing & Development Board (HDB), Singapore
Project Area	Over 9km^2	**Name of Developer**	Housing & Development Board (HDB), Singapore
Project Start and Completion Date	2010 – Ongoing		

2.6.7

GUANGZHOU, CHINA

China-Singapore-Guangzhou Knowledge City

Image Credit: CapitaLand

Introduction

China-Singapore Guangzhou Knowledge City (CSGKC) is a 123km^2 large-scale development located in an initially rural location of Guangzhou, China. As a greenfield development, it presents an opportunity to testbed and showcase new urban solution technologies. With an expected occupancy of 500,000 citizens, the development project aims to leverage smart and green designs to build a sustainable city with a high value-added, knowledge-based economy [47].

Green and Smart Transportation

CSGKC will look to incorporate green corridors in road planning to create a seamless blend of green transportation network and road system. All municipal roads in the city are equipped with cycling tracks and pedestrian walkways. Technological integrations such as advanced information technology and traffic engineering will be used to monitor, model, and manage traffic flow. Such innovations can provide smart driving solutions in the city to reduce congestion and vehicular emissions [47].

Image Courtesy of: CapitaLand

Figure 20: Ascendas OneHub GKC
A building that combines residential and commercial space.

Smart City Ecosystem

CSGKC has identified 4 areas of technology to serve as key economic pillars of the smart-city ecosystem—eServices, eMobility, eHealth & eNergy [47]. The aim is to combine the 4 pillars with community engagement—to provide a quality lifestyle and living environment to create an engaging community and support a smart city ecosystem [48].

In addition, the city will be equipped with an array of social amenities, educational and healthcare facilities to foster a quality lifestyle [47].

Natural Habitats

To preserve the natural green belts and water bodies of the region, only half of the total 123km^2 of land set aside for CSGKC is permitted to be developed [47]. Hence, important channels for wildlife migration are retained as part of the process to maintain local biological diversity. Furthermore, construction and site management will also be planned and executed with minimal environmental pollution [49].

Figure 21: Greenery Integrated Throughout CSGKC

Energy and Water Efficiency

CSGKC aims to promote electricity produced from solar, wind, geothermal, biogas, biomass, and low-impact small hydroelectric sources to reduce greenhouse gas (GHG) emissions. The city also uses a Combined Cooling, Heating and Power (CCHP) system to recover heat lost in the power generation process and provide heating/cooling to nearby buildings. Such systems can enable significant improvements in overall fuel efficiency hence lowering carbon emissions. Water conservation initiatives are also employed. For instance, a rainwater collection and storage system is implemented at the household and community levels to ensure efficient use of water resources, alleviating potential water-logging problems, and improving groundwater recharge [47].

Application to Hong Kong

The case study of CSGKC demonstrates an innovative approach to building a sustainable smart city in Guangzhou. The development encompasses a series of green initiatives, such as the preservation of natural habitats, use of renewable energy, and water conservation, etc., that could be applied to Hong Kong.

When looking to take inspiration from CSGKC in the planning and design of development projects in Hong Kong, it is essential to note the differences in scale—while the CSGKC project is expected to cover a total area of 123km^2, the precinct-level projects discussed in this Guidebook are much smaller. Consequently, there may be limitations when implementing strategies such as district-wide energy system designs. For instance, it may not be as energy and cost-efficient in Hong Kong to adopt similar CCHP systems on a smaller scale.

On the other hand, strategies such as the planning of green corridors in roads has the potential to be further explored in Hong Kong, as the city frequently experiences a shortage of green spaces in urban areas. Furthermore, the similar climate between Guangzhou and Hong Kong suggests that design strategies such as rainwater and storage systems may be applicable to various locations in Hong Kong.

Location	Guangzhou, Guangdong, China	**Name of Owners**	Guangzhou Development District, China; CapitaLand, Singapore HDB, Singapore
Project Area	123km^2		
Project Start and Completion Date	2020 – 2035	**Name of Developer**	Sino-Singapore Guangzhou Knowledge City Investment and Development Co., Ltd

2.6.8

YUNNAN, CHINA

Chenggong New Town

Image Courtesy of: Isocarp Institute

Introduction

Located in Kunming, Yunnan, China, the Chenggong New Town project commenced in 2005 and is currently under construction. Built on a combination of brownfield and greenfield land, the 160km² district, which is capable of housing 1.5 million people, comprises major educational and research institutions, as well as residences to accommodate instructors, students and villagers [50]. This project exemplifies the sustainable development of new districts, particularly with incorporation of sustainable planning principles and transport infrastructure design.

Connectivity

The transit-oriented development (TOD) approach of clustering high density and commercial 'small blocks' around key transit nodes enable dispersed and multi-directional commute trips during peak hours. Major roads have also been modified into pairs of one-way couplets, which can accommodate large traffic volumes without becoming a barrier for pedestrians. Public transportation is convenient, with two metro lines as well as several Bus Rapid Transit lines situated every 600-800 metres [50]. In addition, auto-free streets also link prominent green belts, parks, and playgrounds to form a comprehensive open space system that is safe and convenient for bike and pedestrian traffic [51].

Figure 22: Rendering of 'Superblocks'

Walkable and Liveable Neighbourhoods

The objective of the city's Regulatory Plan, which is the legal land use code for future development, was to build a walkable, bike-able city centre [50]. The city now centres on a green space that is pedestrian, bike and transit friendly, as the central boulevard was modified from an 80m wide ten-lane arterial into a series of 'park blocks' with small one-way streets on either side [51]. To create more liveable neighbourhoods, the city's 'superblocks' and wide boulevards were redesigned into a dense network street system and detailed small block zoning containing mixed uses. Street-level buildings, shops, cafes, and useful ground floor activities are required as part of the town's zoning to enhance street-life and walkability. Furthermore, through a combination of small neighbourhood planning, mixed land use and limited parking spaces, the use of motor vehicles is also discouraged throughout the town [50].

Figure 24: Rendering of Developments Near Metro

Application to Hong Kong

Chenggong New Town is a great example of how walkability and connectivity could be incorporated in the development of a sustainable built environment.

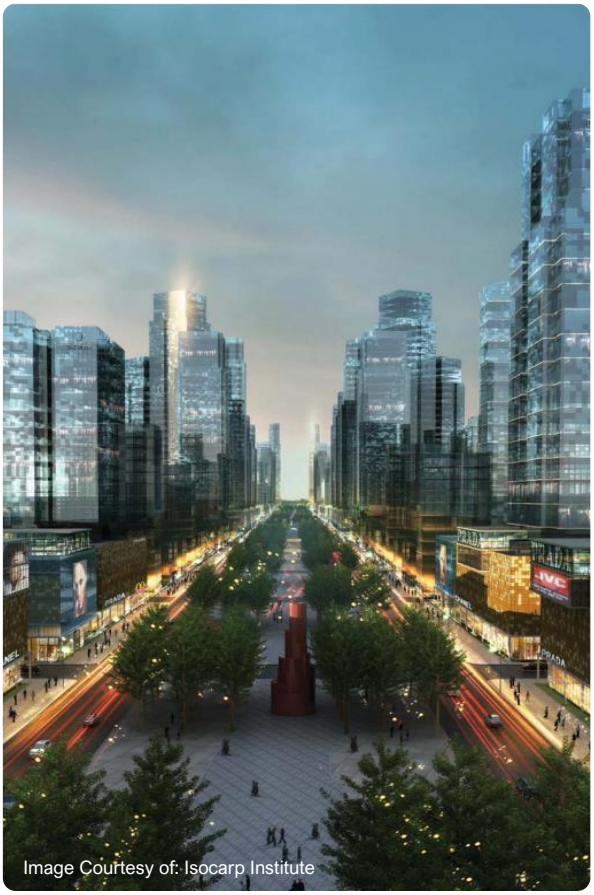
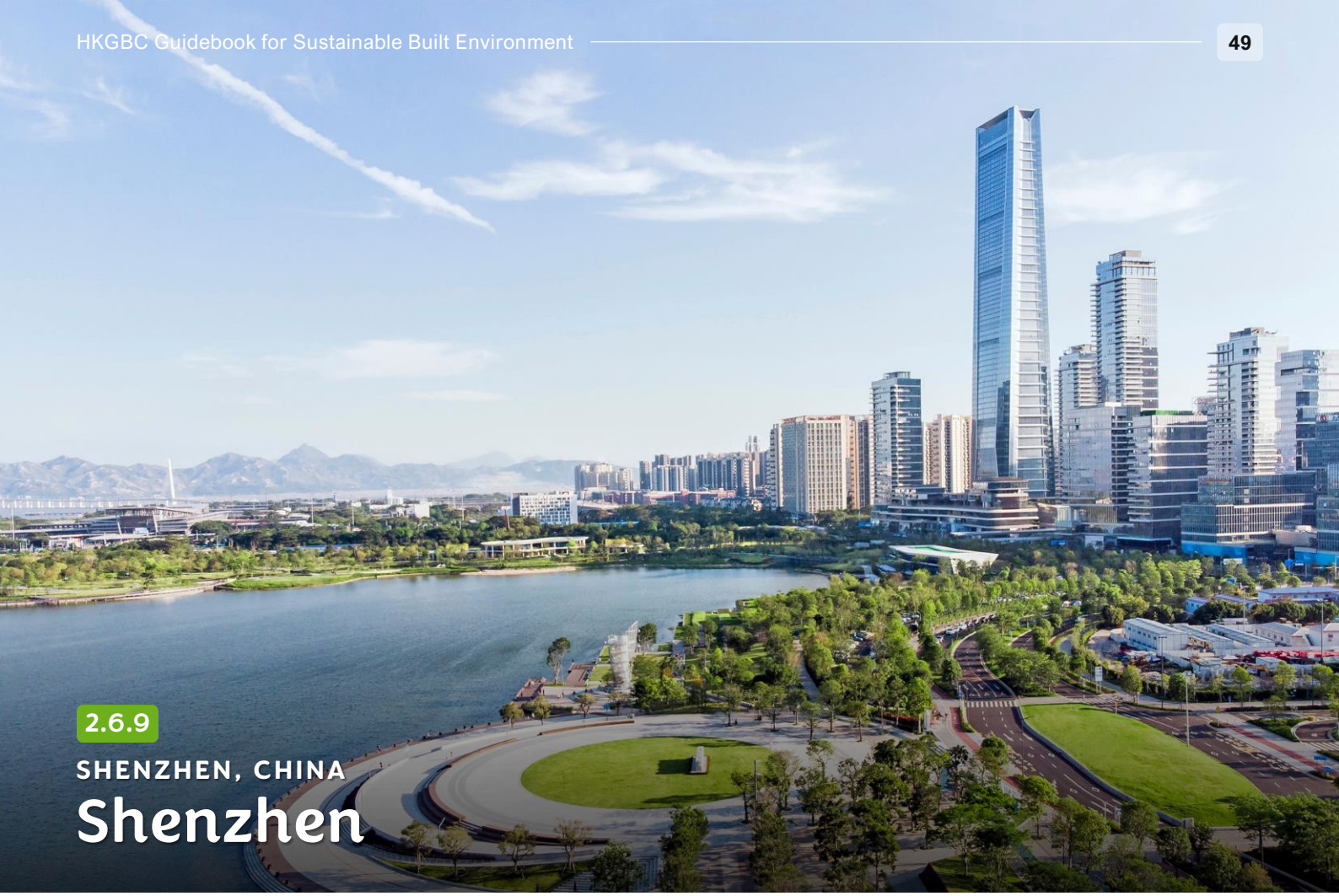


Figure 23: Rendering of Pedestrian-friendly Road

While Chenggong's Regulatory Plan may not necessarily fit the scale of precincts that this Guidebook focuses on, the development project does offer points of inspiration that practitioners in Hong Kong may take into consideration.

Hong Kong can develop more pedestrian and cyclist friendly spaces in its progress towards carbon neutrality. Mixed-use planning could also be adopted to increase street life and vibrancy to enhance social aspects of sustainable urban design. Moreover, although Hong Kong has championed its vast network of public transportation over the years, connectivity could be strengthened through enhanced transport infrastructure design, such as with the addition of more auto-free streets that link community spaces as demonstrated in Chenggong.

Location	Kunming, Yunnan, China	**Name of Owners**	Managed by Chenggong Industrial Park Working Committee & Kunming Chenggong New Area Administrative Committee
Project Area	160km^2		
Project Start and Completion Date	2005 – Ongoing	**Name of Developer**	N/A



2.6.9

SHENZHEN, CHINA

Shenzhen

Introduction

The 2016 Urban Sustainability Index Report ranks Shenzhen as the most sustainable city in China. Across 23 metrics, covering the sectors of economy, society, resources and environment, Shenzhen ranked first in the report's overall scores [52]. Located at the mouth of the rapidly developing Pearl River Delta region, the city is one of China's most prominent economic powerhouses. Shenzhen's increasing adoption of various green initiatives in recent years, such as a carbon emissions trading scheme, high-efficiency power generation technology, among others, have also further contributed to its status as a sustainable city .

Green and Smart Transportation

Shenzhen has adopted a TOD approach in the city's planning with 4 techniques to achieve maximum effect—innovative financing, integrated planning, flexible zoning, and stakeholder dialogue [53]. To showcase support for intelligent infrastructure in district functions, Shenzhen's traffic management department remotely controls traffic lights based on traffic conditions during peak hours. Multiple regulations and incentives in Shenzhen also demonstrate measures that encourage the shift to low carbon, zero pollution vehicles. For instance, the city has fully embraced electric vehicles (EVs), with full support for electrifying the bus fleet by the end of 2017 [53]. There is also a combined network of 200km of bicycle paths to encourage cycling.

Image Courtesy of: N509FZ, Wikimedia Commons

Figure 25: Electric City Buses

Figure 26: Shenzhen Bay Sports Park – Coastal Runway and Bicycle Lanes

Green Infrastructure

Shenzhen currently has the largest stock of green buildings in China. In 2020, around 80% of newly built buildings are 'green' [54]. In addition, the city is aiming to grow public green area per capita to 18m^2 per capita, enabling all residents to be able to access the nearest park within 500m of where they live by 2030 [55]. As part of the city's effort to promote healthy living, it also encourages the adoption of green building life cycle management philosophies in development projects.

Renewable Energy

Shenzhen is aiming to greatly increase the city's share of renewable energy. The government has sped up project demonstrations of BIPV which will provide over 16 million m^2 of solar application area and a total energy generation capacity of 200 MW. In addition, smart grid construction is being piloted to promote grid connection of renewable energy from sources such as bio-mass and wind energy [56].

Figure 27: Renewable Energy Solar Panel Plant in CBD

Smart Healthcare

Shenzhen has actively promoted internet healthcare services where many hospitals can now provide online consulting services. Some had obtained Internet hospital licenses to provide consultation services for common and chronic diseases.

The municipal government has encouraged the development of personalised healthcare services, such as online drug deliveries, to give citizens improved access to medical services without leaving their residences.

Application to Hong Kong

Shenzhen demonstrates numerous sustainable design strategies in the context of the built environment. However, topographical constraints between the two cities should be considered when assessing the feasibility of Shenzhen's strategies for Hong Kong.

The city of Shenzhen is a greenfield development that was purpose-built to advocate China's new "special economic zone." During the planning of Shenzhen, numerous mountains were flattened in urban areas to create even grounds for the construction of buildings [57]. Despite its close connection with Hong Kong, there may be differences in Shenzhen's geographical and topographic environment, such as flatter and more even terrain. As a result, design strategies that advocate bike sharing or cycling for long distances may not be easily applied in Hong Kong.

While Shenzhen may not necessarily fit the type and scale of development that this Guidebook focuses on, there are some points of inspiration which Shenzhen may offer practitioners in Hong Kong. The type of integrated planning used in Shenzhen could be adapted not only to greenfield developments in Hong Kong but in the revitalisation of existing developments as well—from buildings themselves, to urban infrastructure, to open spaces. Similar to Shenzhen, Hong Kong can also look to increase the city's share of renewable energy by employing BIPV in urban areas with exposure to sufficient sunlight. In addition, green and low-carbon practices across the building life cycle can be encouraged at the precinct level, to increase Hong Kong's proportion of green infrastructure and development projects.

Location	Shenzhen, Guangdong, China	**Name of Owner**	N/A
Project Area	1,997.47km^2	**Name of Developer**	N/A
Project Start and Completion Date	N/A		

2.7 Conclusions

The case studies above have demonstrated the application of a wide range of design strategies, among which commonalities can be identified. For example, efforts to mitigate the impacts of energy and resource consumption are evident across different cities through the implementation of renewable energy systems, sustainable waste management measures and smart green building technologies. The quality of the environment is further enhanced across different cities via the creation of walkable spaces and low-emission transportation, as well as an increasing tendency to establish and preserve green spaces to improve urban biodiversity, strengthen climate resilience and elevate human wellbeing. To create a more hospitable social environment, cities have, moreover, supported the construction of accessible and communal spaces that promote inclusivity, interaction, and an overall enhancement in quality of life. This can range from urban parks, open public space, to the encouragement of community engagement activities. As such, commonalities in strategies used across different cities may serve as a useful basis for the development of sustainable design strategies in Hong Kong.

Nevertheless, it is important to note that design approaches may differ depending on the geography and context of a city. Cities with a large body of water, such as Riverside Sunderland, for example, may adopt specific drainage strategies to mitigate flood risks that may not otherwise heavily impact cities that are situated inland. The installation of urban infrastructure and technologies may also be affected by the topography of a city—whereas Songdo's relatively flat landscape could cater for the installation of a pneumatic waste conveyance system, for example, cities with a hillier terrain may need to seek above-ground alternatives when managing waste. In terms of climate, cooling strategies could, in addition, appear as more important for cities that experience warmer temperatures—this is reflected in the way that buildings are designed to minimise heat gain in both Punggol and Masdar City. As such, despite commonalities, design strategies should not be taken as one-size-fits-all--rather, specific adjustments would be necessary depending on the city to which the strategy is applied.

Figure 28: Hong Kong Park – Blue and Green Infrastructure

However, due to differences in geography and landscape, certain cities may choose to adopt distinctive design approaches when considering factors such as climate and topography. For instance, Songdo's relatively flat landscape can benefit largely from the pneumatic waste conveyance system, warmer climate cities like Singapore and Masdar City can benefit from initiatives such as building orientation to minimise heat.

The overview of regional and overseas case studies should also be considered in tandem with the earlier review of existing practices and policies on the design of a sustainable built environment. Inspiration can be drawn from both sides in creating design strategies that specifically target precinct-scale developments, equipped with features that holistically integrate various aspects of sustainability—ranging from social, to environmental, to economic. While doing so, the applicability of these strategies to Hong Kong should be considered together with their relevance toward the three main objectives of this Guidebook—achieving carbon neutrality by 2050, the SDGs, and the creation of a smart green city. Such strategies will be further explored and developed in the following chapter.

CHAPTER 03

DESIGN STRATEGIES FOR A SUSTAINABLE BUILT ENVIRONMENT

3.1 Design Strategies for a Sustainable Built Environment

From a review of some key sustainability challenges for Hong Kong in Chapter 1 and guidelines, policies and directives in Chapter 2, potential areas for further development and to which this Guidebook may contribute were identified. International and regional best practices that could contribute to the creation of a more sustainable built environment in Hong Kong at the precinct level were also presented. It has become apparent that there is no single comprehensive guide or a set of guidelines with which Hong Kong can look to replicate in developing sustainable urban quarters. This chapter introduces a set of strategies, which are based on findings from Chapter 2 and engagement sessions with key industry stakeholders, and applicable to the holistic planning and design of sustainable precincts in Hong Kong, particularly in alignment with the objectives of the Guidebook as stated in Chapter 1. A total of 48 strategies categorised under eight themes as shown below will be introduced in this chapter.

Theme A

Plan Liveable Precincts

1. Nature-based Precinct Design
2. Building Disposition & Site Responsive Precinct Design
3. Urban Design in the Context of Renewal
4. Sustainable Master Planning

Theme B

Integrative Planning and Governance

5. Promote Circular Supply Chains
6. Cross-Sector Partnerships
7. Green Financing Measures
8. Sustainable Project Finance
9. Integrated Engagement in Urban Planning and Management
10. Sustainable Business Models

Theme C

Climate Resilient and Carbon Neutral Precincts

11. Climate Resilient Design
12. Passive Ventilation Mechanisms
13. Natural Lighting Mechanisms
14. Water Conservation Initiatives
15. Solar Energy Systems
16. Wind Energy Systems
17. Wave Energy Systems

Theme D

Connected and Circular Precincts

18. Transport Infrastructure Design
19. Digitalised Mobility
20. Support Electrical Mobility
21. Waste Collection and Management Mechanisms
22. Waste-to-energy Systems
23. Precinct-wide Energy System Design

Theme E

Urban Biodiversity

24. Prioritise (Re-)Development of Low Biodiversity Areas
25. Preserve Existing Habitats
26. Sufficient Space for New Urban Biodiversity
27. Optimise Connectivity of Urban Biodiversity Areas
28. Green/Blue Infrastructure Planning
29. Eco-friendly/Wildlife-safe Infrastructure and Building
30. Establish Urban Biodiversity Areas
31. Ecologically Sensible Design
32. Provide Complex Habitats to Attract Wildlife for Colonisation

Theme F

Inclusive and Accessible Communities

33. Access to Public Facilities and Services
34. Enhance Economic Opportunities
35. Spaces for Community Interaction
36. Mixed Residential Precincts
37. Balanced Approach to Renewal

Theme G

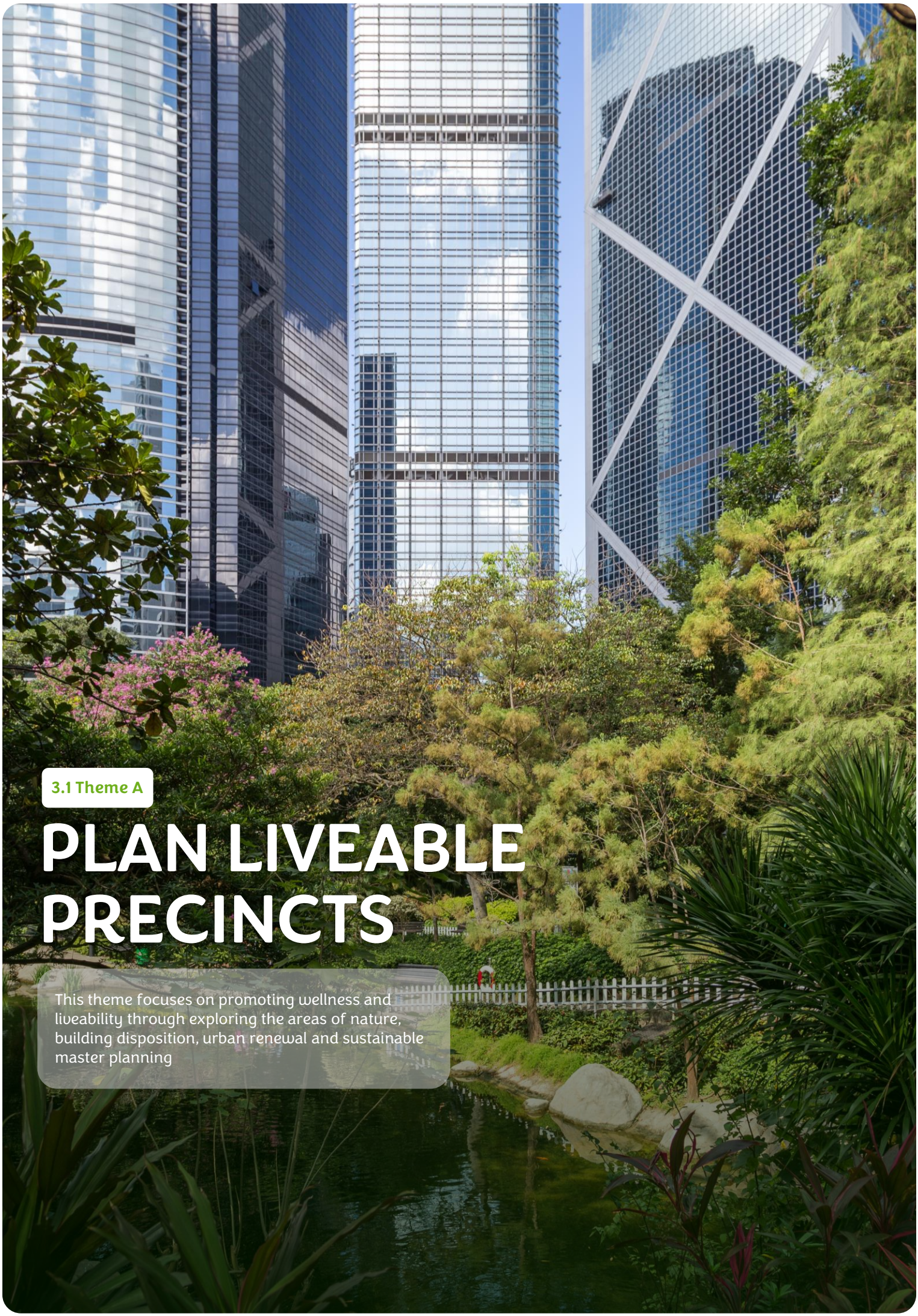
Innovative Sustainable Design and Technology

38. Intelligent Infrastructure for Smart Building and Precinct Functions
39. Off-site Infrastructure Construction Technology
40. Sustainable Construction Materials
41. Flexible Building Design

Theme H

Mitigation of Health Risks

42. Repurpose Public Spaces
43. Improve Physical Form of Buildings and General Physical Environment
44. Enhance Public Facilities To Promote And Maintain Public Hygiene
45. Contact Tracing With Smart-city Tech
46. Self-contained Communities
47. Improve Substandard Environmental Hygiene In Old Urban Areas
48. Segregate Public Services and Facilities



3.1 Theme A

PLAN LIVEABLE PRECINCTS

This theme focuses on promoting wellness and liveability through exploring the areas of nature, building disposition, urban renewal and sustainable master planning

THEME A

PLAN LIVEABLE PRECINCTS

OBJECTIVE

To Enhance Wellbeing and Liveability Through Infrastructure and Urban Design

STRATEGY 1 | NATURE-BASED PRECINCT DESIGN

INTEGRATE NATURAL ELEMENTS INTO URBAN BUILT ENVIRONMENTS

Promote integration of natural elements into the urban built environment. This can be achieved through a variety of approaches including greening and use of natural materials on and around public infrastructure (e.g., roads, footbridges, and ancillary facilities such as public toilets, refuse collection points and ventilation shafts); designing to optimise natural light penetration and shade (as appropriate) and air ventilation; integration of water (lakes, channels, swales, water features, etc.); and integration of ecological habitats into urban areas.

Benefits

- Strengthens connection with nature improves human health and wellbeing
- Instills an appreciation, understanding and respect for nature

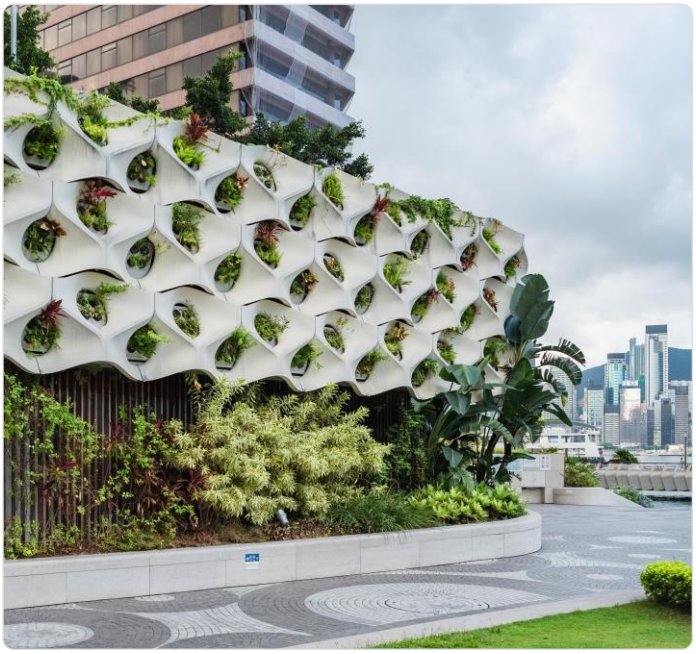


Figure 29: Integration of Natural Elements into Urban Built Environments
Salisbury Garden in Tsim Sha Tsui, Hong Kong, where green facades have been designed into infrastructure buildings.

Figure 30: Urban Forestry
Tree management is essential in ensuring a healthy, age-balanced and species diverse urban tree stock.

URBAN FORESTRY

Promote and engage in the practice of ‘urban forestry’ which is the proactive development and management of the urban tree stock found in parks, gardens, open spaces, roadsides, etc. In forming an urban forest, important considerations include suitable site conditions, a bio-diverse selection of appropriate native and adapted non-native species, and public interests.

Benefits

- Optimises access to nature and improves human health and wellbeing
- Enhances the quality of the surrounding environment through beautification, amelioration of microclimates, removal of air pollutants and enrichment of wildlife habitat.

GREEN AND BLUE INFRASTRUCTURE

Increase and enhance green and blue infrastructure (e.g., gardens, parks, woodlands, urban farming, green corridors, amenity strips, planted roadside verges, planted central medians, terrace gardens, green roofs and green walls, water bodies, drainage channels, rivers, streams) within precincts.

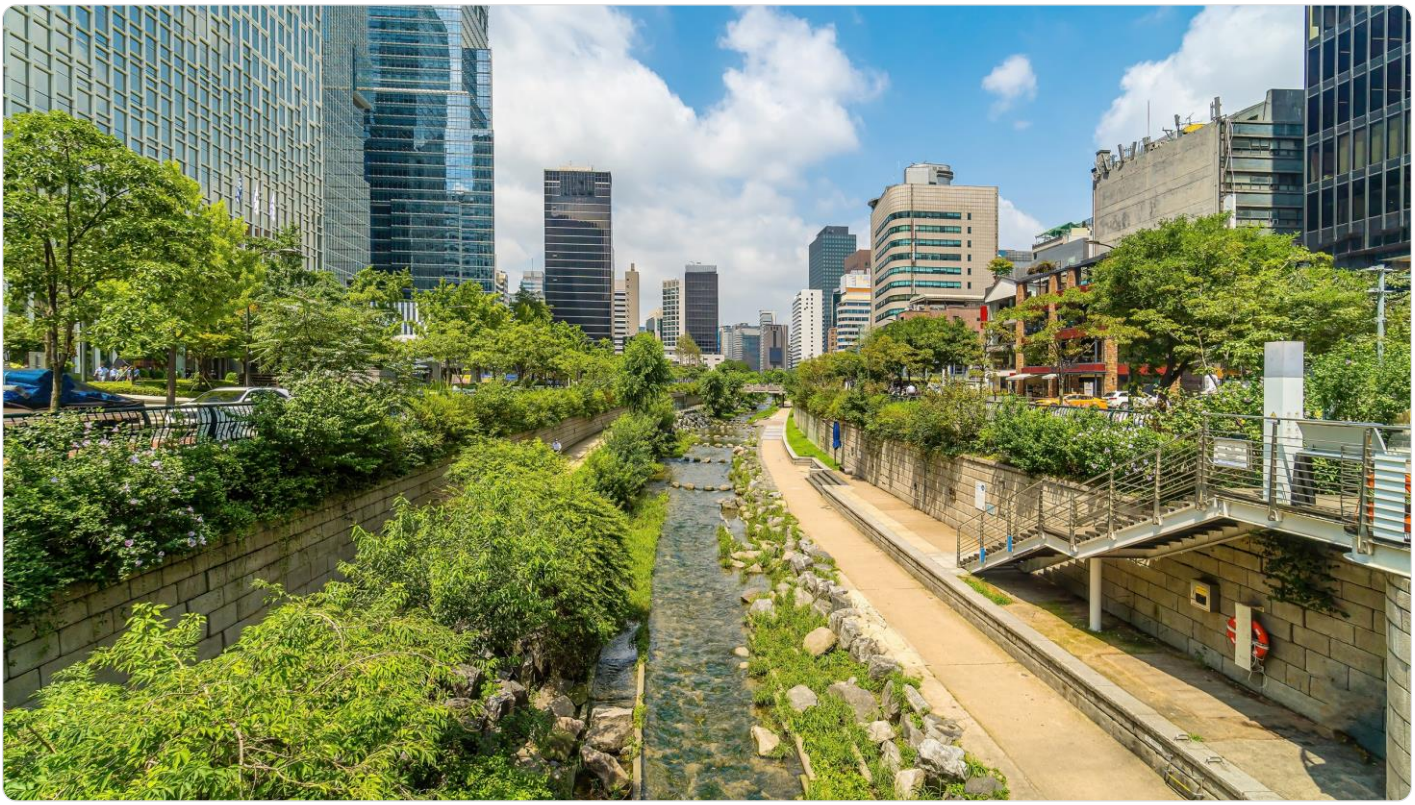


Figure 31: Green and Blue Infrastructure
Cheonggyecheon Stream in Seoul, formerly covered by a transportation corridor, has been restored and revitalised as a blue-green recreational corridor in the city.

Benefits

- Optimises greening of and access to open spaces can improve human health and wellbeing
- Enhances urban microclimate, mitigate the urban 'heat island effect' and mitigate the visual impact of high-density developments
- Recreates natural ecosystems and provide habitats
- Assists with the establishment of an adaptive and climate-resilient built environment

RIVERSIDE REVITALISATION AND COMMUNITY DEVELOPMENT

Improve conditions of areas along the riverside, such as through revitalisation and facilitating the development of social infrastructure and vibrant public spaces to increase interaction between people and waterbodies, as well as improve the quality of the natural environment. Riverfront spaces may include connected promenades, parkways and seating areas which could be used for social, recreational and leisure activities.

Benefits

- Proximity to waterbodies may improve physical and mental wellbeing due to greater air circulation and evaporative-cooling effects
- Increases opportunities for social interactions

INDICATORS

- Percentage of green coverage
- Percentage of water coverage

STRATEGY 2 | BUILDING DISPOSITION & SITE RESPONSIVE PRECINCT DESIGN

PERMEABLE URBAN FABRIC

Create a permeable urban fabric of non-building areas of circulation and open spaces. These should form a highly integrated and connected urban realm. Additionally, wind and visual corridors should also be considered during site carving processes.

Benefits

- Enhances visual permeability and amenity and thereby, wellbeing
- Increases connectivity and walkability
- Enhances sense of place and local identity
- Can be coordinated with the creation of breezeways to help moderate urban temperatures

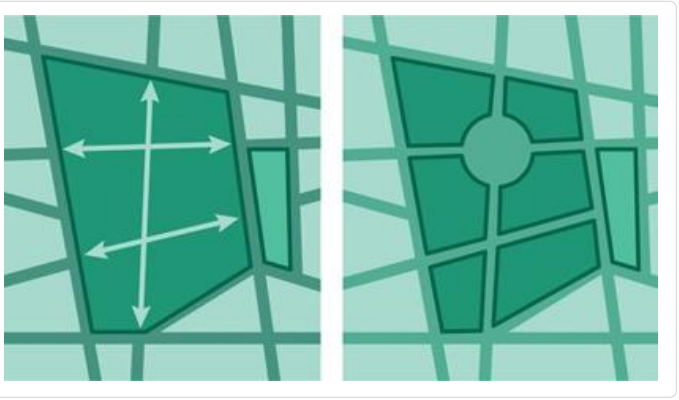


Figure 32: Permeable Urban Fabric
A more permeable urban fabric, making connections with adjacent streets, achieves multiple sustainability goals, including enhanced walkability, ventilation, increased retail frontages and commercial opportunities, thereby enhancing well-being and sense of place.

VARIED HEIGHT PROFILE

Design for building disposition and height profiles that optimise urban air ventilation and shading through varying height profile with low-rise buildings and open spaces located in the windward direction, aligning main streets in parallel. If there are open areas windward of the precinct, main streets can be oriented up to 30 degrees from the direction of prevailing wind to create breezeways.

Benefits

- Enhances wind flow at ground level to strengthen cooling effect and natural ventilation
- Moderates temperatures and enhances pedestrian comfort

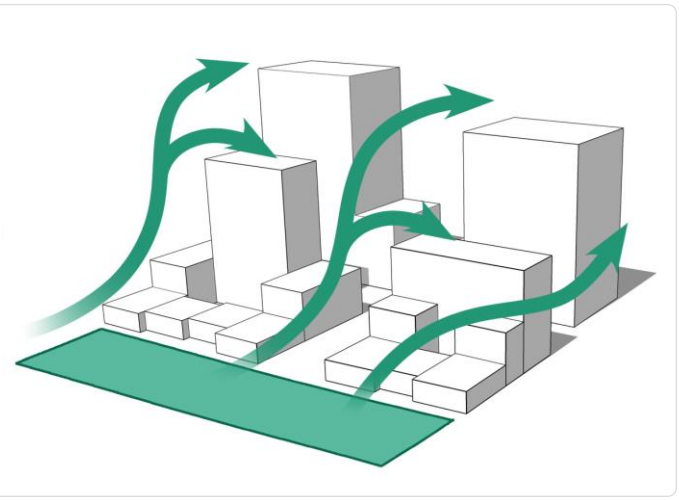


Figure 33: Varied Height Profile
Precinct design principles which optimise urban air ventilation decrease outdoor temperatures and humidity, making external spaces more useable. It promotes outdoor interaction while enhancing personal physical wellbeing and walkability.

PASSIVE URBAN COOLING

Promote passive urban cooling through vegetation and water on buildings and public infrastructure.

Benefits

- The specific heat capacity of vegetation and water is higher than that of hard built surfaces, thus, reducing precinct-wide ambient temperatures and the heat island effect

Figure 34: Passive Urban Cooling
Vegetation and water features contain cooling properties and can reduce the urban heat island effect.

HARMONIOUS PALETTES AND MATERIALS

Use palettes, materials and design features on buildings or infrastructure that are visually harmonious, coherent and responsive to the surrounding context, built character, tradition, as well as culture and heritage.

Benefits

- Enhances visual harmony, amenity and thereby, wellbeing
- Reinforces local identity and sense of place, and positively strengthens people's connection to the site

Figure 35: Visually Harmonious Design Features

The design of buildings or infrastructure can consider their response to and impact on surroundings, with an example being the blending of greenery as pictured above. Precincts which have a consistent and coherent visual character tend to possess an enhanced sense of place and community.

BUILDING ORIENTATION

Building orientation and positioning of windows to maximise passive solar heat gain during the winter and increase passive cooling during the summer. Given Hong Kong's location in the northern hemisphere, north-south daylight can be optimised by positioning buildings along an east-west axis with windows facing north and south to gain good access to daylight, while windows facing west that generally is exposed to excessive solar heat gain shall be avoided. Tools such as Air Ventilation Assessments (AVA) and Computational Fluid Dynamics (CFD) may be carried out to model and optimise natural ventilation in the urban environment.

Benefits

- Reduces energy consumption for the purpose of artificial lighting and heating

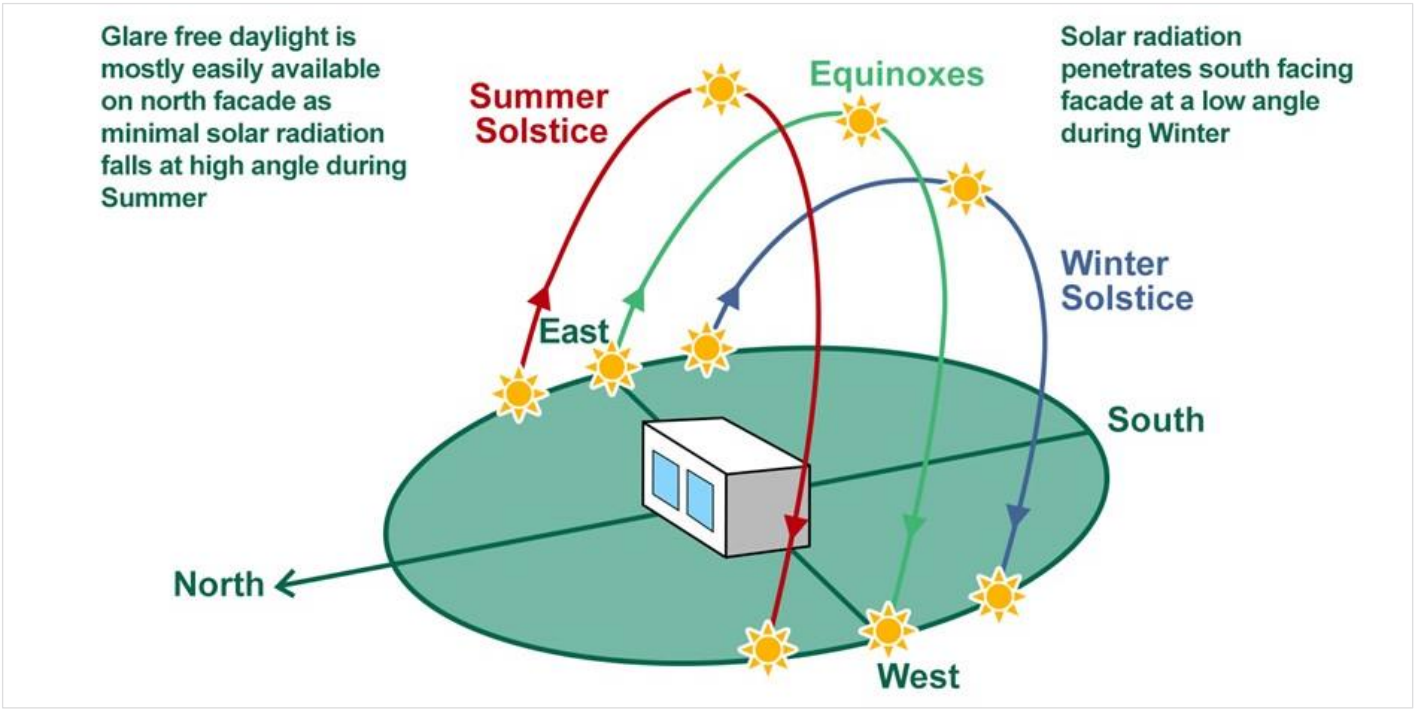


Figure 36: Building Orientation

Urban blocks orientated along east-west axis can optimise daylight penetration to the public realm during winter, provide shaded and walkable streets during summer, and enhanced daylight penetration to building interiors, thereby reducing energy consumption.

INDICATORS

- Average width of space in between buildings
- Ground level temperature reduction

OBJECTIVE
To Enhance Liveability Through Spatial Planning

STRATEGY 3 | URBAN DESIGN IN THE CONTEXT OF RENEWAL

REDEVELOPMENT BEFORE NEW BUILD

Considering redevelopment before new build may optimise the potential of the precinct and preserve unique characteristics while simultaneously facilitating necessary upgrades.

Benefits

- Sustains use and livability of older precincts
- Reduces need for greenfield intake

Figure 37: Redevelopment Before New Build
New residential development has been integrated into industrial gas storage structures in King's Cross, London. This approach preserves unique urban landmarks, whilst minimising loss of habitats and ecosystems.

REHABILITATION AND RETROFITTING

Rehabilitate and retrofit existing buildings with regular repairs and upgrades of key functions and amenities to ensure that they are kept in optimum condition. It also enables the retention of existing uses or adaptive re-use.

Benefits

- Improves living conditions and prevents decay of buildings

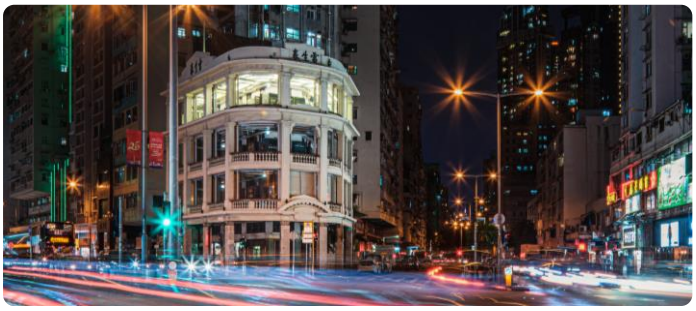


Figure 38: Rehabilitation and Retrofitting
Lui Seng Chun in Sham Shui Po, was formerly home to a bone-setting shop. Its restoration and adaptive re-use as a Chinese medicine centre is a sustainable response to the need for floor space in urban areas. It retains a local landmark which contributes to local identity and sense of place.

Figure 39: Heritage Preservation and Revitalisation
Tai Kwun, former Central Police Station, has been restored and converted into a mixed-use heritage arts hub. The process included retrofitting the old buildings for new uses and inserting contemporary built forms into the complex.

HERITAGE PRESERVATION AND REVITALISATION

Promote heritage preservation and revitalisation through adaptive reuse (e.g., transforming historic city blocks into cultural and entertainment districts) by retention or adaptation of heritage buildings and structures. New buildings could adopt a stepped building profile to respond to the generally smaller-scale of heritage buildings.

Benefits

- Preserves local identity and strengthens community pride
- Preserves integrity of the area and its existing infrastructure
- Offers potential for positive catalytic effects on surrounding communities and local economy

‘QUICK-WIN’ SPATIAL INTERVENTIONS

Use ‘quick-win’ spatial interventions in the form of individual signature re/developments and streetscape enhancement (e.g., introduction or upgrade of planting, lighting, street furniture, façade treatments, etc.) to spark urban uplift in the surrounding precinct. Additionally, suitable interventions may also be used to upgrade public spaces with intent to create proper open spaces.

Benefits

- Creates catalytic improvement effects in surrounding area
- Improves visual quality of the precinct
- Provides visual and physical comfort and prevents accelerated decay
- Rejuvenated places stimulate economy by facilitating growth of local businesses and job opportunities

Figure 40: ‘Quick-Win’ Spatial Interventions
The High Line Manhattan, New York is a former railway viaduct which has been converted into a series of elevated public open spaces. It has a catalytic effect in revitalising and uplifting the public image and economy of the surrounding urban area.

INDICATORS

- Ratio of new versus revitalised developments
- Frequency of repairs and upgrades on buildings

STRATEGY 4 | SUSTAINABLE MASTER PLANNING

POLYCENTRIC PRECINCT DESIGN

A polycentric design, which generally comprises one or more employment subcenters outside of the central business area, may be adopted as an alternative to concentrating key functions and facilities in a single urban centre. Polycentric areas contain services, job opportunities, amenities and quality public services throughout the entire urban fabric, increases proximity to necessities. The spatial distribution of employment that promotes equity in access to employment opportunities plays an important role in the structuring of a polycentric precinct.

Benefits

- Promotes balanced growth, efficiency and equity across districts
- Avoids congestion in the precinct core
- Improves access to workplaces and reduces commuting time and energy consumption
- Fosters community pride and local identity

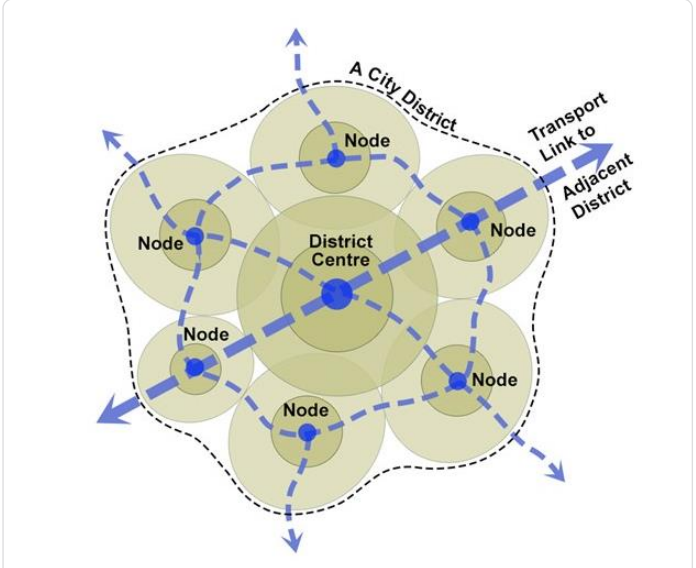


Figure 41: Polycentric Precinct Design
Polycentric urban design comprises the creation of a number of mixed-use precincts or subcenters spread across a city, as opposed to concentrating essential functions and facilities in a single city centre. Each precinct contains all the essential services that a community needs, reducing the need to travel.

FINE GRAIN & MIXED-USE PRECINCT

e. Compact built environments are characterised by:

- Increased densities appropriate to context;
- A fine grain of mixed uses (i.e., promotion of the work-home-services relationship, which includes varying housing typology options, economic opportunities, multifunctional green spaces and social facilities);
- Interconnected streets and transport corridors with a focus on pedestrian, bicycle and public transport-oriented design (i.e., a walkable city);
- Concentrations of populations and/or employment—creating destinations with high levels of accessibility to services to reap the benefits of urban agglomerations; and
- Access to public transport options, green systems and other public facilities.

Benefits

- Enhances vitality of the public realm and thereby business opportunities
- Improves accessibility and walkability
- Stimulates resilient local economy with more divided ownership

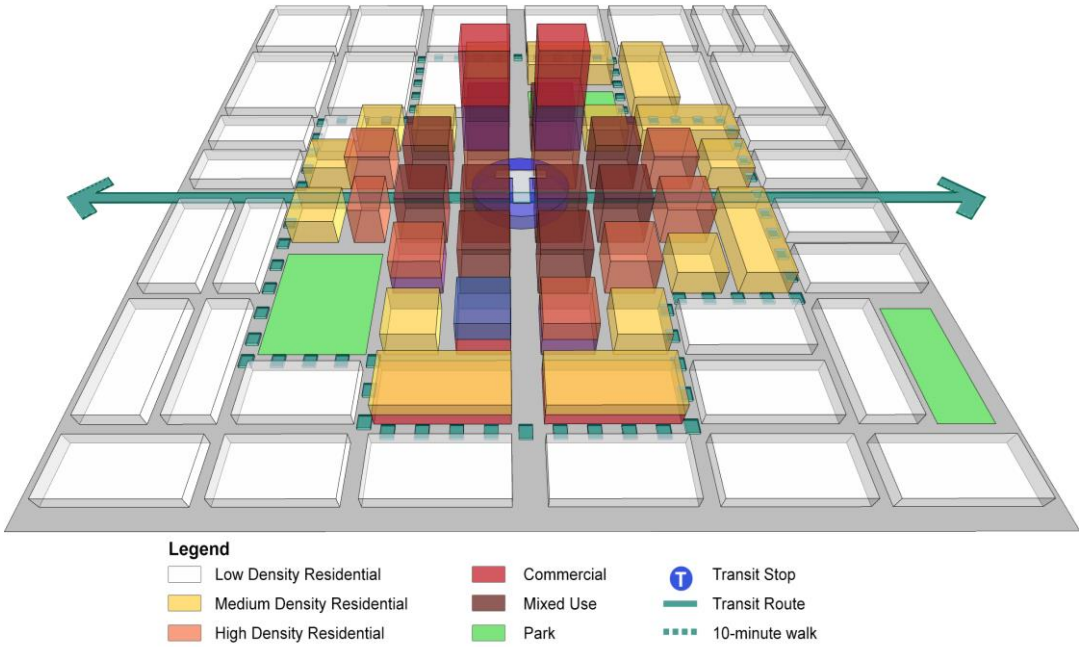


Figure 42: Fine Grain & Mixed-Use Precinct

Compact fine-grain precincts are also referred to as '15-minute neighbourhoods'. They contain a diverse mix of residential, commercial, amenity, open space, and public service land uses and facilities, and reduce the need for travel, promote walkability as well as enhance the vitality of the public realm, through continual footfall and activity at all times of the day.

INDICATORS

- Walking distance to key functions and facilities
- Types and variety of land uses

3.2 Theme B

INTEGRATIVE PLANNING AND GOVERNANCE

This theme focuses on strengthening governance, promoting integrative planning, and leveraging sustainable finance in precinct development, exploring areas such as circular supply chains, cross-sector partnerships, community engagement, and sustainable business models

THEME B

INTEGRATIVE PLANNING AND GOVERNANCE

OBJECTIVE

Promote Sustainable Procurement

STRATEGY 5 | PROMOTE CIRCULAR SUPPLY CHAINS

CIRCULAR SUPPLY CHAINS

Circular supply chains are formed of a model that encourages manufacturers and sellers of products to take discarded materials and remake them for resale. This countermands the traditional model of "take, make, and throw away", a zero-sum situation which is unsustainable, costly and fails to address spiraling raw material costs and volatility. A range of sectors have the potential for circular transition and innovations, such as the built environment, electronics and ICT, energy, etc. Means of applying circular supply chains include:

a. Procuring circular products, materials and services where re-use and recycling are intrinsic to supply

b. Developing and using "circular" procurement criteria in tender specifications such as specified resource efficiency levels, recycled content inclusion, etc.

c. Integrating product lifetime extension into procurement practices through the promotion of re-use, refurbish, recycle, etc.

Benefits

- Utilisation of circular supply chains enshrines sustainability and greening at all stages of the production, use and re-use cycle
- Incorporates the re-use of materials while simplifying product administration and efficiency
- Dramatically reduces waste, resulting in measurable environmental benefits (e.g., saves natural resources and prevents pollution, preserves critical raw materials, etc.)

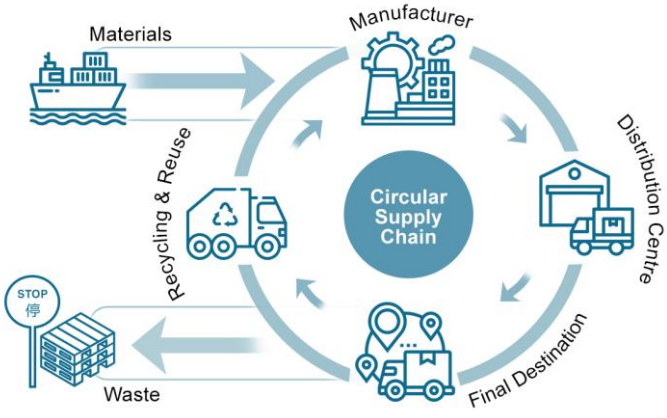


Figure 43: Circular Supply Chains
Sourcing construction materials for new precincts from certified recycled sources reduces carbon otherwise emitted in their production. Wastewater and refuse collection/recycling facilities can also be designed to support the circular economy.

INDICATORS

- Degree to which resource efficiency and sustainability is applied within operating business models underpinning different projects

OBJECTIVE
Optimise the Use of Green Finance Mechanisms

STRATEGY 6 | CROSS-SECTOR PARTNERSHIPS

Figure 44: Application of Cross-Sector Partnership to Green Infrastructure
Public and private sectors can collaborate to accelerate the development of green infrastructure.

METHODS OF PARTNERSHIP

Risks and responsibilities may be shared between the public and private sectors to expedite and deliver urban development projects. Cross-sector partnerships may be organised in different ways for specific projects and/or sites. It may be:

- Through a consultive approach;
- Through public funding for private developers to design;
- The development of public projects in accordance with public sector specifications; and
- Private sector operation and management of publicly owned assets.

Cross-sector partnerships may, for example, be applied to urban green infrastructure (inclusive of development, construction and services provision) with a view to provide a broader range of intensification measures targeted at attracting funds and/or human and intellectual capacity from the private sector, while enabling a more effective and equitable distribution of risks among the parties involved.

Benefits

- Reduces project costs and construction time
- Increases synergy between the public and private sectors, for which resources from both parties are leveraged to optimal potential, thus increasing the efficiency of public sector project development and operation
- Risks are ameliorated through being more effectively distributed
- Cross-sector expertise improves overall quality of construction

INDICATORS

- Proportion and extent of public projects developed through cross-sector partnerships

STRATEGY 7 | GREEN FINANCING MEASURES

LOANS, BONDS AND CARBON FINANCE

Increase the extent to which loans, bonds and carbon finance are utilised to attract sustainable and responsibly resourced private finance from capital markets for green urban investment in development and infrastructure through:

a. Green bonds - a channel for directing institutional investors' capital (e.g., pension funds) towards green projects with steady yields and limited risks;

b. Carbon finance - financial tools such as carbon emissions trading to reduce the impact of GHG on the environment by allocating a price to carbon emissions.

Benefits

- Responsibly sourced green finance ensures that financing is specifically directed towards infrastructure and development projects that are designed, managed and implemented in a green and sustainable manner

Artistic Impression Only - Courtesy of: Rocco Design Architects Associates Ltd, Architectural Services Department and the Leisure and Cultural Services Department

Figure 45: Development of the East Kowloon Cultural Centre (EKCC)
EKCC is financed by the Government Green Bond Programme and received provisional Gold sustainability certification under the HKGBC BEAM Plus New Buildings rating tool.

CARBON TRADING

Implementation of carbon trading—where companies or other parties use the marketplace to buy and sell credits that allow them to emit a certain amount of carbon emissions. This would be done against the following practices:

a. Emitting above the limit would require businesses to purchase additional permits

b. Businesses that curb emissions below the limit may sell their excess permits to other businesses or local authorities

Benefits

- Incentivises businesses to limit carbon emissions by providing permits with overall limit on the emissions amount

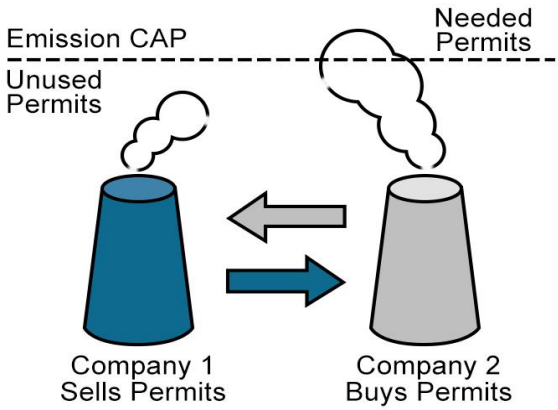


Figure 46: Carbon Trading
Project proponents of new precincts and urban quarters can purchase carbon credits to offset the emissions produced during their construction and operation.

INDICATORS

- Degree to which one or more financing measures are applied in a given project and the magnitude to which they are utilised
- The proven degree to which companies publish their sustainability date and practices and their application of carbon offsetting measures

STRATEGY 8 | SUSTAINABLE PROJECT FINANCE

DUE DILIGENCE TO ENSURE SUSTAINABLE MEASURES

Increase the degree to which due diligence is undertaken to ensure that projects are planned and implemented in a sustainable manner and that project finance is obtained from sustainable sources. Employable measures include:

a. When procuring sources of financial capital, undertake due diligence and an assessment of the environmental background, ethical profiles and sustainability practices of institutional suppliers of finance.

b. Ensuring that capital providers are drawing funds from sustainable sources and have withdrawn investments in unsustainable operations.

Benefits

- Encourages the transition to a sustainable and carbon-neutral economy
- Contributes to the realisation of green and sustainable projects

Figure 47: Due Diligence to Ensure Sustainable Measures
Due diligence is essential if project proponents plan to source sustainable finance. The European Commission has adopted a directive on corporate sustainability due diligence in 2022 that applies to both EU and non-EU companies.

INDICATORS

- Degree to which due diligence has been applied in a project

OBJECTIVE

Promote New Business Models Based on Innovative and Resource-efficient Solutions

STRATEGY 9 | INTEGRATED ENGAGEMENT IN URBAN PLANNING AND MANAGEMENT

Figure 48: Community Engagement

COMMUNITY ENGAGEMENT

Promote community engagement in the planning, design, operation and management of a district with a new or modified range of possible points of engagement that may include statutory planning consultations, informal community design charrettes, questionnaires, and establishment of citizen management committees to oversee public open spaces.

Benefits

- Leads to more inclusive planning processes and outcomes
- Fosters trust and sense of community
- Increases the quality of planning decisions

INDICATORS

- Level of participation as compared to number of stakeholders that are invited

STRATEGY 10 | SUSTAINABLE BUSINESS MODELS

SUSTAINABLE BUSINESS MODELS

Sustainable and efficient business models can be achieved through changes in the way that organisations work, the degree to which value is created, and the extent to which material sustainability initiatives are achieved. Means employed typically include:

a. The adoption of a product-service system that enhances delivery and quality

b. The adoption of supplier take-back systems (e.g., "purchase and buy back", "purchase and resale agreement") to encourage closed-loop production and consumption cycles

c. Using sharing platforms/collaborative consumption which enable optimisation of the life cycle of goods, products and services.

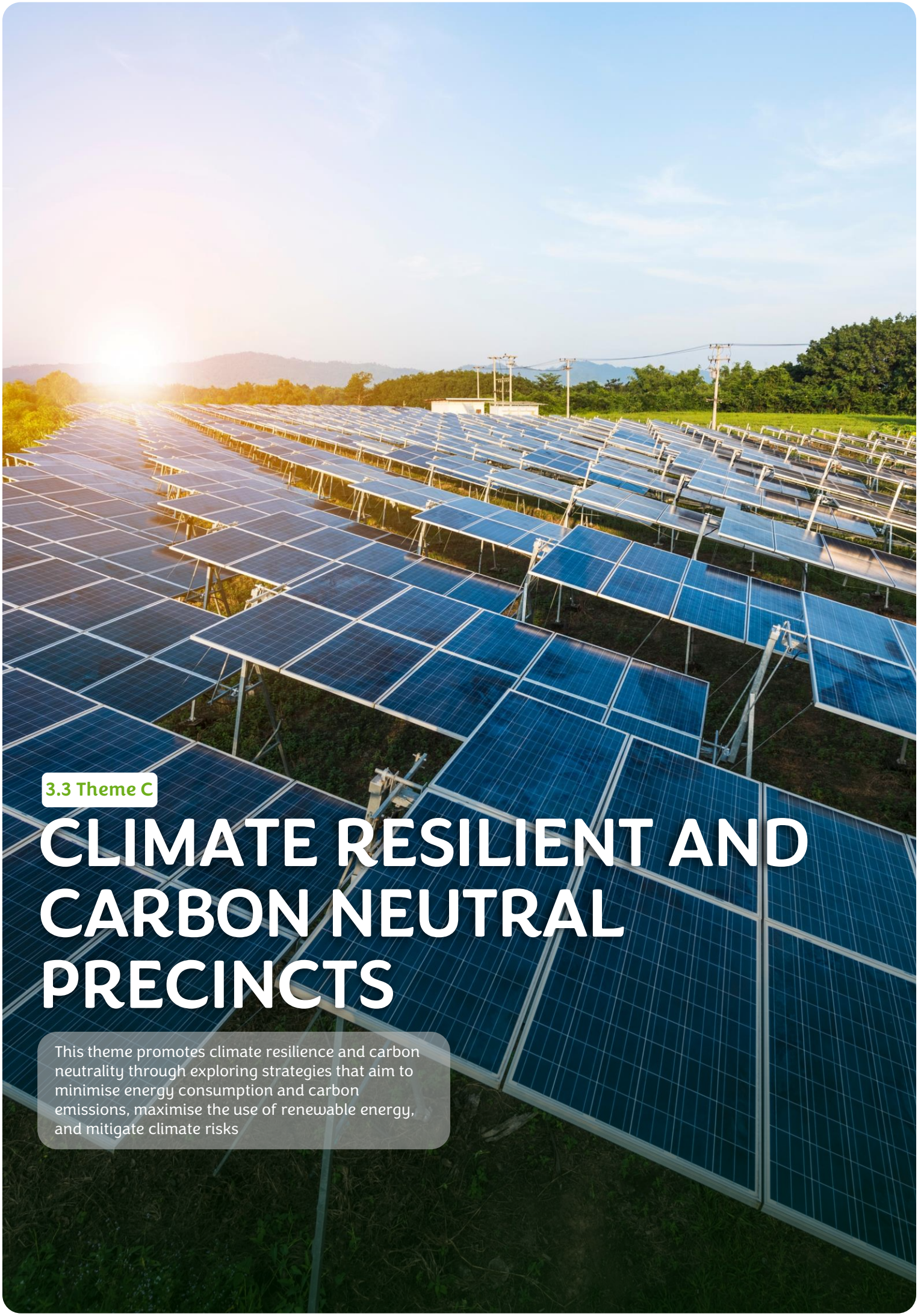
Figure 49: Bike Sharing Platforms
Transport for London's cycle hire scheme is an example of a highly sustainable sharing platform. The scheme has been running since 2010 and has about 800 docking stations and 12,000 bikes across London.

Benefits

- The utilisation of resource efficient business models and operations enhances the production process, delivery of products and efficiency of the management process
- Provides a clear focus on green and sustainable production and delivery practices
- Ameliorates waste and inefficiencies

INDICATORS

- Degree to which resource efficiency and sustainability is applied within operating business models underpinning different projects



3.3 Theme C

CLIMATE RESILIENT AND CARBON NEUTRAL PRECINCTS

This theme promotes climate resilience and carbon neutrality through exploring strategies that aim to minimise energy consumption and carbon emissions, maximise the use of renewable energy, and mitigate climate risks

THEME C

CLIMATE RESILIENT AND CARBON NEUTRAL PRECINCTS

OBJECTIVE
Promote Use of Natural Resources

STRATEGY 11 | CLIMATE RESILIENT DESIGN

SUSTAINABLE DRAINAGE SYSTEMS

Integration of sustainable drainage systems and water sensitive urban design, such as porous pavements, vegetated surfaces, bioswales, soakaways, storm water retention ponds and water harvesting features (e.g., drainage tunnels, underground stormwater storage, etc.) in public spaces.

Benefits

- Effective management of surface water runoff reduces flooding risk, promotes ground water recharge and improves resilience against flooding
- Built environment becomes adaptable to climate uncertainties

Figure 50: Sustainable Drainage Systems
Concrete grid pavers (left) and natural rock pavers (right).

PROTECTIVE ELEMENTS ALONG COASTAL EDGES

Integration of protective elements along coastal edges such as elevated grounds, coastal defences, buffers, etc.

Benefits

- Reduces negative impacts of intense storms and flooding

Figure 51: Climate Resilient Elements along Coastal Edges
Tetrapod coastal protection in Okinawa, Japan.

NATURAL VENTILATION AND SOLAR RADIATION IN PRECINCT DEVELOPMENT

Leverage natural ventilation and solar radiation in the layout and development of precincts to enable cooling. Natural ventilation can be enhanced through various means, including the installation of operable facades, podium gardens and sky gardens to improve thermal comfort—the design of which should take into consideration the expected occupancy (if applicable), building permeability, and access to sunlight. *Theme A Strategy 2: Building Disposition & Site Responsive Precinct Design* provides further details on the adoption of passive ventilation mechanisms and varying building height profiles to improve air circulation.

Benefits

- Reduces energy consumption and impact of high temperatures

STRUCTURAL INTERVENTIONS

Implement structural interventions, such as green and blue infrastructure in different forms, to facilitate the rebalancing of district ecosystems. More details may be referenced from Nature-based Precinct Design under Plan Liveable Precincts. Additionally, any interventions should also be designed in a way that is 'safe-to-fail', such that potential errors/incidents will result in minimal negative effects.

Benefits

- Improves health and social equity of inhabitants

PLANTING OF GREEN AREAS

Planting of trees, shrubs and green areas helps sequester CO_2 and certain pollutants, binds soils, and provides natural shading.

Benefits

- Reduces CO_2 in the atmosphere, a key greenhouse gas
- Reduces soil erosion caused by rainfall and flooding and risk of landslides
- Shading provides cooling effect under high temperatures
- Enhances wellbeing and liveability

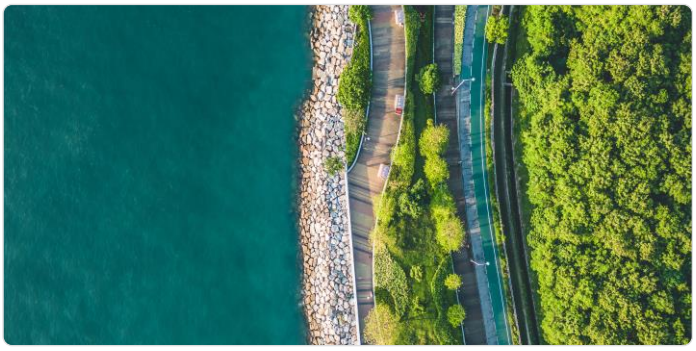


Figure 52: Planting of Green Areas
Tseung Kwan O South Waterfront Promenade in Hong Kong

CONSIDERATION OF BUILDING FACADES

Consideration of building facades in terms of treatment, shading and fabric, to ensure adaptability to the natural environment (e.g., design to maximise natural light, control ventilation, etc.) whilst enhancing thermal comfort within buildings.

Figure 53: Consideration of Building Facades
Curved metal fins on the exterior façade of Hong Kong's Xiqu Centre act as shading devices to reduce heat gain and energy consumption.

INCORPORATION OF PODIUM GARDENS

Podium gardens can be included in development sites to serve a variety of different purposes, such as to enhance ventilation, planting, pedestrian mobility, community use for social cohesion, and to create a climate resilient passages between buildings.

CONTINGENCY PLANS FOR NATURAL DISASTERS

Regular updates to contingency plans for natural disasters or the handling of other emergency situations at major urban infrastructures, together with the carrying out of climate change risk assessments are needed.

WATER RESILIENT DESIGN

Adoption of "sponge city" design approach for stormwater management in tackling drainage issues. This design concept could be adopted through different methods, such as green roofs, porous pavements and other flood resilient infrastructure. Additionally, an extensive rainwater collection and storage system currently exists in Hong Kong.

Benefits

- Effective stormwater and drainage management
- Enables flood prevention

INDICATORS

- Reduction in flooding in areas where sustainable drainage systems are present
- Ground level temperature reduction
- Reduction in concentration of air pollutants in areas containing vegetated buffers

STRATEGY 12 | PASSIVE VENTILATION MECHANISMS

THERMOSTAT-ACTUATED LOUVRES

Natural ventilation can be facilitated by thermostat-actuated louvres, which are built with temperature sensors that detect when to open and close fins for optimal airflow.

Benefits

- Natural regulation of indoor temperature and climate
- Reduces energy consumption and associated costs

Figure 54: Thermostat-actuated Louvres
Solar tracking louvres to maximise ventilation and insulate western sun in Hong Kong Science Park Phase 3.

HORIZONTAL CROSS VENTILATION

Horizontal cross ventilation could be facilitated through installation of operable windows on opposite sides of a building for effective wind-flow in delivering natural cooling.

VERTICAL VENTILATION

Vertical ventilation could be achieved through placing openings at the top and bottom of a space (e.g., solar chimneys) to allow for a stack effect in which air pressure differences enable warm air to escape in exchange for cool air to be drawn in.

Benefits

- Natural regulation of indoor temperature and climate
- Reduces energy consumption and associated costs

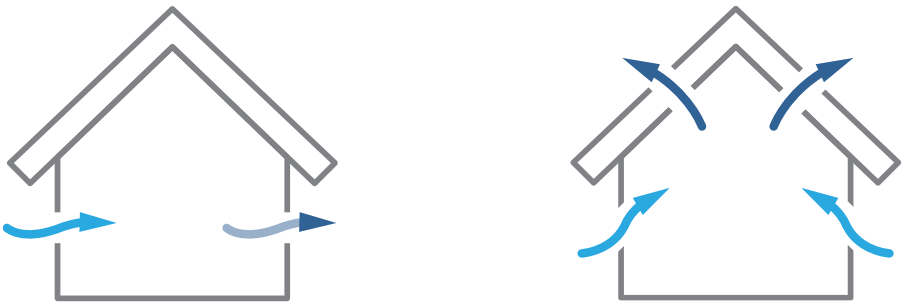


Figure 55: Horizontal Cross Ventilation & Vertical Ventilation

INDICATORS

- Energy saved from reduction in use of mechanical ventilation
- Average speed of airflow

STRATEGY 13 | NATURAL LIGHTING MECHANISMS

Figure 56: Light Shelves
Implementation of light shelves as a passive daylight feature.

Figure 57: Skylight
Adoption of skylights as a passive daylight feature.

PASSIVE DAYLIGHT FEATURES

Natural daylight can be brought further into indoor areas by using passive daylight features. Examples of passive daylight features include light shelves, light pipes and skylights. Light shelves and skylights are suitable features for distributing daylight to windowed indoor areas, while light shelves could also provide peripheral shading around the façade. Whereas light pipes are suitable for bringing in daylight to windowless indoor areas.

Benefits

- Extends daylight reach further indoors
- Reduces energy needed for artificial lighting during daytime
- Carbon-free lighting opportunity

COMPUTER MODELLING ANALYSIS OF NATURAL LIGHT

Computer modelling analysis of natural light could be carried out to determine the intensity and direction of daylight. This could help to identify which types of passive daylight technologies are more appropriate and which locations are best suited for their installation.

Benefits

- Optimises the implementation and impact of daylight features

HIGH PERFORMANCE GLAZING AND MULTI-LAYERED INSULATED GLASS

The undesirable effects of harnessing natural light (e.g., glare, heat gain) could be minimised by using high performance glazing and multi-layered insulated glass. Additionally, ultra-violet (UV) light-reflective glass could be used to mitigate bird-collision risks associated with large areas of glazing.

Benefits

- Reduces energy intensity for indoor cooling
- Reduces sunlight glare for indoor occupants and neighbouring occupants
- Reduces collision risks for local wildlife (i.e., birds)

INDICATORS

- Energy saved from reduction in artificial lighting
- Share of district households using natural lighting mechanisms
- Directional solar lighting intensity

STRATEGY 14 | WATER CONSERVATION INITIATIVES

PUBLIC EDUCATION PROGRAMS

In alignment with the Government's Total Water Management strategy, water demand and supply management could be facilitated by public education programs on water conservation, use of water saving devices, improved water leakage control and use of seawater for toilet flushing, among other initiatives.

Benefits

- Strengthens ability to withstand climate uncertainties such as possibility of low rainfall
- Improves resilience in fresh water supply
- Encourages sustainable use of water resources

RAINWATER HARVESTING

On a precinct level, smaller-scaled rainwater harvesting systems may be considered, in conjunction with surrounding infrastructure. For example, rainwater harvesting systems could be integrated with overhead watershed in public space, which not only enables effective collection of rainwater but also public spaces that could be used and enjoyed during adverse weather.

Figure 58: Examples of Public Education Programs Initiated by the Water Supplies Department in Hong Kong

INDICATORS

- Total amount of water saved from water conservation initiatives
- Reduction in household water consumption

OBJECTIVE
Harness Renewable Energy

STRATEGY 15 | SOLAR ENERGY SYSTEMS

PHOTOVOLTAIC CELLS

Generate electricity by harnessing solar energy through the application of photovoltaic (PV) cells, for example, through installation of conventional PV panels or building-integrated photovoltaic (BIPV) system. PV panels are suitable for flat, unobstructed spaces such as roof tops, while BIPV systems could leverage the large amount of building envelope space, given Hong Kong's high-density high-rise context. In addition, there is potential to explore more spaces for PV panels. For instance, the island in the middle of some pedestrian crossings may be wide enough for solar panels and provide shading for pedestrians.

Cooling technology to reduce the temperature of overheating PV panels could also be integrated for greater energy conversion efficiency.

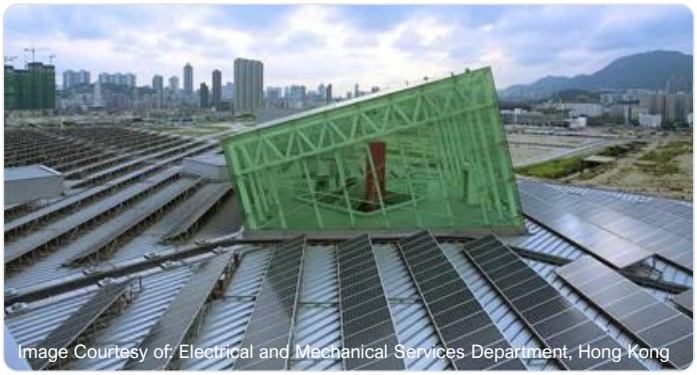


Figure 59: Photovoltaic Cells
A 350 kW PV installation on the roof of the New EMSD Headquarters in Kowloon Bay, Hong Kong.

Benefits

- Provides carbon neutral electricity generation at point of use
- Reduces building cooling needs with BIPV application due to change in thermal insulation of building elements
- Connection to grid systems enables desegregated, micro-grid generation of electricity

SOLAR WATER HEATING SYSTEMS

Use solar water heating systems to harness solar energy for hot water provision (applicable in the summer or when combined with PV application). Unobstructed spaces, such as roofs are usually suitable locations for solar hot water heating system installations.

Benefits

- Provides carbon neutral water heating for the local premise

Figure 60: Rooftop PV Panel Installation
Solar Water Heating Systems at Hong Kong Children's Hospital.

INDICATORS

- Proportion of population served by electric car sharing services

STRATEGY 16 | WIND ENERGY SYSTEMS

SMALL WIND TURBINES

Small wind turbines may be installed within precincts to provide electricity without the need for large swaths of land for wind farms. Examples of such turbines include vertical-axis small wind turbines and micro wind turbine systems. Unobstructed and elevated spaces provide greater potential for installation of small wind turbines. Additionally, small wind turbines can be paired with solar installations to provide a wind-solar hybrid generation.

Benefits

- Provides carbon neutral electricity generation
- Hybrid installations can provide more stable renewable energy in varying weather conditions
- Connection to grid systems enables desegregated, micro-grid generation of electricity

Figure 61: Small Wind Turbines
A 2.5kW grid-connected horizontal-axis small wind turbine on the roof of Marsh Road Station Building.

INDICATORS

- Share of wind energy as part of total energy consumption in the precinct

STRATEGY 17 | WAVE ENERGY SYSTEMS

WAVE POWER DEVICES

Waterfront precincts may harness the waves in the ocean to generate renewable energy. A range of wave power devices are currently available, such as oscillating columns, tapered channel systems, floating wave power devices, and point-absorber technology. The moving body may be located either on the wave surface or submerged.

Benefits

- Provides carbon neutral electricity generation from a stable source, as waves are periodical and easier to predict

INDICATORS

- Share of wave energy as part of total energy consumption in the district

3.4 Theme D

CONNECTED AND CIRCULAR PRECINCTS

This theme focuses on improving urban mobility and enhancing the efficiency of precinct wide systems, touching upon the areas of transit-oriented development, digital intervention, waste collection and management, and the integration of energy systems

THEME D

CONNECTED AND CIRCULAR PRECINCTS

OBJECTIVE

Adopt Transit-oriented Development (TOD) Principles

STRATEGY 18 | TRANSPORT INFRASTRUCTURE DESIGN

INCREASE DENSITY OF PUBLIC TRANSIT TERMINALS

Reduce surface street parking and increase density of public transit terminals to minimise car dependency, with consideration of pedestrian circulation.

Benefits

- Improves access to public transportation

Figure 62: **Increase Density of Public Transit Terminals**
Bus Terminal in Hong Kong.

UPGRADE TRANSIT CORRIDOR DESIGN

Upgrade existing transit corridor design and support the development of multi-modal corridors through:

a. Creating more pedestrian-friendly areas between key transit nodes (e.g., transforming sidewalks into active public spaces, semi-paved corridors, etc.)
b. Enhancing visual impact of streets, with consideration of street lighting
c. Bundling new transit routes

Benefits

- More pleasant corridors encourage walking and use of public transit
- More convenient access to public transit

Figure 63: **Upgrade Transit Corridor Design**
Multi-modal transit corridors in Yuen Long, Hong Kong.

ENCOURAGE ACTIVE TRANSPORT

Encouraging more active over passive transport options can provide alternatives to emission producing vehicles. Contrary to passive transport which is motorised, active transport includes forms of transportation that are not powered by engines (e.g., walking, cycling, etc.), and can be supported by extended cycling tracks (e.g., allocating greater proportion of road to cyclists), more walkable pavements, etc. Where elevated differences are present, footbridges and subways may also be constructed to improve walkability in the city.

Benefits

- Reduces congestion and pollution caused by motorised passive transport

INCLUSIVE DESIGN

Transport infrastructure design to be made inclusive of underserved populations and different age groups, including but not limited to the elderly and persons with disabilities.

Benefits

- Improves access to transportation for all

INDICATORS

- Average distance between public transit terminals
- Proportion of passive versus active transport within a designated area

OBJECTIVE

Digital intervention to transform mobility

STRATEGY 19 | DIGITALISED MOBILITY

Figure 64: Traffic Monitoring

PHYSICAL INFRASTRUCTURE TO SUPPORT DIGITAL MOBILITY

Physical infrastructure to accommodate digital mobility, equipped with the ability to support communications and connectivity, real time analysis, and management of utilities and energy, for example.

Benefits

- Integration of physical infrastructure with digital components enhances overall efficiency and enables the progression towards smart city development

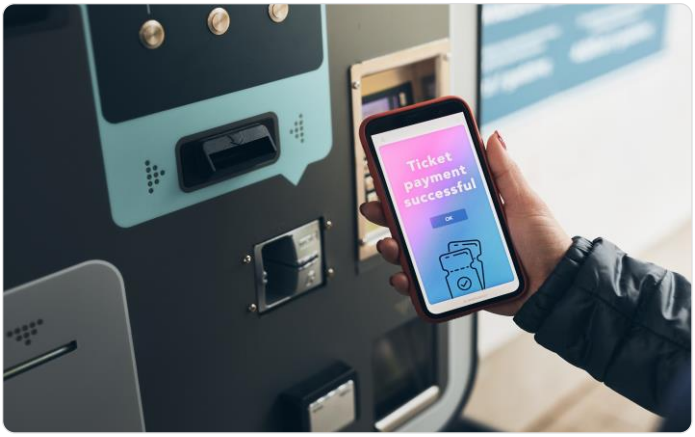


Figure 65: Leverage Mobile Technology
Leveraging mobile technology for transit options, payment, real-time information, etc.

LEVERAGE MOBILE TECHNOLOGY

Technology such as smartphone apps could be leveraged to offer a one-stop platform that integrates multi-modal transportation options, real-time information on public transport, digital payment/ticketing systems, and other public services to make travel more efficient.

Benefits

- Digitalisation of public services can save time and costs while improving efficiency
- Reduces vehicular emissions by cutting unnecessary transportation

SMART PARKING SYSTEMS

Smart parking systems (e.g., via an app) could be implemented to show in real-time when and where parking spaces are available, reducing the time spent on searching.

Benefits

- Reduces traffic and emissions caused in the search for an available parking space

Figure 66: Smart Parking Systems

INVESTMENT IN DIGITAL CONNECTIVITY

Investment in affordable, high quality digital connectivity within the district, such as make Wi-Fi easily accessible.

Benefits

- Enhances sustainable mobility by increasing access to digitalised mobility services
- Enables greater awareness of local services which reduces time and cost needed to commute
- Strengthened connectivity reduces potential inequalities in access to services

Figure 67: Investment in Digital Connectivity
Accessible internet to improve connectivity.

INDICATORS

- Time saved on travel and waiting time
- Time saved on parking search
- Frequency of use of online city services

STRATEGY 20 | SUPPORT ELECTRICAL MOBILITY

ELECTRIC CAR SHARING SERVICES

Implementation of electric car sharing services, such as autonomous/driverless pods to improve mobility and connectivity within the precinct.

Benefits

- Reduces the need for emission-producing vehicles
- Increases accessibility

Figure 68: Electric Car Sharing Services
Driverless pod car at Masdar, Abu Dhabi.

INDICATORS

- Proportion of population served by electric car sharing services

OBJECTIVE
Optimise Waste Collection and Recycling

STRATEGY 21 | WASTE COLLECTION AND MANAGEMENT MECHANISMS

Figure 69: **On-site Composters/Smart Bin Technology**
Composter for food waste.

SUSTAINABLE WASTE MANAGEMENT MECHANISMS

Sustainable waste management mechanisms can be implemented, such as installation of a waste separation and recovery system, expansion of collection points for recyclables and adoption of an automated waste collection system, etc. An integrated approach that covers all sources and aspects, including generation, segregation, transfer, sorting, treatment, recovery and disposal, with an emphasis on maximising resource use efficiency, should be considered.

Particularly in the built environment, a minimum benchmark for adopting recycled building products or materials is important to inform minimum and stretch targets for individual projects (e.g., wastage, waste recovery and recycled content) and to determine corporate targets for overall performance. Actual project data held by an organisation can be sought to develop such benchmarks.

Benefits
- Reduction in waste disposed to landfills
- Increases livability of the precinct through provision of a cleaner environment

ON-SITE COMPOSTERS/SMART BIN TECHNOLOGY

Install on-site composters and/or smart bin technology for the treatment and management of food waste. Smart bins may be equipped with innovative features such as the ability to detect fill-level, reduce odor and sterilise waste, as well as display responsive messages (e.g., the total quantity of garbage recycled) that will educate and drive behavioural changes of the users.

Benefits
- Improves ease and convenience of waste separation
- Enhances precinct hygiene
- Raises awareness about recycling

Figure 70: **Sustainable Waste Management Mechanisms**
Waste bins in Norway integrated with a pneumatic waste collection system.

INDICATORS
- Increase in amount of collected recyclables
- Amount of food waste treated on site

STRATEGY 22 | WASTE-TO-ENERGY SYSTEMS

ELECTRICITY GENERATION VIA BIOFUEL

Cooking oil could be collected and sent to a biofuel supplier for treatment. Biofuel could then be supplied to various areas of the district to generate electricity via systems such as biodiesel trigeneration or temporary site generators during construction works.

Benefits

- Improves efficiency of electricity and heat generation, while providing a renewable energy source
- Uses existing waste heat, in addition to cooking oil, to enable further reduction of energy consumption, emissions and costs

Image Courtesy of: Construction Industry Council, Hong Kong

Figure 71: Electricity Generation via Biofuel
Use of biodiesel tri-generation system at CIC-Zero Carbon Park to generate electricity from biofuel made of used cooking oil.

CONVERSION OF FOOD WASTE INTO BIOGAS

Collection points could also be set up to gather other food waste to be sent to renewable energy generation plants such as O · PARK1—the first facility in Hong Kong that converts food waste into electricity. Using anaerobic digestion technology, the facility turns food waste into biogas, which is then used to generate heat and electricity.

Benefits

- Provides a renewable energy source
- Reduces the amount of food waste sent to landfills


Image Courtesy of: Hong Kong Green Building Council

Figure 72: Conversion of Food Waste Into Biogas
The waste-to-energy facility at O · PARK1, the first organic resources recovery centre in Hong Kong.

INDICATORS

- Amount of cooking oil and food waste converted into energy

OBJECTIVE
Integrate the Energy Systems at Precinct Level

STRATEGY 23 | PRECINCT-WIDE ENERGY SYSTEM DESIGN

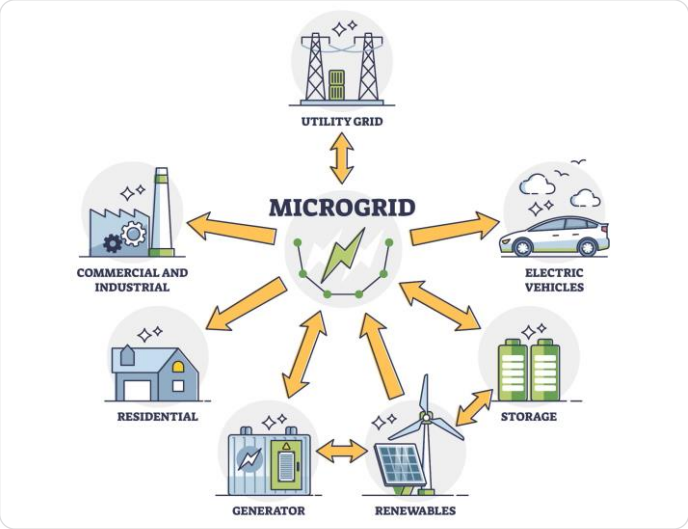


Figure 73: Utilisation of Microgrids

Figure 74: Smart Grid System
Integration of renewable energy via a smart grid system.

UTILISATION OF MICROGRIDS

Energy could be managed more efficiently through the utilisation of microgrids, which are powered by distributed energy sources, including renewable energy. Microgrids are also localised and can operate separately from a traditional energy grid.

Benefits

- Lowers energy costs through reducing energy wasted in transmission
- Provides cleaner energy
- Being able to operate in isolation from traditional energy grid enables ability to respond to unprecedented situations, thus, enhancing local resiliency

SMART GRID SYSTEM

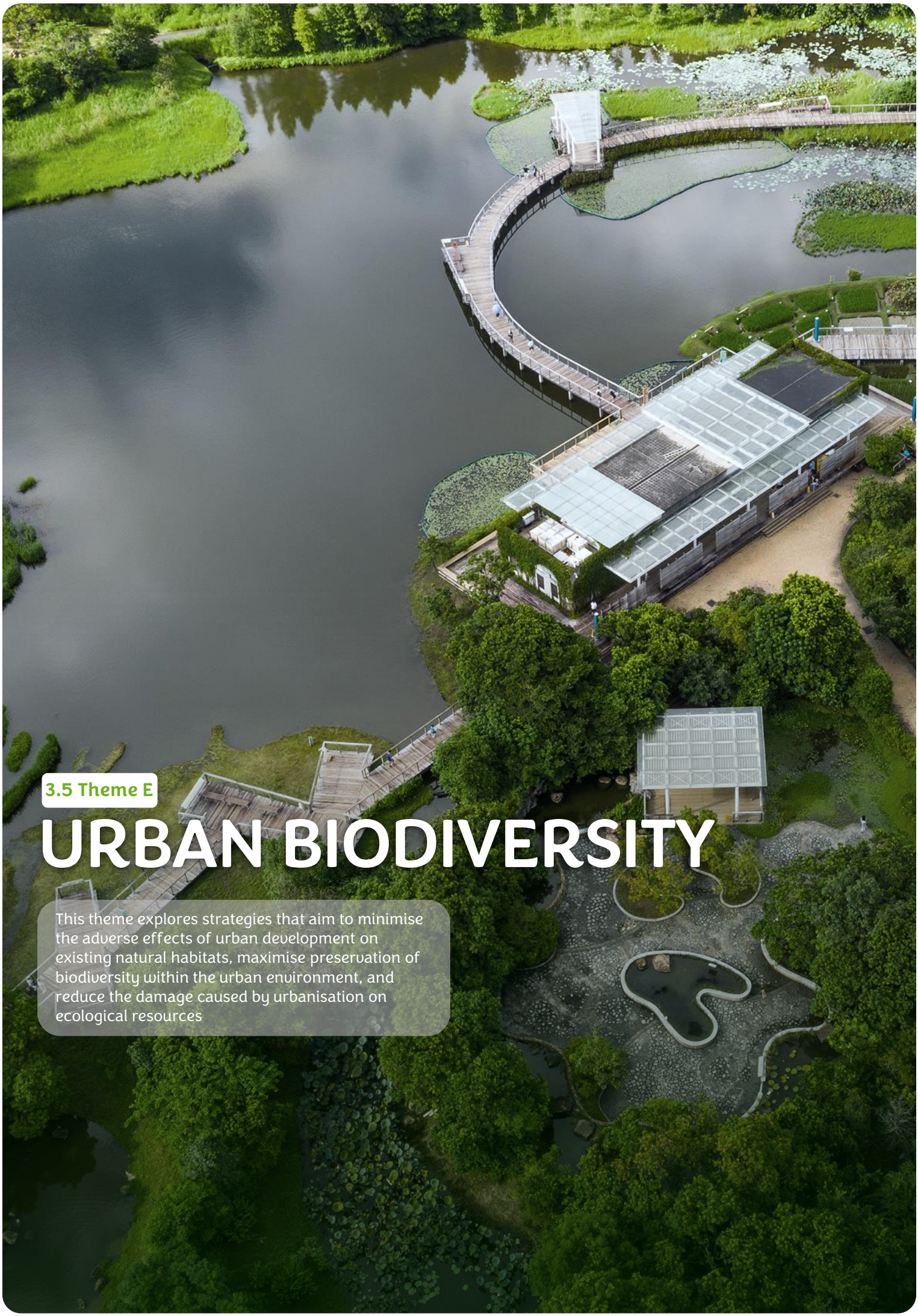
Integration of renewable energy, power storage devices, monitoring technologies and other intelligent systems via a smart grid system, allows electricity and data to flow two-ways.

Benefits

- Provides a timely response to energy demand and improves efficiency of power generation
- Reduces energy consumption in heavy loads
- Increasing use of renewable energy reduces consumption of fossil fuels

INDICATORS

- Increase in proportion of renewable energy used



3.5 Theme E

URBAN BIODIVERSITY

This theme explores strategies that aim to minimise the adverse effects of urban development on existing natural habitats, maximise preservation of biodiversity within the urban environment, and reduce the damage caused by urbanisation on ecological resources

THEME E

URBAN BIODIVERSITY

OBJECTIVE

Planning of Development Area Locations and Boundaries

STRATEGY 24 | PRIORITISE (RE-)DEVELOPMENT OF LOW BIODIVERSITY AREAS

INVESTIGATE REGIONAL CONTEXT AND SITE CONDITIONS

Investigate regional context and site condition of biodiversity resources through desktop studies and/or biodiversity surveys to understand the baseline of existing ecological resources.

AVOID ENCROACHING ON NATURAL HABITATS OF HIGH BIODIVERSITY

Adjust the locations/boundaries to exclude areas with statutory/conservation status (e.g., sites of special scientific interest) and to avoid encroaching or fragmenting natural habitats of high biodiversity (e.g., woodland, natural stream, undisturbed natural coast, intertidal mudflats, mangrove etc.) where possible.

INCLUDE AREAS OF LOW BIODIVERSITY LEVEL FOR REDEVELOPMENT

Include aged infrastructures/development areas without urban biodiversity design or of low biodiversity level for redevelopment.

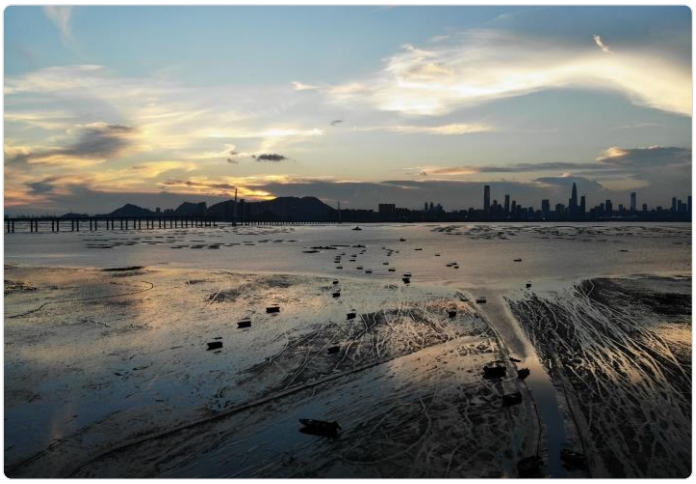


Figure 75: Avoid Interfering With Areas of High Biodiversity
Avoid encroaching on natural habitats with high biodiversity value, such as intertidal mudflats and mangroves, among others.

Benefits

- Reduces impact on natural habitats to facilitate future establishment of urban biodiversity in new developed areas
- Promotes opportunities to improve urban biodiversity in existing urban areas.

INDICATORS

- Proportion of natural habitats preserved in new/re-development projects

STRATEGY 25 | PRESERVE EXISTING HABITATS

IDENTIFY OPPORTUNITIES AND CONSTRAINTS ON URBAN BIODIVERSITY

Identify opportunities (e.g., existing ecological resources) and constraints (e.g., site constraints) on urban biodiversity. For instance, waterbodies can provide habitats for aquatic or water-dependent wildlife (such as dragonflies, frogs and fishes), and provide water sources for wildlife inhabiting terrestrial habitats. Those water-dependent wildlife might potentially be prey for other larger wildlife and thus can attract further wildlife to the waterbodies. For example, fishes in ponds are potential prey for ardeids, thus, ardeids can also be attracted to the habitats and the wildlife use of the habitats increase. Thus, when including waterbodies into urban biodiversity, more wildlife could be supported.

PRESERVE PORTIONS OF EXISTING NATURAL HABITATS WHEN ZONING

Preserve portions of existing natural habitats (e.g., remnant woodlands) or managed vegetated areas (e.g., parks with considerable biodiversity) as urban biodiversity areas when considering land use zoning within the area.

PRESERVE NATURAL WATER CHANNELS

Preserve natural water channels through implementation of ecological measures in their design. Elements that may be considered include the types of grassed lining used, aquatic planting, curves affecting water flow, etc.

INCORPORATE PRESERVED HABITATS

If possible, incorporate preserved habitats in different locations within the area.

Figure 76: Incorporate Preserved Habitats
Managed vegetated areas, such as parks with considerable biodiversity can be preserved as urban biodiversity areas when considering land use zoning within the area.

Benefits

- Accelerates establishment of future new urban biodiversity areas
- Provides sources of recruitment of vegetation seeds or fauna offspring

INDICATORS

- Natural habitats as a proportion of total district area

STRATEGY 26 | SUFFICIENT SPACE FOR NEW URBAN BIODIVERSITY

Figure 77: Sufficient Space for New Urban Biodiversity within Development Area

RESERVE SPACE FOR NEW URBAN BIODIVERSITY AREAS

Reserve space for new urban biodiversity areas, preferably close to existing natural habitats (either inside or outside the development area) as far as possible with consideration of opportunities and constraints within/around the area. It is also important to educate others on the idea of the continuous development of green areas and that biodiversity takes time to nurture.

LOCATE HIGH DISTURBANCE ACTIVITIES AWAY FROM BIODIVERSITY AREAS

Allocate high disturbance activities/infrastructures away from the preserved and new urban biodiversity areas.

INTEGRATE NATURAL HABITATS WITH OPEN SPACE

Integrate with landscape area and open space if feasible.

Benefits

- Provides sufficient space for wildlife colonisation
- Facilitates establishment of biodiversity connectivity

INDICATORS

- Proportion of space reserved for new urban biodiversity within development area

OBJECTIVE
Planning of Urban Biodiversity Area

STRATEGY 27 | OPTIMISE CONNECTIVITY OF URBAN BIODIVERSITY AREAS

FORM ECOLOGICAL LINKAGES WITH CORRIDORS AND STEPPING-STONES

Form ecological linkages by corridors and stepping-stones (e.g., preserved habitats, urban biodiversity areas, and green/blue infrastructures).

LINK EXTERNAL NATURAL HABITATS TO URBAN BIODIVERSITY AREAS

Form linkages between external natural habitats and the urban biodiversity areas.

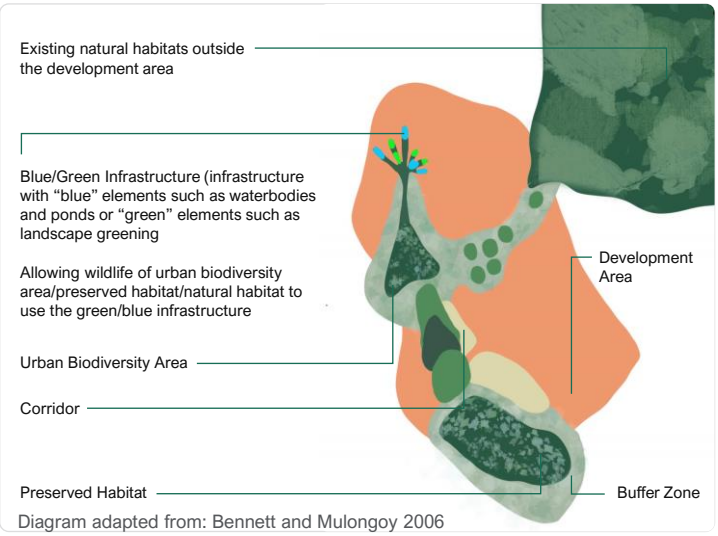


Figure 78: Overview of Linking Natural Habitats to Urban Biodiversity Areas
Ecological linkages via corridors and stepping-stones can be used to establish ecological linkages from natural habitats to urban biodiversity areas.

Figure 79: Example of Natural Habitats Linking to Urban Biodiversity Areas
Ecological linkage within a development area can be used to connect habitats for wildlife.

Benefits

- Expands the range of wildlife habitats and dispersion of species
- Produces synergetic effects by integrating different habitats into an ecosystem

INDICATORS

- Range of wildlife habitats in the district ecosystem
- Range of native species in the district ecosystem

STRATEGY 28 | GREEN/BLUE INFRASTRUCTURE PLANNING

IDENTIFY OPPORTUNITIES FOR GREEN/BLUE INFRASTRUCTURE

Identify opportunities to implement green/blue infrastructures (e.g., green channel, eco-shoreline, GIC facilities with green roof) with considerations of distribution of urban biodiversity areas and prior to the development of grey infrastructure.

IDENTIFY OPPORTUNITIES TO IMPROVE GREY INFRASTRUCTURE

Explore opportunities to improve traditional grey infrastructures and incorporate biodiversity design where possible.

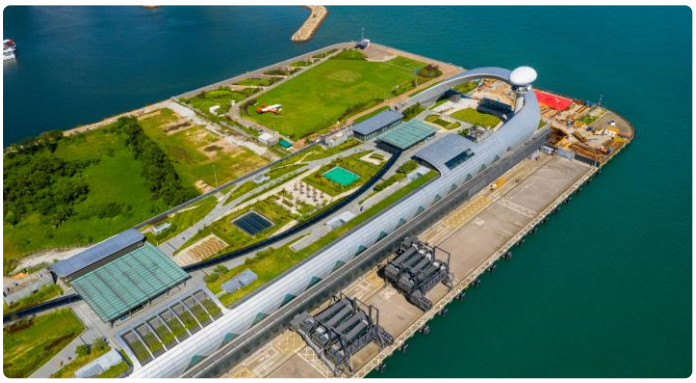


Figure 80: Identify Opportunities for Green/Blue Infrastructure
Green roof adopted at the Kai Tak Cruise Terminal building in Hong Kong.

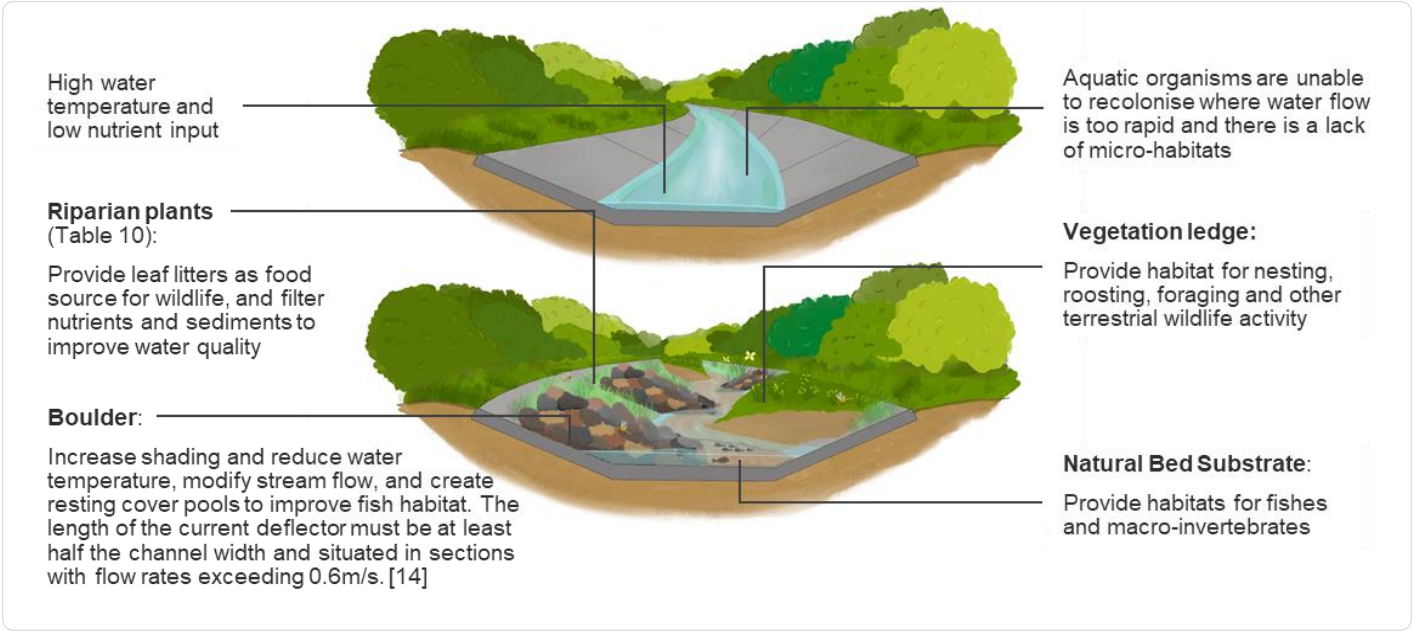


Figure 81: Example of Blue Infrastructure Planning

Performance of Green Channel	No. of Wetland Species Recorded	No. of Native Species Recorded
Poor	0-10	0-30
Typical	11-20	31-60
Good	>20	>60

Table 5: Assessment for Performance of Green Channels
A diverse wetland vegetation along the water margin could provide more micro-habitats for a variety of animals.

Benefits

- Serves as part of urban biodiversity areas
- Enhances the connectivity among urban biodiversity areas

INDICATORS

- Proportion of space reserved for new urban biodiversity within development area

STRATEGY 29 | ECO-FRIENDLY/WILDLIFE-SAFE INFRASTRUCTURE AND BUILDING DESIGN

INCORPORATE WILD-LIFE DESIGN

Incorporate wildlife safe design (e.g., patterns on noise barriers, UV visible glass for windows to prevent bird collision, wildlife corridors at highway to reduce road kills, bird-safe wind turbines)

Benefits

- Reduce risks for wildlife colonising urban biodiversity areas

Figure 82: Incorporate Wild-Life Design
Illustration of a wildlife corridor at a high-speed railway. Wildlife can cross the railway through the corridor without the risk of roadkill.

STRATEGY 30 | ESTABLISH URBAN BIODIVERSITY AREAS

Figure 83: Ecological Resources in New Urban Development
The West Kowloon District in Hong Kong is a conventionally urbanised area with a limited amount of ecological resources. The development of the West Kowloon Cultural District, which involves new greenery, seasonal plantations, and thus, the creation of natural habitats in the city, may contribute to increased biodiversity in the area.

ALIGN APPROACH IN EARLY DESIGN STAGE WITH SITE CONTEXT

Formulate the approach in the early design stage of development in accordance with site context. Three major approaches are:

1) Enhancement of ecological functions of existing habitats

2) Restoration of ecological functions

3) Create new biodiversity area

RESTORE ECOLOGICAL RESOURCES

Leverage new urban development as an opportunity to restore destroyed ecological resources.

Benefits

- Ensures that future urban biodiversity areas are compatible with the local context

INDICATORS

- Proportion of ecological resources restored in new developments

STRATEGY 31 | ECOLOGICALLY SENSIBLE DESIGN

CONSIDER THE SIZE AND SHAPE OF A BIODIVERSITY AREA

Consider the size and shape of an urban biodiversity area. For example, a large biodiversity area is better than several smaller areas with equal total area, whereas round-shaped are better than elongated ones, in terms of reducing the edge effect, which refer to changes to a population that take place at the boundary between adjacent habitats.

ENSURE A BUFFER DISTANCE

Ensure a buffer distance from key sources of disturbances in the urban area.

ESTABLISH A CORE AREA, OFF-LIMITS TO HUMAN ACCESS

Establish a core area which are off-limits to human access, while the outer areas still allow conservation education related activities.

Benefits

- Improves effectiveness of the habitat establishment process

Diagram adapted from: Bennett and Mulongoy 2006

Figure 84: Consider the Size and Shape of Biodiversity Areas
Comparison of sizes and shapes of urban biodiversity area. A larger biodiversity space is preferred over a number of smaller spaces of equal size.

INDICATORS

- Shape requirements of urban biodiversity area

STRATEGY 32 | PROVIDE COMPLEX HABITATS TO ATTRACT WILDLIFE FOR COLONISATION

TOPOGRAPHIC PROFILE AND PLANTING

Provide habitats through topographical profile and planting to create more complex topography.

CREATE A MOSAIC OF DIFFERENT HABITATS

Create a mosaic of different habitats (e.g., woodland, shrub, grassland, etc.) adjacent to each other and with complex structures (e.g., shading, exposed, windy, sheltered).

INCLUDE WATER BODIES

Include water bodies (e.g., aquatic habitat or drinking bath) where possible.

UTILISE NATURAL MATERIALS

Utilise natural materials/substrates, which is common for river revitalisation and wildlife pond creation.

PLANT NATIVE SPECIES

Plant native plant species, especially those with known ecological functions (butterfly larval foodplant, to provide feeding and nursery grounds for species. For exotic plants, only select those locally naturalised or compatible with local ecology (e.g., known butterfly nectar plant species) and remove aggressive exotic plant or animal species.

PROVIDE ADDITIONAL DESIGN

Provision of additional design (e.g., nest box, bat box, wood logs).

CONSIDER BIODIVERSITY IN DISTRICT MAINTENANCE AND PRACTICES

Consider biodiversity in district maintenance and management practices (e.g., control use of pesticide, avoid too frequent maintenance works). Additionally, expanding green coverage in buildings is also beneficial and could be demonstrated in a variety of ways, such as terrace gardens and green facades, among others.

OPERATIONAL PLAN WITH MAINTENANCE MEASURES OF HABITAT QUALITY

Establish an operational plan with maintenance measures of habitat quality to ensure the performance of ecological services while balancing human activities.

Figure 85: Water Bodies
Water bodies such as streams and waterfalls integrated in Hong Kong's urban areas.

Benefits

- Provision of suitable habitats with connectivity with other ecological resources can help speed up wildlife colonisation

INDICATORS

- Diversity of wildlife found in the urban biodiversity area
- Diversity of planted species and ratio of native plant species
- Diversity of habitats created

3.6 Theme F

INCLUSIVE & ACCESSIBLE COMMUNITIES

This theme focuses on strategies that target to improve social infrastructure, strengthen local engagement and sense of belonging within the community, as well as foster inclusiveness and social cohesion

THEME F

INCLUSIVE & ACCESSIBLE COMMUNITIES

OBJECTIVE

Enhance Inclusiveness and Personal Security

STRATEGY 33 | ACCESS TO PUBLIC FACILITIES AND SERVICES

TRANSIT SAFETY EQUITY

Design public spaces for transit safety equity. This can be achieved through:

a. Designing streets and transport facilities to allow safely accessible transport for all members of the community, particularly pedestrians (e.g., 'Streets for People' and 'Woonerf' approaches*); cyclists (e.g., dedicated cycle lanes); elderly, the differently-abled and mothers (e.g., 'Universal Access' principles).

b. Designing transit boarding facilities for inclusive access (e.g., bus stops, rail platforms) to allow for ease of boarding and seating for elders, differently abled and mothers.

Benefits

- Improves accessibility for underserved populations and geographic areas
- Increases use of transit and reduces private vehicle use and consequent emissions
- Enhances personal safety and thereby physical wellbeing

Figure 86: Transit Safety Equity
Safe and inclusive streets with transport facilities design.

INDICATORS

- Proportion of population with convenient access to safe, affordable and sustainable transport, particularly those in vulnerable situations, women, children, persons with disabilities and older persons

*Notes:

1. Street for People is a street design concept that prioritises pedestrian and place-making which has been adopted by many countries including USA, India, and New Zealand.
2. The Woonerf Approach is a street design concept that encourages multimodal transportation and blends pedestrian and vehicle space. It was initiated in Delft, the Netherlands in the 1960s and 1970s as a new way of designing streets to be people-friendly spaces. A woonerf—or "residential yard" in Dutch—is a residential street in which the living environment predominates rather than vehicular infrastructure (https://nacto.org/docs/usdg/woonerf_concept_collarte.pdf).

Figure 87: Access to Educational Facilities
The Hong Kong International School Lower Primary School building is BEAM Plus New Building Gold certified.

ACCESS TO EDUCATIONAL FACILITIES

Enable access to appropriate educational facilities for the size of community based on the following considerations:

a. Provide educational facilities for each age group and sex (e.g., kindergartens, primary schools, secondary schools, special schools, post-secondary colleges, universities) based on an analysis of existing and future population

b. Enhance spatial distribution of educational facilities of different types throughout the precinct

Benefits

- Enhances life opportunity and social equity
- Enhances access to education

INDICATORS

- Participation rate* in organised learning
- Distance to the nearest educational facility

ACCESS TO HEALTHCARE FACILITIES

Enable access to an appropriate range of healthcare facilities for the size of community based on the following considerations:

a. Provide appropriate healthcare facilities (e.g., GP office, clinics, hospitals, ambulatory care centres, hospices, hospitals) based on an analysis of existing and future population

b. Enhance spatial distribution of healthcare facilities of different types throughout the precinct

Benefits

- Ensures that patients receive the most appropriate treatment
- Enhances physical and mental wellbeing and social equity
- Ensures convenient access to healthcare facilities throughout the district

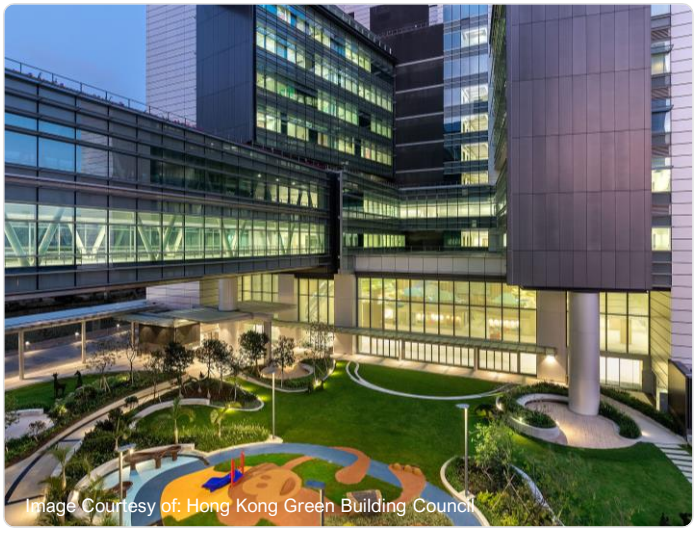


Figure 88: Access to Healthcare Facilities
The BEAM Plus New Building Platinum hospital provides medical services for children and forms a specialist component in the wider network of healthcare facilities in Hong Kong. Precincts co should consider provision of enhanced access to one or more components of the healthcare network.

INDICATORS

- Proportion of population registered with healthcare services
- Distance to the nearest healthcare facility

*Notes:

There are many indicators that can assist in measuring the level of Accessibility to Educational Facilities. "Participation Rates in Organised Learning" or "participation rate of youth and adults in formal and non-formal education and training in the previous 12 months, by sex (SDG Indicator 4.3.1) and disability" is just one of the many indicators. A complete list of indicators can be found in "Illustrative indicators on education" by United Nations Human Rights (https://www.ohchr.org/sites/default/files/article-24-indicators-en.pdf).

ACCESS TO ELDERLY CARE FACILITIES

Provide access to an appropriate range of elderly care facilities in the community based on the following considerations:

a. Provide a range of elderly care facilities at different levels of intervention (e.g., Residential Care Homes for the elderly to Integrated Home Care, Enhanced Home Care and Community Services and Day Care, etc.) based on an analysis of population size and age profile demography

b. Enhance spatial distribution of elderly care facilities throughout the precinct

Benefits

- Enhances physical and mental wellbeing
- Promotes community cohesion and social integration

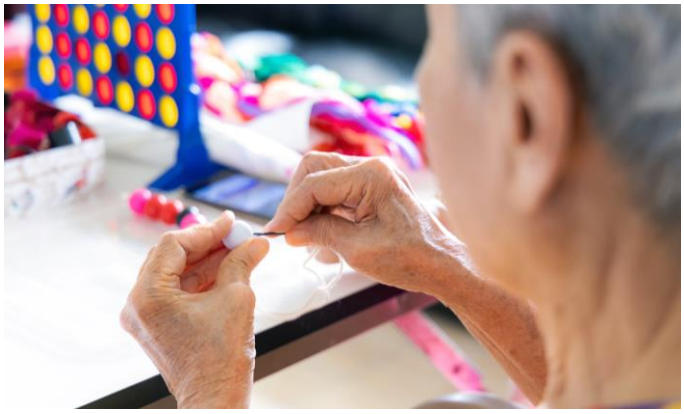


Figure 89: Access to Elderly Care Facilities
Enhanced access to elderly care services requires a network of facilities of different types spread across Hong Kong. Precincts or urban quarters should consider the care needs of its own elderly population as well as the needs of elders across the wider community.

INDICATORS

- Proportion of elderly population registered with elderly care facilities
- Distance to the nearest elderly care facility

Figure 90: Inclusive Design
Spaces should be designed to be inclusive and accessible. For example, handrails may be provided to accommodate the elders.

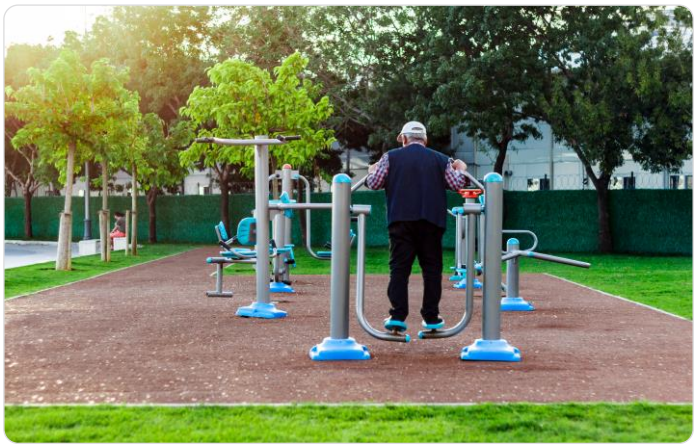


Figure 91: Facilities for Aging in Place and Active Aging
Overseas example of exercise equipment designed specifically for elders, similar to outdoor elderly fitness corners in Hong Kong. Ensures that elderlies live a healthy active lifestyle and are socialising with others.

FACILITIES FOR AGING IN PLACE AND ACTIVE AGING

Provide facilities for Aging in Place and Active Aging based on the following considerations:

a. Make provision for inclusive urban design and developments and spaces that prolong active and independent living for elders. All spaces should be designed with access by elders in mind (e.g., provision of handrails)

b. Facilities should be provided to encourage an active lifestyle for elders such as park exercise equipment specifically designed for elders

c. Consider establishing an 'intergenerational community', which are those designed specifically to facilitate residents of different ages to live in the same development (e.g., Kampung Admiralty model in Singapore). Interaction between age groups can bring mutual benefits for both young and old

d. Distribute elders' residential and care facilities evenly throughout precincts, rather than as segregated communities or units, to promote greater intergenerational social interaction

Benefits

- Enhances mental wellbeing of elders
- Enhances community cohesion and social integration

INDICATORS

- Proportion of elderly population living independently

CONVENIENT AND SAFE ACCESS TO OPEN SPACE FOR ALL

Provide convenient and safe access to open space for all, including elders, the differently abled (e.g., 'Universal Access' principles), women, mothers, children, ethnic minorities, and other groups, based on the following considerations:

a. Provide a diversity of types of open space, including active (e.g., sports facilities) and passive (e.g., gardens, sitting-out areas) public open spaces and facilities

b. Ensure that open spaces of different types are spatially distributed to ensure that they are easily accessible by all residents of a precinct

c. Maximise connectivity inside and among open spaces to allow convenient access and to promote walkability and physical exercise

d. Design of open spaces should ensure personal safety (e.g., 'defensible space' principles, adequate lighting; overlooking, etc.) with particular regards to women, children, and the differently-abled

Benefits

- Enhances physical and mental wellbeing
- Enhances community cohesion and social integration
- Promotes walkability and reduces transport emissions

Images Courtesy of: Playright Children's Play Association

Figure 92: **Convenient and Safe Access to Open Space for All**
The award-winning Inclusive Playground in Tuen Mun Park is the first barrier-free play space in Hong Kong and was designed with direct input from the community.

INDICATORS

- Proportion of precinct/urban area designated as public open space
- Distance to the nearest open space from residential neighbourhood, public facilities and services (e.g., educational, healthcare, elderly care facilities)

MECHANICALLY ASSISTED MOBILITY

Where necessary, lifts and escalators can be installed in place of stairways or ramps in areas with elevation differences, to facilitate the flow of people and goods. Conveyers can also be installed on flat surfaces between two points of long distances. The design of these modes of circulation should consider factors such as type and space of occupancy, handling capacity and inclination and speed, that may affect the comfort of users and the machine's effectiveness.

Benefits

- Improves mobility in the city and increases efficiency
- Alleviates barriers to those experiencing physical disabilities or carrying heavy weights

INDICATORS

- Number of lifts and/or escalators installed in elevated areas previously only accessible by stairways or ramps

STRATEGY 34 | ENHANCE ECONOMIC OPPORTUNITIES

ACCESS TO EMPLOYMENT OPPORTUNITIES

Provide access to employment opportunities by allowing for adequate floor space for employment and commercial activity within precincts, based on an analysis of the size of the existing and future population.

Benefits

- Enhances economic opportunity and social equity
- Enhances citizens' economic security
- Promotes walkability while reducing need to travel, and transport emissions
- Stimulates resilient local economy

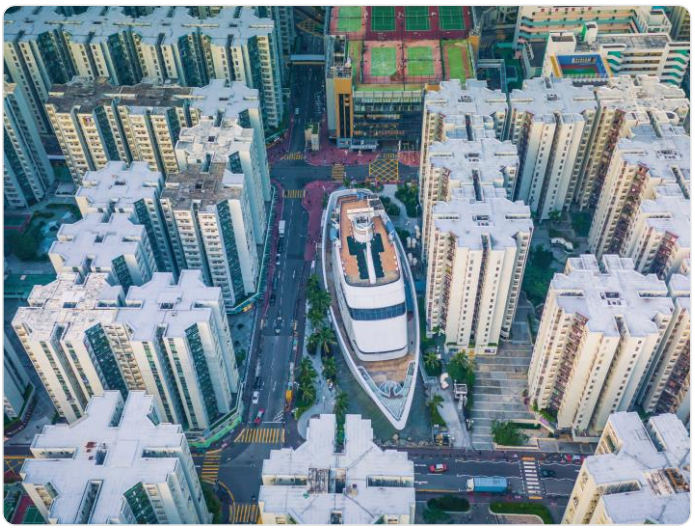


Figure 93: Access to Employment Opportunities
An example of a mixed-use area in Whampoa with retail opportunities in the near vicinity of residential buildings.

INDICATORS

- Rate of un/employment in district

INDUSTRIAL AND COMMERCIAL OFFICES

Provide a range of industrial* and commercial offices/units of different types and sizes (e.g., factory space, workshop, co-working space, etc.) and supporting facilities (e.g., shops, F&B outlets, post offices, etc.).

Benefits

- Enhances economic opportunity and social equity
- Enhances citizens' economic security
- Reduces need to travel long distances and minimises transport emissions
- Stimulates resilient local economy

Figure 94: Industrial and Commercial Offices
Hong Kong needs a wide variety of spaces for different kinds of business, from co-working spaces, to offices, to workshops. Different types of business spaces can reduce emissions generated by commuting and enhances local social cohesion.

INDICATORS

- Proportion of floor space representation of commercial/industrial units of different types

*Notes:

"Industrial Use" as defined under Chapter 5 of the Hong Kong Planning Standards and Guidelines, refers to 'The use of any place, premises or structure for the manufacture, alteration, cleansing, repairing, ornamenting, finishing, adaptation for sale, breaking up, or demolishing or transformation of goods and materials; for the storage, loading, unloading or handling of goods and cargo; or for the training, research, design and development, quality control and packaging in relation to the above processes.'

The definition was adapted from the Factories and Industrial Undertakings Ordinance (Cap. 59). More details of the definition of industrial and factory use can be found under The Town Planning Board's "Definitions of Terms" for "Industrial Use" (https://www.info.gov.hk/tpb/en/forms/dot_revised_index_ftoo.html).

OBJECTIVE
Enhance Social Cohesion

STRATEGY 35 | SPACES FOR COMMUNITY INTERACTION

STREETS/OPEN SPACES FOR COMMUNITY AND SOCIAL USE

Design streets and open spaces for community and social use based on the following considerations:

a. Ensure spaces can be used for community and social events for all age groups, genders and abilities
b. Design streets and open spaces to be flexible so that they can be used for a variety of community events of different scales and types, and during different times of the day
c. Tailor the design of certain public spaces to fit specific user groups
d. Community spaces should be shaded and not be near noisy highways to enhance their functionality. However, any shading in open spaces must not hinder natural air ventilation and sunlight penetration
e. Use the design of public spaces to reinforce local identity and heritage and thereby, community cohesion
f. Allocate urban green space for community use to provide the opportunity to strengthen connection with and participate in the design and maintenance of urban biodiversity

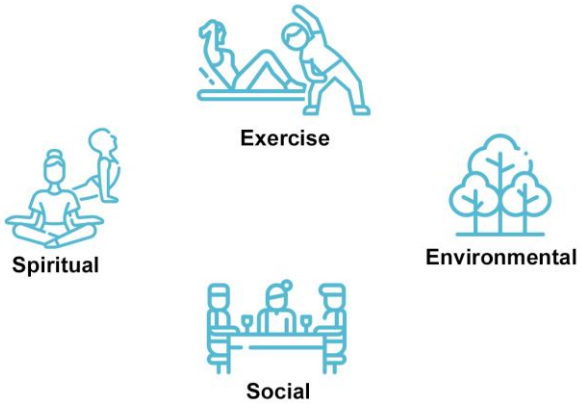


Figure 95: Streets/Open Spaces for Community and Social Use
Open spaces which promote socially sustainable communities are flexible enough to accommodate a variety of different uses by different groups within the community, whilst promoting gatherings and events which fosters community cohesion.

Benefits

- Enhances community cohesion and social integration
- Reinforces local identity and sense of place

INDICATORS

- Proportion of district/urban area that is public open space and can serve community event functions

STRATEGY 36 | MIXED RESIDENTIAL PRECINCTS

STABLE, VIBRANT AND DIVERSE MIXED RESIDENTIAL COMMUNITIES

Design stable, vibrant and diverse, mixed residential communities based on the following considerations:

a. Provide a mixture of affordable housing types, by cost, size, and tenure, to create a vibrant, mixed community and to ensure that social mobility does not require moving district

b. Ensure that housing is integrated with other compatible land uses, to create districts that are diverse and vibrant 24-hours per day, and which reduce travel needs

Benefits

- Enhances community cohesion and social integration
- Reduces private vehicle use and consequent emissions
- Enhances personal safety and thereby physical wellbeing

Figure 96: Mixed Residential Communities
Tseung Kwan O residential building in Hong Kong built on top of MTR station, increasing convenience and access to transportation.

INDICATORS

- Diversity of tenure and size of residential units

STRATEGY 37 | BALANCED APPROACH TO RENEWAL

AVOID GENTRIFICATION AND DESTRUCTION OF EXISTING COMMUNITIES

During urban renewal, avoid gentrification and destruction of existing communities. Even partial retention of existing precincts can help to retain urban diversity and sense of place, reduce alienation and lack of social and economic sustainability.

Benefits

- Retains community cohesion and social integration
- Retains tangible and intangible cultural heritage
- Retains local identity and sense of place
- Retains existing economic base and activity

Figure 97: Retaining Existing Neighbourhoods
The Blue House Cluster in Wan Chai is an example of retrofitting. This approach avoided carbon emissions, and allowed existing residents to retain their homes and provided a new community space within the building.

INDICATORS

- Proportion of area retained or not comprehensively redeveloped within urban renewal project area

3.7 Theme G

INNOVATIVE SUSTAINABLE DESIGN AND TECHNOLOGY

This theme explores strategies in the areas of smart and intelligent systems, construction technologies (e.g., off-site construction technology), sustainable construction materials and flexible building design

THEME G

INNOVATIVE SUSTAINABLE DESIGN AND TECHNOLOGY

OBJECTIVE

Integrated Monitoring and Control Systems

STRATEGY 38 | INTELLIGENT INFRASTRUCTURE FOR SMART BUILDING AND PRECINCT FUNCTIONS

INTEGRATION OF DIGITAL INTELLIGENCE

Digital intelligence can be integrated into urban systems to solve public problems and improve quality of life. Smartphones and real-time sensors can be leveraged to generate important data and insights that help to drive more informed decisions. For example, real-time sensors may be implemented to collect data on variables that impact daily life, such as traffic flow, energy consumption and air quality, which can then be translated, through digital tools, into relevant targets and action items, such as in the areas of mobility, health, energy and resource management, among others. This ultimately improves liveability for multiple aspects.

Benefits

- Transparent and real-time information facilitates more effective use of resources, such as energy, water, mobility, and waste
- Opportunity to control and reduce energy consumption based on insights provided
- Provides solution to monitor and manage the performance of renewable energy generation

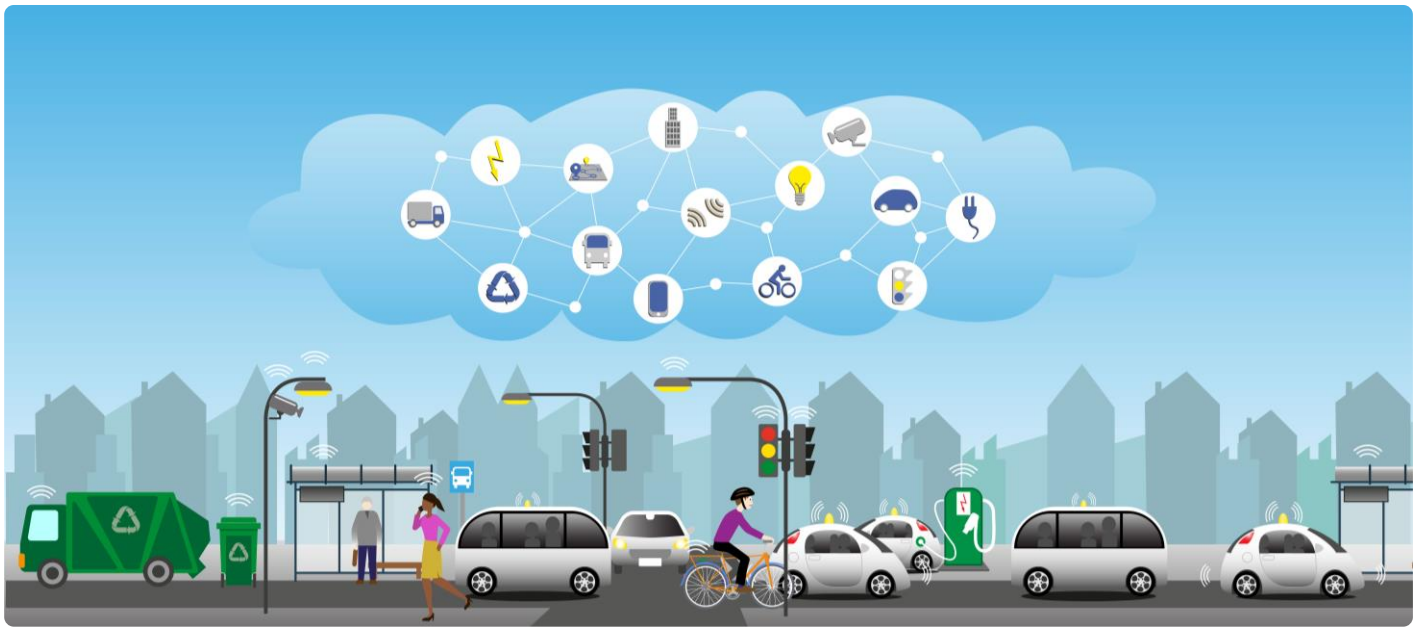


Figure 98: Integration of Digital Intelligence in Urban Systems
Smart cities can leverage digital intelligence to solve urban problems.

INDICATORS

- Proportion of building and district functions digitalised
- Types of parameters monitored per functional area (e.g., temperature, traffic volumes, CO_2 levels)

OBJECTIVE
Leverage Construction Technology to Maximise Resource Efficiency

STRATEGY 39 | OFF-SITE INFRASTRUCTURE CONSTRUCTION TECHNOLOGY

ADOPTION OF MODULAR INTEGRATED CONSTRUCTION/MULTI-TRADE INTEGRATED MECHANICAL, ELECTRICAL AND PLUMBING (MIC/MIMEP)

Adopt MiC/MiMEP to improve productivity, efficiency and precision of construction projects by relocating the construction of different modules off-site.

USE OF BUILDING INFORMATION MODELING (BIM) MODELS FOR SYNCHRONISED UPDATES

The adoption of BIM models allow real-time updates to any changes to the project, enhances communication, improves transparency, as well as strengthens alignment and consistency across all parties involved.

Figure 99: Adoption of MiC
Lifting and installation of MiC modules on construction site.

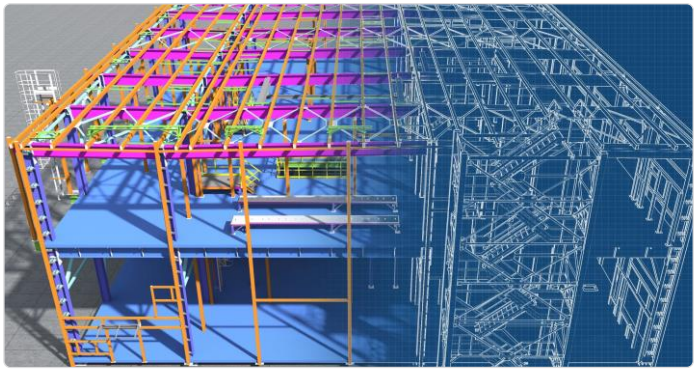


Figure 100: Using BIM Models for Synchronised Updates
BIM model of metal structure.

Benefits

- Greater transparency during the design phase (e.g., 3D modelling for better coordination on sustainable materials and methods used to save time and money on reworking and rescheduling)
- Greater efficiency in the design and construction phases (e.g., 5D modelling with dimensions of timing and cost, as a means of reducing material wastage in manufacturing and energy and carbon footprint, by delivering the required materials only when needed)
- Greater control during the operations phase (e.g., allow long-term, environmentally-conscious operational recommendations and maintenance schedules during the design phase)

INDICATORS

- Time and resources saved in construction
- Reduction in construction waste

OBJECTIVE
Adopt Circular Design and Construction Principles

STRATEGY 40 | SUSTAINABLE CONSTRUCTION MATERIALS

USE OF BIO-BASED MATERIALS

Use bio-based materials available in the local environment (e.g., timber, bamboo, banana tree trunk veneer).

Benefits

- Reduces greenhouse gas emissions more than half compared to fossil-based materials

USE OF RECYCLED MATERIALS FROM LOCAL CONSTRUCTION WASTE

Use recycled materials (e.g., timber, metal, steel, stone and aggregates) from local construction waste.

Benefits

- Reduces energy consumption and carbon emissions from processing reclaimed materials

USE OF LOW-CARBON MATERIALS

Low-carbon materials which require low-energy and low-carbon processes in their production, such as concrete that incorporates sustainable 'cement replacements', can be used in construction projects.

Benefits

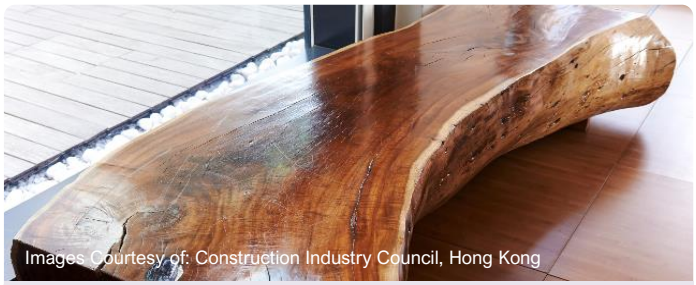
- Reduces embodied carbon or carbon emissions during manufacturing

LOCAL SOURCING OF CONSTRUCTION MATERIALS

Source construction materials produced locally/regionally that align with Hong Kong standards to reduce transportation distance.

Benefits

- Reduces carbon emissions associated with transportation



Natural furniture made from recycled material

Low-embodied carbon paver stones

Recycled debris salvaged from demolition waste used for gabion walls

Figure 101: Use of Low Carbon Materials
Application of low carbon construction and materials in CIC's Zero Carbon Park.

INDICATORS

- Reduction in embodied carbon of a building or infrastructure project
- Proportion of sustainable construction materials used

STRATEGY 41 | FLEXIBLE BUILDING DESIGN

STRUCTURAL ELEMENTS DESIGNED TO ACCOMMODATE CHANGE

Design structural elements of buildings to enable change in uses without requiring major alterations in construction work, such as allowing greater floor-to-ceiling heights and increasing open plan areas, with consideration of the requirements listed under the Building Department's General Building Plan submission.

Benefits

- Reduces construction waste
- Prolongs functional lifespan of the structure
- Mitigates additional embodied carbon by reducing additional construction work needed

FLEXIBILITY IN EXTERNAL AND INTERNAL SPACE

Allow the possibility of transforming internal and external space to serve multi-functional purposes by incorporating flexibility and mobility in partitions, furniture, and equipment.

Benefits

- Extends usability of the space

Figure 102: Flexibility in External and Internal Space
Partitions can be installed or removed to create flexible spaces when needed.

INDICATORS

- Amount of construction work avoided
- Types of uses accommodated by the building

3.8 Theme H

MITIGATION OF HEALTH RISKS

This theme focuses on strategies that target to improve public hygiene and sanitation, air quality and circulation, public response to epidemics and contact tracing

THEME H

MITIGATION OF HEALTH RISKS

OBJECTIVE

Enhance Design and Quality of the Built Environment

STRATEGY 42 | REPURPOSE PUBLIC SPACES

SITE REPURPOSING IN RESPONSE TO A PANDEMIC

In response to a pandemic, factors to consider after a location is selected for repurposing include, availability of resources, the district/street type (i.e., residential, business, etc.), the area's dimensions, the anticipated duration of need, function of the space, and seasonal factors (e.g., repurposing community or convention centers into isolation and care sites). Based on these considerations:

a. Select materials and method used to implement the repurposing (e.g., lightweight materials, MiC).

b. 2 major types of repurposing of public space:
   - Short-term - temporary zoning changes to make additional space to meet a community's needs, e.g., repurpose parking lanes into cycling and pedestrian-oriented spaces (e.g., "Slow Streets Program") with improved lighting and signage, repainted crosswalks, and the addition of cone medians at dangerous pedestrian intersections
   - Long-term - more permanent transition of public space or open additional adapted space for public use (e.g., creating partitions using large planters rather than traffic cones)

Figure 103: Expansion of Site Purposes
Certain cities such as New York have adopted outdoor dining options amid the COVID-19 pandemic, extending seating areas out to streets or walkways to enable social distancing.

Figure 104: Site Repurposing in Response to a Pandemic
Repurposing of Hong Kong Asia World-Expo into a temporary treatment centre during COVID-19.

Benefits

- Extends use and lifespan of selected sites
- Saves resources and materials needed to construct new sites

INDICATORS

- Time and resources saved in repurposing of the space
- Reduction in construction waste

STRATEGY 43 | IMPROVE PHYSICAL FORM OF BUILDINGS AND GENERAL PHYSICAL ENVIRONMENT

GRADATION OF DEVELOPMENT HEIGHT PROFILE

Adopt gradation of development height profile to help wind deflection and avoid air stagnation, with decreasing heights towards the direction where the prevailing wind comes from to promote air movements (i.e., low-rise buildings and open space locating in the windward direction and the waterfront area).

Benefits

- Improves air circulation and reduces presence of lingering air pollutants

BREEZEWAYS AND VISUAL CORRIDORS

Improve air circulation and permeability through the precinct by providing adequate breezeways. Visual corridors may also be implemented to reduce congestion and increase openness. Examples may include strengthening linkages between open space, incorporating building setbacks, avoiding narrow street canyons, and widening pedestrian walkways, among others.

Figure 106: Open Space and Building Setback
Kwun Tong Promenade, an urban waterfront park in Hong Kong.

Figure 107: Local Greening
Hong Kong Park situated on a hillside site as an example of modern design and facilities blending with natural landscape.

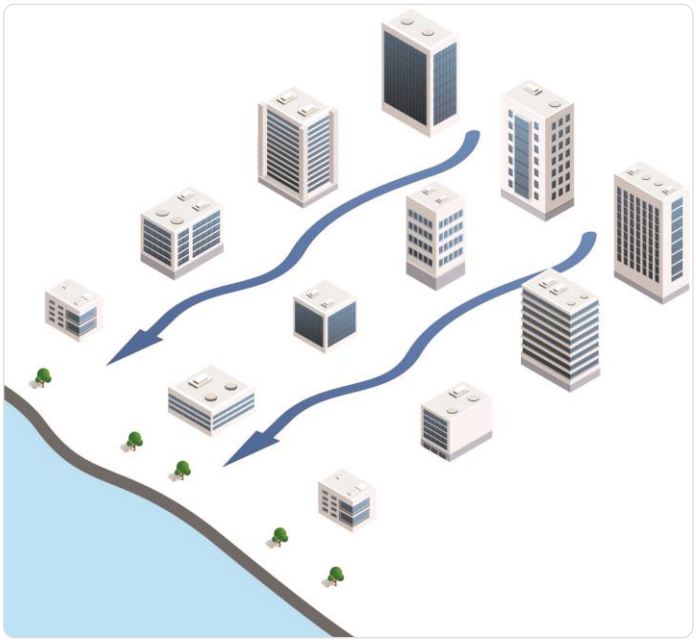


Figure 105: Gradation of Height Profile
Consideration of height profile and breezeways in an area.

INCREASE OPEN SPACE AND ENCOURAGE GREATER BUILDING SETBACKS

Allow more open space in between building blocks and greater building setbacks to enhance air movement and mimimise pollutants from being trapped.

Benefits

- Increases ventilation and reduces risk of disease transmission

LOCAL GREENING

Enhance the microclimate of the urban environment through local greening. For example, taking into consideration Hong Kong's hilly terrain, existing vegetation along hillsides may be leveraged and extended to reduce temperatures along slopes.

Benefits

- Provides greater outdoor comfort and encourages inhabitants to periodically go outdoors where risk of transmission is lower than an enclosed area

INDICATORS

- Average width of space in between buildings
- Average share of the built-up area of cities that is open space for public use

STRATEGY 44 | ENHANCE PUBLIC FACILITIES TO PROMOTE AND MAINTAIN PUBLIC HYGIENE

ENHANCE AIR QUALITY

Enhance air quality such as through the implementation of city-wide air purification systems or frequent use of air quality monitoring devices to control and manage indoor air quality.

Benefits

- Improves sanitation and reduces risks of transmission
- Improves overall public health

SURFACE DISINFECTION

Clean and disinfect surfaces such as through routine indoor spraying of disinfectants, UV irradiation and anti-microbial technology in public transport.

Figure 110: Surface Disinfection
UV steriliser for escalator handrails.

Figure 111: Touchless Solutions for Minimal Contact
Contactless parking payment terminal.

Figure 112: Robotics for Airport Cleansing
A cleaning robot at the Incheon Airport in South Korea.

Figure 108: Enhance Air Quality
Air quality monitoring.

Figure 109: Smart Temperature Sensors and Thermostats
Thermal imaging system to measure surface skin temperature.

SMART TEMPERATURE SENSORS AND THERMOSTATS

Use smart temperature sensors and thermostats for body temperature checks in public space.

TOUCHLESS SOLUTIONS FOR MINIMAL CONTACT

Adopt touchless solutions to minimise contact with public surfaces (e.g., contactless payment and facilities).

USE OF ROBOTICS FOR TRANSIT TERMINAL DISINFECTION

Robotics can be employed at major ports of entry and transit terminals to increase efficiency of disinfection and prevent cross-regional transmission of diseases.

INDICATORS

- Levels of air pollutants within a designated area/space

STRATEGY 45 | CONTACT TRACING WITH SMART-CITY TECH

DIGITAL TOOLS TO ENHANCE CONTACT TRACING

Adopt digital tools to enhance contact tracing for potential epidemics, which may include different functions such as the integration of location-based technology to track the movements of infected persons or close contacts, as well as the development of a portal for users to record any potential signs of infection.

Benefits

- Eases the ability to trace and control the spread of diseases
- Raises public awareness of potential epicenters of diseases as a means of preventing transmission
- Improves overall public health

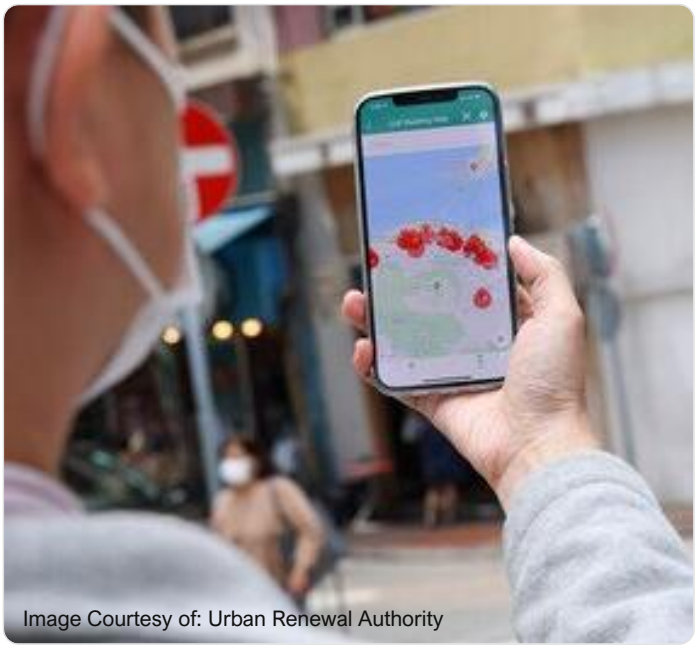


Figure 113: Digital Tools to Enhance Contact Tracing
The "Health Code" 2.0 mobile app developed by the URA was used to alert staff of which buildings were affected by COVID-19 through location-based technology.

INVOLVE HEATH EXPERTS IN DEIGN AND USE OF DIGITAL TOOLS

Involve representatives from the scientific community and public health professionals in the design and implementation of the digital tools.

SMART TEMPERATURE SENSORS AND THERMOSTATS

Ensure provision of transparent, timely and up-to-date information on these tools.

TRANSPARENT AND UPDATED INFORMATION ON DIGITAL TOOLS

Identify alternative approaches for contact tracing for groups with low use of smartphones (e.g., the elderly), and use a combination of digital and manual contract tracing methods.

Benefits

- Eases the ability to trace and control the spread of diseases
- Raises public awareness of potential epicenters of diseases as a means of preventing transmission
- Improves overall public health

OTHER METHODS OF CONTRACT TRACING FOR GROUPS WITH LOW MOBILE USAGE

Use standard performance indicators to assess the public health effectiveness of these tools.

INDICATORS

- Proportion of the population actively using digital proximity tracing (e.g., mobile app)

STRATEGY 46 | SELF-CONTAINED COMMUNITIES

SELF SUFFICIENT NEIGHBOURHOODS

Plan for the self-sufficient or "15-minute" precinct with the necessary services and amenities (e.g., retail, health care centres, schools).

Benefits

- Allows inhabitants to meet their needs locally under lockdowns or restricted mobility

ENHANCE DISTRIBUTION OF PUBLIC SPACE

Public spaces such as parks, gardens and playgrounds, are distributed in a way that is convenient to access for all*.

Benefits

- Promotes physical activity and alleviates stress during times of restricted mobility

Figure 114: Self Sufficient Neighbourhoods
A combination of residential buildings, schools, athletic facilities and transit nodes located in proximity of each other.

INDICATORS

- Distance to key services and amenities
- Distance to public spaces

STRATEGY 47 | IMPROVE SUBSTANDARD ENVIRONMENTAL HYGIENE IN OLD URBAN AREAS

REGULAR REPAIRS AND MAINTENANCE OF EXISTING BUILDINGS

Conduct regular repairs and maintenance of existing old buildings and implement revitalisation works where necessary to prevent the deterioration of physical conditions. Where necessary, sterilisation devices can be installed in dilapidated buildings to create a safer and cleaner living environment

Benefits

- Sterilises virus in pipes as a precaution for air leaks

Figure 115: Regular Maintenance of Existing Buildings
A simulation of a UVC sterilisation device installed on a rooftop ventilation pipe by the URA.

INDICATORS

- Frequency of repairs and upgrades on building structures/services
- Rate of diagnosed cases attributed to unsafe water, unsafe sanitation and lack of hygiene

Notes:

* Hong Kong Planning Standards and Guidelines (HKPSG) Chapter 4 can be referenced for the open space planning considerations.

OBJECTIVE
Promoting Social Physical Distancing

STRATEGY 48 | SEGREGATE PUBLIC SERVICES AND FACILITIES

SMART TECHNOLOGY TO PROVIDE INFORMATION TO RIDERS

Use smart technology to provide riders with information on peak hours[1], transit crowding (e.g., ridership dashboard), service status, among others, for improved trip planning.

Benefits
- Enables riders to avoid crowds and plan ahead of their journey

TRAIN SERVICE TO ACCOMMODATE PEAK TIMES AND SUPPORT SOCIAL DISTANCING

Increase the frequency of train services during peak hours and consider the introduction of express services to reduce congestion.

Benefits
- Allows for phased movement to reduce social contact

PROPER SIGNAGE FOR PHYSICAL DISTANCING

Proper signage for physical distancing (e.g., floor signs), may include information on how to stop the spread of viruses, or reminders to avoid public spaces settings if symptomatic).

PHYSICAL BARRIERS TO MAINTAIN PHYSICAL DISTANCE

Physical barriers to maintain physical distance (e.g., room partitions, planters).

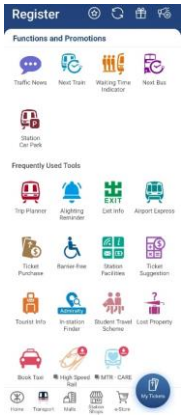


Image Courtesy of: MTR Mobile

Figure 116: Smart Technology to Provide Information to Riders
The MTR Mobile App provides real-time information on train service status, enabling users to better plan their trips.

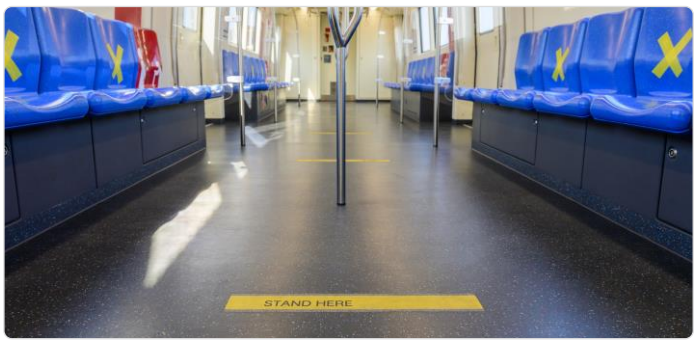


Figure 117: Signate for Physical Distancing
Floor signs on public transit for physical distancing.

Figure 118: Physical Barriers to Maintain Physical Distance
Plastic table barriers became a common method to ensure social distancing when dining during COVID-19

INDICATORS
- Average ridership per transit unit (e.g., train, bus) during peak hours[1]

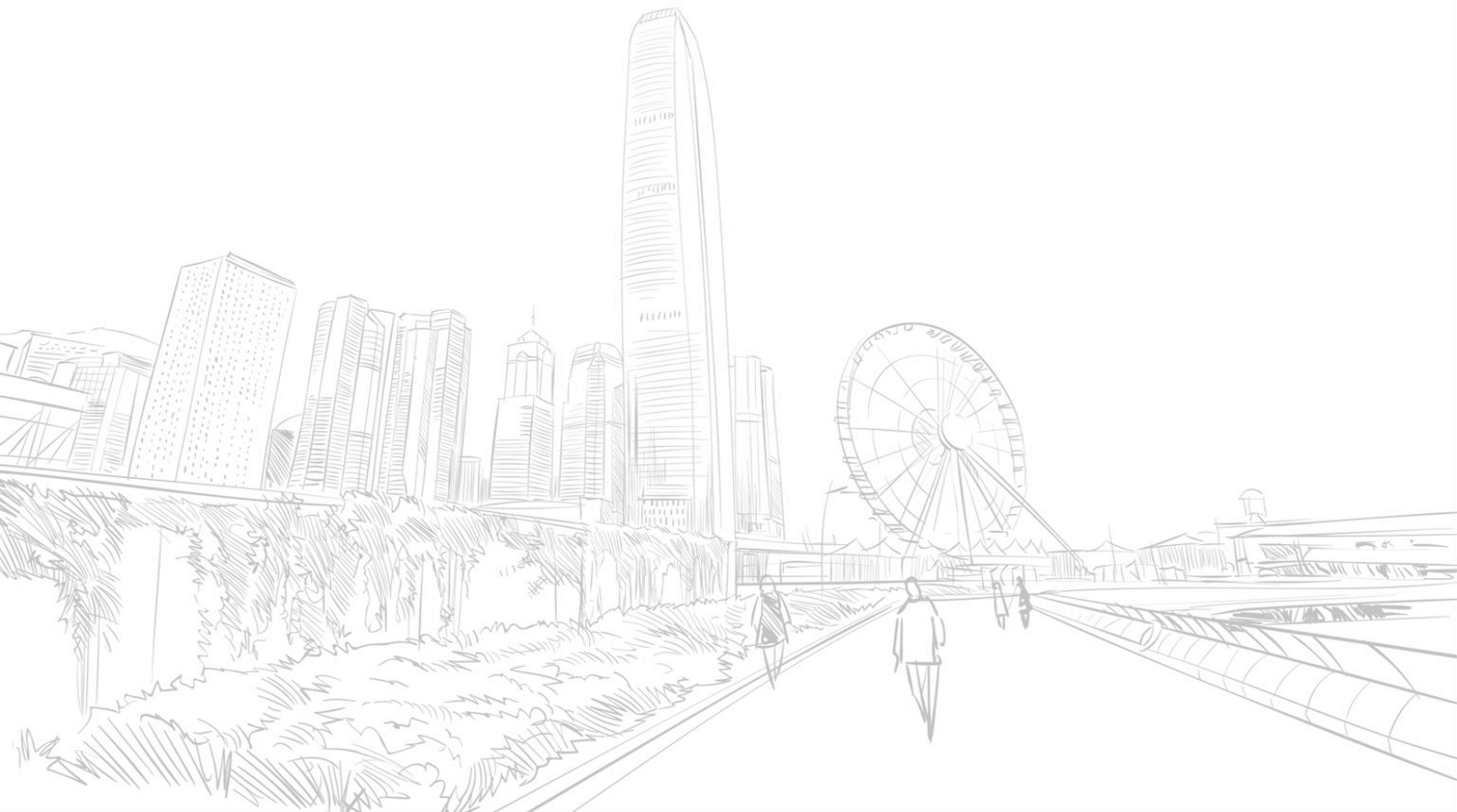
[1] General peak hours in Hong Kong may vary depending on transit type and routes.

3.2 Conclusion

This section presented sustainable design strategies across eight different themes, covering environmental, social, economic, technological and governance aspects. The use and application of such strategies may vary depending on the context, scale and characteristics of the site, together with any potential barriers or challenges.

As such, readers have the flexibility to select which strategies are most applicable to their projects and are encouraged to explore different strategy combinations for synergetic outcomes. In doing so, readers may also find that the strategies are not mutually exclusive but are able to complement each other to bring optimal effects.

The next chapter will examine the different ways in which design strategies could be applied together towards tackling some urban challenges unique to Hong Kong. A series of examples embedded in the context of Hong Kong will be presented to provide inspiration to users in terms of how strategies could be used together to foster the development of a sustainable precinct.



CHAPTER 04

Recommended Design Strategies for a Sustainable Built Environment in Hong Kong

4.1 Application of Design Strategies to Hong Kong

Hong Kong has been facing a variety of challenges in recent years—ranging from climate change to physical and spatial constraints, to pandemic vulnerabilities, among others. Increased energy and resource consumption has led to greater levels of carbon emissions, while rapid economic expansion and urbanisation have led to restricted space and increased density. Moreover, the city's physical geography has caused concerns in the availability of developable land, while an ageing population has called for more inclusive infrastructure and facilities. Such challenges present opportunities to explore the feasibility and effectiveness of the strategies discussed in Chapter 3 to create a more sustainable city. This chapter shows different combinations and applications of design strategies to tackle some of Hong Kong's urban challenges.

This chapter presents five key challenges faced by Hong Kong, along with selected design strategies from Chapter 3, that are suitable in addressing these challenges, and in supporting the advancement towards the city's sustainable development goals. Figures 121–125 summarise the selected strategies under each challenge.

While there are other strategies from Chapter 3 that have not been included in this chapter, it should be noted that they could be applied to other challenges or scenarios not covered in this chapter, and hence could be selected and applied to specific situations and sites in Hong Kong in future updates to this Guidebook. As such, readers should note that the challenges presented in this chapter and the applicable strategies are not an exhaustive list.

4.2 Designing Liveable Precincts in a High-Density City

Hong Kong's High-Density Environment

According to data from the '2021 Population Census' and Planning Department's report on 'Land Utilisation in Hong Kong 2021' [58], the average population density of Hong Kong stood at around 6,800 persons/km^2 [59]. This number increases to approximately 26,090 persons/km^2 within a built-up area [58]. In particular, Kwun Tong, with a population of 59,700 persons/km^2, was the most densely populated district [60].

There are various benefits associated with the construction of a high-density built environment. For example, distances become more walkable and services become more accessible. There is often a greater choice of facilities and services within proximity. The need for carbon generating transportation is also reduced, both for people and goods.

There are, however, undesirable side-effects that could result from high density living, such as rising rental and property costs, increased pollution and air ventilation issues, limited living and open spaces, urban heat island effects and traffic congestion, among others. The following will thus, examine how a selection of design strategies presented in this guidebook could be applied together to alleviate the challenges resulting from a high-density environment in a city like Hong Kong.

This section explores how strategies covering the areas of building disposition, biodiversity protection, precinct-wide energy systems, accessibility and transportation can work in unison to enhance the interrelationships between people, buildings, infrastructure and open spaces in a high-density and high-stress environment. The following strategies from Chapter 3 work together to cope with Hong Kong's high urban density.

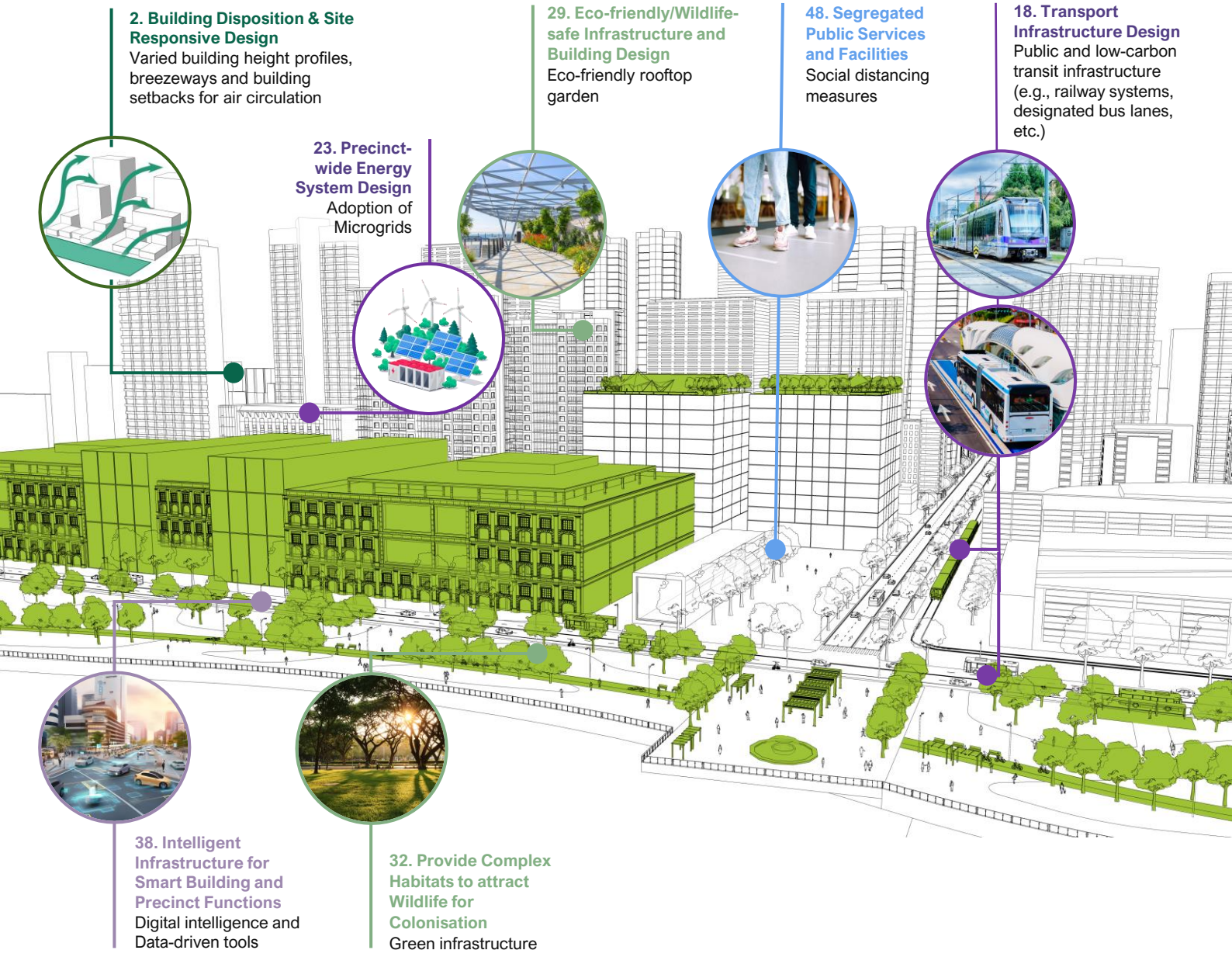


Figure 119: Synergy of Strategies to Cope with Hong Kong's High Urban Density

Synergy of Strategies to Cope with Hong Kong's High Urban Density

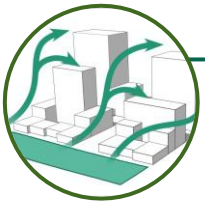
Improve Air Ventilation and Reducing the Urban Heat Island Effect

Considering ***2. building disposition and site responsive*** design, together with improved physical form of building, green infrastructure and waterbodies can bring collective benefits in improving air ventilation, and thus thermal comfort and an overall reduction in urban heat island intensity within a compact space. This also reduces the reliance on mechanical cooling in buildings during warm weather and the associated carbon emissions released to the environment.

Promote Operational and Energy Efficiency through Smart and Intelligent Systems

38. Smart and intelligent systems can be leveraged to drive more informed decisions and reduce energy consumption. On the other hand, the use of data-driven tools and sensors can help to reflect situations more accurately in real-time, and hence, improve the control and management of traffic and provide real-time information on crowds, enabling ***48. appropriate segregation on public services and facilities*** to maintain social distances. Additionally, ***23. smart power generating systems*** such as microgrids may lead to greater energy savings, through the incorporation of renewable energy sources and storage.

Further information is provided on how various strategies can be applied across different areas and effectively work together to adapt to dense environments and address issues arising from compact spaces, an especially, to create a greener and more permeable urban fabric, alleviate congestion, and ensure access to public facilities and services that improves the overall quality of life.



2. Building Disposition and Site Responsive Design

- **Thermal Comfort in Urban Microclimate:** Hong Kong's dense urban fabric and sub-tropical climate can result in an urban microclimate that is both hot and humid in the summer months, often prone to intensifying urban heat island (UHI) effects which can induce discomfort and other heat-related health concerns. To ensure improved health and wellbeing, and overall quality of living, it is important to consider thermal comfort in planning liveable urban precincts. Primary objectives should be to reduce temperatures and increase air circulation.

  This challenge can be addressed through several site responsive planning and design measures, which may include ample provision of vegetated surfaces and open spaces to mitigate the impacts of the UHI effect, as well as reduce concentrated levels of air pollutants. The sensitive disposition of building blocks, use of building setbacks, provision of breezeways, and variation in building height profiles to promote air ventilation and circulation can enhance cooling and facilitate the creation of more breathing space, which may help to improve human comfort.

- **Varied Building Height Profile:** While high rise buildings may allow greater capacity under spatial limitations, positioning low-rise buildings in the windward direction may also improve urban air ventilation, especially in a dense environment.

- **Building Setbacks and Terraced Podium Structures:** Urban street canyons are common characteristics of increasingly dense and vertical cities such as Hong Kong. Such canyons can stagnate airflow and trap both heat and air pollutants which induce negative health impacts. To alleviate these concerns on human health, streets can be widened through building setbacks to allow for more breathable space and complemented with planting strips or well-paved sidewalks to further enhance environmental quality and walkability. In addition, podium structures impeding air movement should generally be avoided or minimised. If podium is present, downward airflow can be facilitated by the adoption of terraced podium design to improve air circulation at the pedestrian level.

- **Permeable Urban Fabric - Breezeways**: Buildings or building blocks can be aligned with prevailing winds to create main streets or open spaces that act as breezeways (In Hong Kong, prevailing winds during summer months come from the east). Such breezeways assist in reducing both urban heat and humidity. Main streets or wide main avenues which are aligned in parallel or up to 30 degrees to the prevailing wind direction, can channel these winds to distribute cooling effects throughout the precinct.

- **Passive Urban Cooling - Urban Green Spaces**: The specific heat capacity of vegetated areas is higher than that of hard urban surfaces. Urban greening therefore has a significant effect in reducing urban temperatures and enhancing comfort. According to the United Nations Environment Programme, urban greening has the effect of reducing urban ambient temperatures by an average of 0.94 degrees Centigrade during the day and by an average of 1.15 degrees Centigrade at night. In Hong Kong's high-rise urban context, green spaces at roof level are equally valuable for this purpose.

18. Transport Infrastructure Design

- **Public and Low Carbon Transit Infrastructure:** Transport infrastructure design should target to reduce congestion and the impacts of carbon emissions in high density areas.

- **Railway Transit Infrastructure:** Railways—be it heavy or light—form a key component of Hong Kong's transportation system. Rail transit and other modes of public transportation maximise passenger flows in high-density urban areas, reduce congestion, and provide efficient access throughout the city. Railways also reduce dependency on cars, thereby reducing carbon emissions. Rail transit infrastructure should be integrated into new developments and served by convenient and accessible multi-modal transport networks to promote its use.

- **Designated Bus Lanes**: According to the Planning Department, private vehicles can only accommodate approximately 10% of passenger trips per day despite accounting for 50% of traffic in some of Hong Kong's major roads [63]. An increase in the number of private vehicles, especially where an area is already dense, could result in greater levels of congestion, reduced public transit efficiency and more carbon emissions. A possible method of mitigation is the implementation of designated bus-only lanes with flexibility—for example, bus-only lanes could replace an existing traffic lane on a multi-lane road, or along the curbside where space is normally reserved for street parking during peak intervals of the day. The resulting increase in speed and frequency of bus services could draw greater attraction to public transit options amid a high-density environment.

- **Electric Car Sharing Services and Facilities:** Where the possibility of traffic congestion is high, such as that in a dense environment, green transit modes should be encouraged over traditional petrol or diesel-fueled vehicles. This could be facilitated in the form of an increased number of electrical vehicle charging facilities in Hong Kong's parking spaces (e.g., shopping malls, office buildings, residential estates, etc.).

- **Cycling Infrastructure:** High density environments could benefit from encouragement of the greater use of Hong Kong's existing cycling infrastructure for further promotion of carbon-free transit.

- **Multimodal Transit Corridors:** Multimodal transit corridors or greenways provide maximum modal flexibility and easy opportunity for modal interchange. Walkable urban quarters and precincts can be achieved through the preparation of an integrated walkability strategy for a new precinct, using methodologies specifically developed to promote walkability and pedestrian friendly areas. Approaches to urban design should favour the creation of pedestrian-only or pedestrian-priority areas by enhancing the permeability of the urban fabric and the connectivity of its components, and by the provision of sidewalks of generous widths as well as adequate shade and shelter. The planning of such areas should also account for inclusive mobility where barriers are

reduced or prevented for people with disabilities. Additionally, walkable precincts planned around a railway station can become highly sustainable with liveable '15-minute neighbourhoods' where residents' daily necessities, including accommodation, work and leisure requirements, and public services are provided within a walkable distance.

23. Precinct-wide Energy System Design

- **Adoption of Microgrids:** The adoption of microgrids could act as a viable method of electricity generation in a dense environment where space is limited. Through integrating distributed energy sources, including renewable energy, microgrids generate electricity on-site and can operate while connected to a traditional electricity grid or independently. They can store electricity, optimise demand, and improve the reliability of electricity supply. Microgrids are used to power a defined area of users, such as a cluster of residential buildings, schools, or shopping malls, and are hence, appropriate in a high-density environment such as that of Hong Kong.

29. Eco-friendly/Wildlife-safe Infrastructure and Building Design; E.32. Provide Complex Habitats to Attract Wildlife for Colonisation

- **Eco-friendly/Wildlife-safe Infrastructure:** Linear infrastructures, such as roads, have the potential to negatively affect wildlife, particularly when they are built through ecologically significant habitats. This can lead to habitat fragmentation, where continuous habitats are divided into smaller, isolated patches. Wildlife crossings are one of the most widely adopted measures to mitigate the potential ecological impact from linear infrastructures. In Hong Kong, a 1.8m diameter concrete tunnel was constructed beneath Route 3 to provide crossing opportunities for wildlife and mammals. Masked palm civets and leopard carts were recorded in this underpass [66].

- **Green Infrastructure:** When determining the plant species to be planted on vegetated surfaces such as public open space and the wall and roof of buildings, native species with known ecological functions and species with high coverage should be given priority. Species with known ecological benefits such as plants with fruit or nectar can assist to attract various species of butterflies and birds, thereby increasing urban biodiversity. Plantation with high surface coverage can provide large areas of shading and aid to cool down surfaces, thereby reducing the effects of urban heat islands.

38. Intelligent Infrastructure for Smart Building and Precinct Functions

- **Digital Intelligence and Data-Driven Tools:** Overcrowding and traffic congestion are often issues that result from a high-density environment such as that of Hong Kong. To improve comfort and air quality, the installation of digital sensors to collect real-time data on traffic and pedestrian flow may facilitate more informed decisions on whether pedestrians or vehicles should visit a particular area based on levels of congestion, thus further enhancing the efficiency of crowd and traffic management systems. The Hong Kong Smart City Blueprint 2.0 also showcases relevant strategies and initiatives, such as the installation of traffic detectors on roads to provide real-time traffic information, establishing a real-time information system for green minibus arrivals, the development of a traffic data analytics system to improve traffic management, among others.

48. Segregated Public Services and Facilities

- **Physical Distancing Measures:** The COVID-19 pandemic has heightened the importance of maintaining physical distances to improve hygiene and reduce the risks of viral transmissions, especially in dense environments where space is limited. Similar measures can remain applicable to congested areas and may be particularly useful in

mitigating the risks of any potential future outbreaks. Measures that can be adopted may include placing proper signages as reminders to maintain a distance, physical barriers such as planters or partitions in congested places and leveraging smart technology such as smart phone applications to provide real-time information on crowds or congestion.

Reference Guidelines

2. Building Disposition and Site Responsive Design

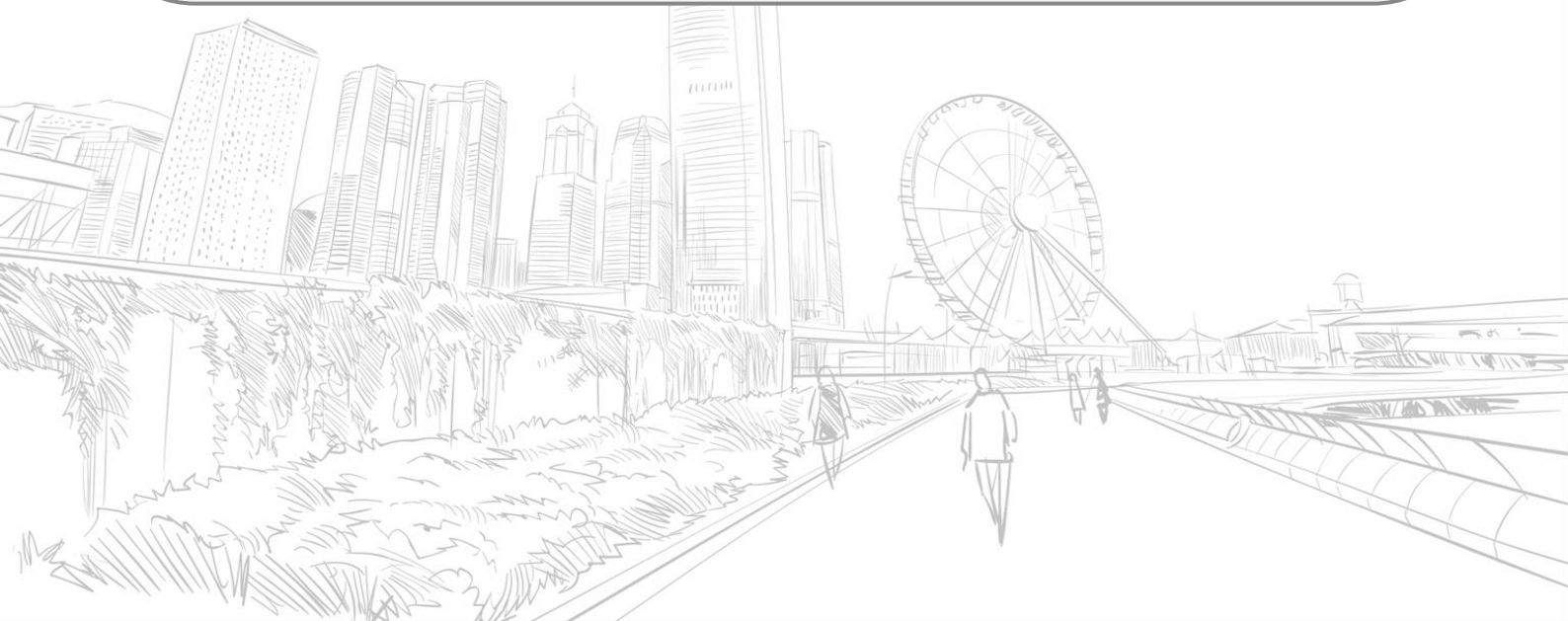
Readers are encouraged to reference the Qualitative Guidelines on Air Ventilation provided in *Chapter 11 Urban Design Guidelines* (November 2015 edition) of the HKPSG by the Planning Department for further suggestions on how Hong Kong's wind environment and air circulation can be improved via urban design [61]. On a site level, it details useful recommendations in the areas of podium structure, building disposition, building permeability, building height and form, landscaping, projecting obstructions as well as the use of cool materials (pp.32-43) [61].

18. Transport Infrastructure Design

Reference can be made to the main focuses of the New Transport Strategy "*Hong Kong Moving Ahead – A Transport Strategy for the Future*", including [64]:

- Better integration of transport and land use planning;
- Better use of railways as the back-bone of our passenger transport system;
- Better public transport services and facilities;
- Better use of advanced technologies in transport management; and
- Better environmental protection.

These 5 objectives have been incorporated into the relevant sections of the HKPSG to ensure that they are adequately considered in the planning process. Specifically, Chapter 8 "Internal Transport Facilities" (August 2021 Edition) of the HKPSG stipulates the standards of provision for Hong Kong's transport facilities. For example, a ferry terminal should have adequate interchange facilities with other types of public transport, such as franchised buses, green minibuses, and taxis. To accommodate the needs of passengers with disabilities, dropped kerbs should be provided at loading and unloading points for goods vehicles (p.19). To improve the coordination of public transport and to encourage its use, park-and-ride (PnR) facilities could be provided at suitable rail stations and major public transport interchanges in the New Territories and/or fringes of urban areas. As a result, traffic congestion along strategic route corridors will be alleviated and parking demand in inner cities will be reduced by encouraging motorists to switch to mass transit (p.45) [65].



4.3 Designing Accessible Space Under Natural Restrictions

Hong Kong's Availability of Developable Land

Hong Kong has a mountainous topography which consists of naturally rugged terrain with limited availability of flat developable land [67]. Flat terrain is mostly found in low-lying coastal areas and as alluvial plains in the northwestern side of Hong Kong [68].

Where 75% of the land is steeper than 15º and more than 30% is steeper than 30º, the city's elevation differences are clear [69]. Natural slopes comprise 60% of Hong Kong's land, indicating evident topographical imbalances [70]. On top of posing risks for construction such as potential landslides, rockfalls and limited working space, the result is also that only about a quarter of the city's land is built-up, with the remaining being not-for-development areas, such as country parks, wetland, reservoirs, etc. [67, 71].

According to Hong Kong 2030+, the projected land requirement is around 5800 to 6200ha between 2019 to 2048—this is met with a committed land supply of around 3200ha, resulting in a land shortfall of around 2600 to 3000ha by 2048 [62]. There is a subsequent need to design and provide inclusive and accessible spaces that take into consideration the city's physical constraints to support growing demands, which could be achieved with the strategies below.

This section explores strategy combinations covering barrier-free and multi-purpose spaces, preservation of natural resources, and physical accessibility amid limited availability of developable land. Collective benefits could be identified from the integration of the following design strategies in Chapter 3 that work together to create an accessible environment.

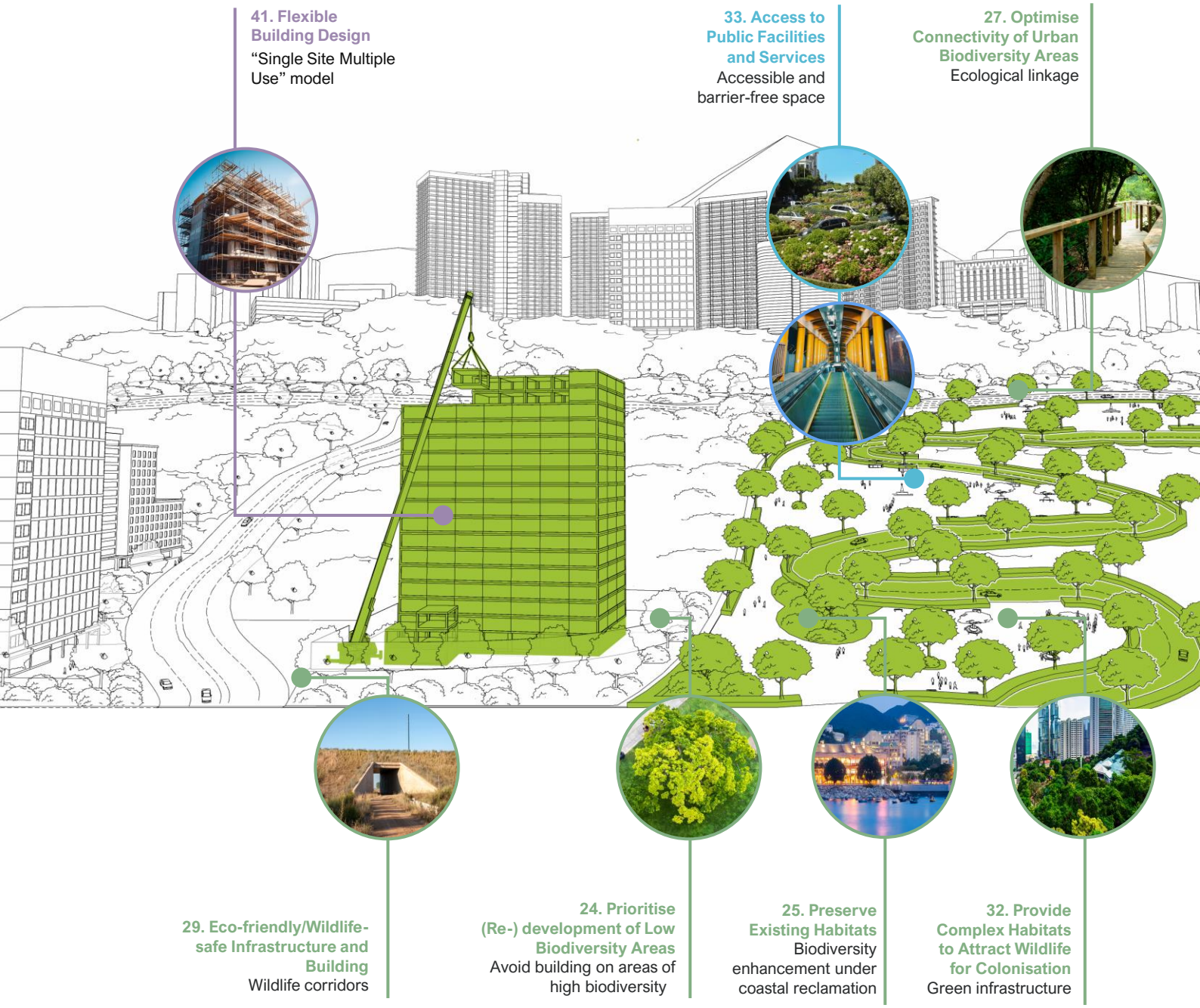


Figure 120: Synergy of Strategies to Create an Accessible Environment

Synergy of Strategies to Create an Accessible Environment

Overcome Geographical Constraints and Improve Accessibility

Topographical challenges such as elevation differences or uneven surfaces can limit mobility and the ability to build on certain spaces. Prioritising ***41. flexible building design*** and intentions to enhance

33. access to public facilities and barrier-free spaces may minimise the impacts of geographical constraints. For example, where buildable space is limited, buildings can be designed to serve multiple purposes. At the same time, city infrastructure may also adapt to topographical concerns, such as building footbridges and subways, and extended escalators. The development and utilisation of underground space may also be a viable strategy where above-ground surfaces pose as a geographical limitation.

Preserve Natural Habitats and Conserve Natural Resources

Pursuing development projects in an area where the availability of land is limited may result in threats to the natural environment. This strengthens the need to preserve and protect natural habitats and ecological resources through ***27. optimising connectivity of urban biodiversity, 29. building wildlife corridors, 32. providing green infrastructure to attract wildlife colonisation*** *for maintaining the balance between natural and built landscapes,* ***24. avoiding building on areas of high biodiversity,*** *and* ***25. enhancing biodiversity under coastal reclamation*** *to ensure minimal impact to urban biodiversity*.

Further information is provided below on how various design strategies can be applied to built environments affected by geographical constraints, as well as address issues related to the lack of developable land.

24. Prioritise (Re-)development of Low Biodiversity Areas

- **Avoid Building on Areas of High Biodiversity:** Building on limited developable land may lead to greater risks in the encroachment on natural habitats of high biodiversity. During site selection, it is important to ensure that project boundaries are adjusted to exclude areas with statutory/conservation status, and to minimise disturbances to areas of high biodiversity.

25. Preserve Existing Habitats

- **Ecological Value of the Urban Waterfront:** The harbourfront in Hong Kong provides an opportunity for urban biodiversity. As part of both existing and new construction reclamation, an eco-shoreline can enhance biodiversity and ecosystem services of the man-made shoreline by special design features. It often involves deployment of structures with grooves, holes, ridges and small pools along the shoreline, so as to increase microhabitats within the shoreline and maintain a certain amount of water during low tide. E.g., live oysters and/or oyster shells are used as a means of increasing the complexity of microhabitats. As a result, an eco-shoreline can provide habitats for more marine organisms, while water filtration can also be enhanced by marine organisms.
- **Biodiversity Enhancement under Coastal Reclamation:** The Tung Chung New Town Extension (TCNTE) project involved significant development efforts—with reclamation of approximately 130 hectares of land in Tung Chung East and developments in Tung Chung Valley. This development project formulated a strategy for biodiversity enhancement in the new reclamation area, by developing an Urban Biodiversity Master Plan to identify target wildlife species and their habitats, identify potential ecological connections, and formulate landscape design guidelines, which align the approach at the early design stage with site context. Elements such as linear parks, eco-shorelines, and open spaces incorporated in this project can create habitats for wildlife, create opportunities for pollination, enhance climate change resilience, and the overall quality and sustainability of the new town extension.

27. Optimise Connectivity of Urban Biodiversity Areas

- **Ecological Linkage:** The effects of climate change may pose threats to the habitability of urban areas for wildlife. As such, linkages may be established to better connect

urban areas with natural habitats to attract wildlife. This should be encouraged where there are neither urban biodiversity areas nor nearby blue/green infrastructures. The building of corridors or stepping-stones will promote a broader spectrum of wildlife habitats and a greater dispersion of species within a precinct. For instance, the plantation of trees can connect rural areas to urban habitats, allowing a pathway for wildlife to roam.

29. Eco-friendly/Wildlife-safe Infrastructure and Building

- **Wildlife Safety:** Highly urbanised areas of Hong Kong usually consist of complex road developments with heavy traffic flow. Thus, it is important to consider the wellbeing of wildlife during the construction of railways and roads. Transport infrastructure design such as railway transit infrastructure and multimodal transit corridors can greatly reduce the number of vehicles and minimise traffic flow. Reduced emissions from vehicles can also benefit wildlife through minimising disturbance to their original habitats. Furthermore, wildlife-safe infrastructure such as wildlife corridors can effectively reduce the likelihood of roadkill on highways.

32. Provide Complex Habitats to Attract Wildlife for Colonisation

- **Green Infrastructure:** When determining the plant species to be planted on vegetated surfaces such as public open space and the wall and roof of buildings, native species with known ecological functions and species with high coverage should be given priority. Species with known ecological benefits, such as plants with fruit or nectar, can attract various species of butterflies and birds, thereby increasing urban biodiversity. Plantation with high surface coverage can provide large areas of shading and aid to cool down surfaces, thereby reducing the effects of urban heat islands.

33. Access to Public Facilities and Services

- **Accessible and Barrier-Free Spaces**: Hong Kong's terraneous landscape and geographical constraints may limit accessibility and mobility for vulnerable groups, including the ageing population. Universal access design principles can be applied to urban public spaces to create barrier-free environments that can accommodate people of all ages, abilities, and disabilities. Examples include providing a handrail on both sides of staircases and ramps, applying slip resistant surfaces on floor finishes, and installing ramps of appropriate widths to improve usability of space and reduce potential falls.

  Innovative methods could also be used to make conventionally barriered spaces more accessible. Hong Kong's elevation differences often limit accessibility and have naturally led to the construction of many stairways. With the intention to create more accessible and welcoming spaces, stairways can be activated and designed in a way to facilitate human contact, meeting both pragmatic and social needs within the community. For instance, THE CASCADE located in Central of Hong Kong provides individual and adjoining seating areas surrounded by plants and equipped with a lighting system, presenting an inviting space with a sociable atmosphere. Such design strategies can be further implemented in other areas to help introduce vitality to previously outdated spaces whilst integrating and optimising the use of Hong Kong's unique topographical features.

- **Mechanically Assisted Mobility:** Hong Kong's hilly terrain has resulted in elevation differences and steep slopes across the city's landscape. Escalators and elevator systems may improve pedestrian accessibility and mobility, including for those who experience physical disabilities, in areas where topography could be a barrier. The Central to Mid-Levels Escalator and Walkway System—the world's longest outdoor covered escalator system—serves as an exemplar of how escalators and inclined conveyers can support pedestrian traffic in areas affected by elevation differences.

- **Utilisation of Underground Space:** In the case where above-ground surfaces present geographical limitations, such as uneven surfaces that limit accessibility, the development of underground space could be taken into consideration. Common examples include the construction of underground carparks, transport infrastructure, pedestrian walkways and commercial spaces including shopping centres. Underground space could also be used to provide linkages between buildings or sites, such as active shopping streets, in the case that above-ground space is limited and undevelopable due to physical constraints. In addition to providing an alternative to above-ground space, underground spaces could be treated as a sheltered, all-weather encompassing environment as well.

- **Footbridges and Subways:** Footbridges are common features of Hong Kong and could be built over steep terrains to provide elevated pedestrian walkways that are flat, safe and easy to access. Similarly, subways are also a popular and effective infrastructural feature of Hong Kong in providing an alternative solution to building pedestrian walkways where uneven grounds are present.

41. Flexible Building Design

- **Single Site Multiple Use Model:** In recent years, the Government of Hong Kong has been promoting the adoption of a ‘single site multiple use’ model, where development projects and public facilities can be used to serve different purposes. Under-utilised sites can be prioritised to maximise the use of existing land. Adoption of such model reduces the demand for additional developments while meeting the needs of the community, which may be especially beneficial in circumstances where the supply of developable land may be limited.

4.4 Planning for Climate Resilient & Green Precincts

Hong Kong's Changing Climate

According to the Hong Kong Observatory (HKO), the average rate of temperature increase rose from 0.14℃ per decade between 1885 to 2022, to 0.28℃ per decade between 1993-2022, indicating an obvious increase in the city's temperatures towards the end of the 20th century [5].

Extreme precipitation events have also become more frequent, with hourly rainfall records at the HKO Headquarters having been broken several times in the last few decades [73].

If global warming exceeds 2℃ by 2030, Hong Kong could experience more severe typhoons, droughts and intense heatwaves [74]. The advancement towards the development of carbon neutral, resilient and green precincts is essential in mitigating the impacts of Hong Kong's changing climate and the resulting impacts towards the built environment and its people.

This section shows how strategies covering climate resilient design features, natural and passive mechanisms, greenery and waterbodies, renewable energy sources, as well as low carbon construction and transport, can ultimately help to mitigate climate change and/or adapt to current and future impacts on the built environment. The following strategies in Chapter 3 are considered together to create climate resilient and green precincts.

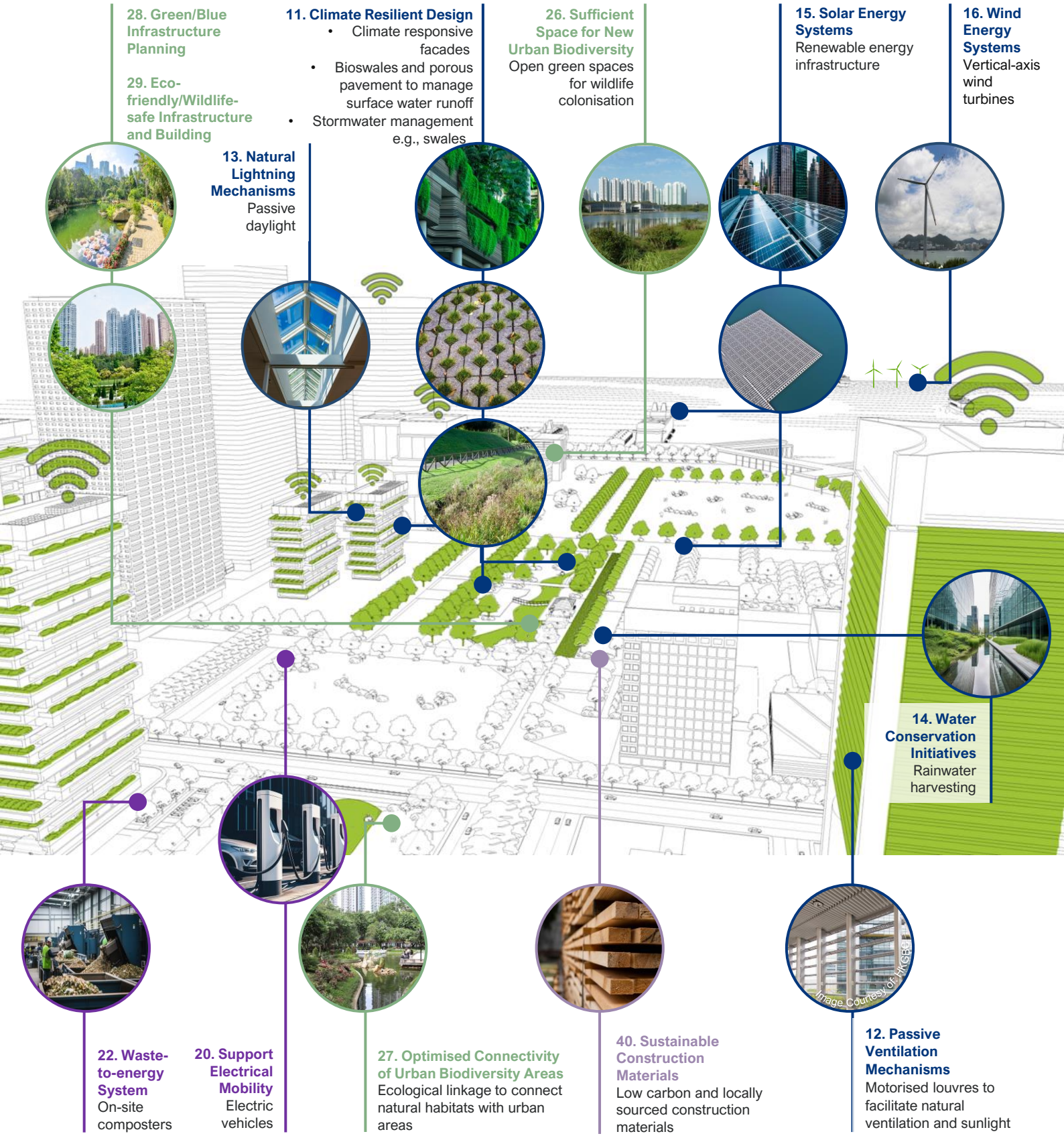


Figure 121: Synergy of Strategies to Build a Climate Resilient Precinct

Synergy of Strategies to Build a Climate Resilient Precinct

Reduce Energy Consumption and Carbon Emissions

11. Climate resilient design, utilising the passive mechanisms of 12. natural ventilation, and 13. natural daylight may reduce the energy consumed in the mechanical cooling and lighting of buildings, resulting in the reduction of carbon emissions. ***40. Sustainable construction materials*** and *transportation methods* can lead to carbon emission reduction. This may include the prioritisation of low carbon and locally sourced materials to ensure minimal environmental impact during construction processes, while the ***20. use of electric vehicles*** can effectively reduce vehicular emissions.

Harness Renewable Energy Systems

Carbon emissions can be further reduced through the active promotion and adoption of renewable energy systems, such as ***15 &16. solar and wind energy systems***, as well as ***22. waste-to-energy systems***. Simultaneous application of various renewable energy sources where feasible improves the reliability of energy supply whilst further enabling energy savings and the reduction of carbon emissions.

Enhance Resilience through Greenery, Waterbodies and Conserving Biodiversity

28. Green/blue infrastructure acts as carbon sinks to reduce the level of pollutants and helps to minimise the impacts of climate risks. Vegetation improves air quality and supports the proliferation of natural habitats amid the impacts of climate change whilst waterbodies help to deliver cooling effects and thermal comfort amid rising temperatures. ***14. Water conservation strategies*** such as rainwater harvesting can help to alleviate the challenges brought by climate events and enhance resilience to water supply shortages. Lastly, ***26. open green spaces for wildlife colonisation, 27. ecological linkages to connect*** natural habitats with urban areas, and ***29. Creating an eco-friendly/wildlife-safe environment*** conserves biodiversity and enables natural landscapes to be resilient amid potential environmental damages.

While climate change is a prominent issue faced by Hong Kong, the following section shows how various design strategies can help to minimise its effects.

11. Climate Resilient Design

- **Climate Responsive Facades:** With tropical cyclones, heavy rainstorms and warming temperatures, the design of building facades should be more resilient to water leakage and be responsive/adaptable to changing local climate conditions. The materials used in the construction of a building should be able to withstand extreme climatic events. For instance, a cementitious coating can be applied to act as a waterproof seal. It can be used alongside watertight concrete to manage water ingress.
- **Climate Risk Assessments:** Conducting climate risk assessments prior to construction can help to further strengthen climate resilience. Data collected from these assessments may be shared with different parties and across sectors to enable the holistic development of a more resilient precinct.

- **Climate Resilient Urban Transport and Street Infrastructure:** Transport systems should be designed such that they can adapt to adverse weather events, with the ability to maintain inter-connectivity for various functions of urban life despite any weather changes. Relevant design considerations to achieve climate resilient infrastructure may include intensified roadside plantations, a strengthened network of green corridors and open paths for sufficient airflow. Additionally, infrastructure that facilitate walkability under various climate conditions, such as canopies installed with PV panels, could also be adopted in open spaces to accommodate pedestrians.

- **Stormwater Management:** Hong Kong is on the common track of tropical cyclones and can experience very heavy rainstorms. During particularly heavy rainstorms, flooding in low-lying areas and natural floodplains may occur. Hence, integrating sustainable drainage systems and water sensitive urban design, such as porous pavements in public spaces can aid in effectively managing surface water runoff. Such designs can reduce flooding risks and promote ground water recharge, further contributing to the adoption of sponge city principles, and improve resilience against flooding.

12. Passive Ventilation Mechanisms

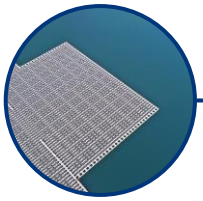
- **Natural Ventilation:** The density of Hong Kong's high-rise buildings and the subsequent street canyons created may cause disruptions to ventilation, and in turn, trap air pollutants and heat. This further impacts several environmental conditions, such as surrounding temperatures, wind, and air quality. Designs that enhance natural ventilation can help to improve resilience against air pollution and achieve thermal comfort without heavy reliance on active building systems. Motorised louvres with solar tracking or thermostat-actuated capabilities have sensors that can detect when to open and close windows for optimal daylight, airflow and ventilation. Both design and smart controls can be utilised to decrease reliance on air conditioning and reduce energy use and carbon emissions, and thus, contribute towards achieving carbon neutrality.

13. Natural Lighting Mechanisms

- **Passive Daylight:** Natural daylight should be leveraged to reduce the reliance on electricity-powered lighting which may otherwise result in increased carbon emissions. Passive daylight features may be integrated in buildings to maximise daylight penetration. Indoor spaces, for example, may adopt skylights in the ceiling or light shelves around the window perimeter to enhance brightness. Many of Hong Kong's shopping malls are also currently designed with sufficient atrium space that allows natural light to reach indoors, thus conserving the energy needed to power artificial lighting during daytime.

14. Water Conservation Initiatives

- **Rainwater Harvesting:** In response to climate risks such as flooding and heavy rainfalls, effective rainwater harvesting strategies could be applied to capture and store rainwater, enabling it to be repurposed for non-potable uses. In Hong Kong, where space is limited, smaller-scaled rainwater harvesting systems may be considered. Rooftops and building walls act as common surfaces to install catchment areas. Since 2013, the Hong Kong Housing Authority has also developed the Zero Irrigation System (ZIS) in public housing estates which serves as a noteworthy example of rainwater harvesting for the purpose of landscape irrigation in urban areas. The ZIS comprises of three components including: (1) a rainwater harvesting system that collects and stores rainwater in planters containing retention boxes; (2) a sustainable urban drainage system that reduces the amount of stormwater runoff entering the sewer system; and (3) a sub-soil irrigation system that enables water from the retention boxes to reach the planted vegetation [75]. The ZIS not only improves landscape design but also enables effective water conservation amid climate risks.



15. Solar Energy Systems

- **Renewable Energy Infrastructure:** To accommodate increasing levels of energy consumption, the switch to renewable energy sources has become important. While limited space in Hong Kong creates difficulties for building large scale renewable energy infrastructure, the Government nevertheless has identified around 3-4% of realisable renewable energy potential from wind, solar and waste-to-energy systems in Hong Kong [6]. Considering Hong Kong's spatial limitations, practitioners can explore the use of BIPV panels which are installed on building envelopes.

  In addition, there are also financial barriers to solar energy application in the city, such as the high initial and repair costs and the long payback period. The Government's introduction of the Feed-in Tariff (FiT) Scheme in 2017 provided a much-needed push for solar energy deployment. The scheme allows people to sell the energy produced by the solar or wind energy generation systems installed at their premises at a higher rate than the normal electricity tariff rate to the power companies.

- **Floating Photovoltaic Systems:** In recent years, floating photovoltaic systems have been installed by the Government of Hong Kong in the city's waterbodies as a method of generating renewable energy. This prevents the need for additional land space, leverages water-cooling effects for the generation of more power, and reduces evaporation due to coverage provided over the water surface. On a precinct level, the installation of small-scale floating photovoltaic panels on waterfronts may be considered to further promote the use of renewable energy and accelerate decarbonisation.

16. Wind Energy Systems

- **Renewable Energy Infrastructure:** Similar renewable energy infrastructure such as vertical-axis wind turbines and micro wind tube systems, can also be incorporated in development sites in rural areas that receive exposure to strong wind intensity. Such measures can effectively address the challenges of spatial limitations in urban areas while incorporating more sources of renewable energy.

20. Support Electrical Mobility

- **Electric Vehicles (EVs):** The use of electric vehicles can be further popularised to promote low carbon transportation and improve air quality. Building developers may look to expand the number of charging spots to incentivise the use of EVs, which can be supported by Government incentives. The Government of Hong Kong has launched the EV-charging at Home Subsidy Scheme, for example, to provide subsidies for the installation of EV charging-enabling infrastructure in existing private residential buildings to increase the number of parking spots equipped with EV chargers. Increasing EV usage may reduce carbon emissions caused by conventional vehicles and contribute to reducing the severity of climate change.

22. Waste-to-Energy Systems

- **On-site Composters and/or Smart Bin Technology:** Hong Kong, like many developed cities, has seen its waste loads grow as its economy expanded. Municipal solid waste includes waste from households, industry and commercial operations. This has placed a tremendous burden on Hong Kong landfills. According to the Environmental Protection Department (EPD), in 2020, 10,809 tonnes of municipal solid waste on average were disposed of in landfills in Hong Kong every day [83]. Of these, about 3,255 tonnes (30%) were food waste, constituting the largest municipal solid waste category [76].

26. Sufficient Space for New Urban Biodiversity; 27. Optimised Connectivity of Urban Biodiversity Areas; 29. Eco-friendly/Wildlife-safe Infrastructure and Building

- **New Plantations:** The plantation of different species of bioswales not only improves stormwater management but can also help to promote urban biodiversity by fostering the creation of micro-habitats in different growth forms, thereby creating more habitat for fauna offspring. This could be executed in different ways, such as podium and sky gardens that provide green open spaces for public use. Similarly, the implementation of native vegetated surfaces with known ecological benefits such as plants with berries or nectar can also assist to attract various species of butterflies and birds, while urban greenery may also act as carbon sinks to improve air quality. When constructing and maintaining vegetated surfaces, including vertical greenery installations, carbon footprint assessments can be considered to ensure that such initiatives produce positive impacts. The types and species of plants should also be carefully considered for urban greenery, where factors such as carbon absorption, wind tolerance, habitat and ecological values for wildlife, etc., should be accounted for.

- **Open Green Spaces**: Conserving biodiversity and developing sustainably is crucial for Hong Kong's long-term prosperity. However, climate change may cause biodiversity loss as certain species may only thrive under certain environmental conditions. Providing open spaces with sufficient greenery can enhance biodiversity and they should be strategically located in proximity to existing natural habitats such as water bodies and woodland to provide sufficient opportunity for wildlife colonisation.

  Furthermore, green spaces may be designed to include the use of a variety of materials, or the provision of additional designs (e.g., wood logs) to encourage substrates, while greatly enhancing the complexity of the habitat.

- **Reserve Space for New Vegetated Areas:** A proportion of development space could be reserved to support the continued growth of green areas, whether outside or inside the development site. Given the limited space in Hong Kong, creating green spaces within a building or its immediate periphery may be an option. On top of providing a natural cooling effect, vegetated areas also function as carbon sinks that help to minimise carbon emissions. This may take the form of enhanced soft landscaping along the perimeters of the development site, temporary green coverage in any idle space, as well as sky gardens and various types of planters.

- **Nature-based Solutions to Climate Change Adaptation:** Due to urbanisation and extreme weather conditions, the drainage capacity of Hong Kong's Kai Tak River is insufficient to meet current flood protection standards. As a result, the Government proposed the implementation of drainage improvement works. The Drainage Services Department (DSD) took advantage of this opportunity to incorporate various greening and ecological elements into the Kai Tak River. This initiative has transformed the River into Hong Kong's first urban green river corridor. Elements include planting aquatic plants to enhance biodiversity, utilising artificial rocks with soil pockets to support plant growth, and creating fish shelters and flow deflectors to modify water-flow path and water current in order to provide fish species with a moderate habitat [77].

28. Green/Blue Infrastructure Planning

- **Green/Blue Infrastructure :** Integrating blue-green elements to the city infrastructure may help to mitigate the impacts of climate change such as rising temperatures and flood risks. Blue-green infrastructure suitable for precinct-scale projects in Hong Kong may include street trees, green roofs and walls, private gardens, waterfalls, as well as small ponds. These features may be incorporated into buildings or pocket spaces between buildings where space is a constraint and may deliver a range of benefits such as thermal comfort, improved air quality, rainwater absorption, in addition to the expansion of urban biodiversity.

40. Sustainable Construction Materials

- **Low Carbon and Locally Sourced Construction Materials:** The use of low carbon construction materials as well as locally sourced construction materials may contribute to the reduction of carbon emissions during construction processes. Project owners and operators may deepen their understanding of the embodied carbon of construction materials and associated carbon emissions from construction processes using existing carbon assessment tools, such as that created by the Construction Industry Council.

4.5 Planning for an Age-Friendly Neighbourhood

Hong Kong's Ageing Population

Population ageing trends have continued. The proportion of elderly persons aged 65 and over in the total population rose from 13% in 2011 to 20% in 2021 [78]. According to the Elderly Commission, over 46% of Hong Kong's hospital day-beds are occupied by older persons [80].

The high prevalence of chronic diseases in the older population can result in considerable economic cost should planning and community initiatives not be promptly introduced that would avoid the need for medical interventions, rehabilitation and institutional care required, etc.

As such, the needs of the ageing population should be considered holistically to ensure the development of physically and socially inclusive places, and thus, to facilitate ageing-in-neighbourhood.

This section explores how the following strategies in Chapter 3 covering the areas of retrofitting, compact mixed-use development, accessible and intergenerational spaces, transit safety as well as improved hygiene, can work together to support the development of age-friendly precincts.

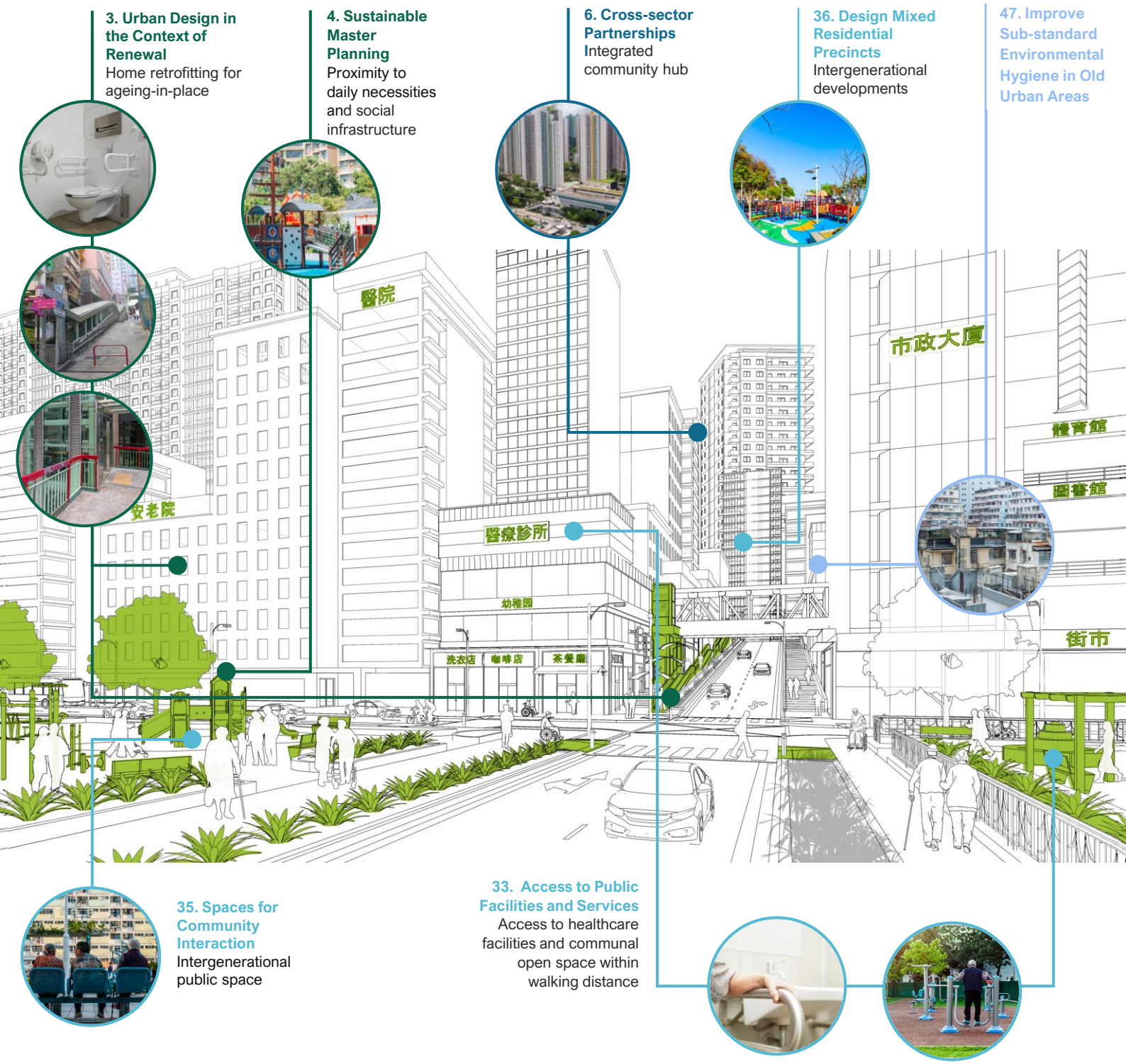


Figure 122: Synergy of Strategies to Create an Age-friendly Neighborhood

Synergy of Strategies to Create an Age-friendly Neighborhood

Create Safe, Inclusive and Accessible Spaces

To accommodate the needs of the ageing population, urban infrastructure, spaces, and facilities should be made safe, inclusive, and accessible. To achieve this, strategies that help to ensure ***33. adequate access to healthcare facilities and communal open space within walking distance, to 47. improve sub-standard environmental hygiene, and 3. encourage retrofitting and regular maintenance of homes and public infrastructure***, could be implemented to create a built environment that accommodates the needs of the elderly. ***4. Proximity to daily necessities and social infrastructures*** that support self-sufficiency, mixed-use neighbourhoods that promote walking with proximity to key public services and facilities can greatly benefit the elderly.

Foster Social Cohesion and Integration

It is also essential to create social spaces that enable interaction, both among the elderly and across generations. Several strategies can work together to optimise social cohesion and integration, such as ***35. intergenerational and community spaces for public use***, as well as ***36. intergenerational development*** through mixed neighbourhoods with facilities. The outcomes of these strategies can result in spaces that are inclusive of all ages..

Further information is provided below on how the selected design strategies presented for this challenge can support ageing-in-neighbourhood.

3. Urban Design in the Context of Renewal

- **Home Retrofitting for Ageing-in-place:** As most elderly persons prefer remaining at their familial homes as long as possible, the Hong Kong Housing Society's Ageing-in-Place (AIP) scheme aims to promote elderly tenants' well-being, resilience to health decline and avoid premature institutionalisation [80]. One of the 5 AIP services is to promote home safety through Assessments of Home Environment and Recommendation of Home Modification/Remodeling and Prescription of Assistive Devices to enhance home safety and prevent home environmental hazard and indoor falls with assistive living. This strategy can be adopted throughout Hong Kong and not be solely limited to public housing development.
- **Retrofitting of Public Infrastructure:** When necessary, infrastructure should be retrofitted to improve usability, safety and security for the elderly.
    - **Responding to the decline in physical and cognitive abilities:** Appropriate infrastructure for the elderly is also important to respond to decline in their physical and cognitive abilities. Older public spaces should, when necessary, be retrofitted with features such as handrails, lifts, accessible ramps, and elderly-friendly signage to facilitate mobility, whilst retaining the existing urban fabric and character of these spaces and the community using them. Retrofit of public social welfare, healthcare and recreational facilities that the elderly would frequently visit can also be considered together with infrastructure such as travellators or other small-scale motorised vehicles to improve mobility and

enhance connectivity for precincts with a higher proportion of elderly population.

- **Personal safety and security:** The adoption of certain measures and facilities to enhance personal safety and security could also be considered, such as the installation of fall detection devices, barrier free facilities and security cameras.

4. Sustainable Master Planning

- **Compact Mixed-use Development:** As a person ages, mobility can decline. Proximity to daily necessities and social infrastructure can foster a degree of self-dependency amongst the elderly. The concept of 15-minute neighbourhood has developed over recent years and has been gaining increasing attention from policy thinkers, academics and planners across the world. The approach focuses on providing day-to-day necessities within a neighbourhood, so that members of the community do not need to travel more than 15 minutes to earn a living, buy food, see a doctor, visit a bank or access public transport when longer journeys are required.

  There are existing examples of 15-minute neighbourhoods in Hong Kong, such as in cases of residential and commercial developments above rail networks that greatly reduces the distance between living spaces, retail and transportation through the bundled provision of services.

  The concept of the 15-minute neighbourhood can greatly benefit the aging community. A self-sufficient, compact, well-conceived mixed-use neighbourhood that reduces car use, promotes walking, and fosters social interaction and care, can be readily employed to ensure adequate support for the elderly and also sustainable and resilient communities that retain a mixed age structure.

6. Cross-Sector Partnerships

- **Development of Integrated Facilities via Cross-Sector Partnerships:** Cross-industry professionals and stakeholders from private and public sectors may collaborate to deliver integrated facilities to serve the needs of the ageing population. An example may be an integrated community hub that provides services in healthcare, social activities, sports and exercise, interest classes, among others. Multi-purpose facilities of this sort may also be especially applicable in a city such as Hong Kong where space is limited. Professionals from commercial sectors may, for example, be better equipped with knowledge on market trends and consumer behaviors of the ageing population—their expertise could be combined with resources provided by the public sector to deliver comprehensive services that meet the needs of the elderly.

33. Access to Public Facilities and Services

- **Access to Healthcare Facilities:** Social Welfare Department operates numerous types of elderly care and support facilities catering to different levels of need. These include Residential Care Home for the Elderly, District Elderly Community Centres, Neighbourhood Elderly Centre and Day Care Centres for the Elderly. It is important to plan for the provision of adequate and appropriate types of healthcare facilities in any precinct, which should ideally be within walking distance of residential areas. Factors such as walking speed and mobility level of the elderly, topography of the concerned areas, etc. should be considered. This will ensure that appropriate health information and services are accessible to older persons. The Jockey Club Credenza Hub in Tai Po is a good example of a community based healthcare facility catering to integrated social and healthcare needs and enhancing the experience of aging in the community.

- **Transit Safety:** Transport infrastructure should account for the age-friendliness of the neighbourhood as a whole and thus should be designed with safety considerations to

ensure accessibility for all. On top of providing additional transport services for elderly who may be experiencing difficulties in mobility, the design of transport infrastructure could also adopt universal access principles, which would not only benefit the elderly but also the differently-abled, children and pregnant women as well. Features to enable transit safety and inclusivity may include the provision of resting spots at transit terminals, use of tactile surfaces for guidance, portable ramps to assist passengers when boarding or alighting public transportation, installation of safety handrails, etc.

35. Spaces for Community Interaction

- **Open Spaces for Community and Social Use:** Apart from declining physical well-being, loneliness and social isolation have become one of the major issues amongst the elderly population, which in turn, could be the cause of serious health conditions. To address this issue, efforts to promote social interaction among the elderly can be implemented. These can be realised through the provision of community facilities and open spaces within, or in close vicinity of, residential areas. To encourage social interaction, such spaces should offer shaded seating where elders can meet or facilities such as in-situ chess boards where they can interact socially. An active ageing hub integrated with an open space can offer older residents opportunities to interact through activities.

- **Intergenerational Park Design:** Parks in Hong Kong are often segregated due to the lack of equipment and facilities to simultaneously accommodate all age groups. To ensure the inclusion of elderly groups, parks can be designed to encourage intergenerational interaction, including the provision of space for both active and passive recreational activities.

- **Intergenerational Community Centres:** social welfare and community facilities for different age groups, such as those that accommodate childcare and eldercare, can be placed under a shared roof in a centralised building or site to strengthen intergenerational relationships and interactions across generations, and hence, enhance inclusion of elderly communities.

- **Multi-functional Urban Infrastructure and Public Space:** public space and infrastructure can be designed to serve more than one function simultaneously to cater to the needs of multiple age groups. For example, community gardens are commonly used in different cities to enhance social interaction as well as reduce food insecurity.

36. Mixed Residential Precincts

- **Intergenerational Development With Supporting Facilities for All Ages**: The young and the old have much to offer to the other. A 2019 study by University College London (UCL) found that increased social contact between the ages of 50 to 70 is associated with a lower risk of developing dementia [84], while the University of Alaska and Anchorage identified that children who mix with older people see improvements in language development, reading and social skills [85].

  Recent precinct design trends have sought to incorporate intergenerational communities where a mix of residential units and supporting facilities for older and younger people are provided. Intergenerational housing can be a healthier alternative to less diverse models. Building cohesive intergenerational communities in Hong Kong will provide support to older persons and allow them to age in place, to be regarded with love and respect, and to be given the support they need within the communities in which they live. Age-diverse development also assists in creating more economically and socially sustainable and resilient communities. The mixed-age Kampung Admiralty residential development in Singapore is a fine example of this approach.

The combined effort of implementing relevant key strategies within the range of sustainable built environments mentioned above can promote healthy ageing, i.e., physical well-being, psycho-social well-being as well as contributing to the alleviation of socio-economic impacts, alienation, and consequences of aging in general.

47. Improve Sub-standard Environmental Hygiene in Old Urban Areas

- **Regular Repairs and Maintenance:** Elderly residents may require additional assistance in repairing and maintaining their homes to upkeep their living environment such that health, safety and hygiene are ensured. This may include financial or technical support in inspecting, replacing and repairing defective appliances or deteriorating features, provision of safety equipment, sterilisation, among other services.

Reference Guidelines

4. Sustainable Master Planning

Readers may refer to the section on "Land Use Mix" in *Planning and Urban Design for a Liveable High-Density City* (October 2016) published by the Planning Department for detailed information on land use zonings that allow mixed uses. In Hong Kong, there are four types of land use zoning that allow mixed uses. "Residential (Group A)" allows high-density residential developments and commercial uses on the lowest three floors of a building, while "Comprehensive Development Area" is intended for comprehensive development/redevelopment of the area for residential and/or commercial uses with the provision of public open space and other supporting facilities. "Other Specified Uses (Business)" permits a combination of commercial and industrial uses, while "Other Specified Uses (Mixed Use)" allows flexibility for mixed non-industrial land uses [81].

The document also lists out different implications of land use mix on city, neighbourhood, and building scales. For instance, on a neighbourhood scale, a commercial centre or shopping street can help boost the vibrancy of the local community and encourage social interaction [81].

33. Access to Public Facilities and Services

Readers can refer to the *Elderly-friendly Design Guidelines (Section 7D)* published by the Architectural Services Department, which provides design enhancement recommendations for public transport facilities. Features include the installation of seating and leaning benches with space-saving design, weather protection at outdoor waiting areas, provision of a buffer zone with proper guard rails at transit terminals that need to be accessed by escalators, as well as vertical transportation options such as lifts to reach terminals that are located above ground [83].

35. Spaces for Community Interaction

Readers can refer to the *Elderly-friendly Design Guidelines (Section 6F)* published by the Architectural Services Department for further details on design considerations for outdoor spaces and amenities in catering the needs of the elderly. In terms of outdoor space, features highlighted include the provision of stimulating focal points, landmarks and landscaping, space to accommodate passive and active activities, sufficient lighting to prevent hazards, and easy access to outdoor spaces to encourage usage [83]. In terms of outdoor amenities, shaded seating areas with clear spaces to store mobility aids should be provided [80]. To encourage social interaction, different types of seating options should also be provided, such as in a group or individual setting [83].

4.6 Planning for Sustainable Economic Growth

Hong Kong's Environment Under Rapid Economic Expansion

The growth of Hong Kong's economy and physical infrastructure will inevitably create challenges for the management of the environment and ensuring that growth occurs in a sustainable manner.

In 2020, more than half of Hong Kong's energy consumption was attributable to the use of electricity. Electricity generation contributes to two-thirds of the city's carbon emissions and buildings alone constitute 90% of electricity consumption [2]. Of the total electricity supply mix, renewable energy only accounted for 0.2% [84].

In 2020, Hong Kong generated close to 15,000 tonnes of municipal solid waste (MSW) on average per day [85]. An additional 56,622 tonnes of construction waste were also generated per day in the same year— a 17% increase from 2019 levels [85].

- The majority of Hong Kong's MSW is currently disposed in landfills in the New Territories, which are predicted to reach maximum capacity by mid-2020s [86].
- Less than 20% of recovered recyclables are locally recycled [85].

Ensuring that the economic and physical growth of Hong Kong will be sustainable will require a coordinated set of actions across numerous sectors, but the planning and design of urban quarters and precincts can make a significant contribution to these efforts.

This section explores strategy combinations across the areas of sustainable finance and business models, integrated engagement in urban planning, waste management mechanisms, biodiversity preservation, the enhancement of economic opportunities, as well as off-site construction technologies to support economic growth in a sustainable manner and alleviate impacts resulting from overconsumption, such as the generation of surplus waste and carbon emissions. The following strategies work together to nurture circular communities and a sustainable economy.

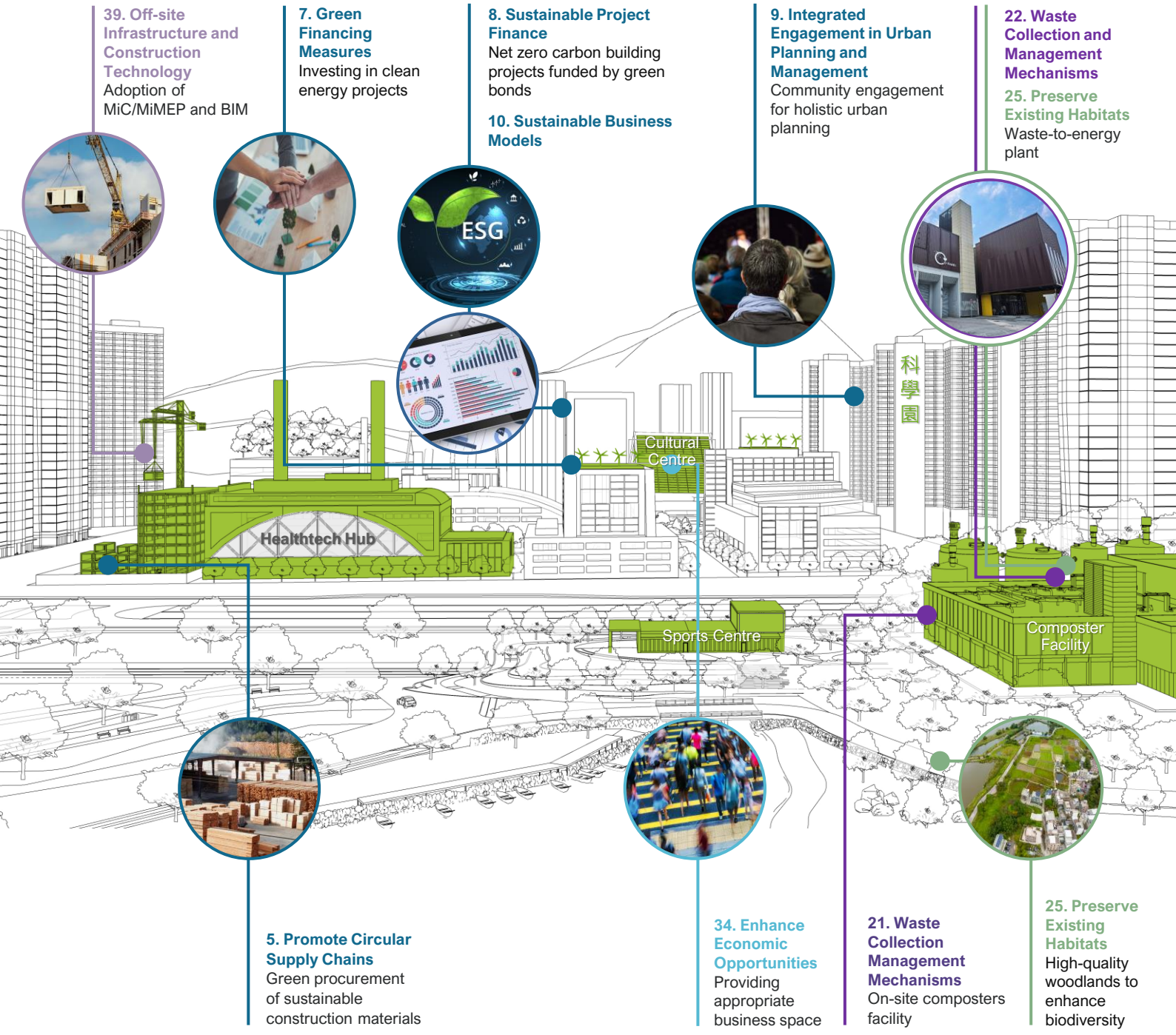


Figure 123: Synergy of Strategies to Nurture Circular Communities and a Sustainable Economy

Synergy of Strategies to Nurture Circular Communities and Sustainable Economy

Sustainable Finance and Business Models

Project owners and operators may look to adopt ***5. circular supply chains, 7. green financing measures, 8. sustainable project finance, 34. provision of appropriate business space, as well as 10. sustainable business models*** *via the development of a circular economy,* ***9. community engagement for holistic urban planning***, and the implementation of carbon trading, for example, to encourage greener investments, more effective use of public resources, and the stimulation of a more resilient economy.

Waste Reduction and Management

Overconsumption is a typical product of a rapidly growing economy such as that of Hong Kong. Green procurement practices may be used alongside with waste collection and management mechanisms to effectively reduce waste such as through ***21. on-site composter facilities and waste-to-energy plant, 39. adoption of MiC/MiMEP and BIM***, as well as conducting waste audits, and proper sorting and disposal processes. Energy may be saved through reducing the amount of waste that needs to be recycled or incarcerated. Moreover, it may also alleviate disturbances to the natural environment caused by waste overload and the subsequent expansion of landfills.

The following section details strategies that complement each other to deliver shared benefits and value that help to alleviate the impacts resulting from rapid economic expansion while at the same time supporting the development of a more sustainable and resilient economy.

5. Promote Circular Supply Chains

- **Green Procurement:** ‘Green Procurement’ or purchasing of products and services from sustainable sources or produced using sustainable processes—particularly those with higher recycled content and improved recyclability, will facilitate the circulation of resources in a closed environmental loop and contribute to a circular economy in Hong Kong. There is growing interest in the concept of ‘urban mining’ (initially a term applied to consumer electronics, but now being used more widely)—which is a process by which during redevelopment projects, existing built infrastructure components are recovered and repurposed elsewhere, so helping to maintain circularity of material procurement.

  To promote the development of a sustainable built environment in Hong Kong, green procurement can be adopted in the planning and design of buildings and public infrastructure of urban quarters and precincts. The EPD has provided, under the “List of 183 Green Procurement Items”, lists of green procurement for building and construction supplies such as concrete, cement, paving units, rubber playground mats and non-structural steel [87].

- **Circular Economy:** The development of a circular economy in Hong Kong and the Greater Bay Area (GBA) would contribute to regional economic growth. Instruments that may be used in Hong Kong to promote a circular economy include:

- Government Led Initiatives and Studies with Independent Involvement - These can identify new measures and strategies that can be applied in the public and private sectors.
- Financial Incentives - Enterprises may be given financial rewards if they have proven participation in the circular economy.
- Technology and Processing - New technologies and processing systems can be applied to enable products to be adaptively re-used and recycled.
- Product Design - All designs should be premised on recycling and adaptive re-use.
- Region Wide Approaches - Harnessing the resources of Hong Kong and the GBA would be a way forward.

7. Green Financing Measures

- **Green Financing:** Hong Kong has already taken significant steps to promote green financing. The Hong Kong Green Finance Association (HKGFA) was founded in September 2018 and the Centre for Green and Sustainable Finance is a cross-sector platform launched under the Hong Kong Monetary Authority. The Centre coordinates the efforts of financial regulators, government agencies, industry stakeholders and the academia in capacity building and policy development. The Centre also provides a data and knowledge portal as well as training in green financing.

  Hong Kong has, in parallel, established standards and reporting frameworks. Capabilities are being progressively developed to expand the range of new green products and standards. In May 2019, the Hong Kong Government raised US$1 billion from the sale of its first green bond under the city's HK$100 billion green bond programme. Proceeds from green bonds are typically used to improve the environment, combat climate change and facilitate the transition to a low-carbon economy. Projects are commonly in the fields of renewable energy, energy conservation, pollution control, nature conservation, biodiversity protection and clean transport.

- **Carbon Trading:** Companies may also consider the practice of carbon trading to further limit carbon emissions. The Hong Kong Stock Exchange (HKEX) established the Hong Kong International Carbon Market Council and launched a new international carbon marketplace known as Core Climate in 2022—a voluntary carbon marketplace that helps connect capital with climate-related opportunities in Hong Kong, Mainland China, Asia and beyond. Companies can continue to seek relevant initiatives in contributing to the development of a low-carbon economy in Hong Kong.

8. Sustainable Project Finance

- The Paris Agreement stipulates that all signatories must make "finance flows consistent with a pathway towards low greenhouse gas emissions and climate-resilient development." This infers that environmental, social and governance (ESG) considerations are account for when making investment decisions in the financial sector with the objective of leading to more long-term investments in sustainable economic activities and projects. One major tool used for sustainable project finance is green bonds.

  Green bonds are loans issued in the market by a public or private organisation to finance environmentally sustainable activities. Internationally green bond issuance has seen an average growth of over 50% per year over the last five years. Green bond value reached US$523 billion in 2021. The use of this mechanism can encourage the financing of green projects by attracting investors and reducing the cost of borrowing.

Hong Kong has developed mechanisms through which sustainable project finance can be used. The Green and Sustainable Finance Cross-Agency Steering Group was established in May 2020 and a strategic plan was promulgated in December 2020. This sets out six key focus areas and five near-term action points for strengthening Hong Kong's financial ecosystem to support a greener and more sustainable future in the territory and the wider GBA region. In May 2021, the Hong Kong Government launched a three-year Green and Sustainable Finance Grant Scheme to provide subsidy for eligible bond issuers and loan borrowers to cover their expenses in bond issuance and external review services.

9. Integrated Engagement in Urban Planning and Management

- **Integrated Engagement in Urban Planning and Management:** Cities can adopt a range of principles and approaches to integrate the environment in urban planning and management as well as in the process of stakeholder engagement. To achieve this requires the adoption of an integrated approach that considers the multi-faceted nature of environmental problems and effective. Public engagement requires that appropriate institutional and administrative mechanisms are in place. Hong Kong has adopted various means and modes of engagement and these may be further refined to ensure that best value is procured from the engagement.

21. Waste Collection and Management Mechanisms

- **On-site Composters and/or Smart Bin Technology:** Hong Kong, like many developed cities, has seen its waste loads grow as its economy expanded. Municipal solid waste includes waste from households, industry and commercial operations. This has placed a tremendous burden on Hong Kong landfills. According to the Environmental Protection Department (EPD), in 2020, 10,809 tonnes of municipal solid waste on average were disposed of in landfills in Hong Kong every day [83]. Of these, about 3,255 tonnes (30%) were food waste, constituting the largest municipal solid waste category [85].

  Installation of on-site composters and/or smart bin technology for the treatment and management of food waste within private and public premises will contribute greatly to the reduction of landfill waste. Collection points for food waste and used cooking oil could also be set up to gather the waste to be sent to renewable energy generation plants such as the Organic Resources Recovery Centre Phase 1 (O·PARK1)—the first facility in Hong Kong that converts food waste into electricity. Using anaerobic digestion technology, the facility turns food waste into biogas, which is then used to generate heat and electricity. Sustainable waste management mechanisms within urban quarters and precincts such as the installation of a waste separation and recovery system, expansion of collection points for recyclables, and adoption of an automated waste collection system for other municipal solid waste can also assist in these efforts.

  As governments seek to upgrade infrastructure and address urban challenges, the use of cross-sector partnerships has grown. Through such a mechanism, the government can have access to private sector resources and expertise, thereby solving some of society's biggest development challenges through market-based solutions. More importantly, such partnership and collaboration can facilitate an environment with two-way sharing of critical information, risk mitigation, and other vital information. This mutual commitment to information sharing through trusted partnerships can support the development of infrastructure and public services as well as further sustainability for Hong Kong.

10. Sustainable Business Models

- **Sustainable Business Models:** Companies have come under increased pressure through increased consumer and investor awareness on issues such as climate change and pollution. Sustainable business models are largely based on the principles of the circular economy and describe how these companies capture economic value while maintaining or regenerating natural, social, and economic capital beyond their organisational boundaries. They help in describing, analysing, managing, and communicating companies' sustainable value propositions to their customers and other stakeholders. Sustainable business models can be used in Hong Kong by all sectors to further sustainable development. The majority of Hong Kong's developers, for example, now produce sustainability reports that detail their approaches to sustainability. Companies adopting sustainable business models can generate higher profits and be more resilient in the market.

21: Waste Collection and Management Mechanisms; 25. Preserve Existing Habitats

- **Waste Management:** Wildlife such as feral dogs, cats and wild pigs can sometimes feed on waste as a food source. This may result in overproduction of some species, which causes disturbance to portions of existing habitats. A systematic waste collection and management mechanism can be implemented to reduce animals' exposure to waste and prevent the over reproduction of certain species. The adoption of a waste-to-energy system such as an incinerator can also help to preserve various portions of existing wildlife habitats. As landfills are often created by the destruction of natural habitats, waste-to-energy systems can effectively reduce waste and decrease the reliance on building landfills.

- **Waste Collection and Management Mechanisms:** In its most comprehensive form, a waste management system comprises of strategies that efficiently manage wastes from their origin until their final disposal. Waste management disposal typically consists of recycling, composting, incineration, landfills, bioremediation, waste to energy, and waste minimisation. These vary in terms of their respective degrees of sustainability. Only a few of these practices are applied within Hong Kong.

- Waste management audits may be conducted which commonly involves the sorting and weighing of a sample of an organisation's waste. This typically involves a three-step process: (1) an examination of waste haulage, disposal, and the identification of contracts with recycling facilities; (2) identification and enumeration of waste-generating activities; and (3) examination of how an organisation addresses the physical collection and sorting of waste. The audit process enables a thorough understanding of the entire waste management process from generation through to disposal to enable identification of how the process may become more sustainable. The audit process could be a valuable technique applicable to Hong Kong as it can raise an organisation's awareness of their waste generation and disposal strategies.

25. Preserve Existing Habitats

- **Preservation of Urban Biodiversity:** Preserving portions of existing habitats such as woodlands or other vegetated areas not only benefits wildlife but could also result in positive economic contributions through a positive multiplier effect. For example, urban biodiversity may increase the resilience of natural ecosystems, hence, reduces the risks of extreme weather events and the subsequent costs needed for potential infrastructural repairs. On the other hand, enabling the proliferation of wildlife through preserved habitats, such as those of pollinating insects, can also help to support the growth of sustainable food systems and ensure food security in a rapidly growing economy. Additionally, preserving vegetated areas may also improve air quality, thermal comfort, and overall wellbeing, which in turn, help to reduce health risks and

associated healthcare expenditures. The preservation of existing habitats can thus be seen to deliver holistic benefits to the environment, people and economy in a built environment where demand is constantly rising.

- **Conserving Portions of Existing Habitats:** In Hong Kong, urbanisation and growth have resulted in the transformation of tracts of land into high density new towns and other urban related developments. In recent years, there have been attempts to conserve portions of existing habitat within major development projects such as New Development Areas. This process requires that areas of habitat are identified and categorised according to their relative importance. Where possible and practical, areas of habitat of value, are integrated into the design of the development. Areas of habit should be integrated into a wider landscape framework that integrates blue-green and other sustainable design practice that contributes to biodiversity [88]. Areas of habitat should not be considered as isolated elements but should form an integrated component of a wider biodiverse landscape design within new developments. This will provide material economic and social benefits to the Hong Kong community. For example, the Lok Ma Chau Loop Offsite Wetland Compensation Area (OWCA) was established as a compensatory measure for the loss of wetland habitats due to development activities in the Lok Ma Chau Loop area. This area has created new habitats and provided benefits for wildlife in the region including re-establishing natural hydrological conditions, reintroducing native wetland vegetation, and creating diverse wetland features. Additionally, planting native vegetation enhances biodiversity by providing food and shelter for wildlife, attracting birds, reptiles, and other small animals. Careful selection of plant species considers their ecological value and potential benefits to wildlife, contributing to the overall ecological balance of the area [89].

34. Enhance Economic Opportunities

Hong Kong's economic growth and sustainability relies in the provision of appropriate physical space and premises for the kind of industries and enterprises that will guarantee the future success of its economy. In the 2022 Policy Address, the Government committed to growing the financial services industry (including green finance), fintech and information and technology (I&T) industries, manufacturing industries, tourism and sustainable agriculture and fisheries. To achieve these objectives, it will be necessary for projects, from the regional to the precinct level, to assist in achieving them.

- **Access to Employment Opportunities:** Economic growth is facilitated if jobs are provided close to those best able to perform them. This not only enhances the economic security of communities but also helps to create a sustainable and resilient local economy. At the same time, there are environmental benefits such as reducing the need to take private or public transport to access employment. At a strategic level, the Government is attempting to provide a spatial distribution of economic opportunity across Hong Kong by creating a CBD2 at Kwun Tong, a CBD3 at the Artificial Islands in Central Waters as well as a range of I&T opportunities in the northern New Territories.

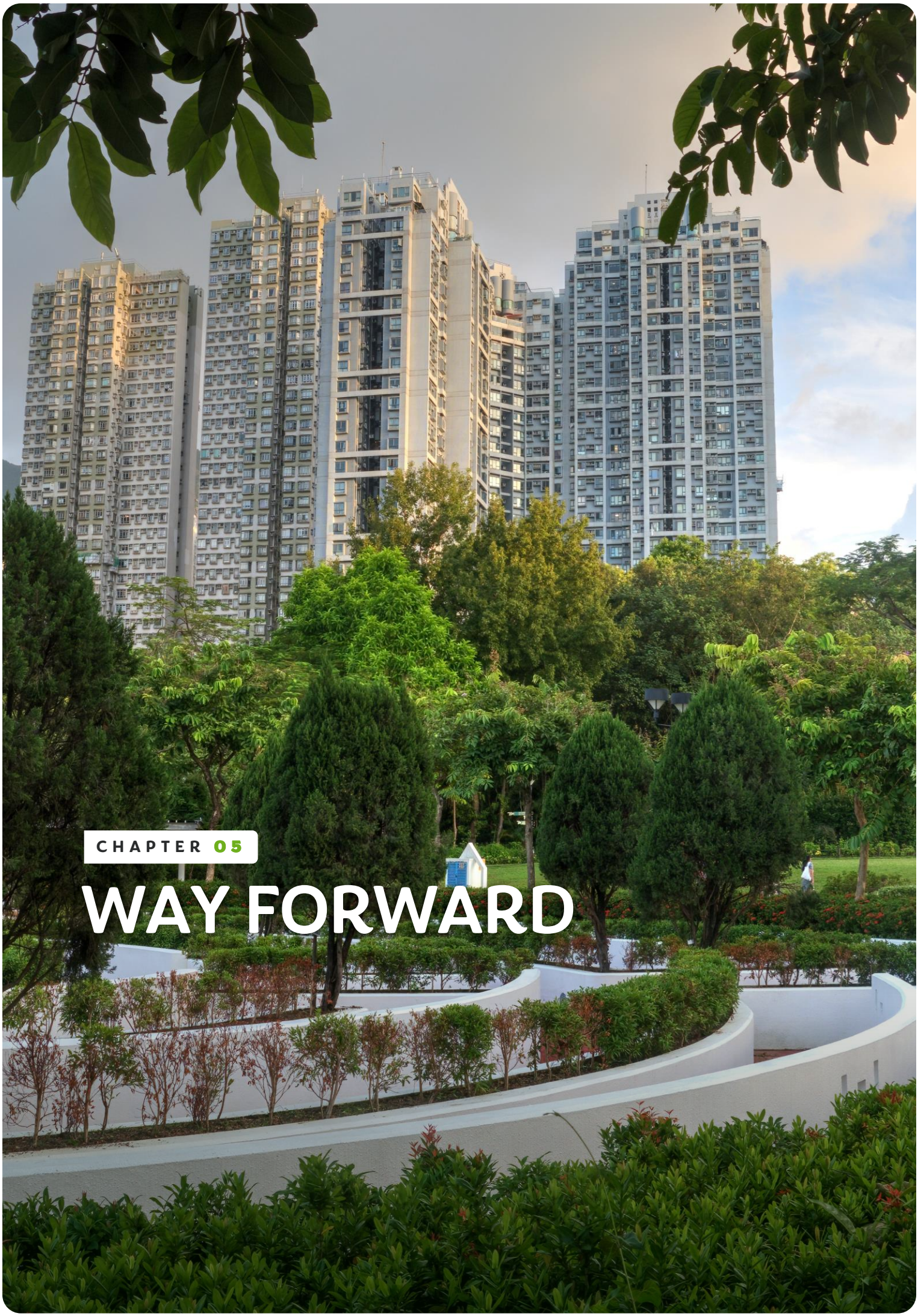
- **Providing Appropriate Business Space:** It is important that the Government's strategic economic objectives are furthered at the precinct level. Precinct level planning could aim to provide a mixture of residential, business and community land uses as the best measure to create sustainable communities as well as liveable 15-minute neighbourhoods. Ideally, business spaces should be flexible and address different types of uses such as light manufacturing workshops, office space, co-working space and spaces for supporting industries such as retail and Food & Beverage. The provision of an appropriate mix of business spaces will ensure a vibrant, economically resilient and sustainable community and precinct.

- **Enhance Economic Opportunities:** The promotion of a green economy and sustainable economic growth generate new and more diverse employment opportunities. One aspect that has been proven to generate employment is the increased development of green buildings. As demand for these buildings increase, so too will the number of employment places that are generated to deliver them. Another aspect is that as land resources are finite, Hong Kong will ultimately have to embark on urban regeneration and renewal which will create jobs and economic opportunities for residents.

39. Off-site Infrastructure and Building Construction Technology

- **Waste Reduction via Off-site Construction:** The high level of construction activity in Hong Kong generates large amounts of waste materials. According to the EPD, the average amount of construction waste disposed of at landfills in 2020 was 3,418 tonnes per day, accounting for 23% of total solid waste at landfills [85]. The adoption of off-site construction technologies such as MiC and MiMEP, which involve the off-site assembly of building components that are then transported to the site for installation, can enhance speed, efficiency and quality in the construction of new developments, whilst reducing the amount of materials consumed, waste produced and carbon emissions. As part of a composite development project by the URA, the use of MiC has been found to reduce construction waste by 68% and construction noise by 75%, while increasing construction speed by 30% [91]. Moreover, these off-site construction technologies also respond to challenges Hong Kong face today, such as the shortage of skilled labour, lack of on-site storage, dust and noise pollution and downtime from adverse weather conditions. The Architectural Services Department (ArchSD) has actively promoted the adoption of MiC and MiMEP.

  Additionally, BIM models can be used to provide a more comprehensive picture of the quantity of materials needed for a development project and can further reduce construction and demolition waste through minimising rework and changes to the design. It can be used to schedule work and ensure that building materials, including pre-fabricated structures built from off-site technologies, are delivered to the site in a timely manner, which further reduces construction waste and energy consumption by allowing materials to be delivered to the site only when necessary [92].



CHAPTER 05

WAY FORWARD

CHAPTER 05

Way Forward

This Guidebook introduces design strategies that can be adopted to support the development of sustainable built environments in Hong Kong, specifically on a precinct-level. Three core objectives form the basis of these strategies, namely carbon neutrality, the UN SDGs and smart green city development. A series of regional and international case studies have been presented to demonstrate real-life applications of such strategies in different contexts, together with examples of several synergies of how the design strategies could be applied in Hong Kong to address some key urban challenges.

5.1 Challenges and Opportunities

Practitioners may encounter challenges in the implementation of the strategies proposed in this guidebook, given the unique characteristics and vastly diverse urban landscape of Hong Kong. With the dynamic nature of urban environments, there is a need to keep up with new priorities. As such, readers should note that the design strategies presented in this Guidebook are not meant to be treated as “one-size-fits-all”—rather, they should be selected and adapted to fit specific site constraints and context, institutional goals, and resource availability.

It should be noted that the intent of the Guidebook is to provide guidance at the conceptual stage of precinct design rather than on details of individual developments.

Precincts that successfully adopt the design strategies presented in this Guidebook are expected to demonstrate principles of sustainability and should be better positioned to garner greater support from stakeholders to take forward their development and implementation of green initiatives on respective sites.

Overall, this Guidebook presents the opportunity to mobilise sustainable development in Hong Kong's built environment, propelling city-wide progression towards achieving carbon neutrality before 2050, the UN SDGs and recognition as a world-class smart green city. However, in the process of striving to meet the three core objectives, fresh challenges may emerge, and new opportunities may be found. As such, it is paramount that the guidance presented in this Guidebook continues to be developed and expanded to meet future challenges.

5.2 Public Education and Awareness

The key practices and initiatives in Hong Kong and abroad, together with reference guidelines mentioned in this Guidebook that target the development of sustainable built environments demonstrate that there is existing effort to spread awareness of this subject matter across different stakeholder groups. However, public and professional understanding could be further enhanced with greater promotion and education.

The content of this Guidebook is intended to be easily understandable, both by industry practitioners, decision-makers and community groups alike. It creates an opportunity for readers to learn about how green and sustainable design could be integrated in the development of built environments in Hong Kong—ranging from buildings, infrastructures, open areas, to public and private facilities. Nevertheless, this Guidebook alone is not enough to raise awareness. Further promotion of sustainable built environments, such as efforts similar or complementary to this Guidebook, is needed to spread knowledge and increase awareness of the field.

5.3 Recommendations on Future Development and Studies

Design strategies should be evaluated during and after implementation to determine their effectiveness. While the strategies presented in this Guidebook do intend to deliver maximum benefits, the level of impact may differ depending on the context and characteristics of the built environment to which they are applied. The Guidebook sets out design strategies for future development of a sustainable built environment in Hong Kong for driving community resilience recovery and achieving carbon neutrality towards 2050. References can be drawn from the indicators provided in this Guidebook, which provide suggestions on appropriate areas for measurement. Proper evaluation also enables more informed decisions on whether adjustments are necessary over the course of strategy implementation for optimal effect.

In addition, future studies may also focus on the design strategies applied at the precinct-level as a means of encouraging wider adoption of sustainable design strategies across Hong Kong. Relevant case studies may also be useful to facilitate a deeper understanding of how similar strategies have been adopted elsewhere in the development of more sustainable cities.

5.4 Summary and Conclusion

As new and old communities continue to be developed and redeveloped to meet Hong Kong's growing urban demands, the need to implement greener and more sustainable design strategies to create more resilient built environments has become increasingly important. As a way forward, continuous efforts and collaboration from public and private bodies alike will be crucial to ensure a more sustainable future for all.

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Table 6: Figures Sourced from External Sites

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APPENDICES

Appendix A
Design Strategies Overview, by Theme

Appendix B
List of Relevant Policies and Guidelines

Appendix A1
OVERVIEW OF DESIGN STRATEGIES FOR THEME A
PLAN LIVEABLE PRECINCTS

This theme focuses on promoting wellness and liveability through exploring the areas of nature, building disposition, urban renewal and sustainable master planning.

Objectives	Design Strategies	Objectives of the Guidebook		
		Achieving Hong Kong's goal of becoming carbon neutrality before 2050	Achieving United Nations Sustainable Development Goals	Achieving Hong Kong's goal of becoming a world-class smart, green and resilient city
To Enhance Wellbeing and Liveability through Infrastructure and Urban Design	**1. Nature-based Precinct Design**			
	1. Integrate natural elements into urban built environments	✓	✓	✓
	2. Urban forestry	✓	✓	✓
	3. Green and blue infrastructure	✓	✓	✓
	4. Riverside revitalisation and community development	✓	✓	✓
	2. Building Disposition & Site Responsive Precinct Design			
	1. Permeable urban fabric	✓	✓	✓
	2. Varied height profile	✓	✓	✓
	3. Passive urban cooling	✓	✓	✓
	4. Harmonious palettes and materials	✓	✓	
	5. Building orientation	✓	✓	✓
To Enhance Liveability through Spatial Planning	**3. Urban Design in the Context of Renewal**			
	1. Redevelopment before new build	✓	✓	✓
	2. Rehabilitation and retrofitting	✓	✓	✓
	3. Heritage preservation and revitalisation	✓	✓	
	4. 'Quick-win' spatial interventions	✓	✓	
	4. Sustainable Master Planning			
	1. Polycentric precinct design	✓	✓	✓
	2. Fine grain & mixed-use precinct	✓	✓	✓

Table 7: Linkage Between Design Strategies for Theme A Plan Liveable Precincts and Guidebook Objectives

Appendix A2
OVERVIEW OF DESIGN STRATEGIES FOR THEME B
INTEGRATED PLANNING AND GOVERNANCE

This theme focuses on strengthening governance, promoting integrative planning, and leveraging sustainable finance in precinct development, exploring areas such as circular supply chains, cross-sector partnerships, community engagement, and sustainable business models.

Objectives	Design Strategies	Objectives of the Guidebook		
		Achieving Hong Kong's goal of becoming carbon neutrality before 2050	Achieving United Nations Sustainable Development Goals	Achieving Hong Kong's goal of becoming a world-class smart, green and resilient city
Promote Sustainable Procurement	**5. Promote Circular Supply Chains**			
	1. Circular supply chains	✓	✓	✓
Optimise Use of Green Finance Mechanisms	**6. Cross-Sector Partnerships**			
	1. Methods of Partnerships		✓	
	7. Green Financing Measures			
	1. Loans, bonds and carbon finance	✓	✓	✓
	2. Carbon trading	✓	✓	✓
	8. Sustainable Project Finance			
	1. Due diligence to ensure sustainable measures	✓	✓	✓
Promote New Business Models Based on Innovative and Resource-efficient Solutions	**9. Integrated Engagement in Urban Planning and Management**			
	1. Community engagement	✓	✓	✓
	10. Sustainable Business Models			
	1. Sustainable and efficient business models	✓	✓	✓

Table 8: Linkage Between Design Strategies for Theme B Integrative Planning & Governance and Guidebook Objectives

Appendix A3
OVERVIEW OF DESIGN STRATEGIES FOR THEME C
CLIMATE RESILIENT AND CARBON NEUTRAL PRECINCTS

This theme promotes climate resilience and carbon neutrality through exploring strategies that aim to minimise energy consumption and carbon emissions, maximise the use of renewable energy, and mitigate climate risks.

Objectives	Design Strategies	Objectives of the Guidebook		
		Achieving Hong Kong's goal of becoming carbon neutrality before 2050	Achieving United Nations Sustainable Development Goals	Achieving Hong Kong's goal of becoming a world-class smart, green and resilient city
Promote Use of Natural Resources	**11. Climate Resilient Design**			
	1. Sustainable drainage systems	✓	✓	✓
	2. Protective elements along coastal edges	✓	✓	✓
	3. Natural ventilation and solar radiation in precinct layout	✓	✓	✓
	4. Structural interventions	✓	✓	✓
	5. Planting of green areas	✓	✓	✓
	6. Consideration of building facades	✓	✓	✓
	7. Incorporation of podium gardens	✓	✓	✓
	8. Contingency plans for natural disasters	✓	✓	✓
	9. Water resilient design	✓	✓	✓
	12. Passive Ventilation Mechanisms			
	1. Thermostat-actuated louvres	✓	✓	✓
	2. Horizontal cross ventilation	✓	✓	✓
	3. Vertical ventilation	✓	✓	✓
	13. Natural Lighting Mechanisms			
	1. Passive daylight features	✓	✓	✓
	2. Computer modelling analysis of natural light	✓	✓	✓
	3. High performance glazing and multi-layered insulated glass	✓	✓	✓
	14. Water Conservation Initiatives			
	1. Public education programs	✓	✓	✓
	2. Rainwater harvesting	✓	✓	✓

Appendix A3
OVERVIEW OF DESIGN STRATEGIES FOR THEME C DESIGN CLIMATE RESILIENT AND CARBON NEUTRAL PRECINCTS (Cont'd)

Objectives	Design Strategies	Objectives of the Guidebook		
		Achieving Hong Kong's goal of becoming carbon neutrality before 2050	Achieving United Nations Sustainable Development Goals	Achieving Hong Kong's goal of becoming a world-class smart green and resilient city
Harness Renewable Energy	**15. Solar Energy Systems**			
	1. Photovoltaic cells	✓	✓	✓
	2. Solar water heating systems	✓	✓	✓
	16. Wind Energy Systems			
	1. Small wind turbines	✓	✓	✓
	17. Wave Energy Systems			
	1. Wave power devices	✓	✓	✓

Table 9 : Linkage Between Design Strategies for Theme C Climate Resilient and Carbon Neutral Precincts and Guidebook Objectives

Appendix A4
OVERVIEW OF DESIGN STRATEGIES FOR THEME D
CONNECTED AND CIRCULAR PRECINCTS

This theme focuses on improving urban mobility and enhancing the efficiency of district wide systems, touching upon the areas of transit-oriented development, digital intervention, waste collection and management, and the integration of energy systems.

Objectives	Design Strategies	Objectives of the Guidebook		
		Achieving Hong Kong's goal of becoming carbon neutrality before 2050	Achieving United Nations Sustainable Development Goals	Achieving Hong Kong's goal of becoming a world-class smart, green and resilient city
Adopt Transit-oriented Development (TOD) Principles	**18. Transport Infrastructure Design**			
	1. Increase density of public transit terminals	✓	✓	✓
	2. Upgrade transit corridor design	✓	✓	✓
	3. Encourage active transport	✓	✓	✓
	4. Inclusive design	✓	✓	✓
Digital Intervention to Transform Mobility	**19. Digitalised Mobility**			
	1. Physical infrastructure to support digital mobility	✓	✓	✓
	2. Leverage mobile technology	✓	✓	✓
	3. Smart parking systems	✓	✓	✓
	4. Investment in digital connectivity	✓	✓	✓
	20. Support Electrical Mobility			
	1. Electric car sharing services	✓	✓	✓
Optimise Waste Collection and Recycling	**21. Waste Collection and Management Mechanisms**			
	1. On-site composters/smart bin technology	✓	✓	✓
	2. Sustainable waste management mechanisms	✓	✓	✓
	22. Waste-to-energy System			
	1. Electricity generation via biofuel	✓	✓	✓
	2. Conversion of food waste into biogas	✓	✓	✓
Integrate Energy Systems at Precinct Level	**23. Precinct-wide Energy System Design**			
	1. Utilisation of microgrids	✓	✓	✓
	2. Smart grid system	✓	✓	✓

Table 10: Linkage Between Design Strategies for Theme D Connected and Circular Precincts and Guidebook Objectives

Appendix A5
OVERVIEW OF DESIGN STRATEGIES FOR THEME E
URBAN BIODIVERSITY

This theme explores strategies that aim to minimise the adverse effects of urban development on existing natural habitats, maximise preservation of biodiversity within the urban environment, and reduce the damage caused by urbanisation on ecological resources.

Objectives	Design Strategies	Objectives of the Guidebook		
		Achieving Hong Kong's goal of becoming carbon neutrality before 2050	Achieving United Nations Sustainable Development Goals	Achieving Hong Kong's goal of becoming a world-class smart, green and resilient city
Planning of Development Area Locations and Boundaries	**24. Prioritise (Re-)Development of Low Biodiversity Areas**			
	1. Investigate regional context and site conditions	✓	✓	✓
	2. Avoid encroaching on natural habitats of high biodiversity	✓	✓	✓
	3. Include areas of low biodiversity level for redevelopment	✓	✓	✓
	25. Preserve Existing Habitats			
	1. Identify opportunities and constraints on urban biodiversity	✓	✓	✓
	2. Preserve portions of existing natural habitats when zoning	✓	✓	✓
	3. Preserve natural water channels	✓	✓	✓
	4. Incorporate preserved habitats	✓	✓	✓
	26. Sufficient Space for New Urban Biodiversity within Development Area			
	1. Reserve space for new urban biodiversity areas	✓	✓	✓
	2. Locate high disturbance activities away from biodiversity areas	✓	✓	✓
	3. Integrate natural habitats with open space	✓	✓	✓
Planning of Urban Biodiversity Area	**27. Optimise Connectivity of Urban Biodiversity Areas**			
	1. Form ecological linkages with corridors and stepping-stones	✓	✓	✓
	2. Link external natural habitats to urban biodiversity areas	✓	✓	✓
	28. Green/Blue Infrastructure Planning			
	1. Identify opportunities for green/blue infrastructure	✓	✓	✓

Appendix A5
OVERVIEW OF DESIGN STRATEGIES FOR THEME E URBAN BIODIVERSITY (Cont'd)

Objectives	Design Strategies	Objectives of the Guidebook		
		Achieving Hong Kong's goal of becoming carbon neutrality before 2050	Achieving United Nations Sustainable Development Goals	Achieving Hong Kong's goal of becoming a world-class smart, green and resilient city
Planning of Urban Biodiversity Area (Cont'd)	**28. Green/Blue Infrastructure Planning (Cont'd)**			
	2. Identify opportunities to improve grey infrastructure	✓	✓	✓
	29. Eco-friendly/Wildlife-safe Infrastructure and Building Design			
	1. Incorporate wild-life design	✓	✓	✓
	30. Approach to Establish Urban Biodiversity Areas			
	1. Align approach in early design stage with site context	✓	✓	✓
	2. Restore ecological resources	✓	✓	✓
	31. Ecologically Sensible Design			
	1. Consider the size and shape of a biodiversity area	✓	✓	✓
	2. Ensure a buffer distance	✓	✓	✓
	3. Establish a core area, off-limits to human access	✓	✓	✓
	32. Provision of Complex Habitats to Attract Wildlife for Colonisation			
	1. Topographic profile and planting	✓	✓	✓
	2. Create a mosaic of different habitats	✓	✓	✓
	3. Include water bodies	✓	✓	✓
	4. Utilise natural materials	✓	✓	✓
	5. Plant native species	✓	✓	✓
	6. Provide additional design	✓	✓	✓
	7. Consider biodiversity in district maintenance and practices	✓	✓	✓
	8. Operational plan with maintenance measures of habitat quality	✓	✓	✓

Table 11: Linkage Between Design Strategies for Theme E Urban Biodiversity and Guidebook Objectives

Appendix A6
OVERVIEW OF DESIGN STRATEGIES FOR THEME F
INCLUSIVE & ACCESSIBLE COMMUNITIES

This theme focuses on strategies that target to improve social infrastructure, strengthen local engagement and sense of belonging within the community, as well as foster inclusiveness and social cohesion.

Objectives	Design Strategies	Objectives of the Guidebook		
		Achieving Hong Kong's goal of becoming carbon neutrality before 2050	Achieving United Nations Sustainable Development Goals	Achieving Hong Kong's goal of becoming a world-class smart, green and resilient city
Enhance Equity and Personal Security	**33. Access to Public Facilities and Services**			
	1. Transit safety equity	✓	✓	
	2. Access to educational facilities	✓	✓	
	3. Access to healthcare facilities	✓	✓	
	4. Access to elderly care facilities	✓	✓	
	5. Facilities for aging in place and active aging	✓	✓	
	6. Convenient and safe access to open space for all	✓	✓	
	7. Mechanically assisted mobility			
	34. Enhance Economic Opportunities			
	1. Access to employment opportunities	✓	✓	
	2. Industrial and commercial offices	✓	✓	
Enhance Social Cohesion	**35. Spaces for Community Interaction**			
	1. Streets/open spaces for community and social use	✓	✓	
	36. Mixed Residential Precincts			
	1. Stable, vibrant and diverse mixed residential communities	✓	✓	
	37. Balanced Approach to Renewal			
	1. Avoid gentrification and destruction of existing communities	✓	✓	

Table 12: Linkage Between Design Strategies for Theme F Inclusive & Accessible Communities and Guidebook Objectives

Appendix A7
OVERVIEW OF DESIGN STRATEGIES FOR THEME G
INNOVATIVE SUSTAINABLE DESIGN AND TECHNOLOGY

This theme explores strategies in the areas of smart and intelligent systems, construction technologies (e.g., off-site construction technology), sustainable construction materials and flexible building design.

Objectives	Design Strategies	Objectives of the Guidebook		
		Achieving Hong Kong's goal of becoming carbon neutrality before 2050	Achieving United Nations Sustainable Development Goals	Achieving Hong Kong's goal of becoming a world-class smart, green and resilient city
Integrated Monitoring and Control Systems	**38. Intelligent Infrastructure for Smart Building and Precinct Functions**			
	1. Add digital intelligence via a 3-layered model	✓	✓	✓
Leverage Construction Technology to Maximise Resource Efficiency	**39. Off-site Infrastructure Construction Technology**			
	1. Adoption of Modular Integrated Construction / Multi-trade Integrated Mechanical, Electrical and Plumbing (MiC/MiMEP)	✓	✓	✓
	2. Maximise productivity with MiC/MiMEP	✓	✓	✓
	3. Use of Building Information Model (BIM) models for synchronised updates	✓	✓	✓
Adopt Circular Design and Construction Principles	**40. Sustainable Construction Materials**			
	1. Use of bio-based materials	✓	✓	✓
	2. Use of recycled materials from local construction waste	✓	✓	✓
	3. Use of low-carbon materials	✓	✓	✓
	4. Local sourcing of construction materials	✓	✓	✓
	41. Flexible Building Design			
	1. Structural elements designed to accommodate change	✓	✓	✓
	2. Flexibility in external and internal space	✓	✓	✓

Table 13: Linkage Between Design Strategies for Theme G Innovative Sustainable Design and Technology and Guidebook Objectives

Appendix A8
OVERVIEW OF DESIGN STRATEGIES FOR THEME H
MITIGATION OF HEALTH RISKS

This theme focuses on strategies that target to improve public hygiene and sanitation, air quality and circulation, public response to epidemics and contact tracing.

Objectives	Design Strategies	Objectives of the Guidebook		
		Achieving Hong Kong's goal of becoming carbon neutrality before 2050	Achieving United Nations Sustainable Development Goals	Achieving Hong Kong's goal of becoming a world-class smart, green and resilient city
Enhance Design and Quality of the Built Environment	**42. Repurpose Public Space**			
	1. Site repurposing in response to a pandemic	✓	✓	✓
	43. Improve Physical Form of Buildings and General Physical Environment			
	1. Gradation of development height profile		✓	
	2. Breezeways and visual corridors		✓	
	3. More open space and greater building setbacks layout		✓	
	4. Local greening	✓	✓	
	44. Enhance Public Facilities To Promote and Maintain Public Hygiene			
	1. Enhance air quality	✓	✓	✓
	2. Surface disinfection		✓	✓
	3. Smart temperature sensors and thermostats		✓	✓
	4. Touchless solutions for minimal contact		✓	✓
	5. Robotics for airport patrol, bagging handling, cleansing, etc.		✓	✓
	45. Contact Tracing with Smart-city Tech			
	1. Digital tools to enhance contact tracing		✓	
	2. Involve heath experts in deign and use of digital tools		✓	✓
	3. Smart temperature sensors and thermostats		✓	✓
	4. Transparent and updated information on digital tools		✓	✓
	5. Other methods of contract tracing for groups with low mobile usage		✓	✓

Appendix A8
OVERVIEW OF DESIGN STRATEGIES FOR MITIGATION OF HEALTH RISKS (Cont'd)

Objectives	Design Strategies	Objectives of the Guidebook		
		Achieving Hong Kong's goal of becoming carbon neutrality before 2050	Achieving United Nations Sustainable Development Goals	Achieving Hong Kong's goal of becoming a world-class smart, green and resilient city
Enhance Design and Quality of the Built Environment (Con't)	**46. Self-contained and Socially Inclusive Communities**			
	1. Self sufficient neighbourhoods	✓	✓	✓
	2. Enhanced distribution of public space	✓	✓	
	47. Improve Substandard Environmental Hygiene in Old Urban Areas			
	1. Regular repairs and maintenance of existing buildings		✓	
Promoting Social Physical Distancing	**48. Segregate Public Services and Facilities**			
	1. Smart technology to provide information to riders		✓	✓
	2. Train service to accommodate peak times and support social distancing		✓	✓
	3. Proper signage for physical distancing		✓	
	4. Physical barriers to maintain physical distance		✓	

Table 14: Linkage Between Design Strategies for Theme H Mitigation of Health Risks and Guidebook Objectives

Appendix B1:
Relevant Planning and Design References in Hong Kong

Theme A: Plan Liveable Precincts

Publication Date/Last Update	Institution/ Government Department	Title of Document/ Reference	Chapter/Section	Relevant Design Strateg(ies)
Oct 2015	Hong Kong Planning Department	Hong Kong Planning Standards and Guidelines	Chapter 4 Recreation, Open Space and Greening	1
Nov 2015			Chapter 11 Urban Design Guidelines	2
Oct 2016	Hong Kong Planning Department	Planning and Urban Design for Liveable High-Density City	2 Planning for a Compact City	3
Jan 2022	Hong Kong Housing Authority	Green Design & Specification	Greening in Housing Estates	1
Sep 2019	Hong Kong Buildings Department, Lands Department, Planning Department	Joint Practice Notice	JPN No.1 – Green and Innovative Buildings	1
Oct 2021	Greening, Landscape & Tree Management Section, Hong Kong Development Bureau	Pictorial Guide to Plan Resources for Skyrise Greenery in Hong Kong	Where applicable	1
Jan 2020	Hong Kong Drainage Services Department	Drainage Services Department Practice Note No. 1/2020 – Guidelines on Implementation of Roof Greening in DSD Facilities	Design and Construction	1
N/A	Hong Kong Development Bureau	Urban Forestry	Where Applicable	1
May 2022	Hong Kong Electrical and Mechanical Services Department	Energy Land	Building – Energy Use in a Building – Building Envelope	1
April 2016	Greening, Landscape & Tree Management Section, Hong Kong Development Bureau	Handbook on Tree Management	Where Applicable	1
Nov 2016	Hong Kong Green Building Council	BEAM Plus Neighbourhood Version 1.0 (Draft Manual)	CA 7 – Conservation of Cultural Assets	4
Feb 2011	Hong Kong Development Bureau	Urban Renewal Strategy	Redevelopment, Rehabilitation	4

Table 15: Relevant Planning and Design References in Hong Kong for Theme A Plan Liveable Precincts

Appendix B2:
Relevant Planning and Design References in Hong Kong

	Publication Date/Last Update	Institution/ Government Department	Title of Document/ Reference	Chapter/Section	Relevant Design Strateg(ies)
Theme B: Integrative Planning and Governance	Apr 2021	Finance Services Branch, Hong Kong Financial Services and the Treasury Bureau	Green and Sustainable Finance Grant Scheme	Where Applicable	7
	Jul 2022	Hong Kong Environment and Ecology Bureau	Green Tech Fund	Where Applicable	7
	Jun 2020	Hong Kong Monetary Authority	White Paper on Green and Sustainable Banking	Where Applicable	7
	Feb 2022	Hong Kong Education Bureau	Education Bureau Green and Sustainable Finance Sharing	Where Applicable	7
	Sep 2021	Hong Kong Legislative Council	Legislative Council Panel on Financial Affairs – Development of Green and Sustainable Finance in Hong Kong	Where Applicable	7
	Feb 2021	Business Environment Council	Circularity Assessment of Hong Kong	Where Applicable	8
	Nov 2020	KPMG China, InvestHK	Future of Sourcing: 2021 and Beyond	Where Applicable	8
	2018	UN Habitat	Civic Participation in Urban Planning and Management	Where Applicable	9
	N/A	Hong Kong Planning Department	Sustainable Development for the 21st Century	The Sustainable Development System	9

Table 16: Relevant Planning and Design References in Hong Kong for Theme B Integrative Planning and Governance

Appendix B3:
Relevant Planning and Design References in Hong Kong

	Publication Date/Last Update	Institution/ Government Department	Title of Document/ Reference	Chapter/Section	Relevant Design Strateg(ies)
Theme C: Design Climate Resilient and Carbon Neutral Precincts	2020	Department of Civil and Environmental Engineering, Hong Kong Polytechnic University	Helping Solar Panels "Sweat" to Increase Energy Efficiency	Where Applicable	**15**
	Jun 2022	Hong Kong Electrical and Mechanical Services Department	HK RE Net	Solar - Solar Water Heating	**15**
				Wind	**16**
				Other Renewable Energy Technologies - Marine Renewables	**17**
	May 2022	Hong Kong Electrical and Mechanical Services Department	Energy Land	Building - Building Envelope	**11**
	2022	Hong Kong Construction Industry Council – Zero Carbon Park (CIC-ZCP)	ZCP's Design Strategies	Passive Design	**11**
	Apr 2021	Hong Kong Housing Authority	Sustainability Report 2019/20	Environmental Performance – Case Study – Zero Irrigation System – The Water Conservation Innovation	**15**
	Oct 2021	Hong Kong Water Supplies Department	Total Water Management Strategy	Where Applicable	**15**
	2017	Hong Kong Drainage Services Department	Sustainability Report 2016-17	Sponge City: Adapting to Climate Change	**11, 14**
	Jul 2020	Hong Kong Development Bureau	Development Bureau Technical Circular (Works)	No.9/2020 Blue-Green Drainage Infrastructure	
	Oct 2016	Hong Kong Planning Department	Green and Blue space Conceptual Framework	Where Applicable	

Table 17: Relevant Planning and Design References in Hong Kong for Theme C Design Climate Resilient and Carbon Neutral Precincts

Appendix B4:
Relevant Planning and Design References in Hong Kong

	Publication Date/Last Update	Institution/ Government Department	Title of Document/ Reference	Chapter/Section	Relevant Design Strateg(ies)
Theme D: Connected and Circular Precincts	Dec 2020	Hong Kong Transport Department	Guidance Notes on the Trials of Autonomous Vehicles	General Requirements	**18**
	Dec 2020	Hong Kong Innovation and Technology Bureau	Hong Kong Smart City Blueprint 2.0	Smart Mobility	**19**
	Aug 2021	Hong Kong Planning Department	Hong Kong Planning Standards & Guidelines	Chapter 8 Internal Transport Facilities	**20**
	Jun 2022	Hong Kong Environmental Protection Department	Environmental Protection Department - Waste	Problems and Solutions	**21**
	2020	Hong Kong Environmental Protection Department	O · PARK1	Where Applicable	**21**
	N/A	CLP	LS-energy.hk	Overview of Hong Kong's Electricity Supply – Smart Grid	**23**

Table 18: **Relevant Planning and Design References in Hong Kong for Theme D Connected and Circular Precincts**

Appendix B5:
Relevant Planning and Design References in Hong Kong

	Publication Date/Last Update	Institution/ Government Department	Title of Document/ Reference	Chapter/Section	Relevant Design Strateg(ies)
Theme E: Urban Biodiversity	Dec 2021	Hong Kong Drainage Services Department	Drainage Services Department Practice Notes	No. 3/2021 Guidelines on Design for Revitalisation of River Channel	28
	Aug 2021	Hong Kong Agriculture, Fisheries and Conservation Department	Threats to Natural Streams and Rivers	Where Applicable	25
	Sep 2020	Hong Kong Civil Engineering and Development Department	Tung Chung New Town Extension – Reclamation and Advance Works	Where Applicable	29
	Mar 2020	Hong Kong Planning Department	Hong Kong Planning Standards and Guidelines	Chapter 10 Conservation	26
	Mar 2014	Hong Kong Planning Department		Chapter 9 Environment	30
	Aug 2019	Hong Kong Agriculture, Fisheries and Conservation Department	Nature Conservation Practice Note	Design of Terrestrial Wildlife Crossing System	28
	Feb 2017	Kowloon Park, Hong Kong Leisure and Cultural Services Department	Conservation Corner	Where Applicable	31
	Oct 2016	Hong Kong Planning Department	Green and Blue space Conceptual Framework	Where Applicable	28
	2010	Hong Kong Environmental Protection Department	Guidance Notes of the Environmental Impact Assessment Ordinance	GN 7/2010 Ecological Baseline Survey for Ecological Assessment	24
				GN 10/2010 Methodologies for Terrestrial and Freshwater Ecological Baseline Survey	
				GN 11/2010 Methodologies for Marine Ecological Baseline Surveys	

Table 19: Relevant Planning and Design References in Hong Kong for Theme E Urban Biodiversity

Appendix B6:
Relevant Planning and Design References in Hong Kong

	Publication Date/Last Update	Institution/ Government Department	Title of Document/ Reference	Chapter/Section	Relevant Design Strateg(ies)
Theme F: Inclusive and Accessible Communities	Mar 2022	Hong Kong Planning Department	Hong Kong Planning Standards & Guidelines	Chapter 3 Community Facilities	33
	Oct 2015			Chapter 4 Recreation, Open Space & Greening	
	Aug 2021			Chapter 8 Internal Transport Facilities	
	Mar 2007			Chapter 5 Industry	33, 34
	Mar 2020			Chapter 10 Conservation	36
	Dec 2021	Hong Kong Buildings Department	Design Manual: Barrier Free Access	Chapter 4 Design Requirements	33
	Jun 2018	Hong Kong Institute of Urban Design	Actions for Active Ageing	Where Applicable	
	Dec 2016	Playright Children's Play Association (funded by UNICEF)	Inclusive Play Guide	Where Applicable	37
	2016	BEAM Society, Hong Kong Green Building Council	BEAM Plus Neighbourhood Version 1.0	Credit SA	33, 36, 37
				Credit CA	33, 34, 35, 36
	Feb 2011	Hong Kong Urban Renewal Authority	Urban Renewal Strategy	Where Applicable	36

Table 20: Relevant Planning and Design References in Hong Kong for Theme F Inclusive and Accessible Communities

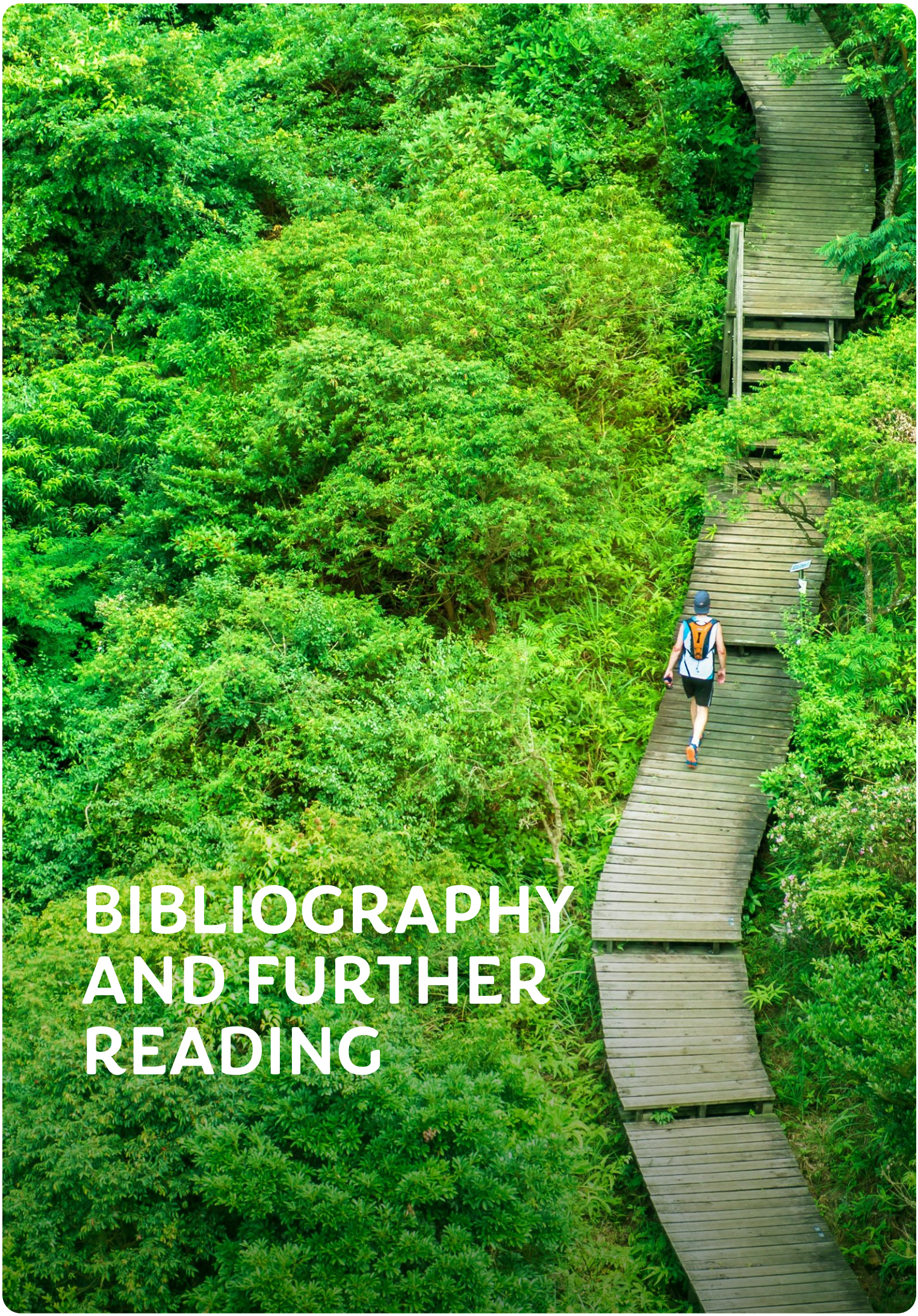
Appendix B6:
Relevant Planning and Design References in Hong Kong

	Publication Date/Last Update	Institution/ Government Department	Title of Document/ Reference	Chapter/Section	Relevant Design Strateg(ies)
Theme G: Innovative Sustainable Design and Technology	2022	Hong Kong Buildings Department	Practice Note for Authorised Persons, Registered Structural Engineers and Registered Geotechnical Engineers	Modular Integrated Construction	39
	2022	Hong Kong Construction Industry Council	Green Product Certification	Where Applicable	40
	2021	Hong Kong Construction Industry Council	Reference Materials – Adopting DfMA for MEP Works	Where Applicable	39
	2019	Hong Kong Construction Industry Council	Carbon Assessment Tool (CAT)	Where Applicable	40
	2019	Hong Kong Construction Industry Council	Guidelines on the Statutory Requirements for Modular Integrated Construction Projects	Where Applicable	39
	2020	Hong Kong Innovation and Technology Bureau	Hong Kong Smart City Blueprint 2.0	Where Applicable	38
	2010-2018	Hong Kong Green Council	Hong Kong Green Label Scheme	008 – Construction Materials	40

Table 21: Relevant Planning and Design References in Hong Kong for Theme G Innovative Sustainable Design and Technology

	Publication Date/Last Update	Institution/ Government Department	Title of Document/ Reference	Chapter/Section	Relevant Design Strateg(ies)
Theme H: Mitigation of Health Risks	Dec 2020	Hong Kong Innovation and Technology Bureau	Hong Kong Smart City Blueprint 2.0	Where Applicable	45
	Oct 2016	Hong Kong Planning Department	Planning and Urban Design for a Liveable High-Density City	2. Planning for a Compact City	46
	Nov 2015	Hong Kong Planning Department	Hong Kong Planning Standards and Guidelines	Chapter 11 Urban Design Guidelines	44

Table 22: Relevant Planning and Design References in Hong Kong for Theme H Mitigation of Health Risks



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