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"Hong Kong-A high Density City into an Era of Sustainability"

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ABSTRACT

Hong Kong is one of the most dense city in the world, with a population of 7.413 million in 2024 people in the small area of 1,104-square-kilometre. The density of living is made more acute with only 23% of the land on buildable area. Yet High Density Living does not imply the sacrifice of Liveability, Sustainability and the well-being of People and the Environment. Hong Kong has been a city under pressure since its time of being a British Colony. The sudden growth in population in 1950s has caused tremendous pressure to the city to with the increased population in a very short time. High Density Living has always been the challenge to Hong Kong. And, at the same time, creative responsive solutions have appeared in the growth of the city and the manifestation of its own unique Architecture. The paper will present the city's experience and ingenious solutions to the challenges of this era: High Density for Sustainability. The paper will be include the narrative of a super-dense urban city, Hong Kong as a 4-D condensed compact city, Changes in Government Policy in Sustainability, endeavours and emerging new movements for Hong Kong in the era for Sustainability, the change and new movements in Urbanism will be illustrated by prominent architectural endeavours in Public and Private, Residential, Institutional and Revitalization Project.

1. Introduction

Hong Kong is one of the most dense city in the world, with a population of 7.413 million in 2024 people in the small area of 1,104-square-kilometre. The density of living is made more acute with only 23% of the land on buildable area. Yet High Density Living does not imply the sacrifice of Livability, Sustainability and the well-being of People and the Environment. Hong Kong has been a city under pressure since its time of being a British Colony. The sudden growth in population in 1950s has caused tremendous pressure to the city with the drastically increased population in a very short time. High Density Living has always been the challenge to Hong Kong. And, at the same time, creative responsive solutions have appeared in response to these challenges and nurtured of its own unique urban form and Architecture.

The paper will present the city's experience and ingenious solutions to the challenges of this era: High Density for Sustainability . The paper will be include the Narrative of a super-dense urban city, Hong Kong as a 4-D condensed Compact City, Changes in Government Policy in Sustainability, Endeavors and Emerging

New Movements for Hong Kong in the era for Sustainability. The changes and new movements in Urbanism will be illustrated by prominent architectural endeavors in Public and Private, Residential, Institutional, Revitalization Project and new Future city developments to come.

2. Methodology

The investigation and research will be conducted in a progressive manner visiting the past data, the present government policy and responsive actions in its city planning and architecture.

2.1. The Growth of the City

The paper has looked into the change of the city population, buildable area, living densities and standard of living from the 19th century upon the change of Hong Kong from being a British Colony to a Special Administrative Region of China. (from 1842 to 2024)

2.2. Climate Change Impacts

Changes brought forth to the city in terms of air pollution, city temperature, intensity and frequency, super typhoon and flooding.

2.3. Government Policy

With the Government Policy has changed from development driven to climate-change-awareness, the research will look into Government Policy Documents inclusive of:

i) Waste Blueprint for HK2035 (issued in 2021)
ii) Climate Action Plan 2050 (issued in 2021)
iii) HK Environmental Report 2012-2022 (issued in 2022)
iv) Clean Air Plan 2035 (issued in 2021)

2.4. Hong Kong Green Building Council

The setting up of the Hong Kong Green Building Council has strong impact in promoting Green Building in Hong Kong, the research will look into the publications of HKGBC:

i) Hong Kong Green Building in Action 2022, 20021, 2020, 2019, 2018, 2017
ii) Hong Kong Report on the state of sustainable built environment 2020, 2017, 2014, 2011
iii) HKGBC Climate Change Framework for Built Environment (Version 2) 2024
iv) HKGAC Retrofitting Guidebook (Version 2)2024
v) HKGBC Guidebook for Sustainable Built Environment (2023)
vi) Advancing Net Zero Ideas Competition 2021
vii) Hong Kong Smart Green Building Design Best Practice Guidebook (2021)
viii) Green Design for Material Resources Optimization in Building Life Cycle (2018)
ix) HKGBC Guidebook on Urban Mian Climate Study (2017)
x) Hong Kong Green School Guide (2013)
xi) Hong Kong Green Shop Guide (2013)
xii) HKGBC Green Guide: Revitalizing Industrial Buildings (2012)

2.5 Hong Kong Strategic Planning 2030+

The study will look into how the government is strategically planning its city's growth into a sustainable, green, smart and liveable city in the coming future.

2.6. Sustainable Urban Projects in Hong Kong

The following Projects would be looked into and remeasured into their different aspects of contribution to sustainability.

i) Government: T-Park, Y-Park, O-Park
ii) Commercial: Airside, the Mills
iii) Residential: Queen's Hill, One Innovate
iv) Institutional: TWGH Eco-Village, Tzu Chi Environmental Action Centre, Chicago School Hong Kong Campus
v) Revitalization: Central Market

2.7. Emerging Rural-Urbanism in Hong Kong

Rural Activism is a new area of attention in Hong Kong, besides the densely populated areas. Remote traditional village revitalization in Mui Tze Lam and Lai Chi Wo will be part of the research.

2.8. Future Sustainable City Development

Northern Metropolis is a major Hong Kong Future City development. It has been planned to be developed into a Green, Smart, Resilient Sustainable City.

3. Results

Research has been conducted in the following areas as per described in the methodology, and results as presented as the following;

3.1 The High-Density Situations of Hong Kong

3.1.1 Population, Land, Density

(i) Population Growth

Hong Kong is comprised of the islands of Hong Kong, Kowloon, the New Territories and over 200 islands. The first population figure in 1841 was 7,450. In the twentieth century, Hong Kong's population continued to grow rapidly. The total population rose from 456,739 in 1911 to 840,473 in 1931, an increase of 84 percent in just 20 years. Hong Kong's Population has grown from 2,000,000 million to in 1950 and 7,500,000 in 2024. Population of Hong Kong from the 1970a to 2024 has grown from around 4.3 million to 7.5 million, an increase of 3.2 million of population. The growth of population was mainly due to migration and natural increase.

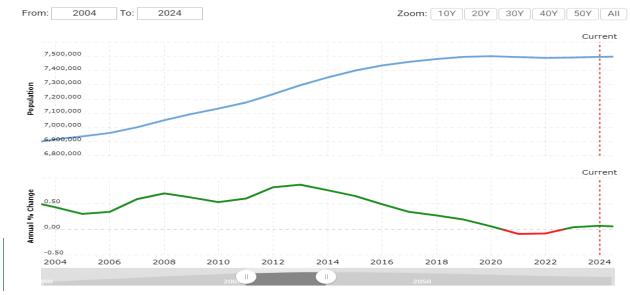

Fig 1. In the past 20 years, the population has raised from 6.915998 million to 7.496681 million which has been increased 8.40% in total.

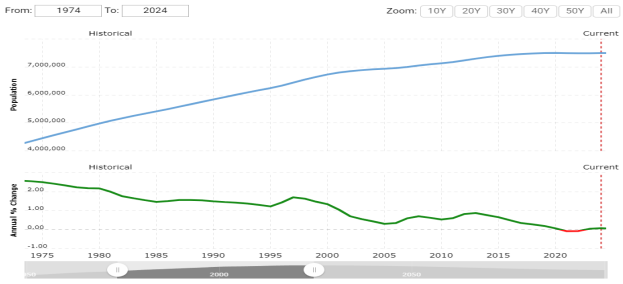

Fig 2. In the past 50 years, the population has increased from 4.342773 million to 7.496681 million which has been increased 72.62% in total.

(ii) Hong Kong Buildable Area

Hong Kong primarily comprises three main regions: the Kowloon Peninsula, Hong Kong Island, and the New Territories, along with several outlying islands. The overall city spans a total area of 1,104 square kilometres, with only 24.3% designated as buildable land, while the remaining 75.7% is comprised of country parks and green zones.

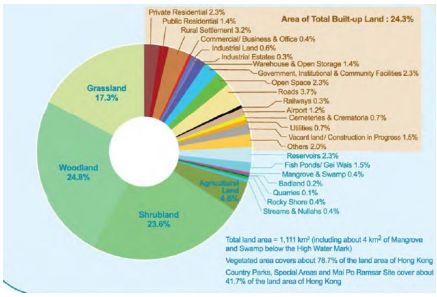

Fig 3. Hong Kong Buildable Area and Green Zones.

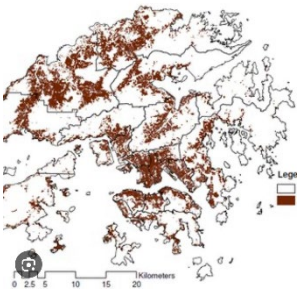

Fig 4. Hong Kong Buildable Area Map

3.1.2. The Living Area Density

Due to the exponential population growth in Hong Kong and limited available land, the city has witnessed a remarkable transformation in its architectural landscape and urban structure, characterized by vertical expansion and high-density living. However, this rapid growth has presented a persistent challenge, as it has created a conflict between liveability and density. The absence of statutory regulations pertaining to minimum living space has resulted in a decline in living conditions, with an alarming prevalence of excessively overcrowded living spaces. Consequently, the population density in the city soared to an unprecedented high of 7,150 people per square kilometre in 2019.

Fig 5. The Population Density in Hong Kong

Fig 6. Highrise Public Housing in Hong Kong

3.2 Hong Kong Environmental & Climatic Situation

3.2.1 Carbon Emissions

On November 30, 2022, the government released the Greenhouse Gas Emission Inventory for Hong Kong, revealing that the total GHG emissions in 2022 amounted to 33.5 million tonnes of CO2. This represents a decrease of approximately 4% compared to the emissions in 2021. Furthermore, when compared to the peak of around 44.2 million tonnes in 2014, there has been a notable reduction of about 24%.

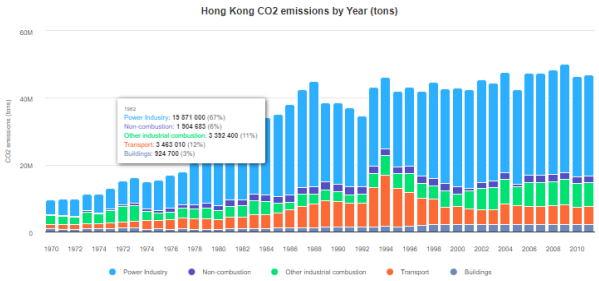

Fig 7. Hong Kong C02 emission by year

The carbon emissions in Hong Kong have experienced a substantial increase of 194.2% between 1974 and 2024. However, in the last two decades, there has been a noteworthy decline in carbon emissions, dropping from 42.5 million tons to 33.5 million tons, which represents a total reduction of 21.67%. When compared to the data from 2022, carbon emissions have risen from 11.39 million tons to 33.5 million tons over a span of 50 years.

Among the various sectors, electricity generation remains the primary source of emissions, accounting for 63% of the total emissions. The transport sector contributes 19% of the emissions, while waste management contributes 8% to the overall carbon emissions. These figures underscore the importance of addressing emissions from electricity generation, transportation, and waste management as key areas for effectively reducing carbon emissions in Hong Kong.

3.2.2 Temperature Rise

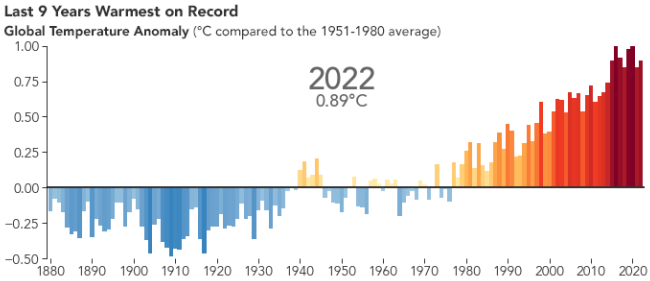

Fig 8. Global Temperate Record Compared to 1951-1980 average)

In the last 50 years, the average global temperature has risen by approximately 0.13°C per decade. This rate of increase is nearly twice as fast as the 0.07°C per decade observed in the preceding 50 years. Looking ahead, scientists project that in the next 20 years, the global average temperature will rise at an even faster pace, with an estimated increase of about 0.2°C per decade. These projections highlight the ongoing acceleration of global warming trends and underscore the urgent need for measures to mitigate climate change.

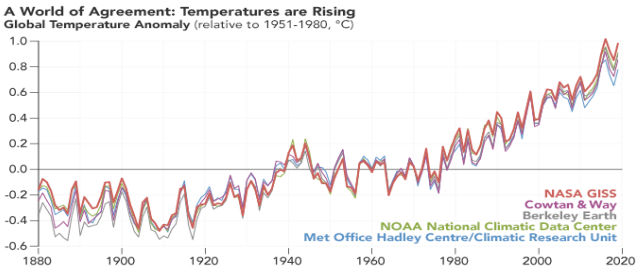

Fig 9. Global Temperate Anomaly (relative 1951-1980)

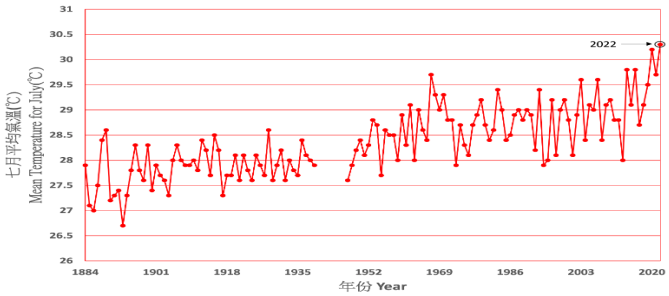

Fig 10. Hottest days of Hong Kong

The number of hot days in Hong Kong has entered the record-breaking high. In July 2023, the hottest days occurred in July of 2023. Global warming has had a profound impact on the global climate, leading to noticeable changes in weather patterns. Hong Kong, in particular, has experienced an increase in the frequency and intensity of super typhoons as a result of rising temperatures. These powerful storms bring destructive winds and storm surges, resulting in severe coastal flooding. In September 2023, Hong Kong felt the impact of Super Typhoon Saola, which unleashed hurricane-force winds and caused flooding in low-lying coastal regions.

Furthermore, the city has grappled with the challenges posed by Black Rainstorms, characterized by intense rainfall occurring within a short time frame. The existing surface drainage infrastructure in Hong Kong is insufficient to handle the significant increase in water volume, leading to widespread flooding in various parts of the city. On September 7 and 8, 2023, Hong Kong experienced an unprecedented continuous Black Rainstorm that lasted for two full days. The Black Rainstorm signal remained in effect for over 16 hours, marking the longest duration since the implementation of the rainstorm warning system in 1912. During this event, the Hong Kong Observatory recorded over 632mm of rainfall in just 24 hours, and over 158.1 mm of rainfall was recorded during the one-hour period, breaking the previous record that was kept for just 15 years.

These instances underscore the vulnerability of Hong Kong to extreme weather events and emphasize the necessity of implementing adaptive measures to address the impacts of climate change. Such measures may include improving drainage systems and enhancing preparedness for severe storms and flooding.


Fig 11&12. Severe flooding in Hong Kong on 7,8 Sept 2023

3.3 Government's Policy in Climate Resilience Protection & Carbon Neutrality (2012-2022)

To address the challenges posed by climate change, environmental degradation, and biodiversity loss in Hong Kong, the government has implemented proactive measures and policies focused on climate resilience. One notable initiative is the establishment of a Carbon Neutrality Road Map. The Hong Kong Environmental Report (2012-2022) serves as a comprehensive documentation of the efforts undertaken during the past decade.

These efforts encompass a wide range of initiatives aimed at mitigating climate change and promoting sustainable development. Specific actions include the adoption of renewable energy sources, energy efficiency measures, waste management strategies, and conservation efforts to protect and restore natural habitats. The report likely highlights achievements, targets met, and ongoing challenges in these areas.

The Hong Kong Environmental Report plays a crucial role in assessing progress, identifying areas for improvement, and raising awareness about the significance of environmental stewardship. It reflects the government's commitment to addressing environmental issues and working towards a more sustainable and resilient future for Hong Kong.

Table 1
Hong Kong Environmental Report

2013-2014	• "Clear Air Plan for Hong Kong " • HK Blueprint for Sustainable use of Resources (2013-2022) • Food Waste Hong Kong Campaign
2015-2016	• Energy Saving Plan for HK's Built Environment 2015-2025 • The First Waste-to-Energy facility T-Park • "Hong Kong Biodiversity Strategy & Action Plan 2016-2121"
	• HK's Climate Action Plan 2030+ • WEEE-Park treatment & Recycling (Waste Electrical & Electric Equipment) • O-Park (The 1st Organic Resources Recovery Centre)
2021-2022	• Hong Kong's Climate Action Plan 2050 • Hong Kong's Roadmap on Popularization of Electric Vehicles • Clean-Air Plan for Hong Kong 2035 • Waste Blueprint for Hong Kong 2035 • Announced Northern Metropolis will resume Wetlands in Deep Bay Area, and to establish a system of wetland conservation. • Long Term conservation of Sha Lo Tong thru non-instu land exchange.
2022-2035 Future Plans	• 2023- Implement + municipal solid waste charing. • 2022- Designation of South Lantau Marine Park
	• Cease new Registration of conventional fuel-propelled private cars • Air quality on a par with major international cities

	• Municipal waste reduced by 40-45% • Recycling increase to about 55% • Develop sufficient waste-to-energy recourse facilities to achieve Zero landfilling of municipal waste.

The Environment and Ecology Bureau has established a comprehensive overall strategy to lead Hong Kong towards a carbon-neutral International City for a sustainable future, inclusive of Hong Kong Environmental Report in 2022, Clean Air Plan Hong Kong, Action Plan 2050 Carbon Neutral Hong Kong and Waste Blueprint for Hong Kong in 2021.

Fig 13. Hong Kong Environmental Report (issued June 2022)

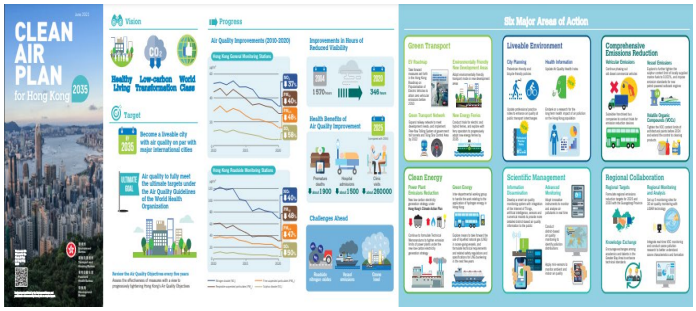

Fig 14. Clean Air Plan for Hong Kong 2035 (issued June 2021)

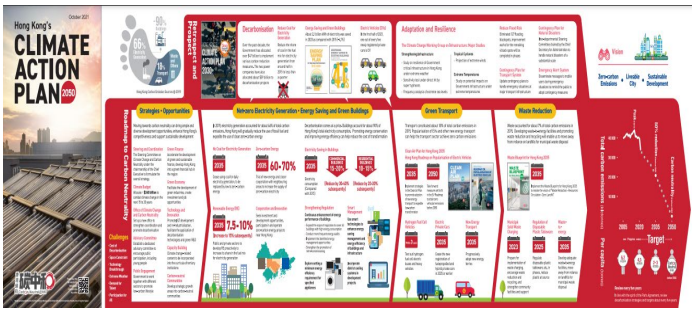

Fig 15. Action Plan 2050-Carbon Neutral Hong Kong (issued Oct 2021)

Fig 16. Waste Blueprint for Hong Kong 2035 (issued Feb 2021)

3.4. Green Building Council's Promotion of Beam Plus Green Building Standard and Green Building Awards:

The Hong Kong Green Building Council (HKGBC) plays a vital role in promoting and advancing green building practices in Hong Kong. The organization's focus on the unique challenges posed by Hong Kong's subtropical built environment, characterized by high-rise structures and high population density, makes its work particularly relevant and impactful.

The Green Building Awards, introduced by the HKGBC in 2010, are a significant initiative that recognizes and encourages outstanding projects, research, planning, and the use of green technologies in the construction industry. By showcasing exemplary examples of sustainable architecture and design, the awards serve as a platform for inspiring further advancements in green building practices in Hong Kong. This recognition helps raise awareness and sets a benchmark for the industry, encouraging other stakeholders to adopt sustainable approaches.

In addition to the Green Building Awards, the HKGBC engages the public, industry stakeholders, and the government through various activities and initiatives. These efforts aim to raise awareness about green building practices and their benefits, facilitate knowledge exchange, and foster collaboration among different sectors. By bringing together stakeholders from the government, industry, academia, and the public, the HKGBC promotes dialogue and cooperation, driving positive change in the built environment.

The HKGBC also plays a role in developing practical solutions tailored to Hong Kong's unique context. This involves considering the specific challenges posed by high-rise structures, population density, and the subtropical climate. By providing guidance, resources, and expertise, the organization helps stakeholders navigate the complexities of sustainable construction and design in Hong Kong.

Overall, the HKGBC's mission to promote green buildings aligns with the government's Carbon Neutrality Roadmap and its goals of reducing carbon emissions in Hong Kong. Through its initiatives, the organization contributes to the adoption of energy-saving technologies, sustainable building designs, and behavioural changes that can lead to significant reductions in energy consumption and carbon emissions associated with buildings. By driving innovation, raising awareness, and fostering collaboration, the HKGBC helps Hong Kong move towards a greener and more sustainable future.

3.5 Architectural Endeavours for Sustainability and Wellness for People& Environment

The projects selected exemplify Hong Kong's commitment to sustainability, driven by the government's environmental policy and supported by the Green Building Council. These remarkable and award-winning projects showcase innovative architecture and developments that are shaping a new era of sustainable practices in the city. The chosen projects span various categories, including Residential, Commercial, Institutional, and Government Projects. These projects are selected for their performances and trails in response to the challenge of Climate Change and Global Warming.

Table 2
The selected project

Governmental	• T-park • Y-park • O-Park
Commercial	• Airside • the Mills
Residential	• Queens Hill Public Housing • One Innovate • Pavilia Farm
Institutional	• TWGH Eco village • Tzu Chi Environmental Action Centre • Chicago School Hong Kong Campus

Revitalization	• Central Market • Tai Kwun

3.5.1 T-Park

Fig 17. T-Park

T. PARK, located at Tsang Tsui, Tuen Mun, is a sludge treatment facility adopting a technology known as “fluidised bed incineration” for treatment of sewage sludge collected from all major sewage treatment works in Hong Kong, with a maximum treatment capacity of 2,000 tonnes per day. The final products of treatment are mainly inert ash and residues that have been reduced to 10% of the original sludge volume, hence greatly reduce the pressure on landfills. The word “T” stands for "transformation", connoting the vision to embrace the concept of “turning waste to energy” and “driving changes in attitude and behaviour towards a greener lifestyle”.

Waste-to-Energy: The sludge incineration process not only eliminates waste but also harnesses the heat energy to generate electricity, powering the facility and exporting surplus electricity to the power grid. This reduces reliance on traditional energy sources and promotes the use of renewable energy.

Landscape and Habitats: The incorporation of a landscape garden and wetland habitat supports natural wildlife and enhances the overall environmental quality. The project's focus on green coverage, including the planting of native trees and shrubs, contributes to biodiversity conservation and the preservation of Hong Kong's native beauty.

Sustainable Architecture: The design of the main plant building and administration building integrates with the surrounding scenery while maximizing natural daylight to reduce the need for artificial lighting. Green building roofs provide additional insulation, improving energy efficiency and reducing environmental impact.

Use of Eco-materials: The project adopts eco-friendly materials throughout the design and construction process, such as low emissivity glass, paving blocks with recycled constituents, and recycled plastic timber decking. Repurposing excavated materials and waste from other projects minimizes the need for new resources and promotes circular economy principles. Upcycling waste materials into furniture further demonstrates sustainable practices.

Total Water Management: The project implements a comprehensive approach to water management, including a seawater desalination plant for generating potable and process water on-site. Rainwater harvesting is utilized for non-potable purposes, and all wastewater undergoes treatment for reuse in irrigation, flushing, and cleaning. This approach minimizes water waste and ensures "zero effluent discharge."

These initiatives collectively demonstrate Hong Kong's dedication to sustainable development and showcase the successful integration of eco-friendly practices in various aspects of the project. By incorporating waste-to-energy, promoting biodiversity, implementing sustainable architecture, using eco-materials, and adopting comprehensive water management, the project exemplifies a holistic approach to environmental sustainability.

3.5.2 Y-Park

Fig 18. Y-Park

Y · PARK, situated near the West New Territories Landfill in Tsang Tsui, Tuen Mun, serves as a dedicated center for recycling yard waste. In its inaugural year, Y · PARK has a daily handling capacity of approximately 30 tonnes, with expectations to increase to an average of around 60 tonnes per day.

Equipped with state-of-the-art facilities and equipment, Y · PARK efficiently converts sorted and suitable yard waste into recyclable products. Yard waste, also known as green waste or garden waste, encompasses various types of vegetation waste that naturally decompose over time. It's important to note that woody materials found in yard waste are combustible. Hong Kong generates an average of about 180 tonnes of yard waste daily, primarily from construction projects and routine vegetation maintenance activities. Additionally, tree clearing operations resulting from emergency events like super typhoons contribute to the overall volume of yard waste generated.

By promoting proper treatment, general yard waste can be reused or recycled. The Environmental Protection Department (EPD) established Y · PARK to encourage government departments and other yard waste producers to sort their yard waste and prioritize its reuse or recycling at the source, whenever feasible.

3.5.3 O-Park

Fig 19. O-Park

O · PARK1, the first organic resources recovery centre locating at Siu Ho Wan of North Lantau adopts anaerobic digestion technology to convert food waste into biogas , a source of renewable energy, for electricity generation whilst the residues from the process can be produced as compost for landscaping and agriculture use. The Park is a government project and is capable of handling 200 tonnes of food waste per day.

Sustainable Site Aspects: The project emphasizes the preservation of the natural environment, with one-third of the site area dedicated to greenery, creating a harmonious integration of nature and architecture. Thoughtful design of exterior lighting minimizes light pollution in rural areas, ensuring it does not disrupt the surrounding ecosystem.

Materials Aspects: More than 80% of the building materials used are sourced from regional manufacturers, significantly reducing the carbon footprint associated with transportation. Effective construction waste management practices have been implemented, resulting in over 30% of waste being

recycled and diverted from landfills. The inclusion of absorption chillers with CFC-free refrigerants promotes sustainable cooling solutions and reflects our commitment to environmental responsibility.

Energy Use: The building has been designed to achieve complete energy self-sufficiency, meeting all electricity consumption through on-site electricity generation and heat production. Renewable energy sources derived from organic waste recycling are utilized to fulfill the building's energy requirements, promoting a clean and sustainable energy future. High-efficiency absorption chillers maximize energy utilization and minimize waste by utilizing waste heat for air conditioning, enhancing overall energy efficiency.

Water Use: The project prioritizes water conservation, achieving over 50% annual water consumption savings through the use of efficient water devices. Efficient flushing devices have been installed, reducing flushing water usage by over 50%. On-site water reuse systems significantly reduce fresh water consumption by 40%, contributing to sustainable water management practices.

Indoor Environmental Quality: The building has obtained Indoor Air Quality Certification at the 'Excellent Class Level,' ensuring a healthy and comfortable environment for occupants. Natural lighting is incorporated as a key design element, enhancing over 90% of occupied spaces, fostering a connection with the outdoors and reducing reliance on artificial lighting. The addition of a covered walkway (O · LINK) and a roof farm garden (O · FARM) improves the building's aesthetics and provides functional spaces, enhancing the overall quality.

Innovations: The waste-to-energy system generates sufficient energy not only to meet internal consumption needs but also to export surplus energy to the public grid, contributing to the local energy supply. To raise awareness about the importance of reducing and recycling food waste, as well as the transformative process of converting food waste into energy and resources, the public is invited to participate in free educational tours.

3.5.4 Airside

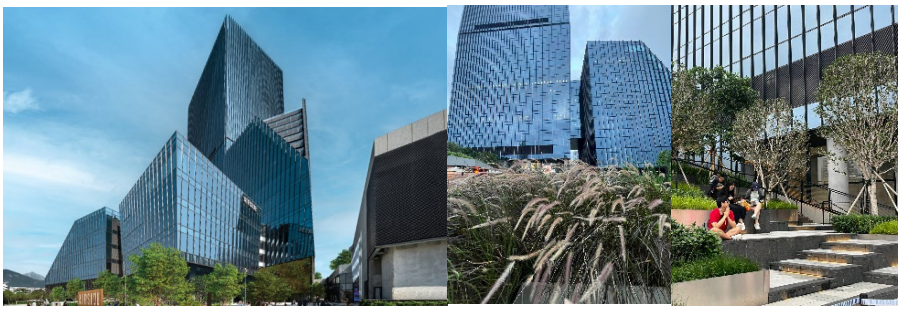

Fig 20. Airside

Airside, situated at the heart of the former Kai Tak airport site, encompasses approximately 1.7 hectares of land and features a substantial gross floor area of up to 177,000 m2. As the focal point of the new Central Business District (CBD) in the Kai Tak Area, the project envisions creating a community that prioritizes people and embraces social inclusivity while setting a high standard for environmental performance. Its strategic location adjacent to the Kai Tak MTR Station and Station Square establishes it as the tallest development in the area, serving as a centralized hub surrounded by residential and commercial buildings, parks, as well as various sports and cultural activities.

The project's primary objective is to seamlessly integrate sustainability into the daily lives of both the surrounding residents and the building's occupants. By incorporating sustainable practices and principles, Airside aims to inspire individuals to adopt eco-friendly behaviours and actively contribute to a greener future.

3.5.5 The Mills

Fig 21. The Mills

The Mills is an impressive project that has revitalized 60-year-old cotton-spinning factories, transforming them into a vibrant shopping and cultural hub. Spanning a total space of 264,000 square feet, this endeavour demonstrates a commitment to preserving Hong Kong's industrial legacy, with 70% of the existing structure and internal finishes repurposed. By seamlessly integrating Mills factories, originally built in the 1960s to 70s, into a cohesive complex, The Mills pays tribute to the heritage of the textile industry while injecting vitality into the surrounding neighbourhood. Through the use of cost-effective materials, innovative building management services and sustainable design practices, the project achieves a harmonious blend of tradition and modernity.

Environmental consciousness is a key aspect of the project, with resourceful measures taken to minimize its impact. Old solid timber doors have been repurposed into benches, showcasing contemporary sustainability values. Similarly, old window frames have found new life as creative signage. More than 80% of construction waste has been recycled in a dedicated material recovery chamber, demonstrating responsible waste management. Additionally, 70% of the original structure and internal finishes have been retained and integrated into the design, preserving the site's heritage and enhancing its sustainability performance.

The complex features various open spaces, including internal lanes adorned with public art and heritage displays, as well as accessible rooftops and green spaces revived from once-vacant concrete roofs. These spaces foster a sense of community and provide opportunities for the public to connect with the site's rich history.

At the heart of The Mills, a three-story space has been transformed into a magnificent skylight, utilizing a high-performance curtain wall and solar blinds to optimize daylighting and reduce the need for excessive air-conditioning. Energy-efficient lighting automation and solar hot water systems further exemplify the project's commitment to sustainability. A mobile-based Building Management System (BMS) enables real-time monitoring and optimization by the property manager and tenants, ensuring efficient operations.

One remarkable transformation is the conversion of the original large, vacant concrete roof into a captivating rooftop park, which has become a beloved public space enjoyed by all. The revitalization of The Mills showcases the power of innovation, sustainability, and community engagement, breathing new life into a historical site while preserving its cultural heritage for future generations.

3.5.6 Queen's Hill Public Housing

Fig 22. Queen's Hill Public Housing

The transformation of the former Queen's Hill Barracks into the vibrant Queens Hill Estate is a remarkable example of sustainable development. The site, which was once abandoned, now provides a sustainable home for over 12,000 families. The development consists of six residential blocks with 7,650 rental flats, as well as retail spaces, a wet market, kindergartens, and social welfare facilities to cater to the needs of the residents.

Several sustainability features have been implemented throughout the project. More than 30% of greenery is provided through vertical greenery, at-grading planting, and green roofs. Building separations have been designed to serve as wind corridors, allowing for natural ventilation and the enjoyment of offshore and downslope breezes by pedestrians. The use of salvaged artifacts and retained wood from the former barracks has been incorporated into artworks and benches, preserving the site's history.

Passive design strategies have been employed to save energy, including considerations in the master layout plan and building orientation. The shopping centre and car park achieve annual energy savings of approximately 15% and 20% respectively compared to the Building Energy Code (BEC) 2015. Photovoltaic systems installed in the residential blocks generate around 90,000 kWh/year, equivalent to about 2% of the energy consumption in the common areas of the residential portion.

Water efficiency measures have been implemented, resulting in a 33% annual reduction in water consumption through the use of water-efficient devices and a 41% reduction in annual effluent discharge through water-efficient sanitary fixtures. The landscaped area benefits from a 75% reduction in freshwater usage through the application of a Zero Irrigation System (ZIS), dripline irrigation system, and the selection of native planting species.

The project incorporates innovative practices such as Building Information Modelling (BIM) for accurate coordination and planning, a twin tank system for uninterrupted fresh and flush water supply, a two-level lighting system for energy efficiency, and a Community Farm to encourage tenant participation in greening activities and environmental awareness. Queen's Hill project has been designed to create a comprehensive community, featuring retail spaces, communal green areas, play areas, recreational facilities, plazas, gardens, artwork displays, and covered walkway systems. The master planning takes into account the surrounding villages, existing trees, and scenic views. Universal design principles have been incorporated to accommodate individuals of different ages and physical conditions.

Through its holistic approach to sustainable development, the Queens Hill Estate exemplifies a commitment to creating a harmonious and inclusive living environment, combining community-centric design and environmental considerations.

3.5.7 Pavilia Farm

Fig 23. Pavilia Farm

Pavilia Farm is an innovative residential development that prioritizes sustainability and wellness for its residents. The project aims to set new standards in residential architecture by introducing the concept of microclimate, which enhances natural ventilation within the property. The design team conducted extensive analysis of local weather data and fluid dynamics to plan the building density, orientation, and green areas in a way that optimizes natural airflow.

To create a comfortable and energy-efficient living environment, intelligent ventilation and natural light transducing systems have been integrated into the development. These systems leverage natural resources to reduce energy consumption. Solar panels and wind turbines generate renewable energy, while high thermal-performance glass curtain walls help regulate temperatures within the buildings. Energy-efficient appliances, an energy-regeneration elevator system, and vertical greening further contribute to the overall energy efficiency of the development.

Pavilia Farm aims to minimize its carbon footprint and provide residents with a healthier and eco-friendly lifestyle. By incorporating sustainable features and technologies, the project showcases the possibilities of integrating sustainable design principles into residential architecture. It redefines the standards for sustainable living and demonstrates how innovative design can create a low-carbon environment while promoting wellness for residents.

3.5.8 TWHGs E-Co Village

Fig 24. TWHGs E-Co Village

E-Co Village is an exceptional initiative that has successfully repurposed a closed landfill site into an environmentally friendly and smart campus development, offering educational and recreational opportunities to the public. This project, a collaboration between the Environmental Protection Department and the Tung Wah Hospitals Group, demonstrates a strong commitment to sustainable practices and community engagement.

The transformation from a landfill site to the "Garbage to Garden" Eco Village showcases the potential of revitalization projects. The village features a range of amenities and attractions, including a camping ground, community farm, butterfly garden, children's green education zones, a green theatre, and two demonstration Green Stations. These facilities not only provide enjoyable experiences for the public but also foster community connections and promote environmental awareness.

In line with its theme of waste transformation, Eco Village incorporates recycled building materials, such as bamboo and palm fibre boards, in its construction. By utilizing these sustainable materials, the project reduces the demand for new resources and minimizes waste generation. Furthermore, the village relies on a 100% renewable energy supply, emphasizing its dedication to clean and sustainable energy sources. The use of recycled greywater for irrigation further reduces water consumption and promotes efficient resource management.

Eco Village serves as a model for sustainable development, showcasing the possibilities of repurposing underutilized land into a thriving and eco-friendly community space. Through its innovative approaches, the project not only provides recreational and educational opportunities but also inspires individuals to embrace sustainability and make environmentally conscious choices. This initiative demonstrates the importance of collaboration between government entities and community organizations in creating impactful and sustainable projects for the benefit of society and the environment.

3.5.9 Tzu Chi Environmental Action Centre

Fig 25. Tzu Chi Environmental Action Centre

The Tzu Chi Environmental Action Centre, founded by Tzu Chi Foundation Hong Kong, is a transformation of an old village school into an Environmental Promotion and Education Centre. The centre's main objective is to raise public awareness about environmental protection and inspire people to take action.

Originally built in 1954 as an orphanage school, the old and dilapidated building has been revitalized while preserving its original structure and charm. The centre now stands as a renewed garden, serving as a gift to Hong Kong. It serves as a platform for promoting recycling, circularity, and innovative eco-technologies to create a future-proof environment. The project successfully combines green architecture with the preservation of the site original beauty.

The entire project is powered by on-grid sustainable solar energy, making it a zero-carbon emission building. The solar energy generated is not only sufficient for the centre's needs but also produces excess power that can be supplied to the central grid. Rainwater collected from the roof is used for irrigation, further reducing the centre's environmental impact.

Innovative upcycled plastic outdoor tiles and plastic wood-style floorboards, made from fabric waste, have been used for the exteriors of the building. Additionally, volunteers have transformed yellow sand scraped from the old wall plastering into DIY bricks. These efforts showcase the centre's commitment to recycling and upcycling materials.

The design of the centre promotes natural cross ventilation, minimizing the need for air-conditioning. The exterior walls are adorned with vertical green climbing plants, adding more vertical greenery and blending harmoniously with the nearby leafy mountains. This design approach aligns with the philosophy of coexistence and prosperity, as reflected in the quote: "When all living beings coexist in prosperity, the world will be at peace."

The Tzu Chi Environmental Action Centre's green architecture represents a small yet genuine effort to bring more peace to the world. By promoting environmental awareness and incorporating sustainable practices, the centre serves as an inspiring example of how buildings can be transformed to support a greener and more harmonious future.

3.5.10 Chicago School Hong Kong Campus

Fig 26. Chicago School Hong Kong Campus

The Chicago School Hong Kong campus is a significant project located on the historically significant Mount Davis site. It serves as a regional hub for research, education, and collaboration while seamlessly blending modern functionality with the preservation and respect for the site's history. This is achieved through the adaptive reuse of existing heritage buildings. The design concept draws inspiration from the concept of a "treehouse of knowledge." The ribbon-shaped building reflects the contours of the hilly seaside site and seamlessly integrates with the repurposed heritage structures, which now house classrooms and student lounges. The campus features a landscaped promenade and a heritage courtyard that are open to the public, inviting visitors to explore and learn about the site's history, which was previously inaccessible.

The design of the building prioritizes the capture of natural sunlight, thereby minimizing energy consumption. The single, curvilinear expression of the structure, along with window glazing and sun screens, maximizes the penetration of natural light. The campus embraces a minimalistic design approach, using light-toned wood to soften the heritage concrete structure and create a warm and inviting atmosphere in the academic and social spaces.

Inspired by the site's rich history, stunning views, and lush natural surroundings, the project aims to create a building that complements and embraces its unique environment. The design stimulates the imagination, encourages personal interaction, and fosters a sense of connection to the site's heritage and natural beauty. The Chicago School Hong Kong campus serves as a testament to the successful integration of contemporary functionality and historical preservation. It provides a space for intellectual growth, collaboration, and cultural appreciation, while honoring the site's history and fostering a strong sense of place.

3.5.11 Central Market

Fig 27. Central Market

Central Market, originally completed in 1939 as a Grade III historic building, has undergone a revitalization and transformation project led by the Urban Renewal Authority (URA) in collaboration with an operator. This project highlights the URA's commitment to sustainability in urban renewal, incorporating principles of Sustainable, Innovative, and Green Design. Building Information Modelling (BIM) played a crucial role in enhancing design coordination, quality control, and clash prevention during the adaptive

reuse of the heritage building. The BIM platform was integrated with facility management to optimize the building services system, reduce the carbon footprint, and evaluate energy performance.

The design of Central Market prioritizes spatial adaptability, incorporating multi-functional spaces, event areas, and internal gardens that are interconnected to promote walkability and foster a sense of community. A greening strategy has been implemented, utilizing plants, air filtration systems, automatic irrigation, and energy-saving features to create a sustainable and comfortable environment within the market. The project aims to achieve a significant reduction in energy consumption, with estimates suggesting a potential decrease of up to 15%. Central Market exemplifies the integration of Heritage Adaptive Reuse and Smart Construction practices. Innovative repair materials, such as Fiber-Reinforced Polymer Composites, have been utilized to improve the building's condition and extend its lifespan. Recycled materials, including flooring and furniture coverings, have been extensively used throughout the space. Moreover, all paints, finishes, furnishings, and furniture selected meet low Volatile Organic Compounds (VOC) standards, ensuring optimal indoor air quality and creating a healthy indoor environment for visitors and occupants.

Central Market serves as a living and innovative heritage site, successfully combining historic preservation with sustainable design and modern functionality. This revitalization project serves as a model for urban renewal, demonstrating how heritage buildings can be transformed into vibrant, eco-friendly spaces that positively contribute to the surrounding community. Through its sustainable practices and thoughtful design, Central Market sets an example for future projects aiming to revitalize and adapt historic structures.

3.5.12 Tai Kwun

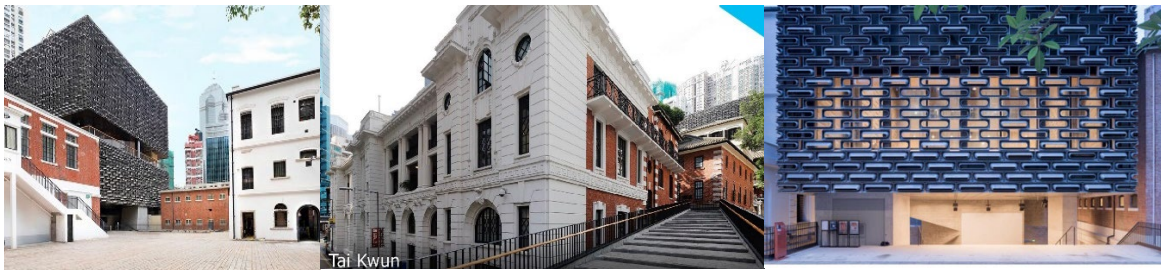

Fig 28. Tai Kwun

Tai Kwun, located in the heart of Central, Hong Kong, is a cultural hub that has been brought to life through a collaboration between The Hong Kong Jockey Club (HKJC) and the Hong Kong SAR Government. This vibrant space serves as a gathering place, fostering community engagement and inspiring through arts, culture, and heritage. Tai Kwun is dedicated to providing immersive and world-class experiences for the people of Hong Kong.

The revitalization of Tai Kwun was made possible by the funding provided by HKJC, who also continues to support its ongoing operation. The site comprises three Declared Monuments: the former Central Police Station, Central Magistracy, and Victoria Prison. Through meticulous restoration and preservation efforts, these historic buildings have been transformed into a centre that celebrates arts, culture, and heritage, making them accessible to the public. Throughout the conservation process, Tai Kwun placed significant emphasis on sustainability. Various aspects of sustainability were carefully considered, leading to the achievement of a Gold rating in the BEAM Plus New Building certification. This recognition signifies that Tai Kwun has met high standards in areas such as energy efficiency, environmental performance, and sustainable design.

By integrating sustainability principles into the conservation and operation of the heritage buildings, Tai Kwun demonstrates a commitment to environmental responsibility and the preservation of cultural heritage. It stands as an exemplary model of how historic sites can be transformed into vibrant cultural

spaces while embracing sustainable practices. Tai Kwun enriches the cultural landscape of Hong Kong, providing a platform for creativity, learning, and community engagement.

3.6. Setting up of The Countryside Conservation office

The Countryside Conservation Office (CCO) was established in 2018 under the Environmental Protection Department with the goal of enhancing countryside revitalization and ecological conservation in Hong Kong. Since its establishment, the CCO has achieved notable successes in revitalizing deserted villages and preserving the natural environment. One of the significant achievements of the CCO is the revitalization of Lai Chi Wo, a dissected Hakka Village. Through collaboration with the local community, the village has been revitalized with reactivated farming activities, attracting new residents, and the establishment of holiday houses. This revitalization project has brought renewed vitality to the village, preserving its cultural heritage and promoting sustainable rural development.

Another successful endeavour by the CCO is the revitalization of Mui Zi Lam, a remote deserted vernacular village in Hong Kong. Through their efforts, the village has been rejuvenated, reinvigorating the area and preserving its unique cultural and architectural characteristics.

These revitalization projects exemplify the CCO's commitment to preserving and revitalizing Hong Kong's countryside. By engaging local communities, promoting sustainable practices, and respecting the cultural heritage of these areas, the CCO contributes to the conservation and sustainable development of Hong Kong's rural landscapes. The work of the CCO not only enhances the quality of life for residents in these revitalized villages but also promotes ecological conservation and sustainable tourism. These projects serve as inspirational examples of how abandoned or neglected rural areas can be transformed into vibrant and sustainable communities, ensuring the preservation of Hong Kong's natural and cultural heritage.

Fig 29. Countryside Conservation Office

3.7. Hong Kong Strategic Planning 2030+

Fig 30. Hong Kong Strategic Planning 2030+

"Hong Kong 2030+: A Visionary Planning Strategy Beyond 2030" is an all-encompassing study designed to enhance the territorial development strategy of Hong Kong. Its primary objective is to provide a spatial planning framework that will steer the future planning, land and infrastructure development, and overall architectural landscape of Hong Kong. By transcending the year 2030, this initiative aims to transform Hong Kong into a vibrant, globally competitive, and sustainable "Asia World City." The

overarching planning goal is to prioritize sustainable development, ensuring the fulfilment of our current and future social, environmental, and economic needs and aspirations.

There are 3 major building blocks in this strategic new planning that is inclusive of Planning for a liveable High-Density City, Embracing New Economic Challenges and Opportunities and Creating Capacity for Sustainable Growth.

Planning for a Liveable High-Density City, Hong Kong will embody the characters of, A Compact city, An Integrated City, Unique, Diverse& Vibrant City, Healthy City, A city leveraging Green & Blue Assets, Re-inventing Public Space and Enhancing Public Facilities, A city to rejuvenate the Urban Fabric and An Inclusive & Supportive City.

In the coming future, it has been planned for 3 major growth areas the Northern Metropolis, City Urban Renewal and the Kau Yi Chau Reclamation.

Northern Metropolis is a crucial future development of Hong Kong. It is situated at the boundary between Hong Kong and Shen Zhen, and is most rich in its cultural, historical, and environmental assets. The 6 Planning principles of the Northern Metropolis are Urban-Rural Integration, Proactive Conservation, High quality outdoor Eco-Recreation/ Tourism attractions, Optimized Spatial Planning for Economic Land, Expansion of Development Capacity, Enhancing the Efficiency, Capacity, and comfort level of cross-boundary travel, Protective Conservation and planning for a Sustainable, Green, Smart and Resilient future city is the goal for the Northern Metropolis.

Fig 31. Northern Metropolis

4. Conclusions

Climate change indeed presents a pressing global challenge that is the result of cumulative human activities. Traditional approaches to city planning and design are no longer sufficient to address the urgent need for sustainability in the future. Hong Kong, as a densely populated city in Asia, has made a firm commitment to achieving carbon neutrality by 2050 and has taken significant steps towards this target. This commitment is evident in the City's Strategic Planning, which emphasizes the promotion of green buildings, environmentally friendly transportation, and sustainable infrastructure.

Hong Kong's government has demonstrated a proactive stance in implementing environmental policies and climate action plans to address these new challenges. The Hong Kong Strategic Planning 2030+ provides a framework for the city's development, guiding the creation of a distinctive and locally responsive architecture and urban landscape that effectively addresses the global challenge of climate change.

In this context, innovative and resourceful designs have emerged in Hong Kong. These designs integrate sustainability principles, such as energy efficiency, renewable energy sources, and green infrastructure, into the built environment. The city's commitment to environmental stewardship and carbon neutrality has fostered the development of green buildings and sustainable infrastructure projects that contribute to reducing greenhouse gas emissions and mitigating the effects of climate change.

By embracing a proactive environmental policy, implementing a comprehensive climate action plan, and adhering to the Hong Kong Strategic Planning 2030+, the city is paving the way for a sustainable and resilient future. Through these efforts, Hong Kong aims to create an urban environment that not only responds to local needs but also contributes to the global fight against climate change.

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