CARE2022

HONG KONG CONFERENCE

Summary Report and Policy Recommendations

FEBRUARY 2023

Contents

Preface

Climate Adaptation and Resilience Conference 2022 (CARE2022) carried forward what we started in 2018 with the first major event focussed on adaptation in Hong Kong. We focussed on adaptation because it was a neglected topic. There used to be much more interest in climate mitigation although both aspects are equally important in light of the changing climate. Adaptation took centre stage internationally at COP27 in 2022, and we expect the theme to continue at COP28 in 2023.

In 2018, we were grateful to have the support of two Bureaux and five Departments of the HKSAR Government working closely with us. In 2022, we had the support of four Bureaux and nine Departments plus three financial regulatory bodies, together with business and professional organizations. It was a demonstration that climate change issues have gained broad and high-level attention in Hong Kong – a positive sign.

A conference is a moment in time for a gathering of people to engage each other on specific issues. A conference's success needs to be judged by what follows. From 2018 to 2022 (despite COVID years in between), we could see Hong Kong's continuing progress on climate science research, further planning and implementation of various adaptation related infrastructure projects; and significant efforts from financial policymakers and regulators. While some gaps are being filled, others are still awaiting attention. We hope CARE2022 had stimulated enthusiasm to push forward on a broad front.

This post-conference report summarizes the three days of CARE2022. The main purpose of this report is to highlight where we have observed gaps that need attention. Our hope at HKUST is that we will focus on some of the gaps within our competence to continue to engage with the HKSAR Government and others in a collaborative spirit because the challenge presented by climate change is so large and urgent.

Our sponsors for both 2018 and 2022 are major enterprises in Hong Kong, some of whom have businesses beyond Hong Kong. They are important and influential in the climate challenge and we are grateful for their continuing support.

We look forward to continuing pushing ahead at HKUST with the support of stakeholders to stimulate the IMPACT needed for Hong Kong to achieve carbon neutrality and be resilient against extreme weather.

Christine LOH
Chi Ming SHUN
Alexis LAU
CARE2022
Co-Chairpersons,
Organising Committee

Observations and Recommendations

The following Observations and Recommendations include those in Chapters 3, 4, 5 and 6. We hope they contribute to deliberation by the HKSAR Government and help all interested stakeholders in Hong Kong. We welcome comments and stand ready to support Hong Kong's climate and sustainability transition.

I: Nexus between Mitigation and Adaptation

Climate mitigation and adaptation are intimately related. Development projects must therefore consider them together. This means a wide range of government Bureaux and Departments need to be involved to align policies. It also needs the steer of the Chief Executive and Financial Secretary who can take the broadest possible view.

The government's role is vital in adaptation because extreme weather events affect the community. Only the government has the capacity, policy tools and financial means to deal with long-term horizons, as well as to build defensive infrastructure. Dealing with climate change requires policies that invariably run up against cost/benefit calculations, concerns over effectiveness of interventions, and achieving equity across society. The government should be transparent about these policies and engage with stakeholders on the trade-offs as part of their decision-making. This will increase public understanding and improve governance.

II: General Observations

Broadly speaking, 12 observations arise from CARE2022:

1. The climate and sustainability transition affects the entire economy, and the transition will be sustained for decades to come because it is a global transition. Hong Kong's development projects offer mitigation and adaptation opportunities can stimulate private sector investment, talent development, and job creation.
2. Hong Kong's policy planning and design processes should explicitly aim to optimize mitigation and adaptation opportunities. Given the importance of the climate and sustainability transition, stronger mainstreaming within the HKSAR Government is necessary and should lead to all Bureaux and Departments considering the impact of these issues on their responsibilities and opportunities.
3. Hong Kong's has carried out outstanding adaptation in slope management and flood prevention – two major risks for the city – backed by strong meteorological science.
4. While sea level rise is a challenge for coastal regions, the risks from it are less imminent than risks from landslides and flooding for Hong Kong. Decisions must, however, be made on designing sufficient margins of safety for coastal defensive infrastructure for the short to medium term and the details explained.
5. The significant policy gap is on buildings regulation. This needs to be urgently reviewed and upgraded to meet both Hong Kong's 2035 carbon reduction target and its 2050 carbon neutrality goal. Buildings must be more resource and energy efficient and better able to cope with extreme heat.
6. New regulatory standards for mitigation and adaptation invariably run up against queries on cost/benefits calculations, effectiveness of interventions, and achieving equity across society. It is unclear what are the trade-offs in areas where the government has been acting and where it has not. For example, why hasn't more progress been made on reducing energy consumption in buildings given they consume 90% of the electricity causing 60% of the carbon emissions.

7. The climate and sustainability transition must be relatable to people. The government is responsible for identifying vulnerable locations and vulnerable groups, as well as to continue to refine Hong Kong's early warning systems and emergency response plans to reduce extreme weather risks. The government must also work with districts and NGOs to raise public awareness to climate risks, and to engage the community in strengthening preparedness.

8. The 'greening' of finance requires a better understanding of physical climate risks, and how these risks could be translated into specific financial value for the city in a credible way. While this is a challenging task, it offers significant opportunities to strengthen Hong Kong's ability to provide international professional services and be a leading finance centre in the climate and sustainability transition era.

9. Training talent for the climate and sustainability era benefits the whole economy, not just financial services, as the relevant knowledge is needed for the transformation of all activities in the public and private sectors.

10. Policymakers have yet to fully embrace ways in which I&T can be applied to deliver in multiple modes, such as the merging of Green-Climate-Prop-FinTech through digitalisation. That said, Hong Kong's public and private sectors are already major investors in climate and environmentally related I&T, where Hong Kong is a leader in some areas.

11. The climate and transition era will be global providing the opportunity for Hong Kong's work on climate adaptation and I&T to strengthen its overall Brand by developing appropriate narratives.

12. Hong Kong needs to communicate and engage more effectively with stakeholders for its efforts to be understood and appreciated. The HKSAR Government has considerable support from academia, professionals, corporates, and NGOs working on the climate and sustainability transition. Engagement between the government and stakeholders through well-design-and-curated deliberations can be mutually rewarding.

III: Based on Presentations by Bureaux and Departments

Observations

1. Hong Kong's public sector has strong climate science and engineering skills developed to deal with risks arising from its hilly topography, subtropical climate, and exposure to typhoons. Its techniques and management methods represent a valuable body of tested solutions.

2. The public seldom see or hear about government work in an integrated, cross-disciplinary manner. The extent of government work is impressive and interesting - more publicity can help to generate public buy-in if properly narrated and presented.

3. Seeing and hearing government work across Bureaux and Departments enables the identification of gaps and trade-offs that need further articulation and deliberation.

4. The government is a major investor in climate and sustainability related I&T that could be properly narrated and presented for both mitigation and adaptation.

5. Young people are clearly interested in climate and sustainability. They expressed an interest to be involved, which presents opportunities for the HKSAR Government to respond although they did not say how they thought they could be engaged.

Recommendations

A. Hong Kong's government leaders tend to focus on branding its economic prowess in financial services, tourism, trading and logistics, and professional and producer services. Hong Kong's capabilities in climate solutions can be developed into a new narrative of economic, professional, finance and I&T strengths to suit the current era.

B. The Steering Committee on Climate Change and Carbon Neutrality chaired by the Chief Executive is the right place for Bureaux and Departments to present their work periodically in an integrated-interdisciplinary manner so that the Chief Executive could have a thorough understanding of the work being done, and for the Financial Secretary to see how funding allocations have been spent. This committee is the right platform for the HKSAR Government to mainstream climate as a major cross-cutting topic within the bureaucracy.

   By mainstreaming within such a setting, it should also stimulate all Bureaux to consider how they could use Hong Kong's climate capabilities and solutions to promote the city. For example:

   - **Financial Services and Treasury Bureau** improving cooperation with Hong Kong's scientific and engineering experts to assist the financial sector's assessment of climate risks in financial terms on an on-going basis (see Chapters 4, and 6 for further elaboration).

   - **Commerce and Economic Development Bureau** using climate and sustainability I&T solutions as part of its Belt & Road promotion.

   - **Constitutional and Mainland Affairs Bureau** sharing Hong Kong's climate efforts and capabilities with the regional and national governments since climate change is a top policy agenda.

   - **Innovation, Technology and Industry Bureau** including Green-ClimateTech and innovation within its scope of work. The government is spending considerable sums to develop and use such technologies, some of which are co-developed with local R&D capabilities (see Chapter 6 which goes further with the integration of Green-Climate-Prop-FinTech). Those efforts are expanding and deepening local capacities that could have use beyond Hong Kong if properly supported and promoted.

C. Climate and sustainability have become a sought-after topic at schools and universities. Bureaux and Departments can reconsider how they can integrate climate and sustainability into their outreach, in particular Home Affairs and Youth Bureau, to engage youth.

IV: Based on Workshop A on the Nexus between Mitigation and Adaptation

Observations

1. Cross-cutting, multi-and-interdisciplinary deliberations and dialogues are essential for co-learning and problem-solving. Designing and conducting these dialogues can progress exploration of issues, where there are different perspectives, methods, and views.

2. There is a great desire among professionals and institutions for appropriate platforms for convening co-learning and problem-solving dialogues across sectors, including with government and regulators at both the senior and working levels.

3. Barriers to sustaining engagements include the lack of time, focus and resources for the planning, design, curating and convening of neutral spaces for dialogue. Everyone wishes someone else could rally stakeholders.

4. Green-ClimateTech emerges as a major innovation area. The public, private and academic sectors are already investing hugely in this, but it has yet to receive adequate attention from the authorities engaged in policy making. Moreover, managing the climate transition requires large-scale digitalisation.

Recommendations

A. Institutions in Hong Kong should coordinate and cooperate to divide up the work required to convene cross-cutting dialogues.

B. Bureaux and Departments should consider how they could organize themselves to enable various institutions to convene and/or participate in such periodic dialogue to exploring issues.

   Two topics on which new dialogue platforms with government involvement could be developed now:

   a) Policies for developing and funding adaptation to counter landslide, flood, and sea level rise risks. This could be hosted by an appropriate financial regulatory or management institution. Its objective would be

a deeper understanding of risk assessments and accident prevention plans relevant to these major risks in Hong Kong.

b) Built environment, which could be hosted by an appropriate institution for the property development and management sector together with the financial services sector to exchange views on what it takes for them to meet the climate transition for new and existing buildings, as well as cityscape, together with relevant Bureaux and Departments, and how large-scale plans could be financed.

C. Innovation, Technology and Industry Bureau may wish to consider the importance of Green-ClimateTech in light of the local, national and global attention to achieving the climate transition (see Chapter 6 on the broader integration of Green-Climate-Prop-FinTech).

V: Based on Workshop B on Emergencies, Security, Health, Water, Heat Stress, and Regional Collaboration

Observations

1. Measures to tackle one issue may conflict with another. For example, moving car parks underground save space but for high-risk properties along the coast, it may increase the risk of inundation due to storm surges.

2. Institutions operating critical infrastructures (energy, airport) consider the worst-case scenarios in their climate projections for adaptation and resilience planning, such as very high GHG emissions, high temperature of 45ºC, and up to ~2.5 m sea level rise by 2100. Other decision-makers adopt intermediate GHG emissions scenarios for their planning of less critical infrastructures and facilities.

3. Companies and users in different sectors of activities have varying circumstances with respect to adaptation and resilience, and assess their risks based on different parameters and probabilities, including the effectiveness and costs involved.

4. The entire Pearl River Delta is a flood-prone area. Extreme weather events could disrupt regional transport networks and supply chains. Droughts, such as in 1963, would have regional impact on water resources.

5. Hong Kong people's awareness and preparedness for disasters is relatively low (~25%) according to a Hong Kong Red Cross survey in 2021. With respect to electricity supply, end-to-end resilience will require actions on the part of users.

6. More data and research are needed to identify different types of risks and the high risk locations, the vulnerable groups affected, the range of intervention measures, better early warning strategies and what the public could do for self-help.

7. In addition to urban planning, green building designs can contribute to 'Cooling Hong Kong' as buildings are a major source of urban heat especially in high-density districts.

Recommendations

A. Government Bureaux and Departments and academia can collaborate to identify the data and knowledge gaps needed on the various climate risks, including heat (a neglected focus), with the aim of filling those gaps to enable the authorities to set evidence-based policies, including unknown tertiary climate risks in Hong Kong but have happened elsewhere.

B. The Government, public utilities, NGOs, and the private sector should collaborate to intensify public understanding of risks and be prepared to play clearly articulated roles in emergency action plans. Greater attention should be paid to identifying vulnerable groups, including occupants in sub-standard accommodation.

C. Codes of practices, guidelines and regulatory requirements need to be reviewed holistically and upgraded for both climate mitigation and adaptation, and this is especially critical for development in low-lying ground and along the coastline, as well as buildings.

D. Consideration should be given to Hong Kong's response to possible larger-magnitude disasters and multi-hazard scenarios (e.g. severe storm surge, landslides and flooding occurring at the same time), such as whether public sector buildings and facilities could be deployed as emergency centres and temporary shelters.

E. Greater transparency is need for actions being considered and planned with respect to adaptation for the whole of the GBA. All parts of the region have an interest in better regional resilience. Consideration should be given to whether a GBA collaborative mechanism should be established for adaptation and resilience.

VI. Based on Presentations and Discussions on Risk Assessment, Data, Industrial Transformation, Innovation & Technology, Talent, and Collaboration

Observations

1. Collaboration is essential across public and private sector stakeholders because climate change and sustainability are complex and require the fusion of different knowledge fields to understand how to achieve strong performance in the economy.

2. Hong Kong's economy needs to expand talent and capability in environmental science and sustainability in general, not just with respect to green finance since finance complements other activities in the economy.

3. The drive to achieve carbon neutrality and sustainability requires organizations to collect, assess, analyse and manage data through digital means. Technology is evolving and fusing "Green-Climate-Prop-FinTech" with implications across the economy, including the government sector.

4. Companies in traditional industries, such as energy, property, manufacturing, shipping, banking etc are becoming digital, and digital companies are becoming consulting services to helping others use data and digital technologies.

5. Standard setting and best practices could come out of Asia, as the circumstances of Asia's development going forward are different from those in developed economies.

Recommendations

A. Mainstreaming climate and sustainability within the government bureaucracy would help the HKSAR Government to enable officers in I&T, environment, housing, planning and development, education as well as infrastructure to work more closely with those in industry, commerce, I&T, transport, and finance because climate and sustainability represent a powerful, long-term global and national overarching driver of change (see also Chapters 3, 4 and 5)

B. Internal mainstreaming should be complemented by external communication to enable the work of the HKSAR Government to be better understood by the public and private sector stakeholders (see Chapters 3, 4 and 5).

C. The newly created Office of the Commissioner for Climate Change under EEB could be the government unit that coordinates the mainstreaming and proper communication of the government's climate related work in a broad and compelling way.

CHAPTER 1

COP26 to COP27 & Design of CARE2022

Cross-cutting, transparent, and inclusive

This chapter refers to the United Nations Framework Convention on Climate Change (UNFCCC) process[1] to provide a brief update of the Conferences of the Parties (COP) in 2021 (COP26) and in 2022 (COP27) with specific relevance to climate adaptation. It also explains how CARE2022 was designed and the outcomes it sought to achieve with inspiration from COP27.

UNFCCC process

The UNFCCC process includes annual gatherings of the Parties to discuss on-going issues under the multilateral treaty on climate change. The current treaty, Paris Agreement (2015), went into force in 2016 succeeding the Kyoto Protocol.[2]

A key provision of the Paris Agreement is for mitigation efforts to be made for global temperatures to stay within 2°C and to strive for 1.5°C, of the pre-industrial level. Since 2015, the latest scientific references point to a preference to staying within 1.5°C to minimize devastating climate change.

Another key treaty provision is climate adaptation. As global warming is already causing more frequent and more extreme weather events worldwide, concurrent efforts are also needed to improve societal resilience against such extremes, especially as the global temperature is already almost at 1.1°C above pre-industrial level and the 1.5°C target could well be missed.

The UNFCCC process is supported by a large group of scientists from around the world who provide on-going, in-depth scientific knowledge to inform policymakers, known as the Intergovernmental Panel on Climate Change (IPCC).[3] During 2021-2022, the IPCC published its Sixth Assessment Reports (AR6): *Climate Change 2021: The Physical Science Basis; Climate Change 2022: Impact, Adaptation, and Vulnerabilities; and Climate Change 2022: Mitigation of Climate Change.*[4]

Moreover, the technical approaches adopted by the UNFCCC process has strong ideals that all such processes on a national and local basis should also strive for – that they be *open, transparent, cross-cutting, and inclusive*.[5]

Climate Change: Conference of the Parties 2021 and 2022

The threat of climate change is widely accepted by governments around the world, but progress remains slow. The essential message of COP27 that took place in Egypt (6-19 November 2022) was that there was an urgent need to catch up in both climate mitigation and adaptation. A key outcome of COP27 was the establishment of a *Loss and Damage Fund* – the culmination of decades of pressure from climate-vulnerable developing countries. The fund aims to provide financial assistance to nations most impacted by the effects of climate change. Climate adaptation, such as building sea walls, preventing landslides, and creating drought-resistant crops, could cost developing countries US$160-340 billion annually by 2030, which could swell to US$565 billion by 2050 should global warming accelerates.[6]

In 2015, the Paris Agreement established the *Global Goal on Adaptation* (GGA) with the aim of driving collective action on climate adaptation. At COP26 that took place in Glasgow in 2021, among its various decisions, was a two-year work program on the GGA, as work towards adaptation had languished.[7] The GGA discussion at COP27 was considered a success with governments agreeing on the way to move forward at COP28 on improving resilience among the most vulnerable countries with some measure of financial pledges to help adaptation solutions.[8]

The details of the work from COP27 to COP28 in 2023 are technical in nature and centres around taking a "structured approach" that included vulnerability and risk assessments, adaptation planning, knowledge transfer, finance, and monitoring and evaluation, with themes covering various topics including cities, oceans and coastal ecosystems, health, food, and water.

The GGA's approach as part of the UNFCCC's process should be *open, transparent, cross-cutting, and inclusive* with sources of information coming from various IPCC and other authoritative reports, and that there would be several deliberative workshops to agree on issues. Reports are expected at COP28 in 2023 scheduled to be held in Dubai.

It should also be noted that close to the time of COP27, other important gatherings took place where climate change was also prominently featured – these included G20 held in Indonesia (15-16 November 2022)[9], and APEC held in Thailand (19 November 2022)[10], where the relevant governments highlighted the risks associated with climate change and the need for international cooperation.

Biodiversity: Conference of the Parties 2021 and 2022

It would have been remiss of CARE2022 to ignore the first part of COP15 (of the UN Conference of the Parties under the Convention of Biological Diversity) relating to biodiversity that was held in Kunming in 2021, and that the second part would be held a few days after CARE2022 in Montreal 2022.[11] While biodiversity was not the key focus of CARE2022, it was included in one of the plenaries and one of the workshops on Day 1. The concept of climate resilience requires healthy ecosystems and the protection of biodiversity, and that the topics considered by the climate and biodiversity multilateral treaties were merging.

Survey of global risks

The World Economic Forum noted in its Global Risks Report 2023 a survey of business leaders how they saw major risks arising in the next 2 years and 10 years – climate and environment risks were prominently featured.[12]

FIGURE 1.1

Top 10 Risks, Global Risks Report 2023

"Please estimate the likely impact (severity) of the following risks over a 2-year and 10-year period."

2 Years

1	Societal	Cost of living crisis
2	Environmental	Natural disasters and extreme weather events
3	Geopolitical	Geoeconomic confrontation
4	Environmental	Failure to mitigate climate change
5	Societal	Erosion of social cohension and societal polarization
6	Environmental	Large-scale environmental damage incidents
7	Environmental	Failure of climate-change adaption
8	Technological	Widespread cybercrime and cyber insecurity
9	Environmental	Natural resource crisis
10	Societal	Large-scale involuntary migration

10 Years

1	Environmental	Failure to mitigate climate change
2	Environmental	Failure of climate-change adaption
3	Environmental	Natural disasters and extreme weather events
4	Environmental	Biodiversity loss and ecosystem collapse
5	Societal	Large-scale involuntary migration
6	Environmental	Natural resource crises
7	Societal	Erosion of social cohesion and societal polarization
8	Technological	Widespread cybercrime and cyber insecurity
9	Geopolitical	Geoeconomic confrontation
10	Environmental	Large-scale environmental damage incidents

Economic
Environmental
Geopolitical
Societal
Technological

Source: World Economic Forum, Global Risks Perception Survey 2022-2023

CARE2022 and COP27

CARE2022 was designed to focus primarily on adaptation but with due emphasis on the nexus with mitigation since the two are so intimately connected. The role of government to speed-up the climate transformation to Net Zero is essential because decarbonizing the economy and providing infrastructure and systems for societies to be resilient against extreme weather events require consistent long-term policies.

CARE2022 took inspiration from the UNFCCC process to be *open, transparent, cross-cutting, and inclusive*. CARE2022 invited the HKSAR Government to discuss their adaptation plans in an open, transparent and cross-cutting manner so that there could be a more fulsome picture of how the work of various Bureaux and Departments aligned with each other, while pointing to the need for continuous mitigation, and the need for both mitigation and adaptation to be considered in the planning and implementation of major development projects in Hong Kong. Moreover, CARE2022 included considerations in finance policies since finance is a critical enabler for both mitigation and adaptation. The design of the climate science plenary and the HKSAR Government adaptation plenary on Day 1, the two Workshops on Day 1, and the design for Day 3 sought to be cross-cutting and as inclusive as possible to bring together areas of knowledge and experience that had not been brought together before, as the climate change must involve them all.

Breadth vs. Depth

The CARE2022 design provided breadth of climate policy issues. Presenters were invited to articulate their most important messages within the shortest time so that related issues could be presented alongside each other. While registration was open for participation for the plenaries and the two Workshops on Day 1, the organizers made considerable effort to invite knowledgeable individuals and institutions, including youth, to participate so that there could be an appreciation of the breadth of issues involved, as well as stimulating exchange of views particularly at the Workshops. The Workshops also provided opportunities for networking for presenters and participants. Broadening networks was an aim of CARE2022, as Hong Kong society would need many more institutions to take up deliberation of the climate challenge.

As for depth, Day 2 provided a chance for university scholars to exchange views based on their work related to adaptation. Moreover, other institutions were organising climate-related events that HKUST scholars participated in. Special mention must be given to Hong Kong Observatory (HKO). During the early design stage of CARE2022, and in discussing the involvement of the HKSAR Government, HKO decided to organize Climate Science Webinar event the weekend after CARE2022 (17 December 2022) to note the outcomes of CARE2022 and to go into depth on specific issues.

Conference participation data

The plenaries on Day 1 were conducted in hybrid mode, while the two workshops in the afternoon were designed for in-person interactions. The presentations and discussions on Day 2 were designed for scholars to showcase their work, which provided a measure of depth, and the conference on Day 3 on Risks, Data, Finance, and Technology was by invitation for in-person participation because of the constrain of the venue but there was online viewing.

The three-day CARE2022 Conference has attracted wide spread interest with a thousand participants joining the event physically and virtually. All presentations are video-recorded and shared online, and have received 2,500 views as of February 2023.

1. For details about the UNFCCC and its process, see https://unfccc.int/.
2. For details about the Paris Agreement and the Kyoto Protocol, see https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement.
3. For details about IPCC, see https://www.ipcc.ch/.
4. For details about the 6th Assessment Reports, see: https://www.ipcc.ch/report/sixth-assessment-report-working-group-i/. https://www.ipcc.ch/report/sixth-assessment-report-working-group-ii/. https://www.ipcc.ch/report/sixth-assessment-report-working-group-3/.
5. For an example of the approach, see https://unfccc.int/sites/default/files/resource/GST%20TD1_1_sreport_26_09_2022_Final.pdf.
6. For Loss and Damage Fund, see https://www.unep.org/news-and-stories/story/cop27-ends-announcement-historic-loss-and-damage-fund.
7. For background of GGA, see https://www.iisd.org/articles/deep-dive/glass-global-goal-adaptation-cop-27.
8. For a brief summary, see https://unfccc.int/news/cop27-reaches-breakthrough-agreement-on-new-loss-and-damage-fund-for-vulnerable-countries.
9. See the G20 Leaders' Declaration, https://www.g20.org/content/dam/gtwenty/gtwenty_new/about_g20/previous-summit-documents/2022-bali/G20%20Bali%20Leaders%27%20Declaration,%2015-16%20November%202022.pdf.
10. See the relevant documents from APEC 2022, https://www.apec.org/press/news-releases/2022/apec-leaders-issue-2022-declaration-and-the-bangkok-goals-on-the-bio-circular-green-economy.
11. For details of COP15, see https://www.cbd.int/article/cop15-cbd-press-release-final-19dec2022.
12. World Economic Forum, 11 January 2023, https://www.weforum.org/agenda/2023/01/these-are-the-biggest-risks-facing-the-world-global-risks-2023/.

CHAPTER 2

CLIMATE SCIENCE – "OUR CLIMATE IS OUR FUTURE"

WATCH VIDEO https://care.hkust.edu.hk/Video_Ch2

Climate Science Plenary

Prof. Petteri TAALAS
Secretary General, WMO

Prof. Panmao ZHAI
Co-chair, IPCC Working Group I on The Physical Science Basis

Dr. Cho Ming CHENG, JP
Director, HKO

Climate change is already affecting every inhabited region across the globe because of human activities. The Opening Plenary of CARE2022 on Day1 focussed on the latest climate science at the global and regional/local levels.

Petteri Taalas, WMO

Climate science - global

Prof. Petteri Taalas, Secretary General of the World Meteorological Organization (WMO) and Prof. Panmao Zhai, Co-chair of IPCC Working Group I on The Physical Science Basis, provided summarizes of the IPCC AR6 reports, which called for the rapid transformation of societies as the world was falling short of the climate goals set in the Paris Agreement. Their key messages were directly relevant to Hong Kong and the Greater Bay Area (GBA):

- The World Economic Forum in June 2022 considered climate action failures and extreme weather to be the top two biggest risks for the global economy for the coming 10 years.

- There has already been 1.09°C warming (2011-2020) since pre-industrial times (1850-1900) and that 2017-2021 were the warmest years on earth. Ocean temperatures has also been rising.

- Global warming of 1.5°C and 2°C (as per the Paris Agreement) will be exceeded unless deep reductions in CO_2 and other GHGs occur in the coming decades. The current best estimate is that the global air temperature will rise by about 2.5°C to 3°C above the pre-industrial level by the end of this century.
- 3°C global warming is a major risk for food security due to a loss of crop yield in most parts of the world. Water security will also be a major challenge due to global warming and population growth.
- Global sea level has been rising at an increasing rate and given the current high GHG concentration level, melting of glaciers and sea level rise will continue in the coming hundreds of years.
- To get on track, the world would need to reduce CO_2 and other GHGs by unprecedented levels over this decade and emissions must continue to decline rapidly to reach carbon neutrality by 2050. Even though the worst-case scenario of 3°C to 5°C warming previously projected by the Fifth Assessment of IPCC (AR5) might be avoided, there will still be a major challenge in mitigation.
- Continued global warming is projected to intensify the global water cycle, including its variability, global monsoon precipitation and the severity of wet and dry events.
- Heatwaves, heavy precipitation, and droughts are projected to be larger in frequency and intensity with every additional increment of global warming.
- Every region will experience concurrent and multiple changes in climatic impact-drivers at higher levels of global warming.

Prof. Taalas also highlighted several global initiatives of the WMO in supporting the United Nations in combating climate change, including to achieve 100% implementation by WMO Members of multi-hazard early warning services and impact-based weather forecasting, enhancements of meteorological and hydrological observing systems, and monitoring of GHG in the atmosphere, and improvements of global climate modelling and prediction.

FIGURE 2.1

Observed global mean surface temperature change relative to 1850-1900

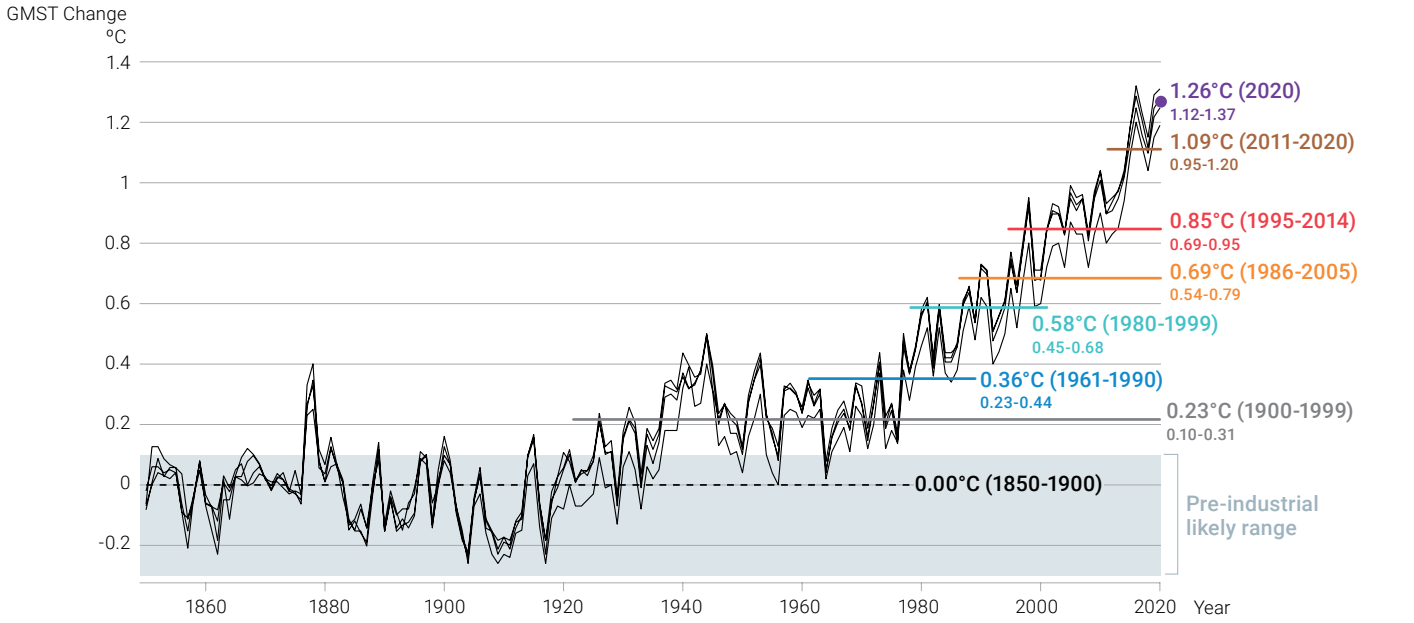


FIGURE 2.2

Projected global surface temperature change relative to 1850-1900 under the five GHG emissions scenarios considered by IPCC AR6

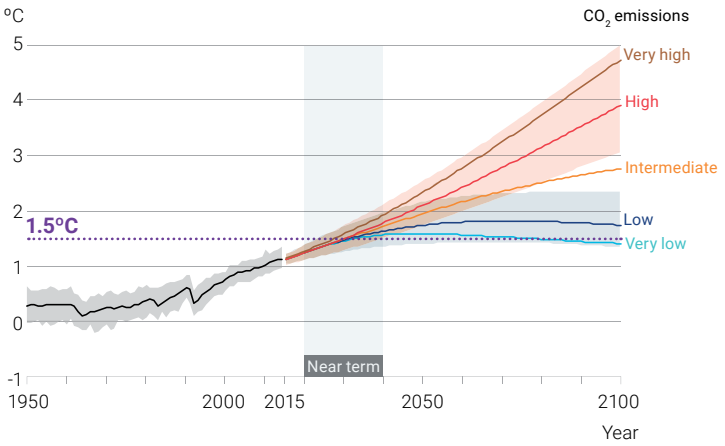


FIGURE 2.3

Range of projected global surface temperature change in 2100 relative to 1850-1900 under the Intermediate GHG emissions scenarios considered by IPCC AR6

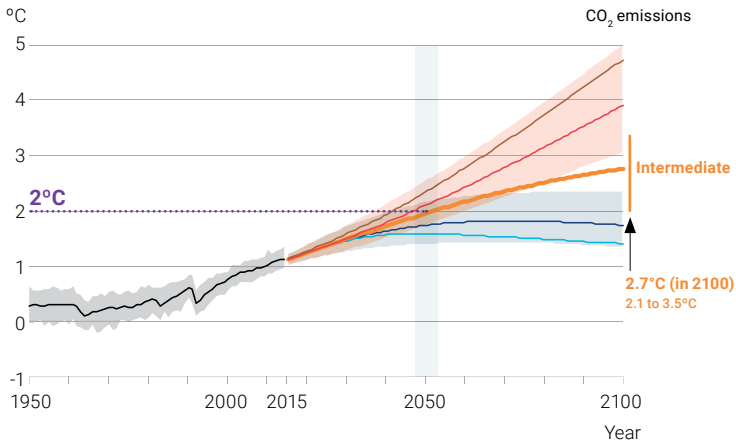
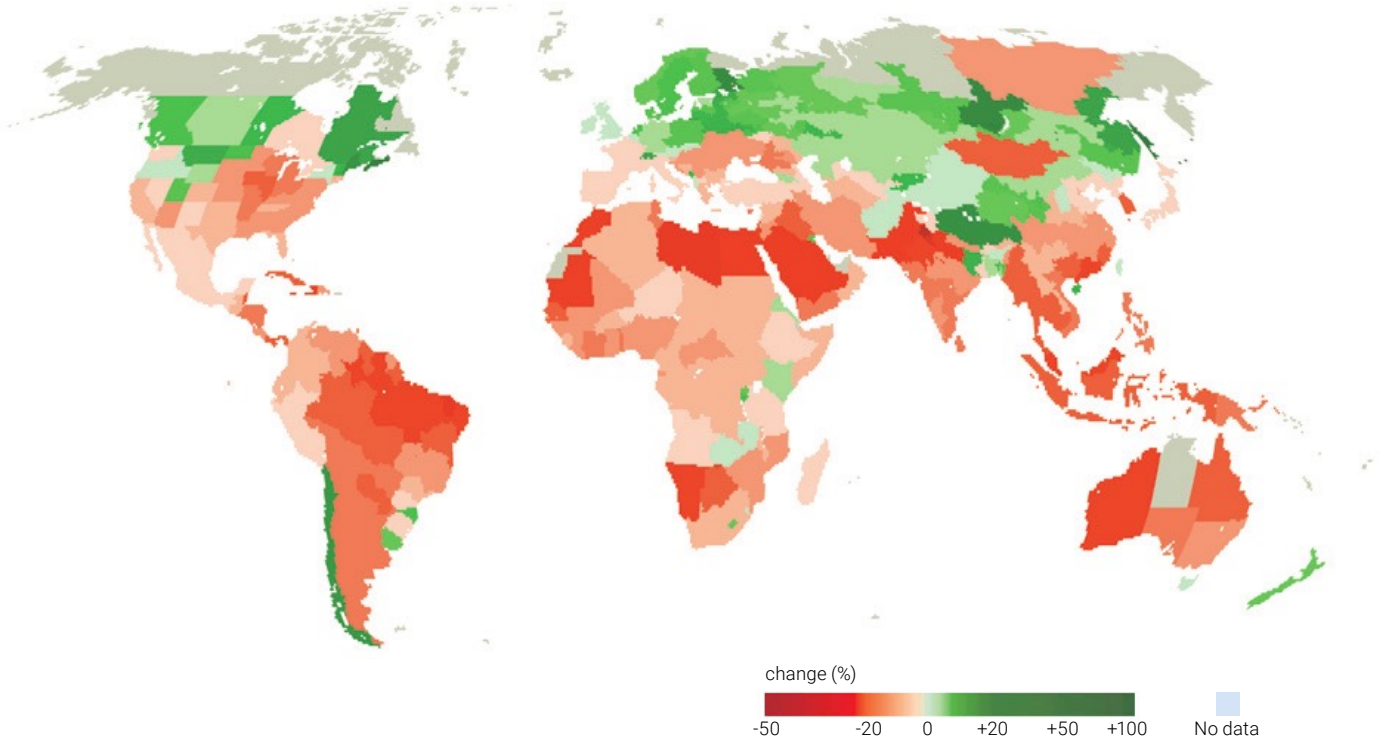


FIGURE 2.4

Percentage change in agricultural crop yields by 2050



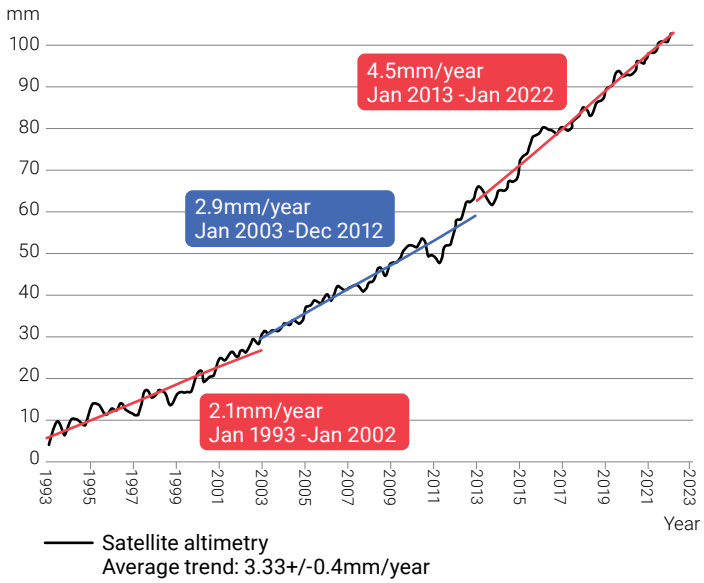
Panmao Zhai, IPCC

Prof. Panmao Zhai also emphasised the impact of climate change on cities around the world:

- As global surface temperature increases, warming is expected larger over land and in the Arctic and amplified in cities.
- Heavy rainfall events are more intense and more frequent in a warming world, and runoff is amplified by urbanisation.
- Low-lying islands and coastal areas are facing accelerating sea level rise, where once per century extreme sea level rise is expected to occur annually. The increasing extreme sea level will increase coastal flooding with the potential risk for widespread mortality and damage to housing, transportation, and energy infrastructure.
- Most cities will experience increase of local temperatures of 1.5-2°C earlier than other areas; and cities are the main sources of climate forcers.

FIGURE 2.5

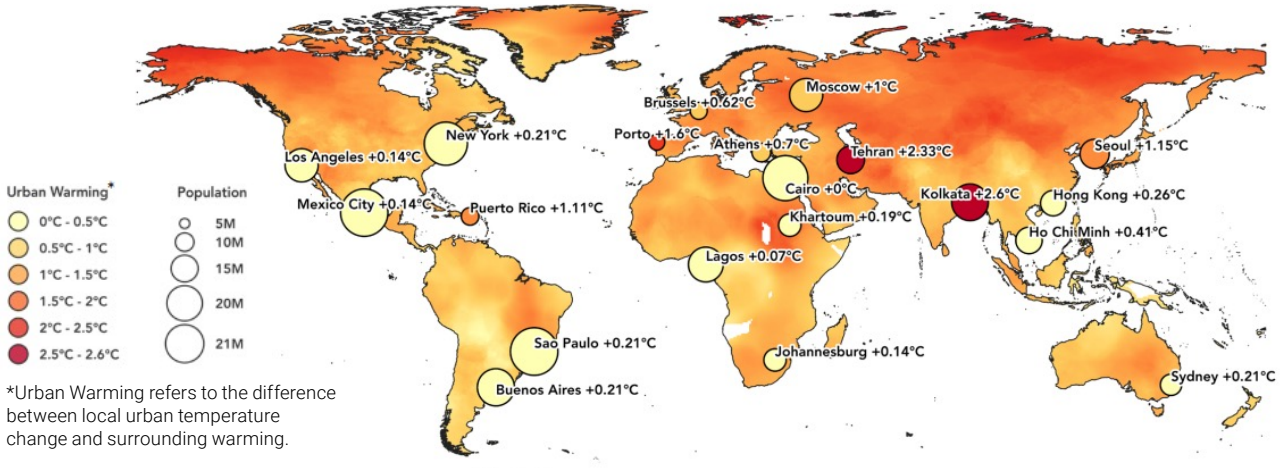
Global sea level from satellite altimetry since 1993



Prof. Zhai ended his presentation with a hopeful note – "Our climate is our future". He emphasized that cities are the sites of innovation. Cities are where mitigation and adaptation plans are reimagined and implemented in the pursuit of the UN Sustainable Development Goals; and that the global community knows what it had to do with cities playing a central role in how societies adapt to a changing climate and to decarbonize.

FIGURE 2.6

Past trends in global surface air temperature (1958-2018) with cities reporting significant temperature increases



*Urban Warming refers to the difference between local urban temperature change and surrounding warming.

FIGURE 2.7

Sea level heights and recurrence frequency

Historical centennial events (HCE) in the recent past will become once per year events in the future due to sea level rise

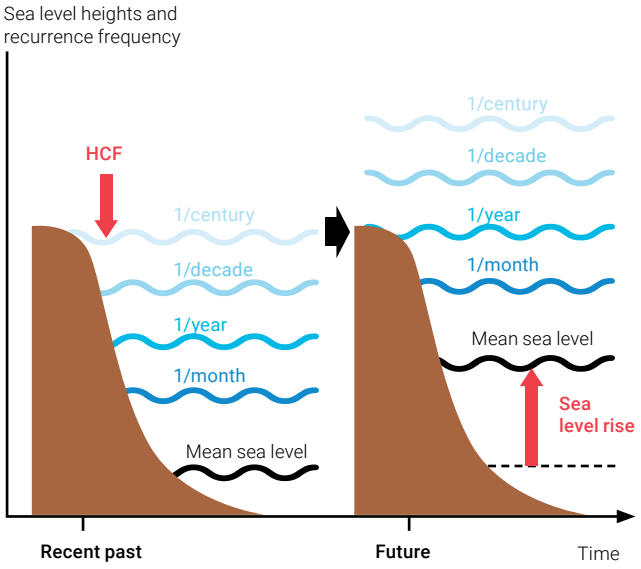


FIGURE 2.8:

Climate resilient development pathways

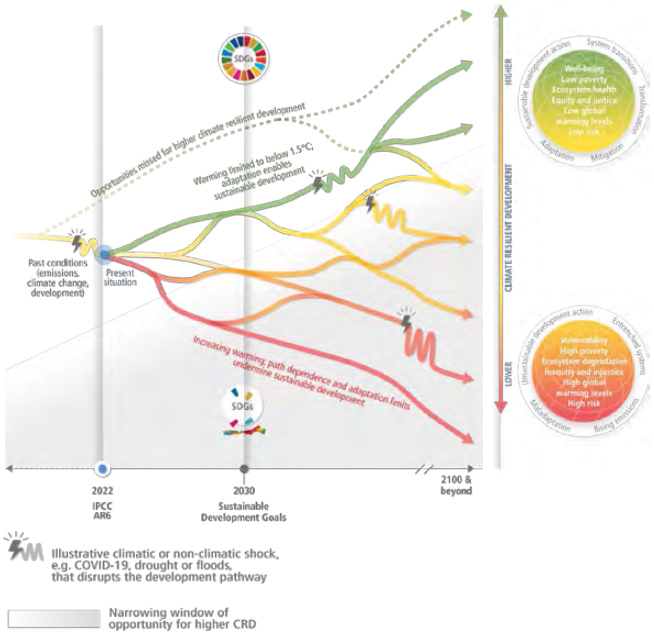
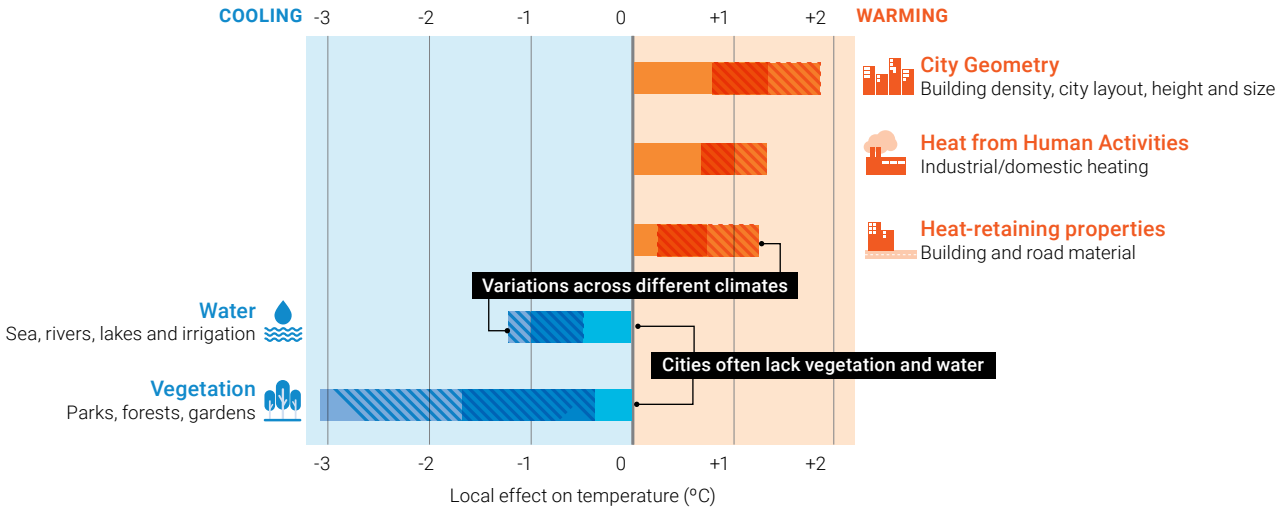


FIGURE 2.9

Local effects of cities on temperature

due to city geometry, heat from human activities, heat-retaining properties, water and vegetation



Climate science – regional and local

Dr. Cho Ming Cheng, Director of HKO, provided a summary of the significant regional-local climate science based on the latest observations and assessments of IPCC AR6, amongst other data:


Cho Ming Cheng, HKO

- The proportion and intensity of most intense tropical cyclones and the precipitation rates are increasing and are projected to increase due to climate change. Tropical cyclone induced storm surge, precipitation rate and wind waves will increase. They will have impacts on the GBA and Hong Kong.

- 2022 was a year with heat extremes: 52 hot nights, 52 very hot days, and 15 days with temperature of 35°C or higher. Their respective numbers over 30-year periods have increased 42 times, 9 times and 13 times (25.0 / 18.9 / 0.9 (1992-2021) vs 0.6 / 2.2 / 0.07 (1885-1914)).

- Under the intermediate GHG emissions scenario (SSP2-4.5), the climate projections for Hong Kong by the end of the century are:
  - Annual mean temperature will increase by 2°C relative to 1995-2014 average;[1]
  - Annual number of hot nights and very hot days will increase to 117 and 95 respectively; and
  - Annual maximum daily rainfall will increase by 16%.

- Under the very high GHG emissions scenario (SSP5-8.5), the climate projections for Hong Kong by the end of the century are:
  - Annual mean temperature will increase by 3.6°C relative to the1995-2014 average;[2]
  - Annual number of hot nights and very hot days will increase to 167 and 152 respectively;
  - Annual maximum daily rainfall will increase by 29%.

- Sea level rise (SLR) in Hong Kong
  - Sea level will continue to rise for centuries to millennia even under large net negative carbon dioxide emissions;
  - Sea level will increase by 0.56 m (likely range: 0.37 – 0.82 m) and 0.78 m (likely range: 0.57 – 1.08 m) by the end of the century under the intermediate and very high GHG emissions scenarios respectively, relative to the 1995-2014 average. These increases will become 0.94 m (likely range: 0.58 – 1.41 m) and 1.36 m (likely range: 0.92 – 1.99 m) respectively in 2150;[3]
  - For the low confidence scenarios considered by IPCC, which indicate the potential impact of deeply uncertain ice sheet processes, sea level will increase by 0.57 m and 0.91 m under the intermediate and very high GHG emissions scenarios by the end of the century. These increases will become 1.0 m and 2.06 m respectively in 2150.[4]

FIGURE 2.10

Tropical cyclone projection for Western North Pacific

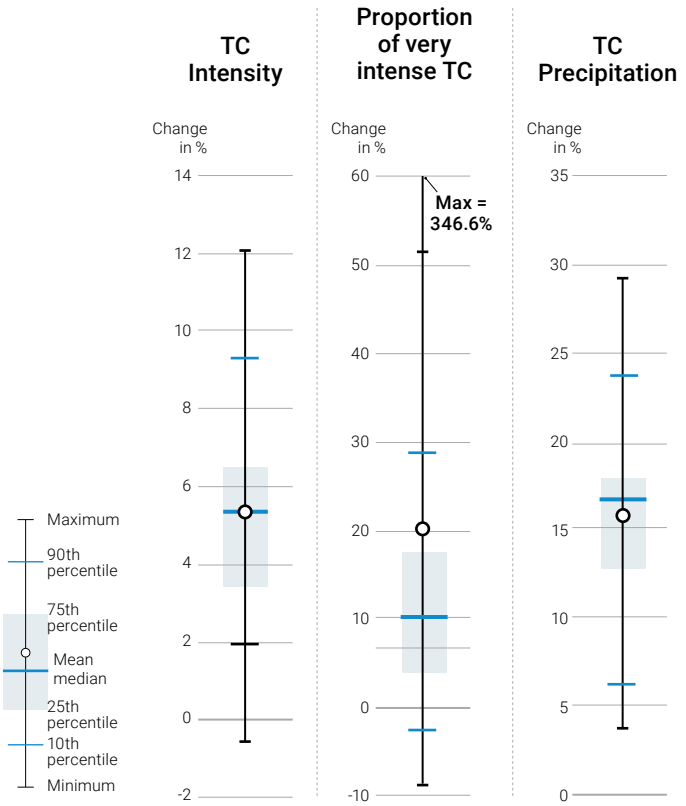


FIGURE 2.11

Projection of annual maximum temperature for Hong Kong relative to the average of 1995-2014

under the Intermediate and Very High GHG emissions scenarios considered by IPCC AR6

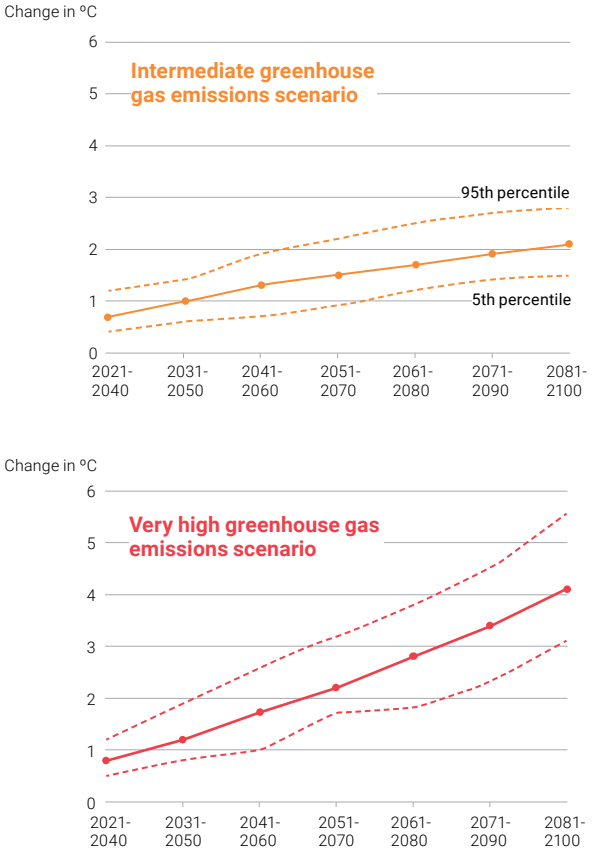


FIGURE 2.12

Projection of annual number of hot nights, very hot days and cold days for Hong Kong

under the Intermediate and Very High GHG emissions scenarios considered by IPCC AR6

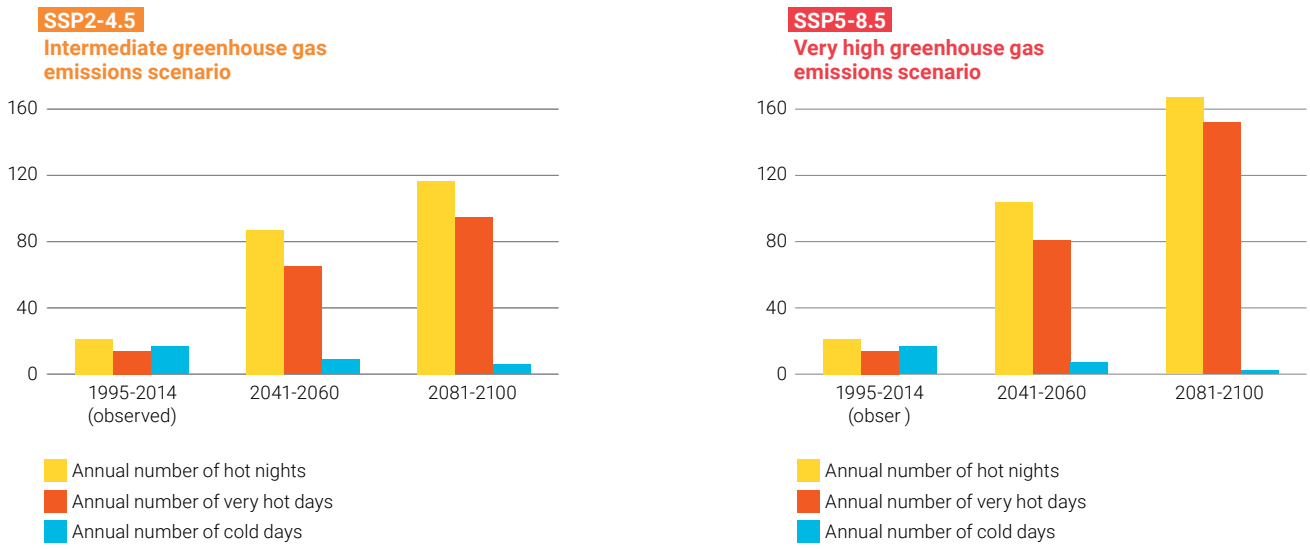


FIGURE 2.13

Projection of annual maximum daily rainfall for Hong Kong relative to the average of 1995-2014

under the Intermediate and Very High GHG emissions scenarios considered by IPCC AR6

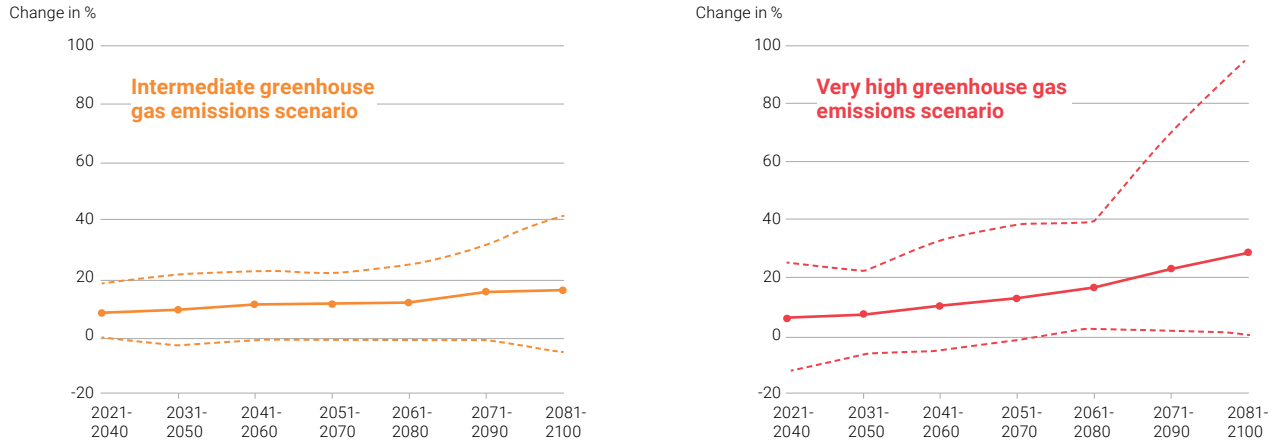
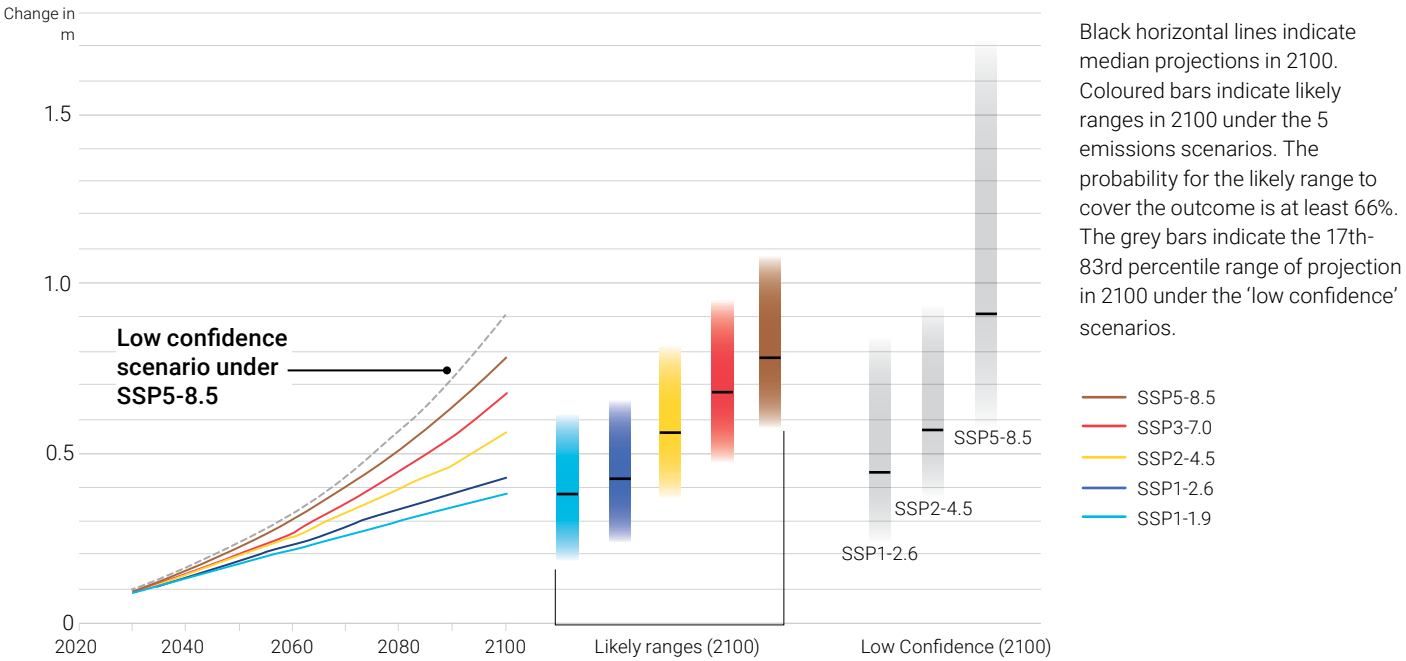


FIGURE 2.14

Projected changes in annual mean sea level for Hong Kong relative to the average of 1995-2014

Coloured solid curves and the grey broken curve show median projections under the five emissions scenarios and the 'low confidence' scenarios respectively considered by IPCC AR6



Black horizontal lines indicate median projections in 2100. Coloured bars indicate likely ranges in 2100 under the 5 emissions scenarios. The probability for the likely range to cover the outcome is at least 66%. The grey bars indicate the 17th-83rd percentile range of projection in 2100 under the 'low confidence' scenarios.

1. Or increase of 3.3°C relative to the average of 1885-1904 (the earliest 20-year period with average instrumental temperature data available at HKO). For comparison, the 2°C target of Paris Agreement is increase in the global temperature by the end of the century relative to the pre-industrial period of 1850-1900.
2. Or increase of 4.9°C relative to the average of 1885-1904. Also see note 1.
3. https://www.hko.gov.hk/en/climate_change/proj_hk_msl_med_conf_info.htm.
4. https://www.hko.gov.hk/en/climate_change/proj_hk_msl_low_conf_info.htm.

CHAPTER 3

Government Panel on Adaptation and Resilience

Complexity, uncertainty, progressive approaches, and innovation

WATCH VIDEO https://care.hkust.edu.hk/Video_Ch3

Government Plenary

Chin Wan TSE, BBS, JP
Secretary for Environment and Ecology, EEB

David LAM, JP
Under Secretary for Development, DEVB

Ir. Ricky Chi Pan WONG, JP
Head of Civil Engineering Office, CEDD

Alice PANG, JP
Director of Drainage Services, DSD

Ir. Dr. Raymond CHEUNG, JP
Head of Geotechnical Engineering Office, CEDD

Dr. Siu Fai LEUNG, JP
Director of Agriculture, Fisheries and Conservation, AFCD

Ir. Kelvin Kwok Wah LO, JP
Director of Water Supplies, WSD

Ir. Ken Chor Kee YEUNG
Chief Building Services Engineer, ArchSD

Ir. Henry Yu Shing CHANG
Chief Building Services Engineer, HD

Moderator:
Prof. Christine LOH, SBS, JP, OBE
Chief Development Strategist, Institute for the Environment, HKUST

The intention of showcasing the HKSAR Government's relevant policies and projects at the start of CARE2022 on Day 1 was to inform the public about the breadth of climate adaptation-related work. The feedback was positive because government Bureaux and Departments with major responsibilities for climate change shared their plans and projects together.

This chapter focuses on what the Bureaux and Departments presented. The intention is not to provide a detailed critique of their work here, as that would require substantial effort beyond the ambit of a post-conference report. Nevertheless, together with Chapters 4 and 5 that summarized the discussions at the two Workshops on Day 1, it is possible to make general observations, such as the Bureaux and Departments are significant users of technology and generators of innovations, and recommendations that would hopefully offer useful reflections for the authorities and the community on where gaps lie and where trade-offs need to be more clearly articulated.

The students and young people attending the Government Panel at CARE2022 showed great interest in the work of the authorities and wanted to know how they could be involved.

Adaptation and resilience policies

Reducing GHGs is no longer enough to stop the impacts of climate change – it is also necessary to start adapting to a warming world. While active mitigation and adaptation are both essential, there are important differences to note:

- The benefits arising from mitigation occur on a global scale, whereas adaptation benefits are essentially local.
- The success of mitigation can be measured by means of calculating GHG reductions but there is no one metric for measuring success in adaptation, thus efforts must be considered against the specific context of location and characteristics.

Role of government

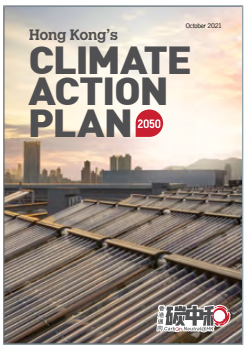
The role of local government is therefore vital in adaptation because extreme weather affect specific communities. Individual actions are seldom sufficient with sea level rise, flooding, and landslides. Governments must act – the benefits to society outweigh the costs in terms of loss of life and damage to assets. Only governments have the capacities, policy tools and financial means to deal with long-term horizons, scale and uncertainties through planning and change of land use or activity, building defensive infrastructure, as well as carrying out restoration works and absorbing losses.

Dealing with climate change requires policies that invariably run up against costs vs. benefits calculations, effectiveness of interventions, and achieving equity across society. As there are many uncertainties in adaptation, it would be wise to design policies with flexibility that could respond to changing conditions over time.

There are long-term fiscal implications for adaptation and the needed public sector investments are large. For Hong Kong, dealing with extreme storms, heavy precipitations, coastal protection and flooding, as well as landslides require continuous research and astute long-term budgeting. Moreover, the built environment will need to be adapted to reduce risks associated with more frequent and extreme weather events, including rising temperatures that will affect community health (see Chapter 5). Government decisions about the location and design of new buildings and physical infrastructures will have long-term consequences. Retrofitting buildings will be a critical adaptation response in a densely built-up environment such as Hong Kong and much of the GBA, as most of the building stock in the region expected to be in use in 2050-2060 have already been built and many are ageing. While retrofitting buildings was not discussed on Day 1, it was an issue brought up by stakeholders in the property development sector on Day 3 (see Chapter 6).

The rapid pace of climate disruptions results in loss of biodiversity and ecosystem services. Government policy is needed to reduce such risks through thoughtful planning alongside biodiversity protection and restoration.

Nexus between mitigation and adaptation

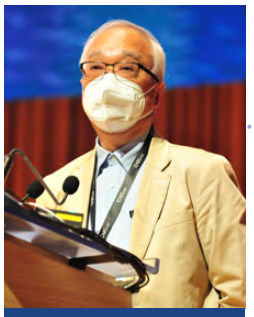


The Secretary for the Environment and Ecology and the Under Secretary for Development, explained the nexus between mitigation and adaptation. The HKSAR Government's climate mitigation timelines and targets are well-publicised in the *Climate Action Plan 2050* and need not be repeated in this report.[1]

The HKSAR Government aims to "converge the diversified expertise" from various departments to enhance the speed, efficiency and effectiveness in planning and implementing adaptation efforts.

The HKSAR Government have major development plans, such as Northern Metropolis Development Strategy, and Kau Yi Chau Artificial Island in Harbour Metropolis, as well as many other plans and projects with climate implications. Current policy already requires departments to integrate sustainability features into them wherever possible, such as renewable energy (for example, Drainage Services Department (DSD) and Water Supplies Department (WSD) both have large solar PV projects), biodiversity, and community enjoyment. This chapter also summarizes the innovation and technology aspects of the government's work in pursuing climate challenges.

"Our target is to achieve carbon neutrality before 2050 … The Chief Executive have … [pulled] all policy secretaries and relevant department heads together to have a whole government approach to tackle the issue and reach the objective."



Chin Wan Tse, EEB

Chin Wan Tse
Secretary, EEB

"Since the promulgation of the IPCC Sixth Assessment Report in 2021, [we have] promptly assessed the climate change projection parameters for Hong Kong and then updated the relevant design manuals for port works and storm water facilities to reflect the latest projection of sea level rise, extreme wind increase, and spearheaded departments for planning for more resilient government infrastructure. We will continue the initiatives like the blue-green coastline, flood attenuation measures, coastal enhancement and landslip preventive measures.""

David Lam, DEVB

David Lam
Under Secretary,
DEVB

FIGURE 3.1

Converging expertise of government departments for adaptation

CEDD's coordination role

In 2016, the government established the Climate Change Working Group on Infrastructure (CCWGI) led by CEDD to coordinate the efforts of the works departments and HKO in adapting to climate change. The CCWGI reports its work plans and progress to the Steering Committee on Climate Change and Carbon Neutrality[2] chaired by the Chief Executive. The CCWGI has been updating the relevant standards for design of infrastructure in tandem with the release of IPCC AR6 since August 2021.[3] It coordinates the efforts of the relevant departments to strengthen the government critical infrastructure. It has also been carrying out studies to

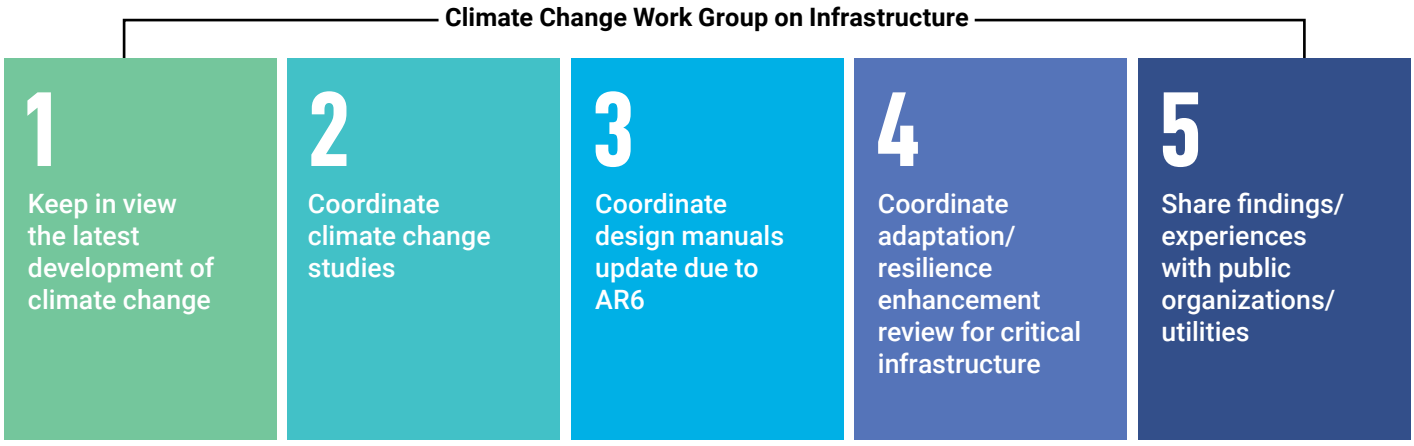
"CEDD emphasises both climate mitigation and adaptation in taking forward our projects. CEDD will continue to … work in concerted effort with other departments to make our infrastructure more climate resilient."

Ricky Wong, CEDD

Ricky Wong
Head of Civil Engineering
Office, CEDD

FIGURE 3.2
Seven categories of government critical infrastructure

FIGURE 3.3
Work of CCWGI



assess and deal with the climate change on infrastructure. The CCWGI shares its experience and findings with public organizations and utility service providers, thereby enhancing the non-government infrastructure's resilience.

Sea level rise and Hong Kong

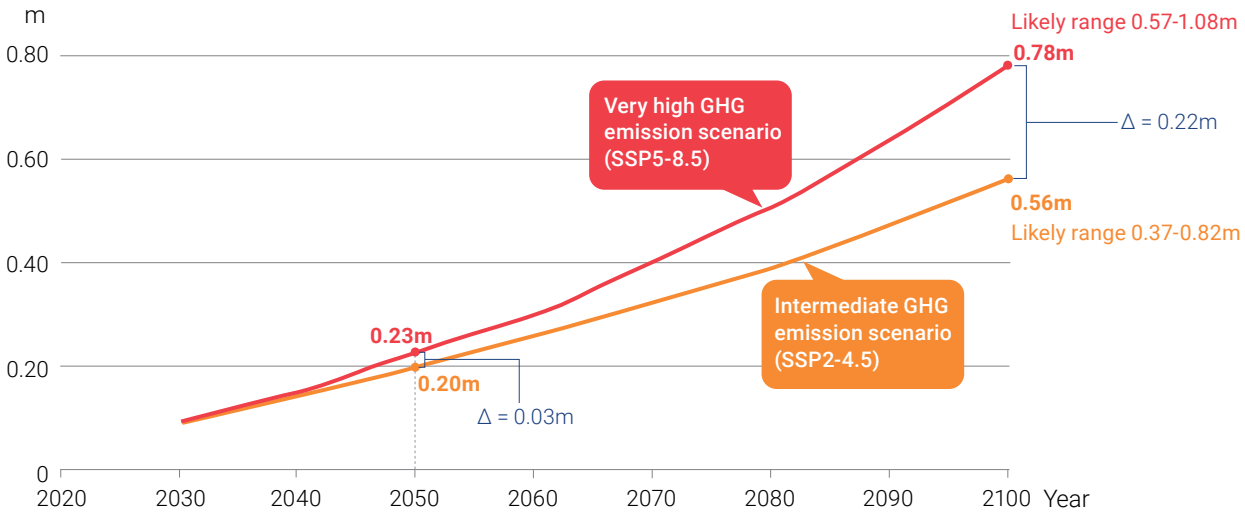
Sea level rise is an inevitable consequence of a warming world. There are many uncertainties to reflect upon for decision-making. The issue is the timing and extent of sea level rise over the coming decades (up to 2050) and further out in this century (up to 2100) so that it could consider what types of adaptive measures would be needed in which locations, when and how to construct them, and the cost implications.

HKO based its sea level rise projections on the range of GHG emissions scenarios as per IPCC AR6. In summary, there is greater certainties near-term than longer-term. IPCC AR6 and local studies show that there are insignificant differences in sea level rise projections going out to 2050 under the intermediate and very high emissions scenarios. However, the

FIGURE 3.4

Sea level rise projections 2030-2050 and beyond

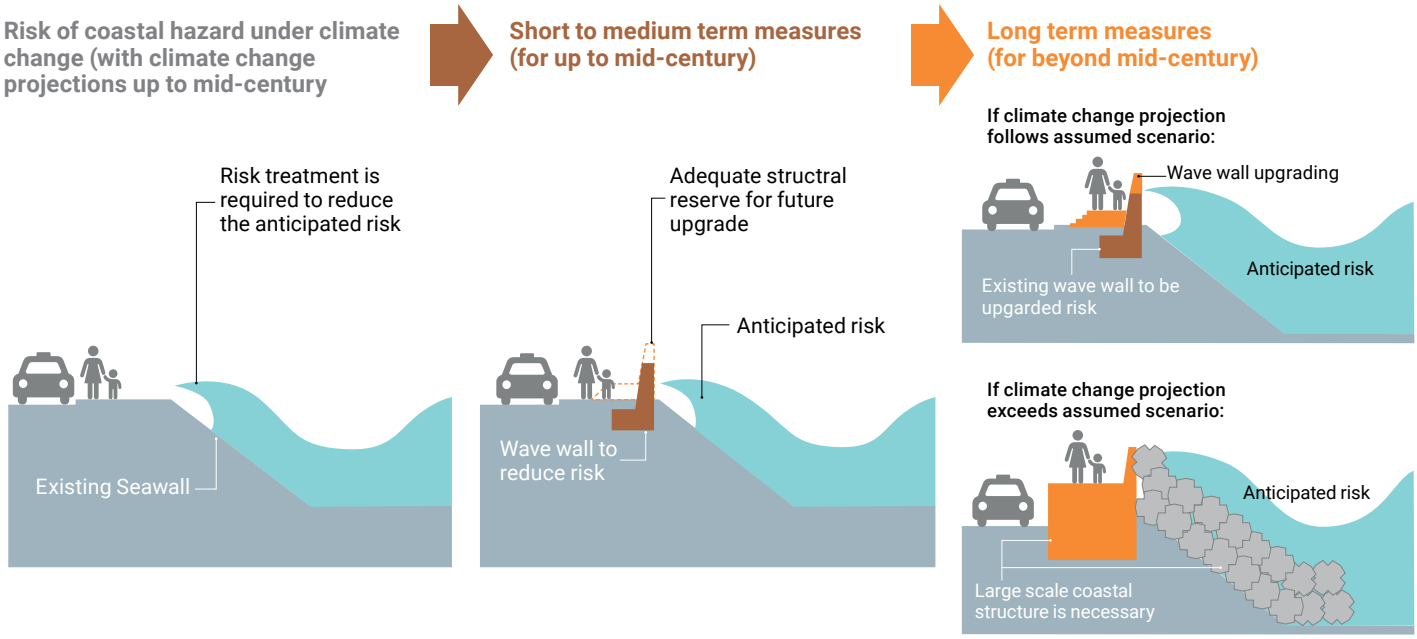
relative to the average of 1995-2014



Reference: The Sixth Assessment Report of the Intergovernmental Panel on Climate Change

FIGURE 3.5

Progressive adaptive approach



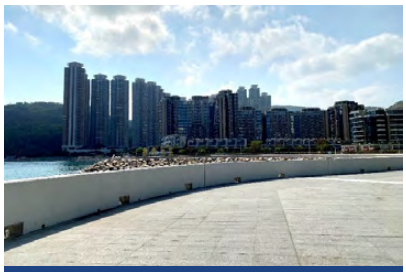
difference becomes increasing large towards the end of this century (by 2100), demonstrating the increasing uncertainties further out in time. This is the same challenge faced by other jurisdictions.

While there is consensus in using IPCC AR6 as the base for projections, government engineers must decide when to build what types of coastal protection infrastructure to defend against sea level rise. CEDD uses IPCC AR6's intermediate emissions scenarios that goes out to mid-century as the starting point to consider near-term infrastructure needs (up until 2050) because the science is more certain (see Figure 3.4). As such, CEDD's current thinking is that, for enhancement of existing structures, measures like wave walls with adequate reserve for future upgrade would be sufficient for Hong Kong in the near-to-medium term (i.e. up to mid-century). Nevertheless, for the design of new structures considering their end-of-design life need beyond mid-century (i.e., final design for end-century), CEDD would include "design allowance" to cater for possible higher emissions scenarios further out in time under the "progressive adaptive approach" in planning coastal infrastructures. In other words, for new coastal infrastructure, CEDD would take into account the design allowance needed for climate change effect end-century. For new infrastructure, the infrastructure design could either adopt the design allowance in one-go or in stages. This approach has the advantage of reducing capital, maintenance, and operating costs in the near-term but has the design flexibility to enable additional infrastructure works that could deal with a higher risk in the future (see debate in Workshop A below).

CEDD also showed different types of adaptation measures that could be used along coastlines, including wave walls and flood barriers, and demountable flood barriers at the frontages of buildings as the last line of defence.

FIGURE 3.6

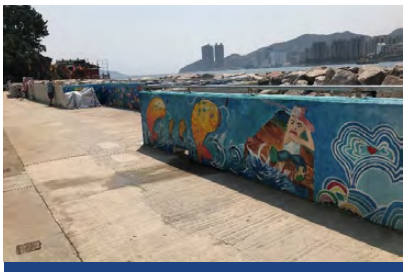
Types of adaptation measures



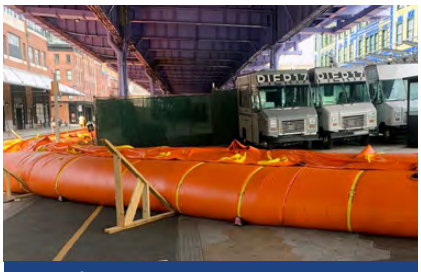
Tseung Kwan O Waterfront Park

Flood Wall

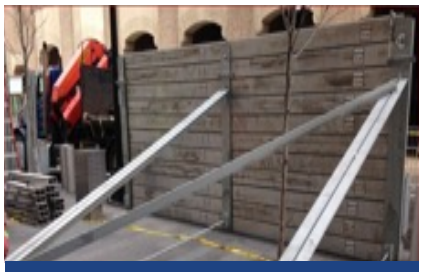
Demountable Flood Barrier



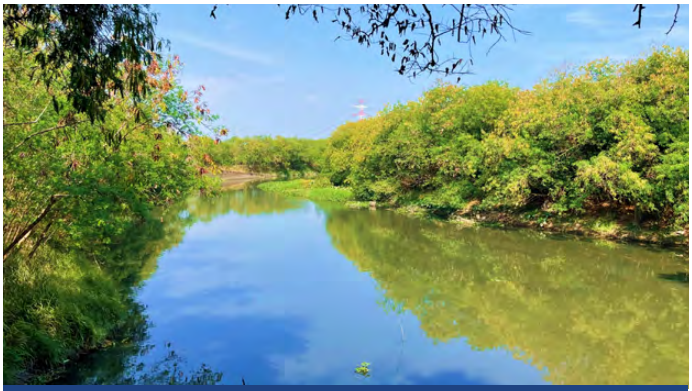
Ma Wan Tsuen, Lei Yue Mun



Water-filled Tube Barrier



Demountable Flood Barrier



Yuen Long Bypass Floodway

Dealing with excess precipitation and drainage

DSD is concerned about climate change's impact on the drainage system, as one of Hong Kong's major climate adaptation challenges is dealing with heavy precipitation during storms and super-typhoons that could cause flooding. Over the past several decades, Hong Kong had invested in and successfully implemented many flood-prevention measures, such as stormwater interception, river training, flood storage and drainage improvements and eliminating flood-prone blackspots.

DSD had already transformed its approach to incorporating multiple green and ecological features to beautify the living environment and reduce heat island effect that could be seen from many popular river training projects, such as Ng Tung River, Ho Chung River, and Yuen Long Bypass Floodway, and river revitalisations of Jordan Valley Channel and Tsui Ping River. Community facilities can also be provided for public enjoyment under DSD's *River in the City* initiative.

DSD is evolving its design philosophy for adaptation and resilience further to combat climate challenge, such as applying *blue-green infrastructure* (resembling sponge city concept that helps to absorb/store/reuse water), as well as the "land co-use concept" to locate stormwater storage tanks under planned facilities, such as playgrounds and sports grounds.[4]

The new design philosophy requires embedding the desired outcomes during the early land use planning stage. Successful land co-use examples include the Tai Hang Tung Recreation Ground and the Happy Valley Recreation Ground that enable stormwater storage. New projects include the Shek Kip Mei Stormwater Storage Scheme with an open tank design that integrates with the local park, which will allow community and recreational activities during dry days. Another significant new concept is creating "floodable areas" that serve as temporary water retention basins during heavy rain but could revert to its normal recreational use (such as basketball courts or a lake in a park) during dry days. DSD together with CEDD is creating such a flood lake under the Anderson Road Quarry Development.

Flood lake under the Anderson Road Quarry Development

"Besides straightforward infrastructure for flood alleviation, we need to be people-oriented, ecology-directed and smart-driven so as to push forward sustainable development and build a liveable city ... this design has to be embedded in the early land planning stage."

Alice Pang, DSD

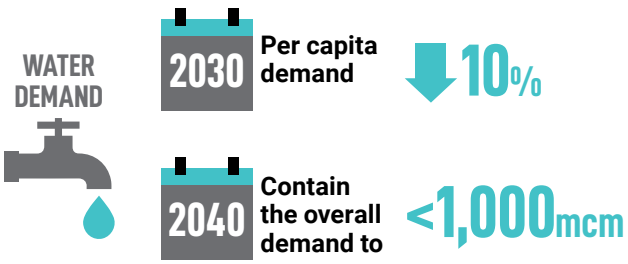
Alice Pang
Director, DSD

Clean water supplies and water saving

WSD is responsible for providing Hong Kong with water at 99% reliability. One of WSD's responsibilities is to encourage water saving because water is a scarce resource, and water and energy usages are intimately tied because energy is needed to pump water. Saving water means saving energy too.

Figure 3.7 shows Hong Kong imports nearly 60% of its total water supply from the mainland. Climate change will impact not only Hong Kong's local yield but also the yield in Pearl River Delta Basin. WSD's Total Water Management Strategy addresses both demand and supply issues.[5]

WSD's demand management measures promote water conservation and water loss management. The demand-side KPIs are to:



(current demand is 1,055 mcm per year)

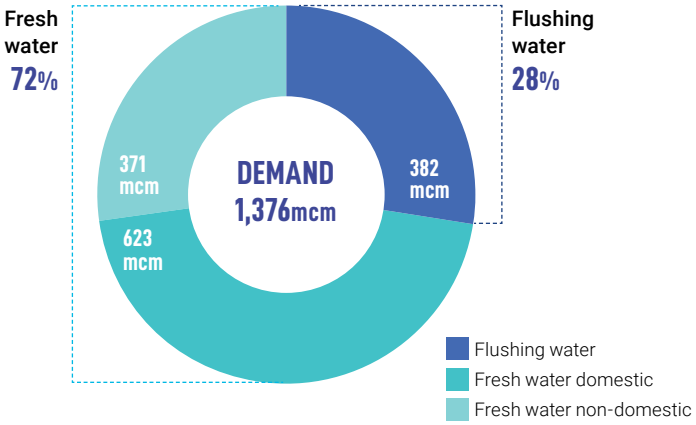
Achieving these KPIs would also reduce energy consumption by 60 gigawatt-hour a year. Other than public education to promote saving water, other means include implementing effective network management with establishment of the Water Intelligent Network to reduce water loss, charging water loss on private mains, launching smart metering system, and mandating the Water Efficiency Labelling Scheme for water using apparatus.

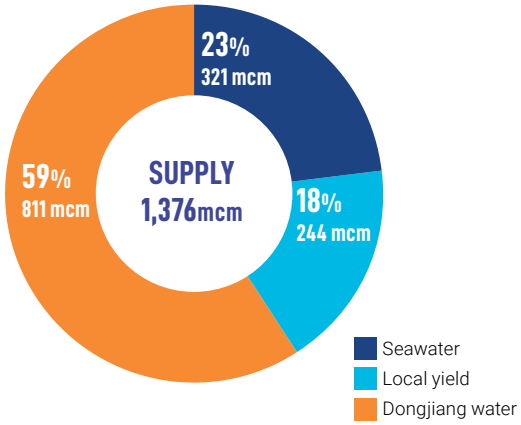
On the supply side, the key is diversifying water sources to ensure greater water security because of rising water demand in the GBA and climate change impact that could lead to drought, such as the drought in 2021 in Guangdong. WSD's Inter-Reservoirs Transfer Scheme can provide extra local yield of about 3 mcm per year, and there are other measures that could expand water gathering grounds to increase local yield too.

There are possibilities to extend the non-potable uses of lower grade water, including seawater and recycled water. The benefit of recycled water is that it is not affected by climate change, and it could be applied in new development and large re-development areas. WSD and DSD are cooperating for higher

FIGURE 37

Overview of water demand and supply in Hong Kong (2021)





"WSD has embedded climate adaptation into our planning and strategy of securing water sustainability. We look forward to collaborating with every concerned stakeholder and the public to build a sustainable future for our next generations."

Kelvin Lo
Director, WSD

Kelvin Lo, WSD

efficiency in water recycling, and recycled water could also be used for non-domestic purposes.

Despite its energy intensiveness, desalinated water is a potable water resource and desalination is a major endeavour of WSD. The first stage of Tseung Kwan O Desalination Plant will be commissioned in 2023 to produce potable water of 50 mcm per year; and the second stage could double the production.

Managing slopes and preventing landslides

Hong Kong has been particularly successful in managing slopes to prevent landslides since the 1970s. Its slope safety system is highly regarded around the world. However, climate change is increasing extreme rainfall events that pose new landslide risks to the hilly conditions of Hong Kong. An example of an extreme weather event was on 7 June 2008 when very heavy downpours occurred that led to 3,000 landslides, with 2,500 of them on Lantau Island where the rains were the heaviest. A notable landslide also occurred on 8 June 2022 in Sai Kung that resulted in the closure of Pak Tam Road for 7 days affecting more than 400 villagers, and where emergency ferry services had to be arranged. Going forward, the Geotechnical Engineering Office (GEO) of CEDD is strengthening preparedness to "expect the unexpected".[6]

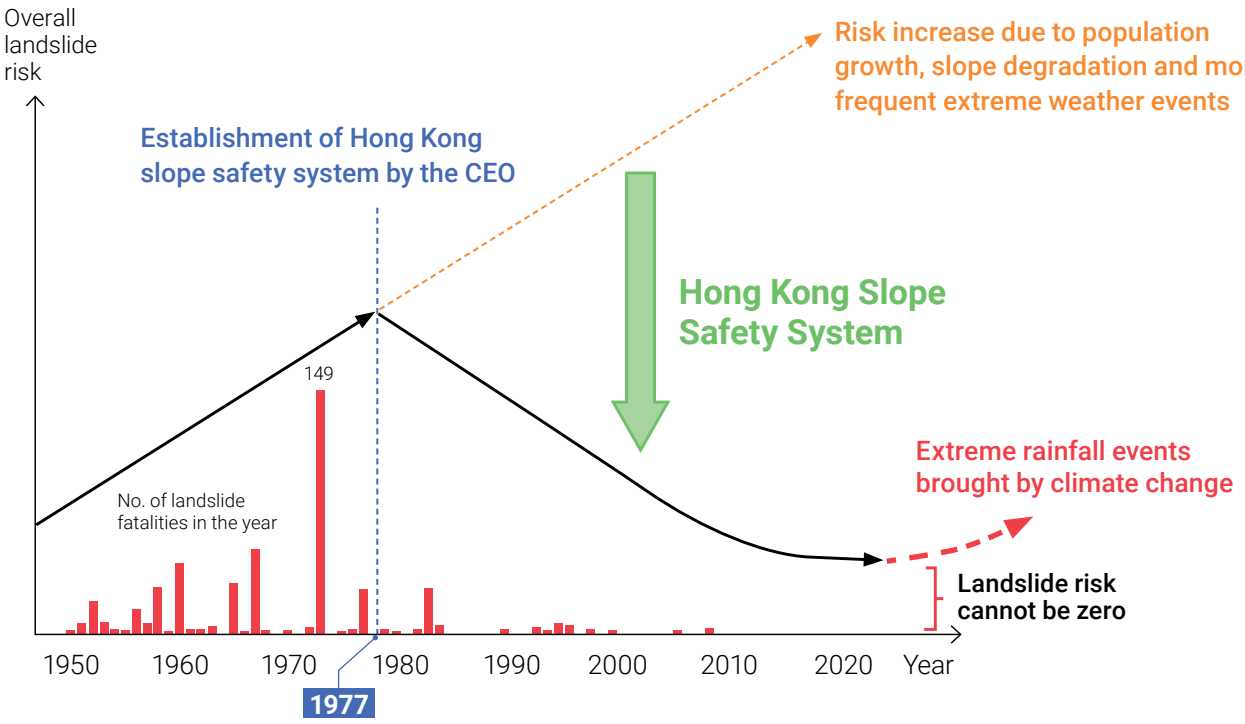
To prepare for the unexpected scenarios, GEO continues to strengthen Hong Kong's slopes through various means, such as robust slope stabilization measures like soil nails, enhanced drainage provisions, and an underground drainage tunnel at Po Shan with adverse site settings and innovative natural terrain landslide risk mitigation measures. Furthermore, GEO continues to work with academia, research institutions and industry practitioners to advance knowledge and practice

"Landslide risk in Hong Kong cannot be zero. We need to strengthen our preparedness to "expect the unexpected" scenarios"

Raymond Cheung, CEDD

Raymond Cheung
Head of Geotechnical Engineering Office, CEDD

FIGURE 3.8
Landslide risk in Hong Kong



on geotechnical engineering, as could be seen from the visuals below. Over the years, GEO has taken the surrounding environment into account so that the engineering works look as natural as possible and through using bio-engineering techniques, landslide scars are restored contributing to safety, sustainability, and aesthetics.

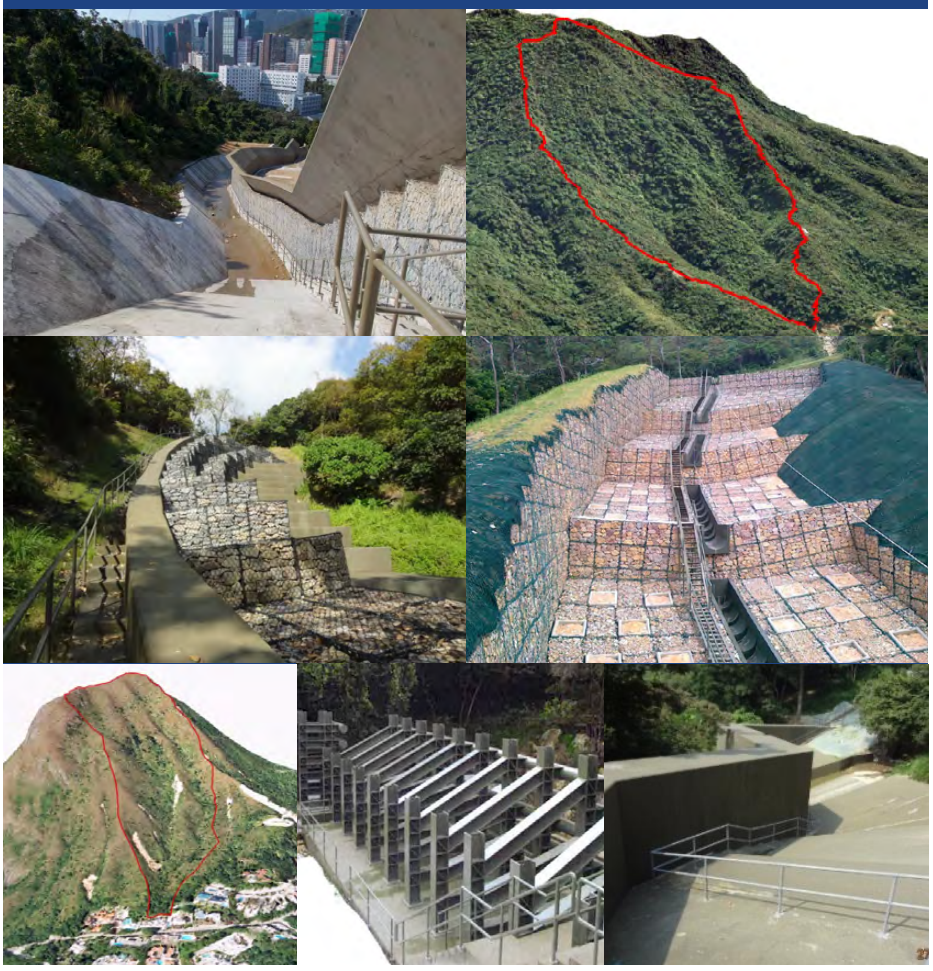
Beyond hardware, developing a sophisticated rainfall-based early warning system is also critical so that the government can be prepared for emergency response capacity, as well as to improve community resilience through public education (see Chapter 5).

Strengthen our slopes for the expect-the-unexpected scenarios

Soil nailing

Enhanced drainage

Innovative Natural Terrain Landslide Risk Mitigation Measures



Safe, sustainable, liveable city

Biodiversity and ecosystems

Good management of natural assets helps to sequester and store carbon that contribute to climate mitigation. Protecting and restoring ecosystems can help to reduce the extent of climate change and cope with its impact. Agriculture, Fisheries and Conservation Department (AFCD) under Environment and Ecology Bureau (EEB) formulates and implements plans for the conservation, management, and sustainable development of Hong Kong's natural resources with a view to enhancing the capacity for climate mitigation and adaptation.

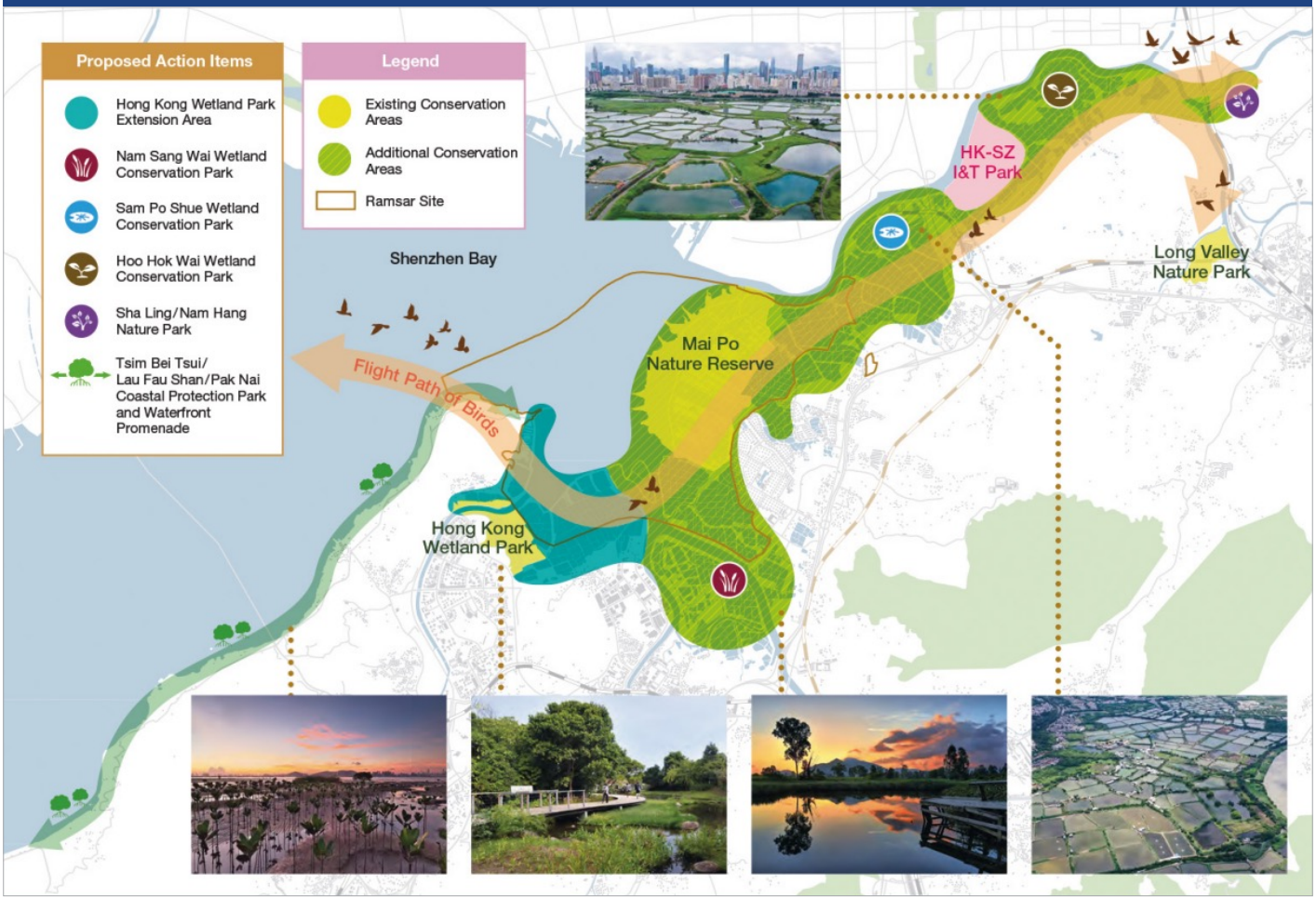
AFCD currently manages 24 country parks, 22 special areas and 8 marine parks/reserves that cover over 40% of land area and about 4% of sea area of Hong Kong, and new areas are being added (Robin's Nest Country Park and North Lantau Marine Park). There are on-going afforestation and plantation enrichment programs, and AFCD plays an important role in hill fire prevention. Coastal ecosystems are important to adaptation for flood prevention and coastal protection.

"...AFCD will continue to collaborate with other government Bureaux and Departments, academics, professional associations and industry practitioners, to conserve our precious natural resources and habitats, and to promote the sustainable development of our agriculture and fisheries, with a view to enhancing our capability to combat climate change."

Siu Fai Leung, AFCD

Siu Fai Leung
Director, AFCD

Wetland Conservation Parks System under NMDS



Hong Kong is well-known for its wetlands in Mai Po and Inner Deep Bay, which is listed as Wetlands of International Importance under the Ramsar Convention.[7] In October 2021, the HKSAR Government proposed to establish a Wetland Conservation Parks System (WCPS) of some 2,000 ha to create environmental capacity and to achieve "Co-existence of Development and Conservation". This concept is part of the Northern Metropolis Development Strategy and is envisaged to contribute to adaptation through flood prevention and coastal protection.

Another significant aspect of AFCD's work was the government's adoption of a new agricultural policy that included developing an Agri-Park, designating Agricultural Priority Areas, and promoting hydroponic technology and urban farming to enhance the resilience and stability of the food supply systems in light of climate change. Additional measures include:

- **Agriculture:** assisting farmers to increasing productivity and reducing carbon footprint, such as selecting crop varieties which are more adaptive or tolerant to climate change and help farmers to set up greenhouses and rain shelters to protect their crops from extreme weather conditions.

- **Fisheries:** designating new Fish Culture Zones, using WCPS for sustainable aquaculture production, developing storm-resistant deep-sea mariculture system, as well as using technologies to increase fisheries production and enhance resilience against extreme weather conditions.

Siu Sai Wan Sports Ground

Public sector architectural designs and buildings

Ken Yeung, ArchSD

Architectural Services Department (ArchSD) is the HKSAR Government's architect. It sets itself out to achieve high environmental standards that illustrates the nexus between mitigation and adaptation. It chooses green construction materials and methods as far as possible, and it designs in features that save energy and water. Many government buildings receive high rating under the local green building environmental assessment scheme, BEAM Plus. This section will not go into details about the many climate mitigating outcomes of public buildings, but it is important to highlight those aspects relating to adaptation and resilience. ArchSD operates under three core strategic directions (3As):

- **Accurate:** It conducts performance-based analysis, such as wind, daylight and solar analyses, to shape architectural designs to optimize energy saving and minimise impacts of buildings on surrounding microclimates.

- **Accommodate:** It builds capacity to strengthen the design of public facilities and government buildings to protect the life, health, and property from extreme weather, including integrating sponge city concepts and nature-based solutions into its project design. An example is the construction of a new wave breaking boundary wall and the alternation of existing boundary wall at the Siu Sai Wan Sports Ground to prevent damage caused by flooding while also enhancing infrastructure preparedness for future extreme weather conditions. The sports ground suffered extensive damage during typhoon Mangkhut in 2018.

- **Agile:** It adopts best practices and cutting-edge technologies in projects to groom government architects to deal with climate challenges. The Design for Resilience Working Group has been set-up to (i) acquire new climate related and sustainable building knowledge from global practices; (ii) identify appropriate projects to carry out field trials; and (iii) develop best practices and design guides against adverse weather and other problems, such as epidemics, vandalism, etc.

On Tai Estate, completed in 2018, was designed and constructed with various sustainability and inclusivity features https://youtu.be/_SyN1U3GNzY

Henry Chang, HD

Housing Bureau is responsible for formulating housing policies, while Housing Authority builds and provide public housing with the Housing Department being its executive arm. As far as climate change is concerned, Housing Authority-Housing Department's (HA-HD) policy is "to proactively echo government policy on carbon neutrality," and continue to review and enhance its climate adaptive public housing design, in green construction and energy management. HA-HD is the pioneer in Hong Kong to adopt large-scale precast concrete components in the construction of public housing which reduce significant amount of construction waste; and is actively exploring innovative high productivity construction technology such as Modular Integrated Construction (MiC) as a means to reduce environmental footprints. While the design of public housing takes a no-frills approach to keep cost down, HA-HD has been successful in designing in green buildings features that achieve high BEAM Plus rating.

Climate-related innovation and technology

An observation is that government departments are major users of innovation and technologies (I&T) to solve problems, and their efforts have led to many innovations that could be inspiring if showcased with the appropriate narratives.

To start with, HKO is the HKSAR Government's climate science authority. HKO has a strong national and international reputation, and its officers are meteorological experts with a deep focus on climate science. Other government departments consult and rely on HKO for climate projections to guide them on their plans and projects. HKO uses data science and works with university experts across a whole range of relevant disciplines that are impressive and forward-looking.

Each of the departments noted in this chapter are major users of IoT and Big Data, and they also innovate to solve problems together. The Inter-departmental Multi-faceted Common Operation Platform, established by GEO, is impressive and essential for good governance in the era of climate change.

Other notable use of I&T include:

- **DSD:** The use of "smart" water gate to regulate the water level in Tsui Ping River; and the Yuen Long Barrage Scheme will be the first flood control barrage in Hong Kong with a mega-sized pumping station. The operation will be optimized based on real time tidal and rainfall and the short-range weather nowcasting system.

- **WSD:** Its Water Intelligent Network will be completed by 2024 after many years of progressive implementation. It will identify anomalies with IoTs so water losses could be identified and fixed. WSD is also developing digital twins of water treatment works and water supply networks to improve many areas of operation.

- **GEO:** It is conducting cutting-edge research that has led to implementing a smart barrier system, using satellite images to enhance overall situational awareness of large-scale landslides events and deploying automation and robots in slope management, as well as working with top local, national and international research experts to solve extreme climate risks.

- **ArchSD and HD:** They apply many green buildings designs with the help of I&T, and they represent leading users of such technologies in Hong Kong that has strong demonstration uses for the private sector.

Application of automation and robotics

Pilot study on the application of advanced quadruped robots in carrying out inspections and data collection where the environment is potentially dangerous

Collaboration with the Centre for Slope Safety on various landslide-related research projects

1. Climate Change Action Plan 2050 (October 2021), see https://www.climateready.gov.hk/files/pdf/CAP2050_booklet_en.pdf.
2. The Steering Committee on Climate Change was set up in 2016 and chaired by the Chief Secretary. It became the Steering Committee on Climate Change and Carbon Neutrality in mid-2021 and is chaired by the Chief Executive.
3. The CCWGI coordinates to update infrastructure guidelines from August 2021. Updates of CEDD Port Works Design Manual and DSD Stormwater Drainage Manual were released in August 2022. The review and update of other infrastructure design guidelines and manuals would follow.
4. See https://www.dsd.gov.hk/EN/Publicity_and_Publications/Publicity/DSD_Sustainability_Reports/19/blue-green-infrastructure.html.
5. See WSD's Total Water Management Strategy, https://www.wsd.gov.hk/en/core-businesses/total-water-management-strategy/index.html.
6. See GEO's website, https://www.cedd.gov.hk/eng/about-us/achievements/geotechnical/safety-system/index.html.
7. Hong Kong has a total of 6,000 ha of wetlands, of which 1,500 ha are listed under the Ramsar Convention due to its importance as a wintering site for waterbirds during their migration.

OBSERVATIONS

1. Hong Kong's public sector has strong climate science and engineering skills and experience because it has had to deal with the city's extreme conditions, such as its hilly topography and subtropical climate. Its techniques and management methods are important because they represent a large body of tested solutions.

2. The public seldom see or hear about government work in an integrated, cross-disciplinary manner. The extent of government work is impressive and interesting, which can help to generate public buy-in if properly narrated and presented.

3. Seeing and hearing government work across Bureaux and Departments enables the identification of gaps and trade-offs that need further articulation and deliberation.

4. The government is a major investor in climate and sustainability related I&T that could be properly narrated and presented for both mitigation and adaptation.

5. Young people are clearly interested in climate and sustainability. They expressed an interest to be involved, which presents opportunities for the HKSAR Government to respond.

RECOMMENDATIONS

A. Hong Kong's government leaders tend to focus on branding local economic prowess from the perspective of financial services, tourism, trading and logistics, and professional and producer services. Hong Kong's capabilities in climate solutions can be developed into a new narrative of economic, professional, finance and I&T strengths to suit the current era.

B. The **Steering Committee on Climate Change and Carbon Neutrality** chaired by the Chief Executive is the right place for Bureaux and Departments to present their work periodically in an integrated-interdisciplinary manner so that the Chief Executive could have a thorough understanding of the work being done, and for the Financial Secretary to see how funding allocations have been spent. This committee is the right platform for the HKSAR Government to mainstream climate as a major cross-cutting topic within the bureaucracy.
By mainstreaming with such a setting, it should also stimulate all Bureaux to consider how they could use Hong Kong's climate capabilities and solutions to promote the city, such as:

   - **Financial Services and Treasury Bureau** furthering its efforts in cooperating with Hong Kong's scientific and engineering experts to project climate risks that could assist the financial sector in their assessment of climate risks in financial terms on an on-going basis (see Chapters 4 and 6 for further elaboration).
   - **Commerce and Economic Bureau** using climate and sustainability I&T solutions as part of its Belt & Road promotion.
   - **Constitutional and Mainland Affairs Bureau** sharing Hong Kong's climate efforts and capabilities with the regional and national governments since climate change is a top policy agenda.
   - **Innovation, Technology and Industry Bureau** including Green-ClimateTech and innovation within its scope of work. I&T are enablers for more desired outcomes – and the climate/sustainability transition is a major global desired outcome. The government itself is spending considerable sums to develop and use such technologies, some of which are co-developed with local R&D capabilities (see Chapter 6 which goes further with the integration of Green-Climate-Prop-FinTech). Those efforts are expanding and deepening local capacities that could have resonance beyond Hong Kong if properly supported and promoted.

C. Climate and sustainability have become a welcomed and sought-after topic at schools and universities. Many Bureaux and Departments can reconsider how they can integrate climate and sustainability into their outreach, in particular **Home Affairs and Youth Bureau**, to engage youth.

CHAPTER 4

Nexus between Mitigation and Adaptation

WATCH VIDEO https://care.hkust.edu.hk/Video_Ch4

Workshop A

Kim Wai NG
Chief Town Planner, PlanD

Prof. Charles NG
CLP Holdings Professor of Sustainability, Department of Civil and Environmental Engineering, HKUST

Debra TAN
Director & Head, CWR

Dr. Michael LAU
Founding Member, Hong Kong Wetlands Conservation Association

Gillian MELLER
Legal and Governance Director, MTR Corporation Limited

Ir. Don CHENG
General Manager, Commercial & Industrial Marketing & Sales, The Hong Kong and China Gas Company Limited

Albert WONG
CEO, Hong Kong Science and Technology Park

Eli KONVITZ
Chair of the Programming and Events Committee, Urban Land Institute

Eric HUI and Cindy PAU
Data Working Group Co-chair, Centre for Green and Sustainable Finance of the Green and Sustainable Finance Cross-Agency Steering Group

Kelvin AU
GM & Head of Wholesale Banking Division, The Bank of East Asia, Limited

Moderator:
Prof. Christine LOH, SBS, JP, OBE
Chief Development Strategist, Institute for the Environment, HKUST

WORKSHOP A

Urban Planning, Infrastructure, Biodiversity, Climate Risks and Finance

The purpose of Workshop A on Day 1 of CARE2022 was to enable wide-ranging discussions with stakeholders about the nexus between mitigation and adaptation.

The presentations made by Planning Department (PlanD) and by others in the academic and private sectors covered a range of related topics that included two major climate-related physical risks (landslides and sea level rise), role of biodiversity, provision of energy and mobility, contribution from I&T and financing the green transition.

While time did not permit extensive discussions, several issues did emerge that would benefit from further exploration – these included:

- Land use planning in Hong Kong.
- Built environment and nature conservation.
- Landslide prevention and sea level rise.
- Nurturing Green I&T.
- Filling knowledge gaps in climate risk assessments in finance.

- Designing and hosting cross-cutting deliberations that can handle complexity, especially about gaps and trade-offs.

Government planning perspective

PlanD summarized the HKSAR Government's long-term conceptual spatial framework formulated under the Hong Kong 2030+ : Towards a Hong Kong Planning Vision and Strategy Transcending 2030 alongside the goals and timelines set out in Hong Kong's *Climate Action Plan 2050*. The framework mainly covers radiates two metropolises and two development axes on the eastern and western sides of Hong Kong (Figure 4.1).[1]

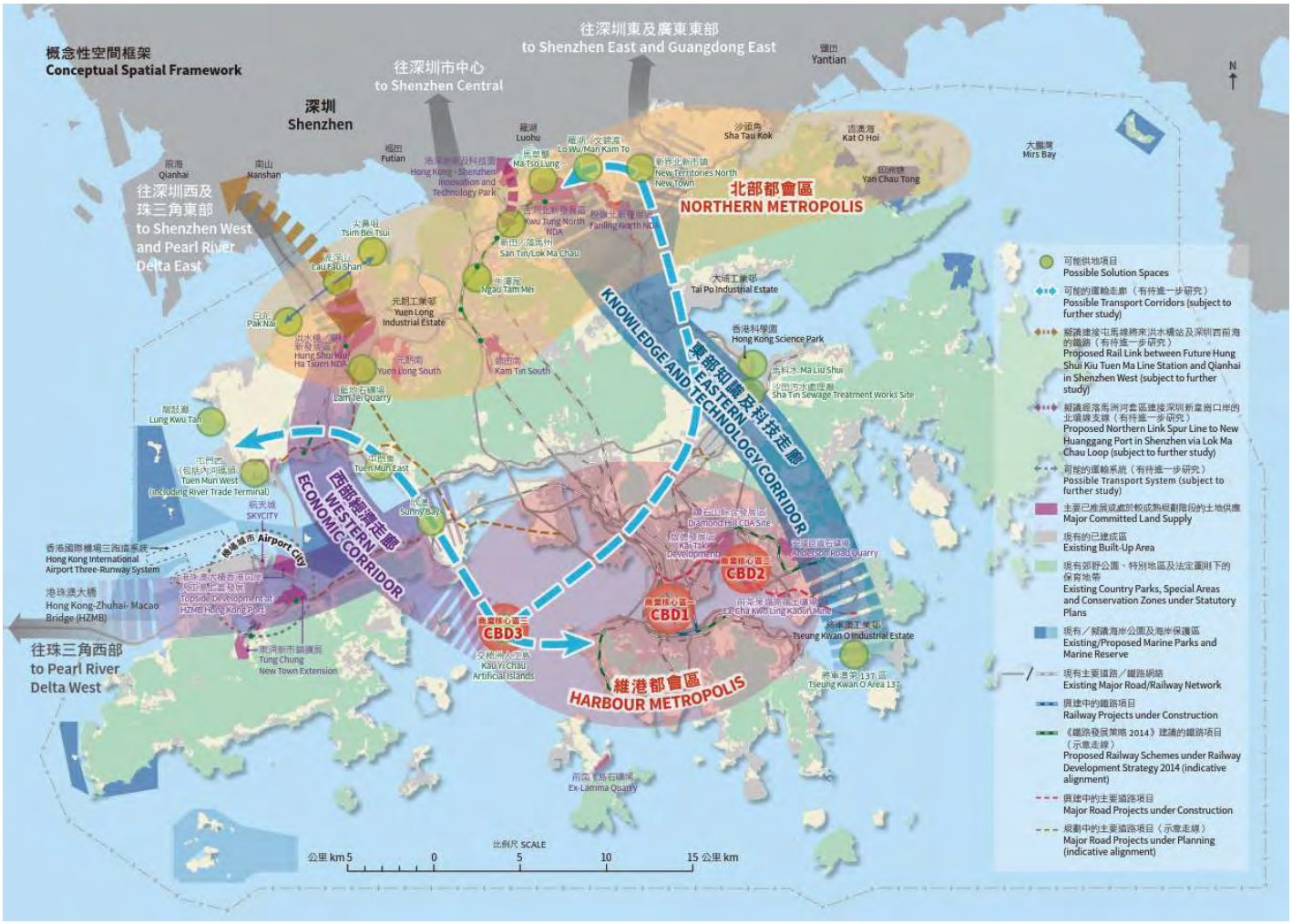
Kim Wai Ng, PlanD

The framework and relevant development plans are well-publicised and need not be discussed here, except to note that the overall planning vision is for Hong Kong to be a *"liveable, competitive, and sustainable Asia's world city"* that *"champions sustainable development"* through *"enhancing liveability in a compact high density city, embracing new economic opportunities and challenges, and creating capacity for sustainable growth"*.

Climate transition - transport, energy, green-tech, and banking

Rail is the backbone of Hong Kong's transport system. As the HKSAR Government continues with various large scale development projects, the rail operator (MTR Corporation) works closely with the authorities on the expansion of the rail network. MTR Corporation has a corporate carbon reduction roadmap that aligns with the Paris Agreement,[2] and it will work with its supply chain (many of which are SMEs)

FIGURE 4.1
PlanD's conceptual spatial framework



to decarbonize. It is working with the academic sector to develop and introduce more novel low-carbon technologies to accelerate the transition. It highlighted the importance of government taking the lead to:

- Issue detailed actions/legislation to achieve the *Climate Action Plan 2050*.
- Explore regional cooperation to import clean energy from the mainland, and work with power companies to improve fuel mix and provide cleaner energy.
- Develop policy and infrastructure to support the use of low-carbon or zero-carbon fuels, such as hydrogen.
- Provide funding and technological support for companies, especially SMEs, to decarbonize.
- Drive behavioural change in the community to adopt a low-carbon lifestyle.

Likewise, the provider of gas-based energy in Hong Kong (Towngas) also has climate goals, and it has similar views to the MTR Corporation about the role of government. It is developing hydrogen for transport, which needs policy support, that could power rail, buses, trucks and vessels.[3]

Potential Hydrogen Applications in Hong Kong

Bus

Train

Heavy vehicle

Marine

Combined heat & power / electric generation

The corporate sector is keen for the government to define clearer policies and regulations for the climate transition between now and 2050, as well as to work with the finance sector as they need bank loans; and listed companies have international investors, who are increasingly demanding greener performance. A local bank (The Bank of East Asia, Limited) provided perspectives and a suggestion to the authorities.

"Banks are keen to work with their clients to achieve Scope 3 net zero since financed emissions (i.e. emissions attributed to activities financed by a bank) can be 99% of a bank's Scope 3 emissions. While many listed companies and big firms have begun work on carbon reduction, most SMEs do not have the knowledge and tools to assess where they are in terms of their carbon footprint and what they can do. To address this gap, the government could step up efforts to help SMEs. Like the Occupational Safety and Health Council, which was established in 1988 to promote knowledge and provide advisory service to companies in Hong Kong, the government could set up an agency to support ESG development and the transition to net zero."

Kelvin Au, BEA

Kelvin Au

GM and Head of Wholesale Banking, The Bank of East Asia, Limited

As already noted in Chapter 3, the public and private sectors are investing in research and using technology to drive innovation. As "green" must be measurable, this has to be done using data and digital technologies. Hence public sector R&D institutions, such as the Hong Kong Science and Technology Park (HKSTP), play an important role in nurturing innovators in green-tech.

"Reversing the trend of carbon is key … encouraging more of these technologies … there could be crazy ideas … you can work in laboratories but how you make it commercially viable [makes the difference]."

Albert Wong, HKSTP

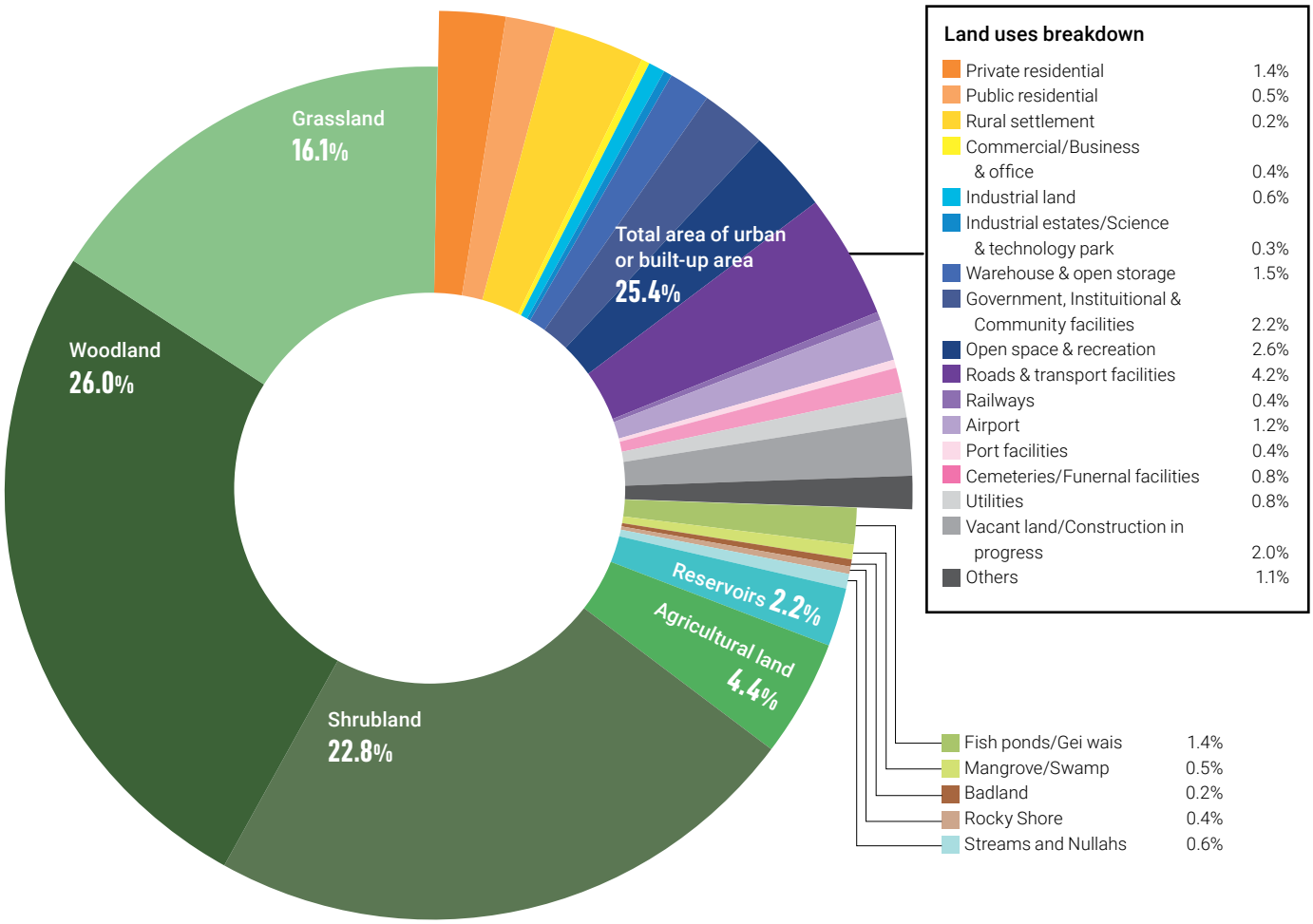
Albert Wong
CEO, HKSTP

Land use in Hong Kong

Urban-built-up land occupies 25.4% of the city's total area. PlanD's data (Figure 4.2) stimulated questions about how to enhance liveability and climate-friendly sustainable development in Hong Kong to fulfil the HKSAR Government's vision and strategies noted above. While many observations could be made, two questions were raised at Workshop A:

- What led to the high percentage of land used for roads and transport facilities and what might that signify? The highest percentage is for roads and transport facilities at 4.2%, exceeding that for private and public residential uses at 3.9%.

FIGURE 4.2
PlanD's total area of urban or built-up land in Hong Kong[4]



- What ecosystems services are serving Hong Kong in light of the large percentage of land with natural assets, such as woodland, shrubland, grassland, mangroves, swamps, fish and shrimp ponds etc (>66%) and how could they be enhanced through restoration?

"The challenge is to consider how interventions can work together to improve the current development paradigm and differentiate the urban design of Hong Kong such that it tackles our specific mitigation and adaptation problems, and provides a better living experience with resilient placemaking that works in concert with the land we have."

Eli Konvitz, Urban Land Institute

Eli Konvitz

Chair of the Programming and Events Committee, Urban Land Institute

Landslide risk in Hong Kong

Workshop A noted landslides and debris flows caused more than 10 million casualties and US$80 billion in financial loss around the world between 1970 and 2022.[5]

Slope safety is a major concern in Hong Kong considering the city's hilly topography. Presentations by HKO (Chapter 2) and GEO/CEDD (Chapter 3) provided the backdrop to landslide risk in Hong Kong. The Centre for Slope Safety at HKUST works closely with the authorities to identify knowledge gaps and find ways to increase slope safety. Going forward, challenges include:

1. Embedding in the design of slope management practices the increasing incidences of extreme rainfall events.
2. Adding an early landslide warning system within the current warning system specifically for extreme rainfall.
3. Improving the understanding of the initiation and failure mechanisms of slopes under extreme rainstorms.
4. Improving the understanding of how green preventative measures can help under extreme rainfall conditions.
5. Strengthening public awareness of and preparedness for landslide hazards, as landslides have become rare in urban areas due to good management.

In addition to the methods and technology shown by GEO/CEDD (noted in Chapter 3), studies are being carried out to understand landslide initiation, slope failure mechanisms and the interaction between landslide debris and designing barrier systems. With today's computing power and Big Data/AI capabilities, unprecedented modelling is being carried out to simulate extreme rainfall events under specially created conditions. Moreover, Hong Kong and the mainland are cooperating to construct the world's longest model on a mountain side in Kunming to conduct tests.

Continuous investment in slope safety research and application of technology not only helps Hong Kong to deal with a major climate risk, but also to be among the best in the world in the field, including developing climate-tech solutions that are exportable to other places facing similar risks (see also Chapter 7 for Prof. Charles Ng's presentation).

Smart Barrier System (IoT Technology)

CLARIFYING THE DEBATE ABOUT PROGRESSIVE APPROACH

The effects of climate change such as unanticipated temperatures, rainfall and sea level rise have become more apparent over the last few decades. Various and numerous predictive models have been proposed by researchers to predict temperatures, rainfall, and sea level rise etc in 2050, 2100 and beyond, leading to different calls, including sensible and non-sensible ones, for new and modified design infrastructure guidelines to protect society.

However, any new or modified design guidelines must be scientifically based and practically implementable. At present, no one knows which predictive models are accurate enough for design purposes, unless you are a good friend of "God". It will not be responsible, scientific, and practical to implement dramatic revised design guidelines. We must assess the most credible, worst-case scenarios and adopt the "observational method" to revise and implement our current designs progressively.

Charles WW Ng

CLP Holdings Professor of Sustainability, Department of Civil and Environmental Engineering, HKUST

Sea level rise and Hong Kong

The planning approach of CEDD in relation to sea level rise is summarized in Chapter 3. The question raised in Workshop A by China Water Risk (CWR)[6] was whether CEDD's view was too conservative considering sea level could be rising faster than previously thought. CWR suggested that CEDD's plan for dealing with sea level rise of ~0.5m by 2100 was insufficient because at current trajectory global warming would likely exceed 1.5℃ within a decade, which would in turn lead to faster melting of glaciers, and furthermore, sea level rise might be amplified if the "low confidence scenarios" of IPCC AR6 materialised. As such, the question was whether Hong Kong should plan for 2-3m rise by 2100 instead. CWR suggested that other jurisdictions, such as New York City and Singapore, were taking a 'no regret' approach to plan for faster and higher sea level rise to protect their assets.

While there was insufficient time to fully discuss the question, clarity could be brought about by:

1. Ensuring discussions compare like with like (between scenarios the government is using versus those used by others) such as on time scale, including the 'low confidence scenarios', and the range of projections for 2050, 2100 and beyond.[7]
2. What might be the worst-case extreme weather scenario for Hong Kong that includes high tide, storm surge and direct hits of super typhoons going out to 2050?
3. Better understanding of CEDD's *progressive adaptative approach* and whether current plans would enable infrastructure to be added at what speed, scale, and cost.
4. What would be a 'no regret' approach for Hong Kong?

Climate data and financial services

Financial regulatory and relevant Bureaux formed the Green and Sustainable Finance Cross-Agency Steering Group (Steering Group) in 2020. The Centre for Green and Sustainable Finance (CGSF) was then created to build

Eric Hui & Cindy Pau, Green and Sustainable Finance Cross-Agency Steering Group, HKMA

capacity.[8] Market professionals and academics serve on CGSF working groups, one of which is the Data Working Group (DWG) that works to enhance data resources for the financial industry. To address transition risk data gaps, DWG is collaborating with CDP[9] to develop a comprehensive and user-friendly questionnaire template for financial institutions to collect SME/non-listed company transition risk data from their clients. Partnership with CDP allows for periodic updates of questionnaires for alignment with global disclosure standards (TCFD and ISSB reporting framework)[10] and leverages CDP's education support to train and guide relatively new reporting institutions.

DWG had identified 10 categories of data gaps that need further work:

1. **Historical catastrophe losses** of typhoons, flooding and landslides by district, asset, property and industry, for damage estimation.

2. **District level micro-climate conditions** such as storm surge, wind speed, drainage and flooding, and precipitation.

3. **Precise geographical information** of (assets and) properties including latitude, longitude, elevation and distance from the coast.

4. **Existing resilience mitigation measures** built into infrastructure to withstand major extreme weather events, in place and planned, as well as the estimated effectiveness.

5. **Insurance costs and claims** by physical risk, district, and industry.

6. **Death and accident figures** iin extreme weather events, as well as second order effects in case workers are unable to get to their workplace.

7. **Carbon footprint** (including carbon emission source and level, carbon intensity, energy and water consumption) of SME and non-listed companies, especially on a gross basis (prior to any carbon offsetting) and Scope 3 emissions.[11]

8. Impacts / sensitivity of transition risk drivers such as **carbon prices, technological advancement** and market sentiment on corporate business decisions, and revenue and cost structure.

9. **Projections** on transition risks including demand and prices for carbon-intensive raw materials (such as steel, cement, glass, and plastics), and expected regulatory changes and impacts (such as penalty).

10. **Transition capability and readiness of companies** to low-carbon economy, including pass-through of carbon prices to customers, carbon reduction / transition plans (such as R&D investment plans) and their estimated impacts, as well as emission reduction targets.

The demand for such fulsome data presents considerable challenges. With Hong Kong's ambition to be a leading international green finance centre, it is necessary to be proactive. However, it requires long-term effort and commitment to collaborate across disciplines to develop digital systems that provide usable data that are evidence-based and thus credible. It is encouraging that the process has started in earnest in Hong Kong.

Designing and conducting cross-cutting dialogue

The global climate transition is pushing governments and business to decarbonize, and at the same time to restore biodiversity to strengthen nature's carbon absorption capacities, as well as to increase nature's effectiveness in defending against extreme weather (such as in flood and landslide prevention). In addition, the rise of ESG reporting is stimulating the corporate sector to measure their performance much more widely. The climate transition cannot be achieved without evidence-based approaches, which requires the involvement of many areas of expertise. Moreover, mitigation and adaptation projects require the finance sector to base climate risk on credible data and calculation methods that are transparent and scientifically robust. Much more effort will have to go into meeting these complex challenges that require extensive collaboration from many disciplines, as well as from government, regulators and business.

1. See Hong Kong 2030+, https://www.pland.gov.hk/pland_en/p_study/comp_s/hk2030plus/index.htm. The two metropolises are Northern Metropolis (with a development strategy promulgated in 2021, https://www.policyaddress.gov.hk/2021/eng/pdf/publications/Northern/Northern-Metropolis-Development-Strategy-Summary.pdf) and Harbour Metropolis (which includes proposed reclamation for artificial islands near Kau Yi Chau in the Central Waters). The two development axes run north to south on the eastern and western side of Hong Kong are the Eastern Knowledge and Technology Corridor and the Western Economic Corridor respectively.
2. For details, see https://www.mtr.com.hk/sustainability/en/home.html.
3. For details, see https://www.towngas.com/getmedia/606f4b03-f911-4efc-b184-9c5937736e84/Towngas_ESG2021_EN.aspx,
4. See Planning Department, https://www.pland.gov.hk/pland_en/info_serv/statistic/landu.html.
5. See the international disasters database, 2022, https://public.emdat.be/data.
6. China Water Risk, see https://www.chinawaterrisk.org/.
7. The issue of whether CEDD's view is too conservative can be discussed through considering its Port Works Design Manual (PWDM) and DSD's Stormwater Drainage Manual (SDM) published in end-August 2022. Those manuals adopted the median value of HKO's latest projection based on IPCC AR6 up to 2100 for the intermediate GHG emissions scenario. For design of new coastal structures, considering the sea level rise, storm surge increase and increase in wave height due to climate change together with the application of design allowance to address the very high GHG scenario, the resultant rise of extreme sea water level up to end of 2100 being planned by CEDD and DSD will be not less than 1m approximately, tallying with overseas places such as New York City and Singapore. With the adoption of the progressive adaptive approach, coastal structures could be progressively upgraded in stages to allow flexibility to cope with the uncertainties in climate change impacts. For the government, this approach avoids premature implementation of large-scale adaptation measures and reduce maintenance and operating costs. IPCC AR6's low confidence scenarios (mean sea level rise projection for SSP1-2.6 Low Confidence; SSP2-4.5 Low Confidence; and SSP5-8.5 Low Confidence) involve low-confidence-high-impact and uncertain ice sheet processes. The government does not dispute that successive administrations would need to keep close monitoring of the trend of global GHG emissions and global mean sea level rise and would need to formulate suitable measures at suitable timing based on the observed trends and other latest climate change related studies.
8. The Steering Group is co-chaired by the Hong Kong Monetary Authority and Securities and Futures Commission. Members include Environment and Ecology Bureau, Financial Services and the Treasury Bureau, Hong Kong Exchanges and Clearing Limited, Insurance Authority and Mandatory Provident Fund Schemes Authority. It co-ordinates the management of climate and environmental risks to the financial sector, accelerate the growth of green and sustainable finance in Hong Kong and supports the Government's climate strategies. The CGSF is a cross-sector platform launched by the Steering Group in 2021 to coordinate the efforts of financial regulators, relevant government agencies, industry stakeholders and academia in capacity building and improving data availability for the financial industry.
9. CDP, headquartered in London with offices around the world, is a non-profit charity that runs a global disclosure system for companies, investors, cities, states and regions to manage their environmental impact, see https://www.cdp.net/en.
10. The Task Force on Climate-Related Financial Disclosure (TCFD) was created in 2015 to develop consistent climate-related financial risk disclosures for use globally so that companies, banks, and investors could provide shareholders with such information. The International Sustainability Standards Board (ISSB) was established at COP26 to develop comprehensive global baselines for sustainability and climate disclosures requirements for the capital markets. ISSB is expected to replace TCFD.
11. There are Scopes 1 to 3 for reporting purposes. Scope 1 covers direct emissions from owned or controlled sources. Scope 2 covers indirect emissions from the generation of purchased electricity, steam, heating and cooling consumed by the reporting company. Scope 3 includes all other indirect emissions that occur in a company's value chain.

OBSERVATIONS

1. Cross-cutting, multi-and-interdisciplinary deliberations are essential for co-learning and problem-solving. Designing and conducting complex dialogue can help to progress exploration of issues, where there are bound to be different perspectives, methods, and disagreements.

2. There is a great desire among professionals and institutions to have appropriate platforms and proper convening for co-learning and problem-solving dialogue across sectors, including with government and regulators at both the senior and working levels.

3. A barrier to sustaining engagements is the lack of time, focus and/or resources for the planning, design, curating and convening of neutral spaces for dialogue. Everyone wishes someone else could rally stakeholders.

4. Green-ClimateTech emerges as a major innovation area that the public, private and academic sectors are already investing hugely in, but it has yet to receive adequate attention from the authorities to view them from a policy perspective. Moreover, managing the climate transition requires large-scale digitalisation.

RECOMMENDATIONS

1. Institutions in Hong Kong can coordinate and cooperate to divide up the work to convene cross-cutting dialogue.

2. Bureaux and Departments can consider how they could organize themselves to connect with various institutions so that they could convene or participate in such periodic dialogue for exploring issues.

3. Two early examples to develop new dialogue platforms with government involvement could be about:

   (a) Landslide and sea level rise risks, which could be hosted by an appropriate financial regulatory institution for financial institutions to have a deeper understanding of the risk assessments and prevention plans relevant to two major risks in Hong Kong; and

   (b) Built environment, which could be hosted by an appropriate institution for the property development and management sector together with the financial services sector to exchange views on what it takes for them to meet the climate transition for new and existing buildings, as well as cityscape, together with relevant Bureaux and Departments, and how large-scale plans could be financed.

4. Innovation, Technology and Industry Bureau may wish to consider the importance of Green-ClimateTech in light of the local, national and global attention in achieving the climate transition (see Chapter 6 on the broader integration of Green-Climate-Prop-FinTech).

CHAPTER 5

Preparedness and Resilience

WATCH VIDEO https://care.hkust.edu.hk/Video_Ch5

Workshop B

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WORKSHOP B

Emergencies, Security, Health, Water, Heat Stress, and Regional Collaboration

The purpose of Workshop B on Day 1 of CARE2022 was to facilitate discussions with stakeholders about the initiatives of the government, public utilities, community services and academics in preparedness and resilience to cope with extreme weather and other climate risks.

The joint presentations made by HKO, DSD, GEO/CEDD, and Fire Services Department (FSD), and by the Airport Authority Hong Kong (AAHK) and CLP Power Hong Kong Limited (CLP) addressed several major physical risks in terms of territory-wide emergency preparation and responses and ensuring security of critical infrastructures. Workshop B also focussed on extreme heat, which had attracted considerable attention in 2022, with presentations from the perspectives of town planning, academic research, emergency medicine and community service. The issue of hitherto unknown tertiary climate risks was also raised, which could guide preparedness for the uncharted waters of the future.

Due to time limitation, the following themes could have been further elaborated although useful feedback and ideas emerged from the discussion:

- Resilience to drought and water conservation.
- Regional collaboration especially in the GBA.
- Climate change and health, beyond extreme heat.
- Green building designs for 'Cooling Hong Kong'.
- Risk levels to be considered / adopted in climate adaptation and resilience planning.
- Local climate data collection and sharing of climate projection data.
- Subdivided flat issues pertaining to heat stress.

I: Warnings and Emergencies

- **Warnings and response for rainstorms and heat**

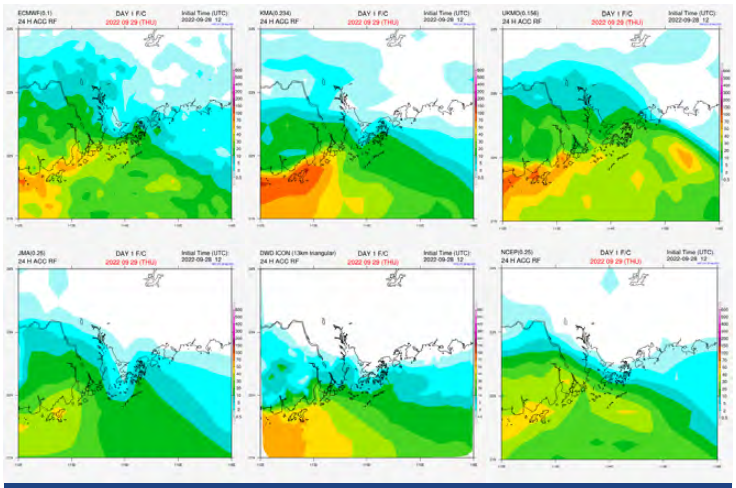
HKO uses the well-established territory-wide Amber/Red/Black warnings for rainstorm. Probabilistic forecast of heavy rain for the next day is under trial by HKO with some government departments internally. While there have been requests for higher granularity of the rainstorm warnings, it should be noted that rainstorm warnings at the district level, for example, will invariably lead to higher false alarm rates which, given the present technologies, are beyond the public's tolerance, and thus such possibilities are only being explored with specialised users.

During the hot spells in 2022, HKO launched the prolonged heat push messages associated with the very hot weather warnings for the public. To further raise public awareness, two levels for the very hot weather warning is being considered.

FIGURE 5.1

Probabilistic approach for heavy rain forecasting

Source: HKO



Grand ensemble of multiple numerical weather prediction models

Category	Definition
High	~70% chance of heavy rain
Medium	~50% chance of heavy rain
Medium Low	~25% chance of heavy rain
Low	<5% chance of heavy rain

Trial of a potential new service on a trial with various government bureaux and departments

FIGURE 5.2

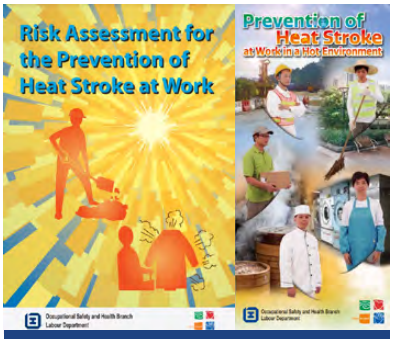
Enhancement of very hot weather warning services

Source: HKO

Special alert on prolonged heat starting from July 2022

Year	No. of days with maximum temperature ≥ 33°C at HKO	No. of days with maximum temperature ≥ 35°C at HKO
2017	29	1
2018	36	5
2019	33	2
2020	47	3
2021	54	4
2022	52	15

Explore further enhancement on the Very Hot Weather Warning



Coordinate closely with related government B/Ds on necessary revision of guidelines

- **Warnings and response for storm surges**

HKO currently provides storm surge forecast to the public and special users mainly with reference to the tropical cyclone forecast track and the worst-case scenario. Risk-based and impact-based products based on the probabilistic forecast are being tested, which could support emergency response decision-making of possible storm surge scenarios at specific locations out to several days ahead that could be converted into a risk matrix.

The protection measure adopted in Tai O was a successful example of enhancing the resilience of a vulnerable community against storm surge impact due to extreme weather. Subsequent to the storm surge inundation of Tai O during Severe Typhoon Hagupit in 2008, the government put in place both hardware (polder scheme consisting of riverwall and demountable flood barriers) and software (an emergency response plan) to protect the village. The response plan kicks into the place whenever the predicted sea level at Tai O exceeds the 3.3 mCD threshold. Tai O residents and relevant supporting organizations will be notified, DSD will install the demountable flood barriers to form a flood protection zone, and various disciplinary forces will help evacuate residents. The plan proved effective during subsequent typhoons, such as Super Typhoon Hato of 2017. HKO's new risk-based storm surge foreast noted above, currently under internal trial, can enhance the precision of mobilization of the Tai O response team.

FIGURE 5.3

Risk-based and impact-based storm surge forecast concept

Source: HKO

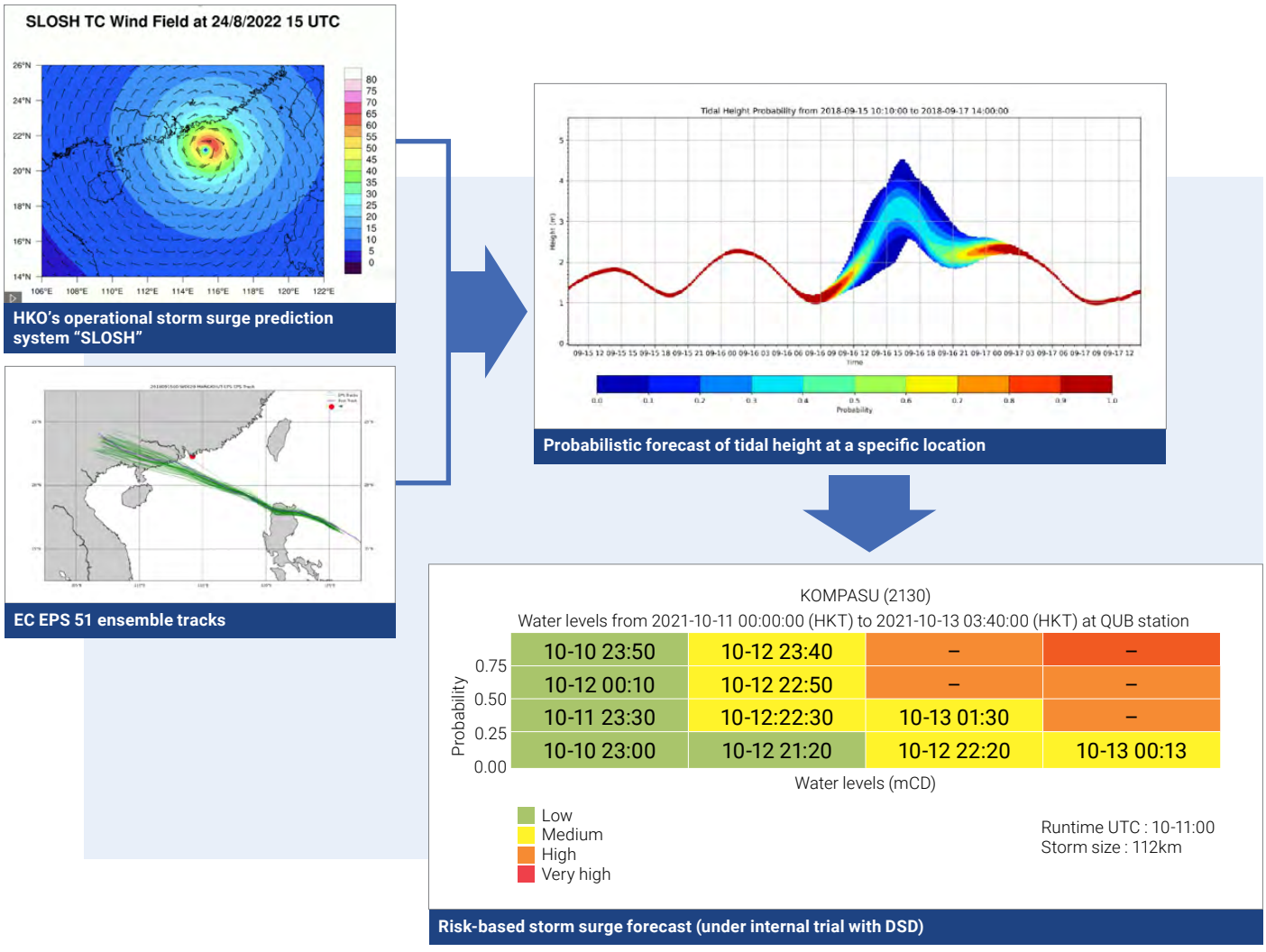


FIGURE 5.4

Hardware protecting Tai O against storm surge

Source: DSD

FIGURE 5.5

Emergency response plan for protecting Tai O against storm surge

Source: DSD

- **Public education and slope safety**

Given the mountainous topography, with some 60,000 man-made slopes and more than 60% of land with steep terrain, Hong Kong is exposed to risks of landslide normally triggered by heavy rain brought by tropical cyclones and troughs of low pressure. The Hong Kong Slope Safety System, implemented since the establishment of the GEO in 1977, has been highly effective in substantially reducing landslide risks. However, it is anticipated that the landslide risks will increase with the projected increase in extreme rainfall events due to climate change. Over the years, the GEO provided 24-hour year-round landslide emergency service, and established the inter-departmental multi-faceted Common Operational Picture for emergency management; implementing the Po Shan Drainage Tunnel and its digital twin[1] for stabilizing land of adverse geotechnical settings; developing smart barrier system for monitoring landslide impact; deploying remote sensing techniques and robotics for landslide identification and inspection; informing instant map-based landslide locations for enhancing public communication; and promoting public education for increasing public awareness of potential to landslide risks and providing landslide self-help tips (see also Chapters 3, 4 and 7).

FIGURE 5.6

Evolution of landslide risk in Hong Kong

Source: GEO

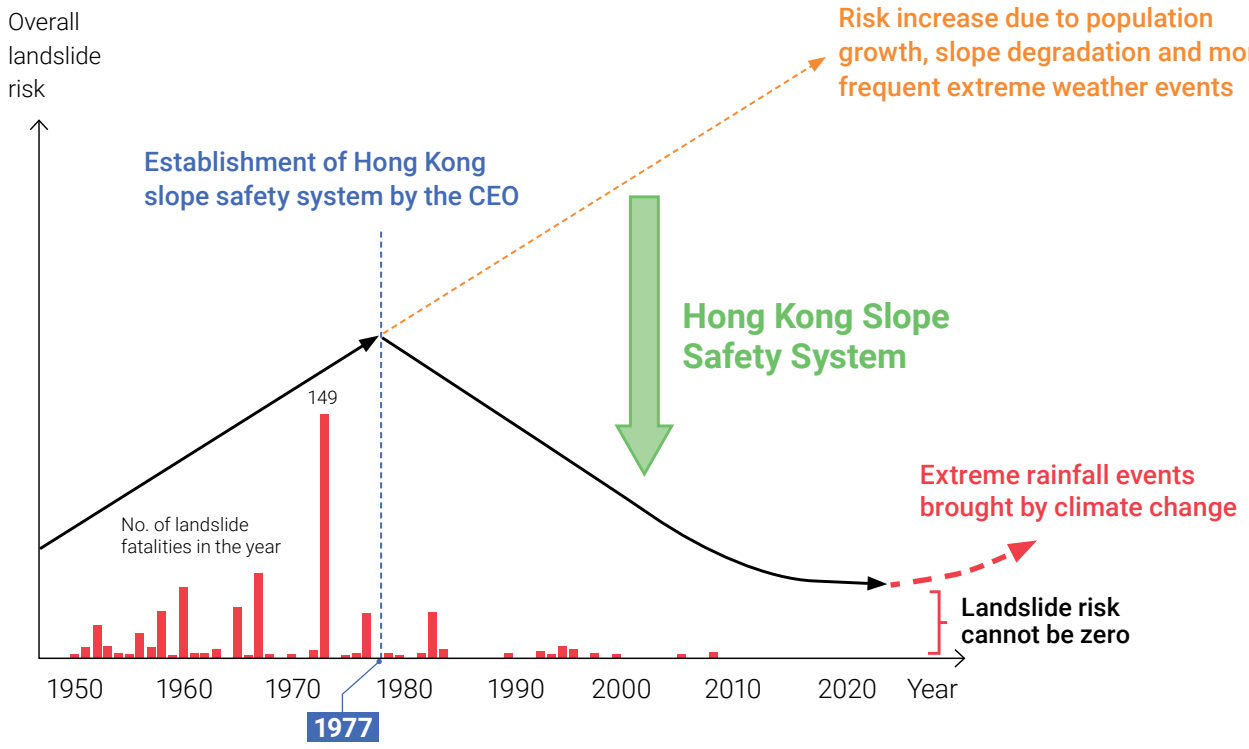


FIGURE 5.7

Inter-departmental multi-faceted Common Operational Picture for emergency management

Source: GEO

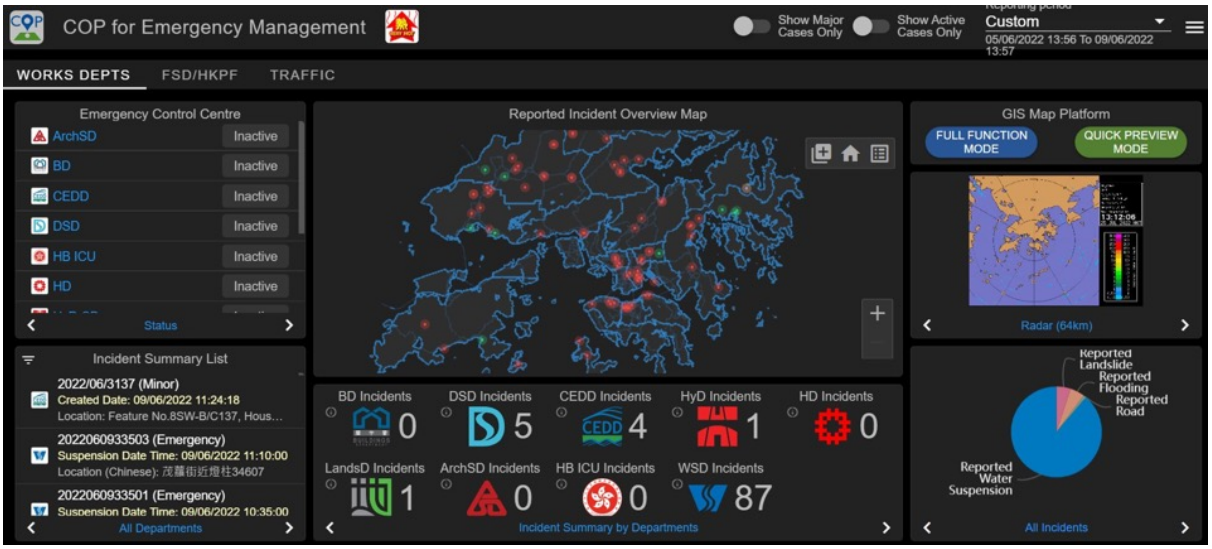


FIGURE 5.8

Remote sensing techniques for monitoring landslides

Source: GEO

- **Rescue operations**

FSD extensively adopted various measures for the enhancement of operational preparedness for the more frequent extreme weather conditions including the usage of new technology in operation, community recovery after disaster and public education for arousing awareness of risks arising from extreme weather conditions.

In carrying out search and rescue (SAR) operations for emergency responses to extreme weather, FSD addressed these challenges through application of technological innovations including deployment of underwater remotely operated vehicle, unmanned aircraft systems (UAS) and AI.

FIGURE 5.9

Application of technological innovations: underwater remotely operated vehicle (top) and unmanned aircraft systems (bottom)

Source: FSD

FIGURE 5.10

Volunteer teams of FSD supported community recovery after Mangkhut

Source: FSD

FIGURE 5.11

Social media platforms of FSD promoting public education

Source: FSD

The underwater remotely operated vehicle was designed to perform various tasks such as underwater SAR and subsea survey. The unmanned aircraft systems could carry different devices, such as high-resolution camera, thermal imaging camera, spot light and loudspeaker. FSD also employed the AI technology in detecting human objects from the analysis of hundreds to thousands of photos taken by camera on board the UAS during mountain SAR operations.

Under extreme conditions, such as the case of Typhoon Mangkhut in 2018, FSD also supported community recovery through its volunteer teams. To arouse the public awareness of severe weather conditions, safety tips and warnings were posted via FSD Facebook page and YouTube Channel from time to time.

II: Security of Essential Infrastructure

- **Airport's resilience to extreme weather**

To strengthen the resilience of the Hong Kong International Airport (HKIA) to extreme weather and its adaptive capacity to the changing climate, AAHK commissioned an 18-month climate resilience study in 2020. Coastal flooding due to sea level rise and extreme weather events, damage of runways, airport terminals and power installations, and problems with access roads and transport networks surrounding the airport were identified as risk factors. Climate scenarios RCP4.5/6.0 and RCP 8.5 (50th and 95th percentile) of IPCC AR5 and H++ sea level rise scenario[2] of US National Oceanic and Atmospheric Administration (NOAA) were considered in the deep dive assessment of physical risks for six priority assets (airfield (including runway and drainage), airfield power distribution system, airfield tunnel, baggage handling system, terminal and building structures and chiller and seawater systems) and the following hazards for 2030, 2050 and 2100:

- Typhoons (wind and storm surge)
- Sea level rise
- Extreme rainfall
- Tidal flooding
- Lightning strikes
- Average annual temperature

FIGURE 5.12

Climate projections for Hong Kong considered by AAHK

Source: AAHK

Climate Projections for Hong Kong under RCP8.5

Temperature increase

Climate projections	2030	2050	2100
Annual temperature increases (°C relative to 1986-2005)	1.4°C	2.4°C	5.5°C

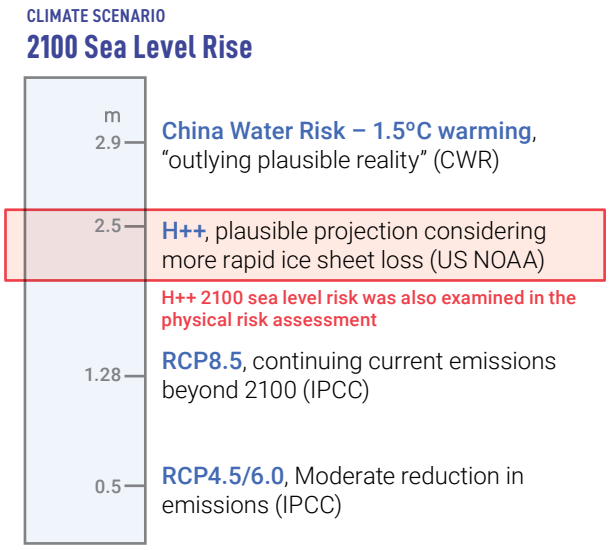
Typhoon and storm surge

Climate projections	1986-2005	2030	2050	2100
Frequency	~6 affecting HK each year	-5.5%	-9%	-17.7%
Intensity (10-min wind speed)	–	+3.4%	+5.4%	+10.5%
Frequency of Cat 4-5 typhoons	–	+7.7%	+12.5%	+24.5%
Typhoon associated precipitation	–	+9.8%	+15.9%	+31.2%

Extreme rainfall and related flooding

Climate projections	1986-2005	2030	2050	2100
Annual number of extreme rainfall days (daily rainfall ≥ 100mm)	4.2	6.2	7.6	7.4
Annual maximum daily rainfall	221mm	359mm	413mm	534mm

FIGURE 5.13
Sea level rise projections considered by AAHK
Source: AAHK



The study concluded that HKIA already had a high level of resilience to climate change with the existing controls in place, as follow:

- Operational procedures
- Monitoring and maintenance
- Emergency management
- Physical system protection

To further enhance HKIA's resilience, a Climate Adaptation and Resilience Plan (CARP) has been formulated to set out a list of actions. CARP is to be reviewed every five years or as part of planned major investments or changes in infrastructures. A Climate Resilience Guidance Note has also been developed to communicate AAHK's expectation to embed climate change considerations into future infrastructure development or asset renewals. AAHK has also adopted the TCFD framework[3] to position AAHK as a leader in Hong Kong and among its peers in the aviation sector.

- **Energy security**

As extreme weather could lead to widespread power supply interruptions, climate change will bring increasing challenges to energy security due to:

- Stronger (super) typhoons – damaging overhead lines and structures of power stations.
- More intense storm surge and heavier rain – flooding of generation plants along the coast and low-lying power substations.
- Rising temperature and heat waves – temperature effects on generation capacity and equipment rating.

CLP has undertaken a Climate Change Risk Assessment for 2030 (near-term), 2050 (mid-term) and 2080 (far-term). A prudent approach using the worst values, based on RCP8.5 ('business as usual' scenario) climate projections of IPCC AR5, was adopted, with localised data from HKO as baseline. The following adaptation measures were developed:

Reinforcements

i) Super typhoons – strengthen tower structures and foundations of 400 kV overhead lines (OHL), implement predictive vegetation management system to predict the growth of vegetation for timely pruning.
ii) Storm surge and heavy rain – regular flooding assessment and mitigation measures for new and existing substations (flood gates, sump pumps, cable sealing, flood alarm systems), flood calculator to evaluate flooding risk at substations during typhoons and deploy asset-specific anti-flooding measures in power stations (sea walls, flood gates, flood barriers).
iii) Heat wave – new standard for equipment against high temperature of 45°C since 2007.

Network design

i) Closed ring and 'N-1' design[4] adopted.
ii) Backed up by interconnectors for fast recovery.
iii) Remote monitoring and control capability.

Operational monitoring

Daily load forecasting model is operated in cooperation with HKO to trigger Peak Demand Management when appropriate, e.g., during extreme high temperature conditions. Incentive for customers to reduce consumption during peak demand period is also in place.

Emergency response

i) Emergency restoration system for 400 kV OHL.
ii) Mobile generators for swift supply restoration.

FIGURE 5.14

Climate change risk assessment conducted by CLP

Source: CLP

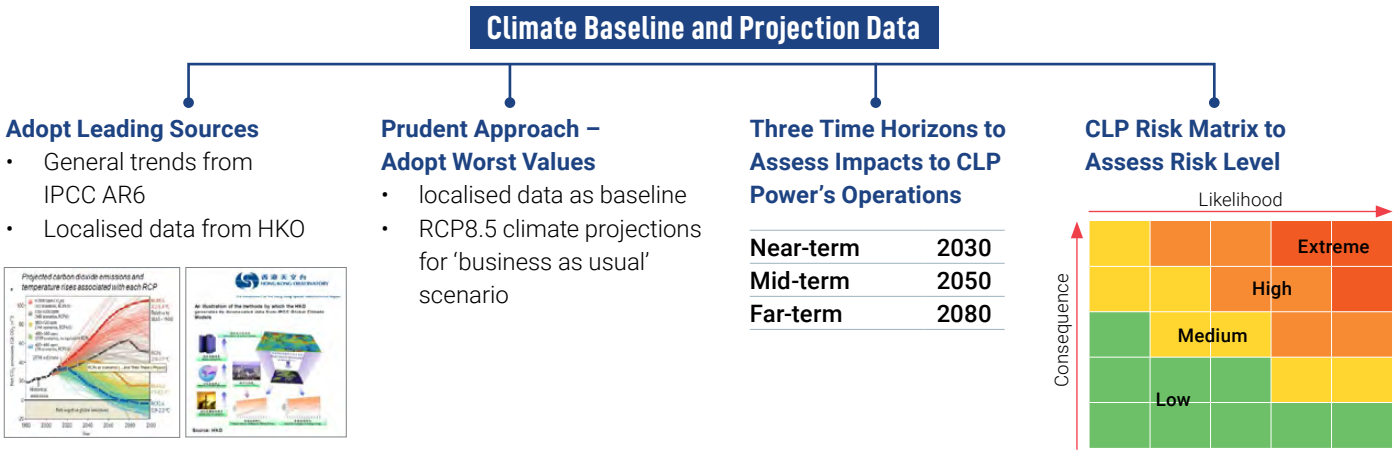
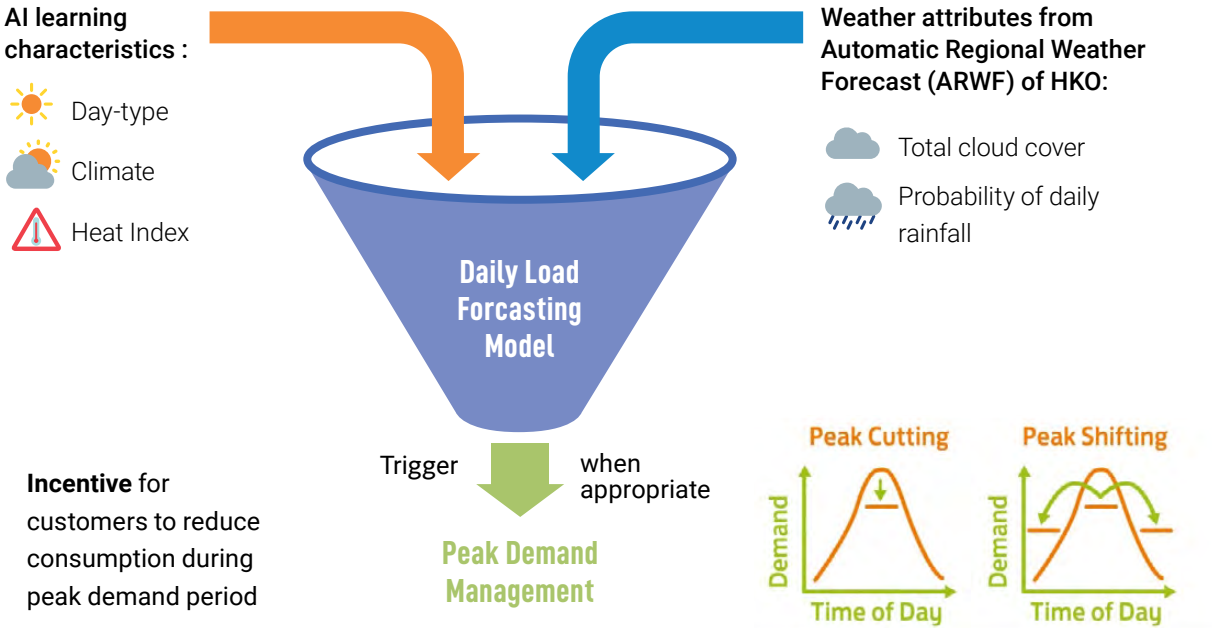


FIGURE 5.15

Peak demand management in cooperation with HKO

Source: CLP



CLP also works with customers to strengthen resilience of equipment on customer side to climate hazards:

i) Typhoon damage to outdoor customer equipment – reinforce the structure of outdoor equipment.
ii) Flooding to customer supply facility – flooding control at customer switch rooms.
iii) Failure of equipment – safety factor on equipment specifications.

III: Heat Stress, Health and Community Resilience

a) Cooling Hong Kong – urban planning aspect

- **Strategic Blue-Green framework**

The territory-wide Blue-Green framework is strategic to keeping Hong Kong cool. Fundamental to minimising the urban heat island (UHI) effect is to carefully control the extent of urban areas and to conserve as much as possible the natural land. Out of the 1,110 m^2 of the land area of Hong Kong, 67% is countryside (including 42% as Country Parks, Special Areas, Geoparks, Ramar Sites, Sites of Special Scientific Interest, etc) and only 24% is urban or built-up land. About ninety percent of the population lives within 3 km of Country Parks. Urban parks or open space also plays a significant role in cooling Hong Kong (see also Chapter 4). The current planning standard specifies 2 m^2 of open space per person but in the final recommendation of HK2030+, this figure will be substantially increased to 3.5 m^2 of open space per person. This substantial enhancement in the provision of public parks within built-up areas not only will improve the availability of outdoor recreational outlets for our people but will also contribute to mitigating the UHI effect.

- **Urban design framework**

Not only provides landscape greenery, the urban design framework also plays a strategic role in keeping Hong Kong cool through laying out the open space systems within built-up areas. In the latest urban design framework of new development areas, the open space systems will have five functions: amenity spaces, pedestrian links, shopping streets, air ventilation corridors, and visual corridors. The urban park systems of Kwu Tung North New Development Area (NDA) and Fanling North NDA are examples of the five-in-one concept. The waterfront promenades planned for Tung Chung East and Kai Tak Development Area provide highly permeable sea/land interfaces which will optimize air ventilation and thus help cool the temperature. At Hung Shui Kui NDA, apart from having an interlinked public park

FIGURE 5.16

Conceptual spatial framework for Blue-Green asset planning

Source: PlanD

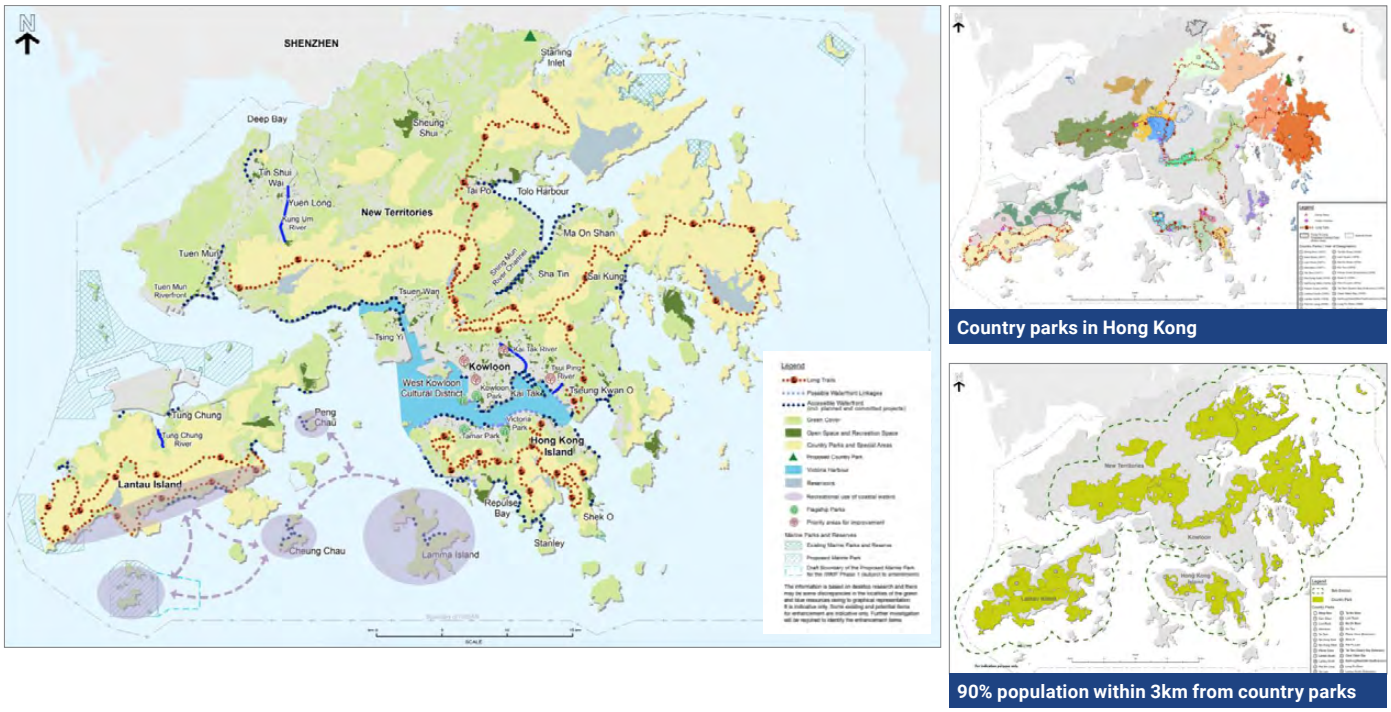
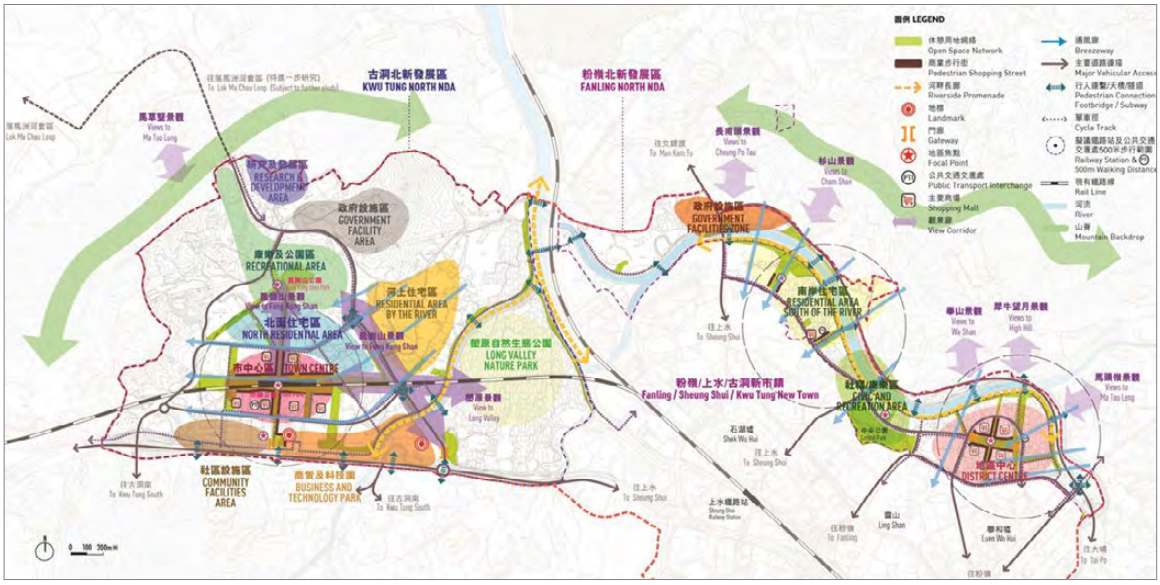


FIGURE 5.17

Urban park systems of Kwu Tung North and Fanling North NDAs

Source: PlanD



system which provides green buffers among high-density development parcels, the planned provision of a large flood retention pond will have the dual function of addressing the need of flooding prevention and achieving district cooling by the presence of a large water body amidst the built-up areas. Similar urban design feature of a large flood retention lake also presents in the ex-Anderson Road Quarry site. Conservation of a natural stream to become an urban riverside park of the Tung Chung New Town will be another example integrating flood prevention, urban design and recreation purpose, with the preservation of natural features. In the Northern Metropolis Development Strategy, the Government will undertake proactive conservation policy for the first time to create environmental capacity by resumption of about 700 hectares of private land with high ecological value to form an integrated natural coastline and wetland conservation system with a total size of about 2000 hectares. Under this development, apart from conserving the ecologically sensitive fish ponds and wet land, the entire natural coastline of Tsim Bei Tsui-Lau Fau Shan-Pak Nai will be preserved and turned into a 12.5 km long coastal protection park with waterfront promenade which will become the longest urban park in Hong Kong (see also Chapter 3 and Chapter 4).

FIGURE 5.18

Waterfront promenades planned for Tung Chung East and Kai Tak Development Area provide highly permeable sea/ land interfaces which will optimize air ventilation

Source: CEDD

Open space network of Tung Chung East Development

Kai Tak Development

FIGURE 5.19

Proactive conservation policy to be adopted for the Northern Metropolis Development Strategy

Source: https://www.policyaddress.gov.hk/2021/eng/related-publications.html

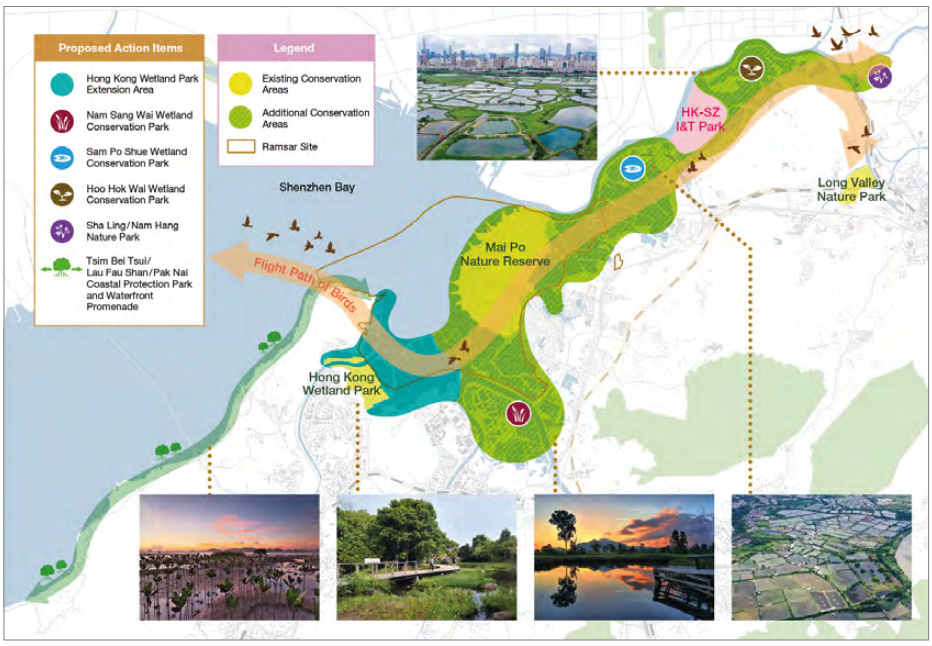


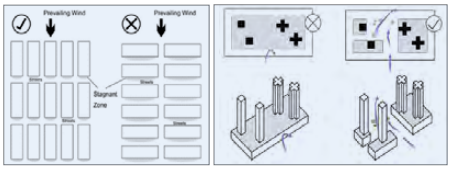
FIGURE 5.20

Air ventilation assessment introduced by PlanD in 2006

Source: PlanD

ORIGIN

Technical Circular No. 1/06 – Air Ventilation Assessments was promulated in 2006 subsequent to a reserach comissioned by the Planning Department to understand the design and planning of the city fabric for better natural air ventilation and cooling



- **Air Ventilation Assessment (AVA)**

The introduction AVA in mid-2000's had met with strong reservation, even objection, from certain developers and practitioners due to worries on constraining development potential and design of buildings, Now, AVA has become the norm in site planning and building design. The Urban Design Guidelines incorporated in the Hong Kong Planning Standards and Guidelines (HKPSG) – has helped to maintain important breezeways within the urban area to achieve cooling without affecting the development potential of the sites concerned.

b) Cooling Hong Kong – warnings on heat

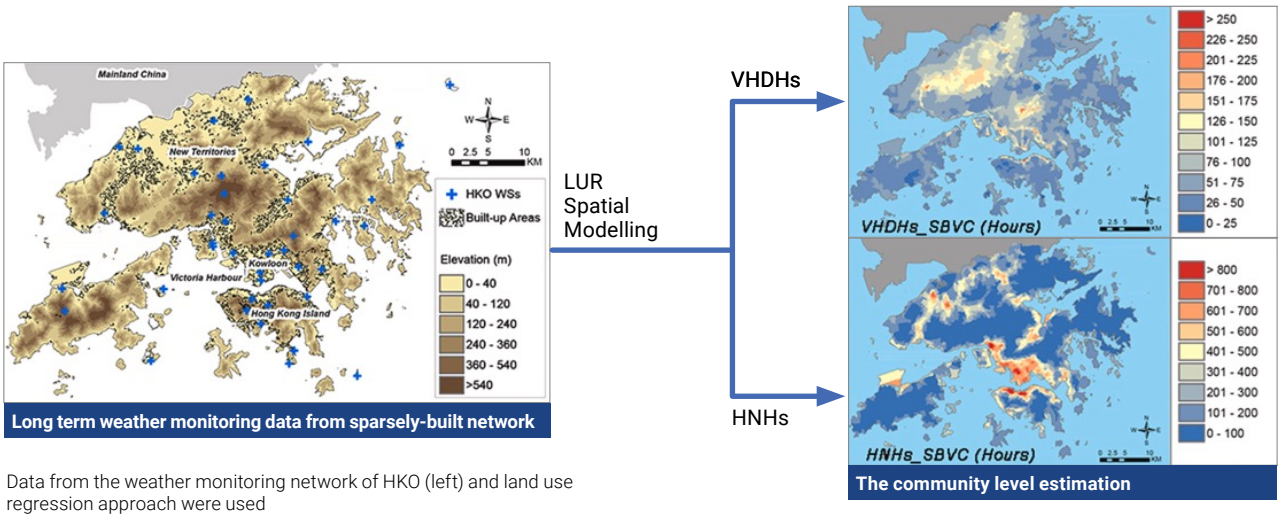
A series of Hong Kong heat-health studies have been conducted. The first study on heat and health found that more consecutive hot nights (HNs, with daily minimum temperature >= 28°C) contributed to higher mortality risk, while the number of consecutive very hot days (VHDs, with daily maximum temperature >= 33°C) did not have significant association with excess mortality.[5] Following the first study, local researchers conducted a further study and found that significant associations with raised mortality risks were observed for a single HN, while stronger associations with mortality were observed as significant for five or more consecutive VHDs/HNs. Three thresholds (5VHDs, 5HNs, 2D3N) were determined to be representative of identical types of Extreme Hot Weather Events (EHWEs) in Hong Kong. Females and older adults were also determined to be relatively more vulnerable to all defined EHWEs.[6] These thresholds are being considered by HKO for alerting the public to prolonged heat situation. These studies sought to better understand the heat risks, measures for mitigating these risks, enhancement of weather warning system, as well as using urban planning and design to mitigate high heat in Hong Kong.

The third study on the spatial pattern of extreme hot weather conditions in Hong Kong found a significant spatial variation in the extreme hot weather conditions of Hong Kong in both day-and-night times. This indicates that the spatial variation of land use configurations must be considered in the risk assessment and corresponding public health management associated with extreme hot weather.[7] Built on the third study, local researchers developed a spatiotemporal hazard-exposure-vulnerability assessment of the extreme heat risk in Hong Kong and found that the risk was spatially variant, and high-risk spots were identified at the community scale for both daytime and nighttime, with high risks mainly occurring in the core urban areas.[8] Based on the above research findings, HKO enhanced the precautions associated with the Very Hot Weather Warning in September 2021, which better suit the health needs of the elderly and persons with chronic medical conditions.

FIGURE 5.21

Spatial variation in extreme hot weather conditions in Hong Kong during daytime (upper right) and nighttime (lower right)

Source: Shi et al, 2019[6]

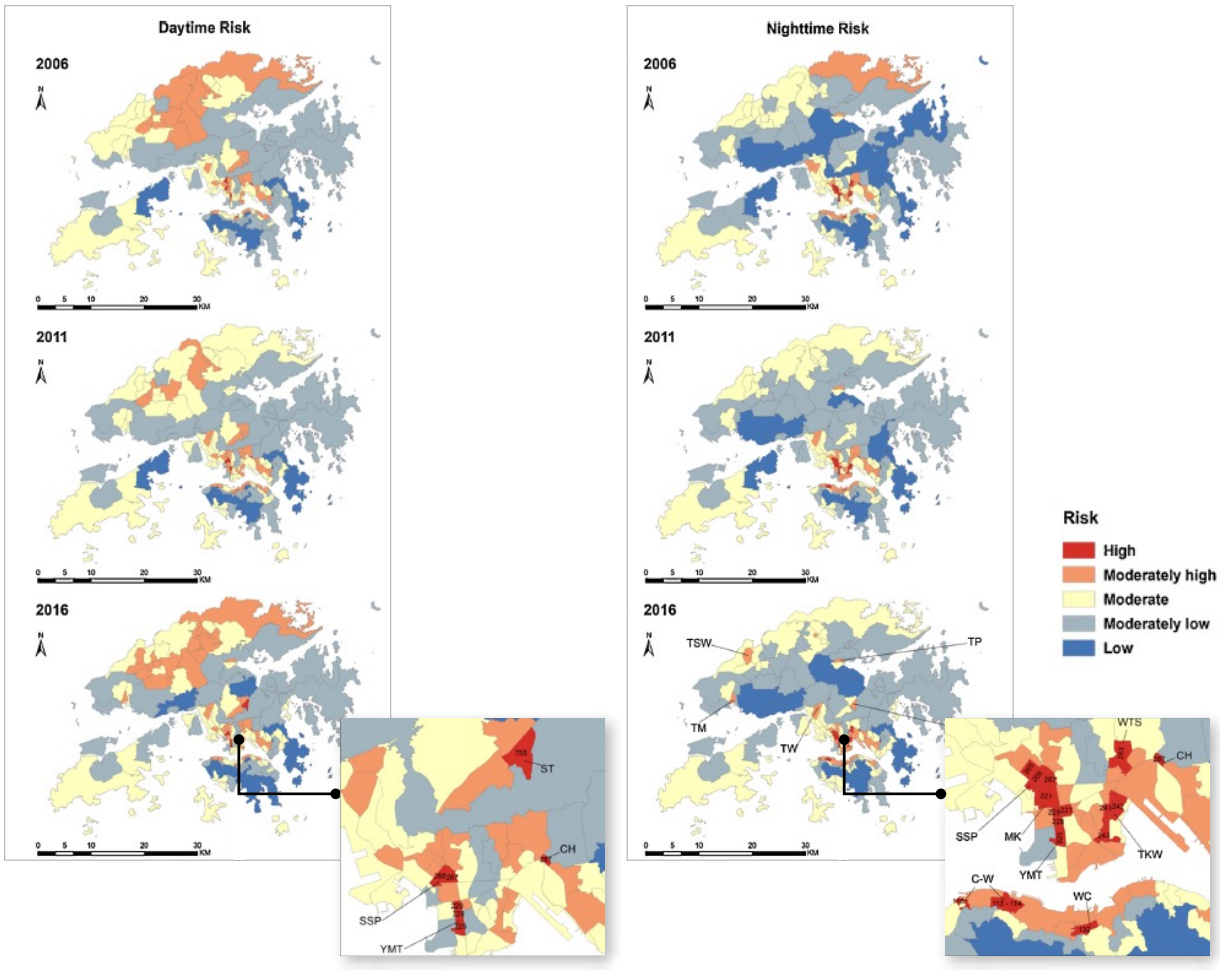


Data from the weather monitoring network of HKO (left) and land use regression approach were used

FIGURE 5.22

High-risk spots identified at the community scale in Hong Kong for both daytime and nighttime

Source: Hua et al, 2021[7]



c) Heat waves – challenges to physicians and healthcare system

The very hot summer of 2022 broke high temperature records in Hong Kong and alerted the community to the associated risks. According to a study published in *The Lancet*, positive associations between the ambient temperature and mortality has been established in various cities around the world, with relatively small increases in the temperature leading to relatively large increases in mortality in hot conditions.[9] Similar results have also been found in a Hong Kong study, which formed the basis for the development of HKO's Hong Kong Heat Index.[10]

Heat related illnesses include heat rash, sunburn, heat cramp, heat exhaustion and heat stroke. Heat exhaustion is the phase where heat stress leads to compensatory responses of the body, which can be followed by heat stroke, where the affected person could lose consciousness and eventually die if not treated quickly. Vulnerable groups include the elderly, disabled persons, children, and outdoor workers.

FIGURE 5.23

Associations between the ambient temperature and mortality in various cities around the world

Source: Dear and Wang, 2015[9]

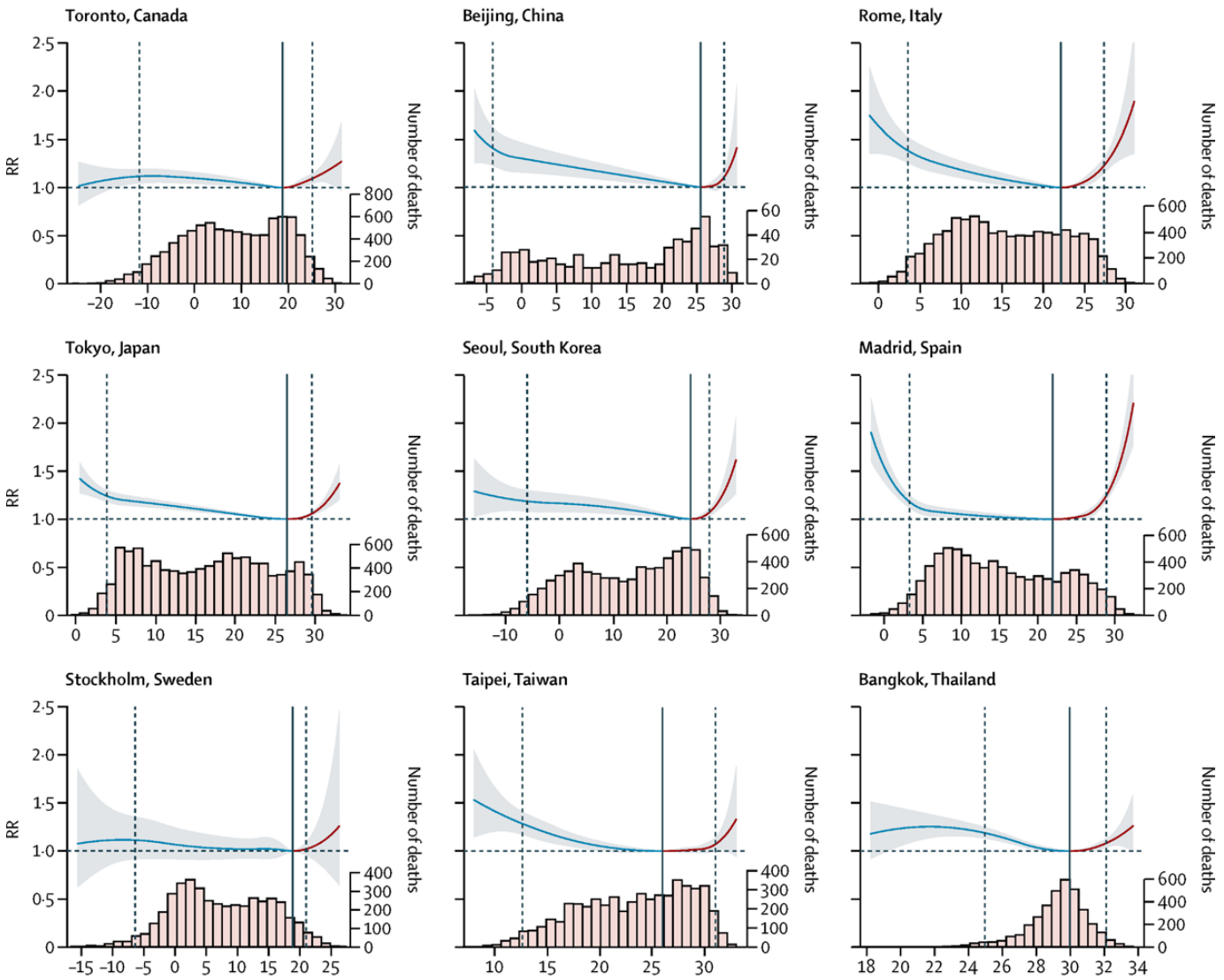
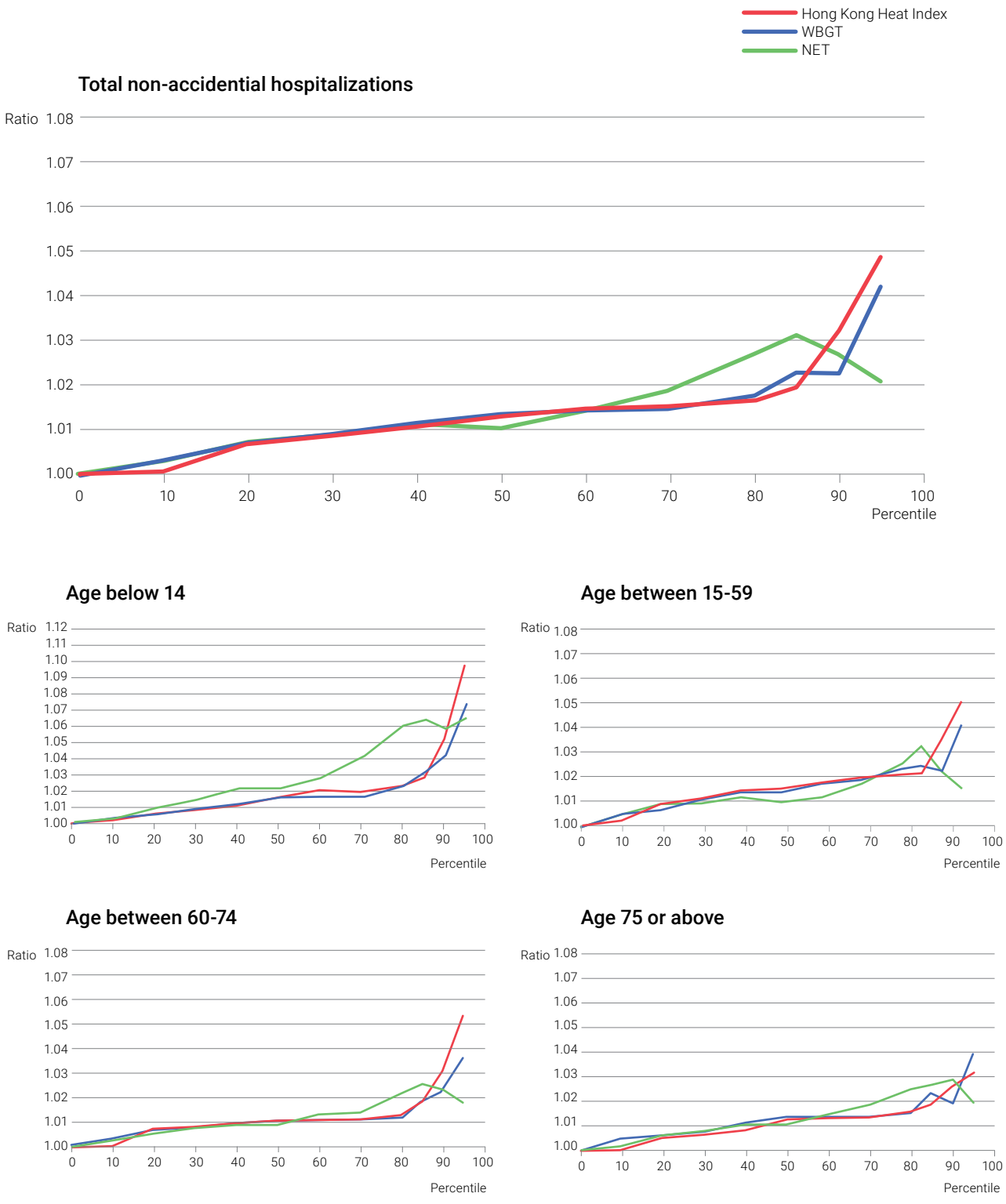


FIGURE 5.24

Association of excess hospitalization ratio with different percentiles of daily maximum Hong Kong Heat Index

Source: Lee et al, 2016[9]

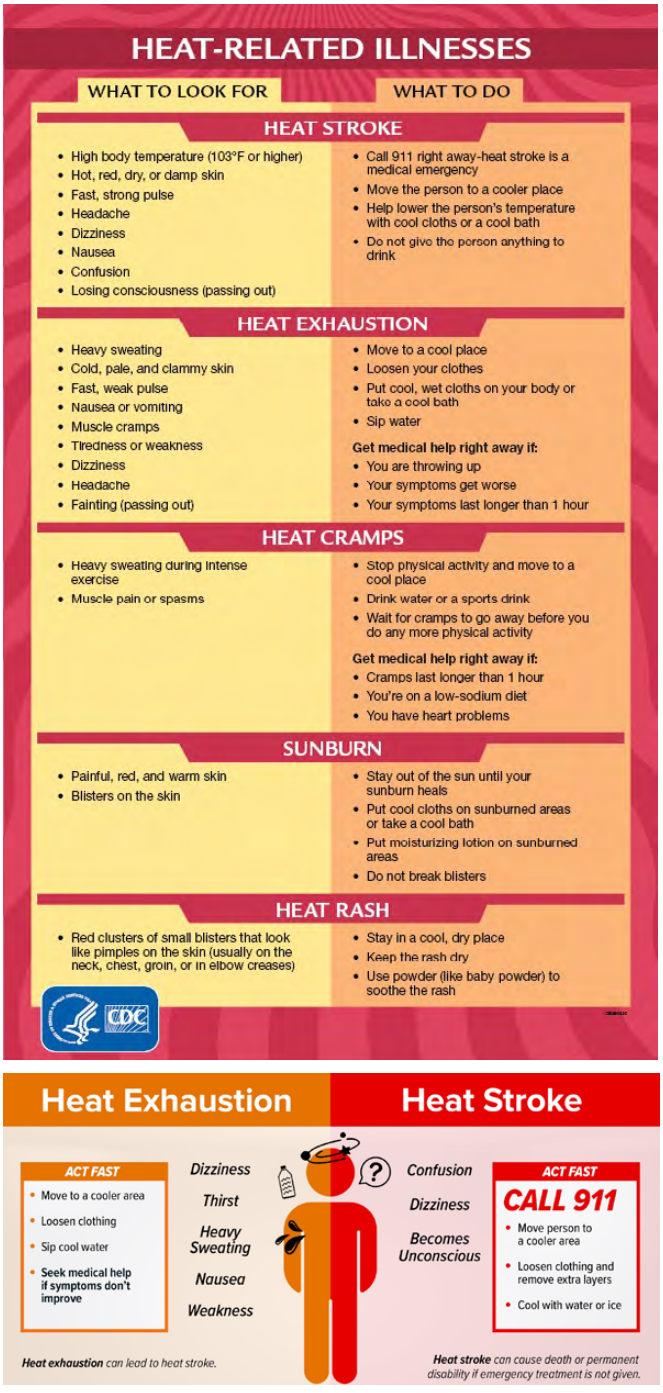


The blue and green curves show the corresponding relationships for the wet-bulb globe temperature (WBGT) and the net effective temperature (NET) respectively

FIGURE 5.25

Heat related illnesses

Source: Centers for Disease Control and Prevention, USA



There are jobs where the work is performed outdoors, such as construction workers, which raises the question about whether heat stroke should be classified as an occupational safety issue. Heat stroke can occur indoors, such as with occupants of flats with no air-conditioning. Heat stroke can occur in outdoor recreational activities, such as hiking and running. Another type of risk could be seen from the tragic death of a young child who died after being locked inside a car for some hours, with the engine off, but exposed to sunlight.

FIGURE 5.26

Heat stroke situations in Hong Kong

Sources: Skypost, HK01, Oriental Daily News, ETtoday and Hong Kong Economic Times

As heat stroke could kill rapidly, prompt treatment must be given on the scene to cool down the patient, preferably using ice water, before transfer to the hospital. Upon arrival at the hospital, it is important for the physician to maintain a high index of suspicion as the patient may appear to be relatively normal on the body surface but actually the core temperature may be very high internally. Monitoring of the core temperature, aggressive cooling, and supporting the end organ function are the subsequent steps to be applied.

In addition to the important roles of the medical practitioners and clinical management discussed above, the Government and relevant NGOs also have the roles of promoting awareness of the heat issue through public education, building a resilient healthcare system targeting health issues arising from global warming, in particular in face of Hong Kong's aging population, as well as addressing the needs of high-risk individuals.

d) Community resilience to heat and other risks

Even though Hong Kong faces many extreme weather risks noted in this report, including high air pollution under certain meteorological conditions, the associated risks do not impact everyone equally.

The International Federation of Red Cross and Red Crescent Societies defines community resilience as "the ability of individuals, communities, organizations or countries exposed to disasters, crises and underlying vulnerabilities, to anticipate, prepare for, reduce the impact of, cope with and recover from the effects of shocks and stresses without compromising their long-term prospects". A resilient community possesses the following characteristics:

- is knowledgeable, healthy and can meet basic needs,
- is socially cohesive,
- has economic opportunities,
- has well-maintained and accessible infrastructures and services,
- can manage its natural assets, and
- is connected.

Development of community resilience intervention programs by the Red Cross are guided by the following elements:

- risk-informed,
- holistic and systems-oriented approach,
- demand-driven,
- people-centred and inclusive process, and
- climate smart and environmentally sustainable.

The International Federation of Red Cross published an Extreme Heat Report in October 2022, noting that "people living in urban poverty, particularly those in informal and off-grid settlements, face a deadly combination of exposure to higher temperatures, higher vulnerability and lower access to coping mechanisms".[11]

FIGURE 5.27

Extreme Heat Report published by IFRC, United Nations Office for the Coordination of Humanitarian Affairs (OCHA), and the Red Cross Red Crescent Climate Centre in October 2022

Source: IFRC

Luckily, heat waves are relatively easy to forecast in most places of the world, including Hong Kong, and early actions are low-cost and effective to beat the heat. Effective response mechanisms include proper education campaigns, access to cool water and designating cooling centres, which are no-regret steps that can be done in the community. Red Cross is also trialing partnerships with various institutions on improved data analysis and scaling up flexible cash support to finance solutions in thirteen countries.

In Hong Kong, Red Cross works on community programs and public awareness. Community programs focus on the high-risk populations living in subdivided flats and communities located in remote, rural, or low-lying districts by engaging them to better understand their vulnerabilities and capacities, and providing them with equipment, drills, and home visits. Public awareness programs are done through exhibitions, mass events, thematic talks, and community tours to promote better understanding of the risks they face. Formal courses are also offered to institutes including the social sectors, government departments, uniform groups, and the private sector on emergency planning.

FIGURE 5.28

Community program of Red Cross for high risk population in Hong Kong

Source: Hong Kong Red Cross

Disaster Preparedness Workshop, Drill and Equipment
(Pok Fu Lam, Tai O, Cha Kwo Ling, Sai Kung)

IV: Tertiary Unknown Risks

It is crucial to understand vulnerabilities and exposure to climate related events to better prepare for them. While primary risks are predictable, secondary risks are more challenging, and tertiary risks can be total surprises. Primary risks are the direct physical impacts of a changing climate, such as rising temperature, heavier rainfall, stronger winds etc., which are predictable by models. Secondary risks are the known indirect impacts of climate change, such as food security, water security, and health issues. Tertiary risks are the indirect and unpredictable consequences of climate change that are difficult to prepare for, as an example, the increase of large-scale intense wildfires that have happened in some parts of the world, such as California and Australia, when high temperatures dried the land, increasing the thermal contrast which led to strong winds, amplifying the intensity of wildfires. Such climate risks are highly non-linear and difficult to predict. Another example is the increase in potholes on asphalt roadways, such as in many parts of the United States, caused by changes in the freeze-thaw cycle associated with changes in subsurface temperatures.

Resilience can be strengthened by learning from examples worldwide even if those incidents have not happened before in one's own region because tertiary risks represent the unknown unknowns. An example illustrates what this means:

FIGURE 5.29
Primary, secondary and tertiary risks

Primary Risks

Direct physical impacts of climate change:
- Rising temperature
- Changes to the water cycle
- Ecologocal impacts
- Stronger storms
- Sea level rise

Secondary Risks

Indirect impacts of climate change that we aware of:
- Food security
- Water security
- Disease
- Healthcare

Tertiary Risks

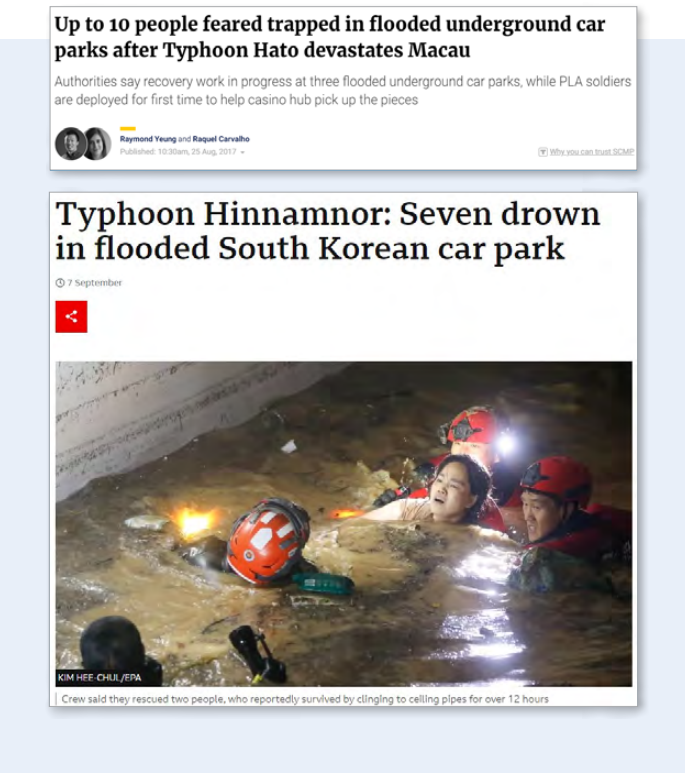
Indirect abd unpredictable consequences of climate change that are difficult to prepare for:
- One tertiary impact that has become apparent is the increase of large-scale, intense wildfires.

four people drowned in underground car parks in Macao during Super Typhoon Hato in 2017. Such deaths had not happened before. Macao and Hong Kong learnt from it, and they were able to issue warnings in the face of Super Typhoon Mangkhut in 2018. Deaths occurred in South Korea in 2022 under similar circumstances. Models could not have predicted those deaths but knowing that it could happened, as it did in Macao, could provide foresight for others to consider the circumstances under which they could face the same risks. Instead of trying to predict such tertiary risks, an alternative is to establish a platform and share information and experiences of disasters across the world.

A research project is being pursued at HKUST to gather climate tertiary risks and impacts from news and social media postings using AI and to categorise them to form a CARE risk database, which could then be used by public and private sectors to develop their own early warning systems with sector specific criteria. It will help to inform decision makers to better prepare for possible disasters brought by climate risks.

FIGURE 5.30
Four people drowned in underground car parks in Macao during Super Typhoon Hato in 2017, Similar incidents occurred in South Korea in 2022

Sources: SCMP and BBC



1. The digital twin simulates the actual groundwater monitoring system installed at the Po Shan Drainage Tunnel in a virtual model and provides real-time data for monitoring purposes.
2. The H++ scenario was developed by NOAA in 2017 for the Fourth National Climate Assessment of the USA in which a global sea level rise of 2.5 m was projected for 2100 under the premise that the physics governing ice Antarctic ice sheet mass loss will change after mid-century due to overall warmer global temperatures. The H++ scenario is at present highly uncertain and is a topic of ongoing scientific research.
3. TCFD stands for the Task Force on Climate-related Financial Disclosures, and its framework is designed to help public companies and other organizations disclose climate-related risks and opportunities.
4. 'N-1' means the power transmission grid shall be capable of experiencing outage of a single transmission line, cable, transformer or generator without causing losses in electricity supply.
5. Hung Chak Ho, Kevin Ka-Lun Lau, Chao Ren, Edward Ng, "Characterizing prolonged heat effects on mortality in a sub-tropical high-density city, Hong Kong", International Journal on Biometeorology, Nov 2017, 61(11), p1935-1944.
6. Dan Wang, Kevin Ka-Lun Lau, Chao Ren, William Bernard Goggins, Yuan Shi, Hung Chak Ho, Tsz-Cheung Lee, Lap-Shun Lee, Jean Woo, Edward Ng, "The impact of extremely hot weather events on all-cause mortality in a highly urbanized and densely populated subtropical city: A 10-year time-series study (2006-2015)", The Science of the Total Environment, Nov 10 2019, 690, p923-931.
7. Yuan Shi, Chao Ren, Meng Cai, Kevin Ka-Lun Lau, Tsz-Cheung Lee, Wai-Kin Wong, "Assessing spatial variability of extreme hot weather conditions in Hong Kong: A land use regression approach", Environmental Research, Volume 171, April 2019, p403-415.
8. Junyi Hua, Xuyi Zhang, Chao Ren, Yuan Shi, Tsz-Cheung Lee, "Spatiotemporal assessment of extreme heat risk for high-density cities: A case study of Hong Kong from 2006 to 2016", Sustainable Cities and Society, Volume 64, January 2021, 102507.
9. Keith Dear and Zhan Wang, "Climate and health: mortality attributable to heat and cold", The Lancet, Vol 386, Issue 9991, July 25, 2015, p320-322.
10. K L Lee, Y H Chan, T C Lee, William B Goggins, Emily Y Y Chan, "The development of the Hong Kong Heat Index for enhancing the heat stress information service of the Hong Kong Observatory", International Journal on Biometeorology, Jul 2016, 60(7), p1029-1039.
11. See https://www.ifrc.org/sites/default/files/2022-10/Extreme-Heat-Report-IFRC-OCHA-2022.pdf

OBSERVATIONS

1. Measures to tackle one issue may conflict with another. For example, moving car parks underground save space but for high-risk properties along the coast, it may increase the risk of inundation due to storm surges.

2. Institutions operating critical infrastructures (energy, airport) consider the worst-case scenarios in their climate projections for adaptation and resilience planning, such as very high GHG emissions, high temperature of 45ºC, and up to ~2.5 m sea level rise by 2100. Other decision-makers adopt intermediate GHG emissions scenarios for their planning of less critical infrastructures and facilities.

3. Companies and users in different sectors of activities have varying circumstances with respect to adaptation and resilience, and assess their risks based on different parameters and probabilities, including the effectiveness and costs involved.

4. The entire Pearl River Delta is a flood-prone area. Extreme weather events could disrupt regional transport networks and supply chains. Droughts, such as in 1963, would have regional impact on water resources.

5. Hong Kong people's awareness and preparedness for disasters is relatively low (~25%) according to a Hong Kong Red Cross survey in 2021. With respect to electricity supply, end-to-end resilience will require actions on the part of users.

6. More data and research are needed to identify different types of risks and the high risk locations, the vulnerable groups affected, the range of intervention measures, better early warning strategies and what the public could do for self-help.

7. In addition to urban planning means, green building designs could also contribute to 'Cooling Hong Kong' as buildings is a major source of urban heat especially in high-density districts.

RECOMMENDATIONS

1. Government Bureaux and Departments and academia can collaborate to identify the data and knowledge gaps needed on the various climate risks, including heat (a neglected focus), with the aim of filling those gaps to enable the authorities to set evidence-based policies, including unknown tertiary climate risks in Hong Kong but have happened elsewhere.

2. The Government, public utilities, NGOs, and the private sector should collaborate to intensify public understanding of risks and be prepared to play clearly articulated roles in defined emergency action plans. Greater attention should be paid to identifying vulnerable groups, including occupants in sub-standard accommodation.

3. Codes of practices, guidelines and regulatory requirements need to be reviewed holistically and upgraded for both climate mitigation and adaptation, and this is especially critical for development in low-lying ground and along the coastline, as well as buildings.

4. It is not too early to consider Hong Kong's response to possible larger-magnitude disasters and multi-hazard scenarios (e.g. severe storm surge, landslides and flooding occurring at the same time), such as whether public sector buildings and facilities could be deployed as emergency centres and temporary shelters.

5. Greater transparency about the actions being considered and planned with respect to adaptation is needed for the whole of the GBA, as all constituent parts of the region have an interest in better regional resilience; and to consider whether a GBA collaborative mechanism should be established for adaptation and resilience.

CHAPTER 6

Financing the Climate Transition

Risk assessment, data, industrial transformation, innovation & technology, talent, and collaboration

WATCH VIDEO https://care.hkust.edu.hk/Video_Ch6

Government & Regulators Presentations

Christopher HUI, JP
Secretary for Financial Services & Treasury, FSTB

Eddie YUE, JP
Chief Executive, HKMA

Cho Hoi HUI
Head of Banking Policy, HKMA

Megan TANG
Senior Director, Corporate Finance, SFC

Ken CHIU
Senior Vice President, Head of Carbon and ESG, HKEX

Moderator:
Simon Ng
Chief Executive Officer, Business Environment Council

The purpose of Day 3 of CARE2022 was to bring together government and finance regulators, as well as business and professional leaders in industry, energy, property, technology and finance to deliberate on the breadth of the issues they must navigate to achieve carbon neutrality by mid-century in the hope that further cross-cutting discussions could ensue so as to encourage interdisciplinary collaboration going forward in light of the complexities involved and knowledge gaps that would need to be filled.

The various presentations made by the HKSAR Government and financial regulators[1] provided a comprehensive picture of the current situation on policy relating to green finance, and their high degree of coordination and policy alignment through the Green and Sustainable Finance Cross-Agency Steering Group (see also Chapter 4).

As Hong Kong is an international financial centre, its regulators are at the forefront of global discussions on finance, including helping to shape sustainable and green finance best practices. Hong Kong's regulators also engage with the relevant mainland and international authorities and institutions to promote interoperability across jurisdictions and influence evolving best practices affecting many jurisdictions.

While time did not permit extensive discussions, several issues did emerge that would benefit from further exploration – these included:

- Deepening collaboration across public and private sectors to serve the climate transition.
- Improving data quality and emissions tracking systems and services to enable Hong Kong to be a green data service hub.
- Increasing the capacities and capabilities of sustainability talent across the economy.
- Incentivising the retrofit of existing buildings at scale for climate and liveability.
- Financing the green shipping transition in partnership with Asian-based stakeholders.
- Regional collaboration on many fronts, especially within the GBA/mainland.

Eddie Yue, HKMA

Government perspectives

The Secretary for Financial Services referred to the importance of the Paris Agreement, that the 1.5°C target was not yet out of reach, and that the outcomes of COP27 included the Loss and Damage Fund for the most climate-vulnerable developing countries (see also Chapter 1). He emphasised Hong Kong's role as an international financial centre connecting global capital with opportunities, and channelling capital to empower green and sustainable development projects. Government, regulators, and the finance industry were working on strategies to provide the right infrastructure and catalysts to match international capital with quality green projects. Apart from having developed an active green debt business, HKSAR Government had also issued retail green bonds and was piloted tokenised green bonds as continuing innovation was important to growing the market. Another area of innovation was to develop Hong Kong as a voluntary carbon trading location, which the Hong Kong Exchanges and Clearing Limited (HKEX) was doing. The government understood the need for nurturing talent and HK$200 million had been earmarked to support green finance training for locally based market practitioners,[2] as well as providing internships for young talent coming into the finance field.[3]

Christopher Hui, FSTB

Regulators perspectives

Regulators emphasised the need for collaboration to succeed in green and sustainable finance, as the role of finance should help economic activities to respond to climate change. Hong Kong's financial regulators had three key tasks:

- Setting clear and consistent climate risk rules – sharing the common aim to strengthening the management of climate risk and promoting the flow of related information, Hong Kong's regulators issued climate risk management and disclosure rules for institutions they respectively supervised following global best practices. They have been working to adopt the *Common Ground Taxonomy*, produced by a working group of the International Platform on Sustainable Finance co-chaired by European Union and China, as the classification tool to assess "green". Having such a taxonomy can lower the likelihood of greenwashing and improve the credibility of green financial products to help direct funds to support green businesses, assets, and projects.[4]

- Creating infrastructure and ecosystem – talent and data being the two essential elements to enable the financial industry to go green (see also Chapter 4):

  i) On talent, apart from increasing local capacity (as noted above),[5] attracting overseas talent to Hong Kong was also being pursued.

  ii) On data, the Green and Sustainable Finance Cross-Agency Steering Group launched the Green and Sustainable Finance Data Source Repository in 2022 to help the financial industry locate data sources for climate risk management that included HKSAR Government data sources.[6]

- Developing markets – Hong Kong's ambition to be a leading green fundraising centre required constant innovation. The government's Green Bond Program expanded the city's green bond market;[7] and Shenzhen and Hainan local governments raised their first offshore RMB-denominated green/sustainability bonds in Hong Kong in 2021 and 2022 respectively.[8] HKMA's own Exchange Fund incorporated ESG principles in its investments. While still nascent, HKEX's interest in developing carbon credits was on-going although it would take time to sort out standards and increase liquidity.


Choi Hoi Hui, HKMA


Megan Tang, SFC


Ken Chiu, HKEX

Evolving regulation

As climate change represented a major global risk, finance should contribute to the global effort to decarbonize. HKMA had embedded climate risk in its banking policy. It had conducted a pilot climate risk stress test in 2021 to evaluate the overall climate resilience of the banking sector in Hong Kong. The results indicated that the banks had strengthened their capabilities for measuring and assessing climate risks, and many had developed plans to enhance their climate strategies and risk-governance frameworks. HKMA would conduct another stress rest between 2023-24.[9]

In regulating the securities and futures market in Hong Kong,[10] SFC and HKEX worked closely together alongside HKMA to support the development of a global uniform set of sustainability reporting standards emerging through the International Sustainability Standards Board (ISSB),[11] which would eventually be adopted in Hong Kong. The disclosure challenges include the lack of data from supply chains, the standards were not yet interoperable across jurisdictions, and companies were at varying stages of readiness in their sustainability practices, including reporting. Companies needed time to develop internal systems to adapt to new disclosure requirements, although surveys of listed companies in Hong Kong in 2021 were encouraging as many of them were on the way to evolving their practices. While ISSB was finalising its standards, transition and phasing in measures would be needed around the world and regulators in Hong Kong were working with their mainland and Asia-Pacific counterparts to ensure a smooth transition.

Expanding markets

HKEX saw itself as a "change agent" to develop the ESG space and in developing global carbon markets.[12] In March 2022, it partnered with the China Emissions Exchange (CEEX) in Guangzhou to cooperate on promoting sustainability through carbon finance. HKEX and CEEX would develop a voluntary carbon emission reduction program in the GBA to support mainland China's efforts to peak carbon emissions by 2030 and reach carbon neutrality by 2060. In July, HKEX launched the Hong Kong International Carbon Market Council, a partnership with leading corporates and financial institutions to develop an international carbon market that would leverage Hong Kong's position as a leading global financial centre, which led to the launch of CORE Climate in October 2022, a new international carbon marketplace to connect capital with climate-related products and opportunities in Hong Kong, Mainland China, Asia and beyond. CORE Climate provided a platform for participants to source, hold, trade, settle and retire voluntary carbon credits, and it allowed for trades to be denominated in HK Dollar or RMB.

Private Sector Perspectives

Zoey LAU
GM & Head of People and Sustainability, The Bank of East Asia, Limited

Charles TSAI
CEO, Power Assets Holdings Limited

Aldous MAK
CFO, Hong Kong Science and Technology Park

Daniel CHENG
MD, Dunwell Group

Frederick LONG
Founding MD, Olympus Capital

Christy YEUNG
Head of Fintech and Green Finance Projects, School of Business Management, HKUST

Moderator:
Simon NG
Chief Executive Officer, Business Environment Council

Private sector perspectives

Banking

Zoe Lau, BEA

The Bank of East Asia, Limited (BEA) is a Hong Kong-based home-grown bank.[13] BEA's ESG vision was to be a leader in Asia. Success would require an enabling culture of sustainability that inspired staff to contribute, and long-term success depended on meeting the diverse expectations of stakeholders and in BEA's environmental and sustainability performance. A staff survey in 2022 showed 85% of the staff felt they could make a difference on BEA's ESG performance, and 90% believed in the company's sustainability commitment. The learning curve was steep in developing internal capabilities in carbon risk management and green finance. A key challenge for the bank was its Scope 3 emissions, which were around 1,000 times greater than the bank's own operational emissions – 90% of those emissions arose from BEA's corporate lending and bond investment business. Other challenges included the lack of accurate emissions data from its client base, many of whom were non-listed smaller companies. Nevertheless, BEA had been able to set climate timeline and targets to meet Net Zero operation emissions by 2030 and Net Zero financed emissions by 2050 and for roadmaps to start in 2023. BEA would set reduction target in the high carbon sectors (starting with energy and utilities) by 2025. In 2022, BEA expected 10% of its corporate loans and bond investments would be green. Moreover, BEA would provide new capital in technology to help expedite the Net Zero transition.

The energy business

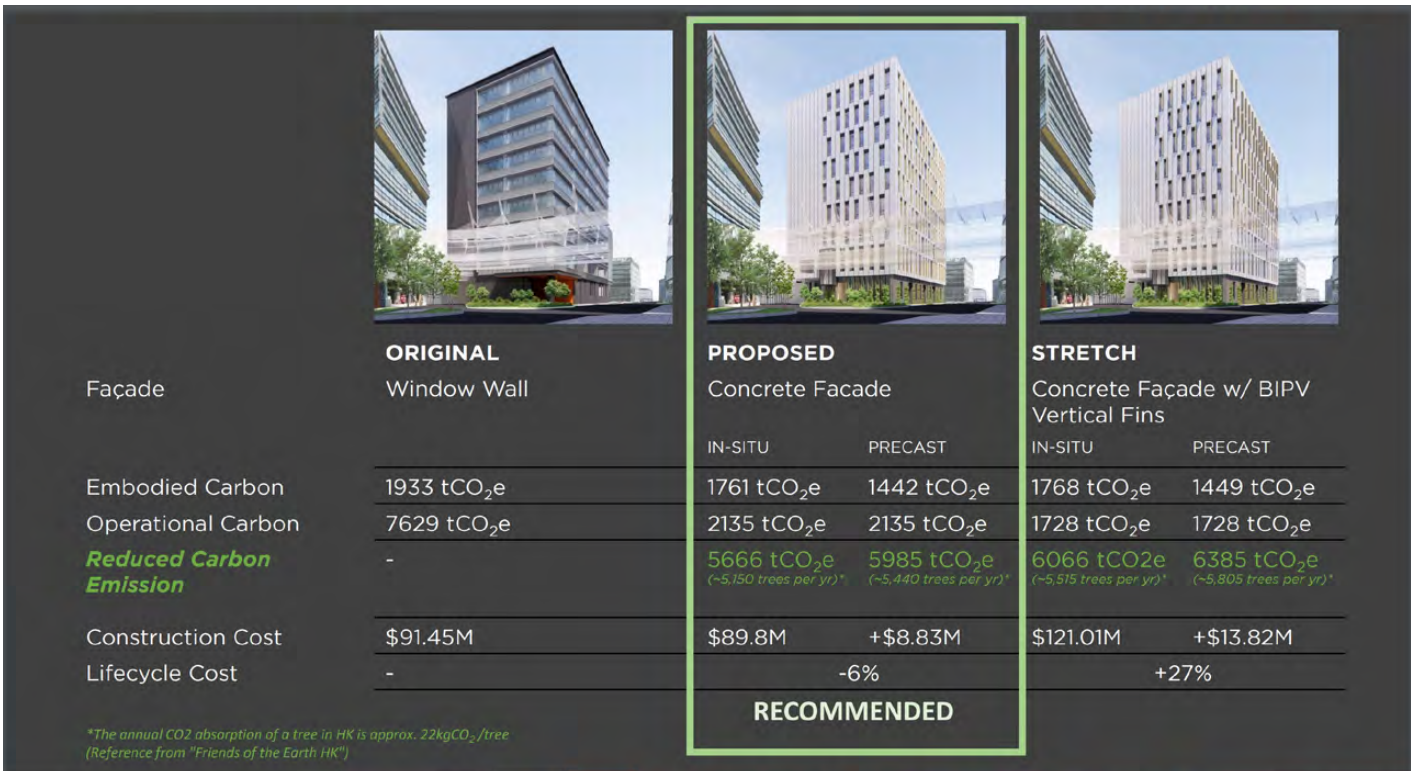

Charles Tsai, Power Assets Holdings Limited

Sustaining profitability long-term was a challenge for any company. For an energy company, such as Power Assets Holdings Limited,[14] with highly regulated businesses around the world, decisions needed to be taken to navigate a variety of difficult questions to ensure long-term profitability. For example, scheduling the repurposing of gas pipes to carry hydrogen, accommodating interruptible renewable energy and even EVs (electric vehicles) in the energy system, and automating and digitalising the infrastructure. Yet, decisions could not all be in one direction because there would be multiple volatilities depending on locations, demand/supply, prices, and politics that all present risks. Moreover, uncertainties abound in the climate change era, including the outcomes of COPs and government regulations, as well as whether the world could hold to 1.5°C or tip to runaway warming at 4°C, which could mean businesses might become uninsurable and non-financeable. Hence, business must take a long, holistic and sustainable view of the future in their decisions, and all stakeholders need to collaborate. Ultimately, it would depend on what people might be prepared to do to change their habits and way of life to reduce their carbon footprint.

A CFO's decision-making

Aldous Mak, HKSTP

A CFO faces new challenges in the climate change era. Hong Kong Science and Technology Parks Corporation (HKSTP)[15] has new buildings to construct and existing buildings to retrofit for better environmental performance to achieve climate goals but with higher cost implications. In considering the added costs, a CFO's traditional way of evaluating a project's capital expenditure investment was whether the rate of return of the project was greater than the hurdle rate.[16] Today, a CFO must also take into account the organization's carbon reduction targets determined by some common standards (such as SBTi[17]). The CFO's mindset would need to adapt to a new way of measurement of success by achieving higher sustainability performance while managing the financial returns. Both aspects must be considered together. Reflection on two projects at HKSTP illustrated the unavoidable dilemma. One was a new building for developing new laboratories with three design options of varying carbon performance. The mid-performance option was chosen – while the higher performance option would reduce carbon by a larger margin at a higher cost of up to 47%, the mid-performance option had sufficient reduction potential with up to 8% higher cost only, which was acceptable from a finance perspective. Another successful example was an upgrading project of a local District Cooling System, of which the saving in energy costs by the upgrading could payback the upfront investment of HK$200 million in 12 years.



Achieving circular economy

Daniel M. Cheng, Dunwell Group

In manufacturing, Dunwell Group (designs and manufactures wastewater systems and Group Chairman Daniel M Cheng was past chairman of Federation of HK Industries)[18] emphasised the importance of decisions made in the coming years to transform production and sales. Manufacturing could no longer rely on making more and more products as the basis of profitability. Achieving Net Zero by mid-century required "drastic" re-tooling of global manufacturing. Financiers represented a vital lever because products were made because they could be financed. However, financing products designed to be easily reparable, reusable, and recyclable might not be a priority for traditional investors because they might be less profitable although the world must reduce the use of natural resources and logistics activities. There would need to be new sales business models too, such as minimising single-use products, and developing leasing or exchange models. The transition in manufacturing and business models would not happen on their own – they would need a new approach on the part of business coupled with the right policy tools from governments to help sustain financing so that achieving Net Zero timelines could be achieved.

Making green investments

Frederick Long, Olympus Capital

Olympus Capital is a private equity firm[19] with a long history in green/sustainable investments in Asia, having invested US$2.6 billion of equity capital on behalf of its funds and co-investors in over 65 portfolio companies in the past 15 years. Olympus Capital focused on two categories of investments:

- Sustainability projects that were (a) city based, or (b) finance based. In (a), projects had UN Sustainable Development Goals, such as providing water services and efficiency, waste management or recovery, or sustainable transport; and (b) projects were ones that assisted underserved communities, such as recycling and recoveries of e-waste so that reconditioned products could be used.

- Projects that could show significant improvement in sustainability, such as in logistics, or use of sensors, that could reduce the use of natural resources.

Olympus Capital invested in companies with strong management teams and required clear accountability through having KPIs, measurable baselines, as well as independent certification and auditing.

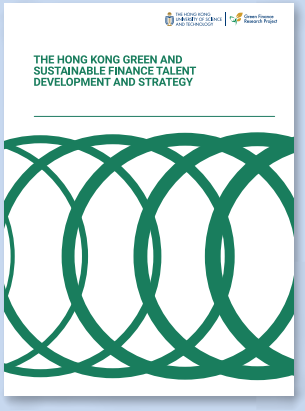
Nurturing talent in sustainability

Christy Yeung, HKUST

The ability to define the specific sustainability skills needed is essential to develop the talent pool for finance and sustainability roles in the economy. HKUST used AI and machine learning to collect data since November 2021 to look at sustainability-related job postings to identify what skills were called for. The postings were very general in nature with no specifics about what skills were needed. For example, posting merely noted skills in "ESG", "finance", and various soft skills. Singapore's regulators had outlined 12 competency

skills, and it would be helpful for HKMA to do the same for Hong Kong. Universities already had various environmental and sustainability courses that were helping to expand the talent pool but courses could be better shaped with clearer identification of specific competency skills. Universities could also facilitate cross-cutting, cross-sector dialogue, such as CARE2022, which would help raise public awareness about the importance of sustainability (HKUST's survey showed only one-third of the public had heard of ESG, for example). HKUST used the CARE2022 conference to publish a first report on sustainability talent.[20]

The Hong Kong Green and Sustainable Finance Talent Development and Strategy



HKUST study The Hong Kong Green and Sustainable Finance Talent Development and Strategy mapped out the key stakeholders, desired skill areas and knowledge progression path of the current green and sustainable market, providing employers, educators, and job seekers information of this up and rising sector to help guide the Hong Kong's strategy in sustainability talent development. The study included recommendations on professional certification, skills framework, engagement of scientific expertise, and compare different international practices, such as the UK's chartership bodies in delivering sustainability training, Singapore's approach in upskilling its public officials on sustainability, and European Union's emphasis on educating its workforce on regulatory changes.

Panel 1: Funding Projects at Scale in Asia-Pacific

The purpose of Panel 1 was to include a diverse group of business leaders who were engaged in developing green and sustainable projects in Hong Kong and the region to hear their perspective on successes and challenges.

Funding Projects at Scale in Asia-Pacific Panel

Johnny YU
Advisor to the chairman, Henderson Land

Stephanie LO
Executive Director, Shui On Management Limited

Lincoln PAN
Partner & Co-Head Private Equity, PAG

Eric YIP
General Manager, The Bank of East Asia, Limited

Kenneth LAM
Managing Director, Credit Agricole CIB

Moderator:
Prof. Christine LOH, SBS, JP, OBE
Chief Development Strategist, HKUST Institute for the Environment

Property development: new and existing buildings

Two property-related businesses based in Hong Kong shared their sustainability efforts and longer-term strategic thinking.

- **Henderson Land**

Henderson Land's top leadership adopted sustainability as a core principle, which included being climate-friendly and supporting community well-being. Its strategy, represented by the acronym "GIVE", encompassed *Green for Planet* (through adopting smart and climate-resilient building designs to enhance the adaptability of properties to the adverse effects of climate change and reducing the environmental impact and carbon footprint of business model), *Innovation for Future* (e.g. creating digital twins of their buildings for higher performance; and improving the surrounding areas of urban renewal projects), *Value for People* (e.g. care for staff and partners' health and safety, including improving indoor air quality in buildings), and *Endeavour for Community* (enhancing the living standards and proactively address stakeholders' needs). Henderson Land committed to SBTi,

which required measuring and reducing up-and-down stream emissions with targets and timelines. For a large property developer to go green and become socially sustainable, support from banks was essential – its standby loan facilities amounted to HK$28 billion from 10 banks in 2021. Two examples showed its commitment in sustainability: (i) the Kong Ha Wai transitional housing project to help alleviate adverse living conditions for those waiting for public housing in Hong Kong;[21] and (ii) receiving the Business Leadership in Sustainability Award at the Asia Pacific Leadership in Green Building Awards 2022, organized by the World Green Building Council.

- **Shui On Management Limited**

The built environment generates 40% of annual global carbon emissions. Of those, building operations were responsible for 27% annually, while building and infrastructure materials and construction (embodied carbon) contributed an additional 13% annually.[22] Shui On had rethought how to construct new buildings in more sustainable ways, such as through the extensive use of Modular Integrated Construction (MiC) technology[23] which also resulted in a safer working environment and faster construction time. Beyond new buildings, retrofitting existing buildings was essential to improving the aging building stock in Hong Kong. For example, Shui On was currently going through the retrofit of its 30-year-old flagship building, which would improve its performance when completed, and it would also benefit landlords and tenants. While necessary, obstacles to retrofitting buildings were considerable – such as getting agreement from multiple owners, disrupting leases and loss of income, and high capex for major hardware replacements. Shui On's strategy to creating a retrofit business had to first reduce the obstacles, such as promoting retro-commissioning services through creating software for building owners to manage energy and building operation better by using data, which is less disruptive and less costly. However, replacing air-conditioning systems and elevators could not be avoided because the performance of aged equipment could only improve by a small margin. Considering the importance of retrofitting buildings to the climate agenda, as well as refreshing the building stock, government policies were needed to incentivise owners. The HKSAR Government's scheme to subsidise the purchase of EVs could be adapted and applied to buildings retrofits for high gains for society and climate. Furthermore, a case could be made for the emissions reduction from retrofits to be considered carbon credits, which would be another incentive.

Panel 1 discussion

Finance under green pressure

PAG is a homegrown asset manager in Hong Kong operating across Asia with over 600 staff and over US$55bn in assets under management.[24] PAG emphasised the significance of the asset management industry to Hong Kong, and that it was a driver of growth in Asia. Many of PAG's investors – pension funds, insurance companies, sovereign wealth – had higher and higher ESG and climate expectations of not only PAG's own performance but also that of the 40+ companies it controlled and owned in its private equity portfolio. In fact, all investments were facing green pressure. Most large sources of capital expected return on capital and green performance and buying carbon credits was less optimal than businesses reducing their emissions and getting customers to compensate them for being green. A significant challenge was finding firms that could help measure and verify emissions data and green performance in a credible way to improve accountability and reduce "greenwashing". Thus, the opportunity for Hong Kong to lead on measuring and verifying emissions was very large, not only for local projects but also on projects on the mainland and elsewhere. Collaboration between the public and private sectors in tracking and reporting on data would make Hong Kong a leader in the field.

A mainland perspective

In considering the mainland market and Hong Kong's role, BEA's experience was that the mainland generally "Do Big Things Fast" and tended to overachieve. However, from a banker's perspective, in assessing risks, the key was to "do the small things right", the importance of which could be summarized using the acronym "E, F & G". "E" stood for green externalities. On the mainland today, "everyone is doing green" because that was a key national mandate. The market for EV

illustrated what could go wrong in going "Big and Fast". The mainland EV market had many companies producing many models, and most of them lose money. There would have to be painful consolidation. "F" stood for fingerprints, which was not just about data disclosure, but the data represented a pathway to re-engineer the economy. Going out 5, 10, 15 or 20 years, there would be tremendous transformation in technology, information processing, supply chains, and everything else – the mainland economy would be different and of higher quality. "G" was governance – it took time and effort to get things right. HKEX's efforts today with developing the carbon trading market could be an example of getting small things right in the green space and becoming a part of the transformation complementing what was happening on the mainland.

Financing green shipping

Credit-Agricole has a major ship finance business, including a base in Hong Kong, a city with a large community of shipowners and professionals in various parts of the shipping business. Financing shipping is a major business, as shipping carried 90% of international trade. There were about 60,000 ocean-going vessels carrying 12 billion tonnes of cargo in 2021. That fleet was worth US$1,400 billion. There were US$260 billion worth of new ships on order and capital expenditure of about US$80-100 billion per year. By 2030, the annual capex needed for renewal of the fleet was expected to be US$130 billion to US$150 billion, with Hong Kong being a base for a part of that business. Shipping contributed about 3% of global GHG emissions. The International Maritime Organization (IMO), which regulates shipping in international waters, announced targets for international shipping to reduce its emissions by half by 2050, with intensity reduction targets by 2030 of 40%.[25] Shipowners were busily collecting data and looking for ways to reduce emissions to meet IMO targets. It would become increasingly difficult for shipowners to raise finance if they could not improve their climate and sustainability performance.

Panel 2: Risks, Data, Trading and Talent

The purpose of Panel 2 was to introduce how innovation and technology (I&T) is impacting business, and that the climate transition and digitalisation was merging into new ways of assessing risks and opportunities, as well as transforming the need for new talent.

Risks, Data, Trading and Talent Panel

Jim TAYLOR
Senior Director, Planning & Development, CLP Power

Jason TU
Co-Founder and CEO, MioTech

Bénédicte NOLENS
Head, BIS Innovation Hub

Jenny LEE
Under-Secretary General, Hong Kong Green Finance Association

John LO
Founder, Asia Carbon Institute

Moderator:
Grace HUI
Adjunct Professor, HKUST Division of Environment and Sustainability

Energy and technology

The energy industry must change to meet the climate transition. CLP Power (CLP), the larger of two electricity suppliers in Hong Kong, has a history of making technology investments. It now has I&T investments in Israel, the United States and mainland China. A major example of CLP's investment history was its investment in HKNIC nearly 40 years ago in the Daya Bay Nuclear Power Plant across the border that had been providing, clean, stable, and affordable zero-carbon electricity to Hong Kong. Another example was Smart Charge, a joint venture between CLP and HK Telecom in 2016 to provide EV charging in Hong Kong. CLP, a member of *Free Electrons*, worked with other leading utilities around the world to enable start-ups to pilot projects, deploy products, and facilitate investment opportunities.[26] CLP Innovation Enterprises Limited could be considered a corporate-sponsored start-up focused on using decarbonisation and digitalisation to help turn CLP, a traditional energy utility, into a digital company and transform the energy market.

Data and technology

MioTech, a Hong Kong homegrown company, started life in fintech and became a data and carbon technology service with 300 employees focused on Asia.[27] The market had been growing quickly – in 2020, there were only 108 listed companies in Hong Kong that had set carbon targets but by 2021, the number had grown to 651 (out of ~2,500). There were three pressure points for companies to start reporting – pressure from regulators, clients, or bankers and investors. While companies were willing to report but those that had not

Panel 2 discussion

reported before did not have the data or had not digitalised their data. MioTech would offer them the software to do so, and to promote the concept of data value chain on how to collect, manage, compile, and manage data. Once companies started the process, they would want to benchmark and compare themselves with their peers, and then to get ready to disclose information internally and then externally. MioTech saw its business as part of the building bricks of a whole new ecosystem in climate and sustainability technology.

Innovation in finance using technology

Bank of International Settlement Innovation Hub (BISIH) in Hong Kong collaborates closely with HKMA. It worked on Project Genesis 1.0 and 2.0 to demonstrate the art of the possible by making the green finance market more transparent, efficient, and effective using innovation technology and public-private partnerships. Project Genesis 1.0 focused on improving the transparency and access to the government green bond market by retail investors. Two prototypes were developed using both a public blockchain and a permissioned blockchain to allow retail investors to trade tokenised green bonds and track the environment impact through an app, with the possibility to integrate with the HKSAR's *iAM Smart* and *Octopus* which had established large footprints and community acceptance.[28] Project Genesis 2.0 explored the use of blockchain, smart contracts, and IoT to tackle greenwashing in the green bond market by attaching digitised carbon forwards to a green bond, and to transform the carbon market from an ex post reward to an ex ante enabler for green project.[29] BISIH also emphasised the value of human relations beyond data and technology because the sustainability and climate transition required the contribution and cooperation of many types of knowledge and experience, which could only be mastered through dialogue and collaboration.

Finance and green training

Hong Kong Green Finance Association (HKGFA) is a non-profit that provides a platform to facilitate the development of green finance and sustainable investments in Hong Kong, and beyond through mobilising public and private resources and talent.[30] As a green finance industry emerged in Hong Kong, members of HKGFA focus on leading and hosting industry dialogue in advising and harmonising sustainability policies and frameworks, building capacity, including promoting the emergence of green I&T, advocating the unifying of common standards through *Common Ground Taxonomy* and ISSB, and developing educational programs for market professionals to upgrade their knowledge (such as through collaboration with HKUST to run a certificate course in sustainable finance) to satisfy near-term needs. Deepening the collaboration and capacity of sustainability talent across the ecosystem is essential to accelerating sustainable finance to support a corporate's transition to Net Zero. HKGFA will continue working with the HKSAR Government, policymakers, regulatory bodies and the private sector to advance Hong Kong's role as a leading green and sustainable financial hub.

Standards setting for Asia

Asia Carbon Institute (ACI),[31] a brand-new non-profit based out of Singapore and Hong Kong, intended to fill a gap in Asia to create standards for voluntary carbon credits and to ensure harmonization with international standards. The intention of ACI is to accelerate the climate transition, and carbon credits were seen as an accelerant to fund projects that otherwise could not be financed, such as building retrofits. While there were already international carbon credit standards by such organizations as VERRA and The Gold Standard,[32] they were developed primarily with nature-based solutions in mind, such as protecting forests. Such credits would be limited in quantity. Asia needed to have credible projects that suited their circumstances – high density cities, and heavy in manufacturing – hence ACI would focus on projects that brought additionality to green projects in urban settings. Moreover, only by having an organization with Asia's development in mind and with knowledge about Asian economies, would it be possible to also help generate jobs and develop talent on the ground in Asia.

1. HKMA performs central banking functions in Hong Kong and regulates banks, SFC regulates Hong Kong's securities and futures markets, and HKEX is the stock exchange and determines the listing of companies.
2. The 2022-23 Budget earmarked HK$200 million for a pilot training scheme to provide subsidies to eligible persons to help build up the local green and sustainable finance talent pool. On 13 December 2022, the government announced the three-year Pilot Green and Sustainable Finance Capacity Building Support Scheme for Hong Kong residents who are market practitioners and prospective practitioners of green and sustainable finance. The subsidy covers 80%-100% of the relevant fees subject to a ceiling of HK$10,000. The scheme is administered by the Centre for Green and Sustainable Finance (CGSF), a public-private collaboration platform launched under the Green and Sustainable Finance Cross-Agency Steering Group, see also Chapter 4 for background.
3. For internship scheme, see https://www.hkma.gov.hk/eng/key-functions/international-financial-centre/green-and-sustainable-finance/gsf-internship-opportunities/.
4. For details, see https://www.hkma.gov.hk/media/eng/doc/key-information/guidelines-and-circular/2022/20221209e3a1.pdf.
5. See https://www.hkma.gov.hk/eng/news-and-media/press-releases/2022/06/20220621-5/.
6. Ibid.
7. Green Bond Programme, see https://www.hkgb.gov.hk/en/greenbond/greenbondintroduction.html.
8. For Shenzhen and Hainan's sustainability bonds, see https://www.info.gov.hk/gia/general/202210/24/P2022102400500.htm.
9. For details of HKMA's 2021 stress test, see https://www.hkma.gov.hk/media/eng/publication-and-research/quarterly-bulletin/qb202203/fa2.pdf.
10. For details on SFC's policies, see https://www.sfc.hk/-/media/EN/files/COM/Reports-and-surveys/SFC-Agenda-for-Green-and-Sustainable-Finance_en.pdf.
11. For background on ISSB, see https://www.ifrs.org/groups/international-sustainability-standards-board/.
12. HKEX joined the Glasgow Financial Alliance for Net Zero (GFANZ) and the Net Zero Financial Service Providers Alliance (NZFSPA) in 2021 as part of its ongoing commitment to the long-term sustainable development of global financial markets to meet the goals of the Paris Agreement.
13. See https://www.hkbea.com/html/en/index.html.
14. Power Assets Holdings Limited is a global investor in energy and utility-related businesses with investments in electricity generation, transmission and distribution; renewable energy; energy from waste; gas distribution and oil transmission, see https://www.powerassets.com/en/about-us.
15. For details see https://www.hkstp.org/.
16. A hurdle rate is the minimum rate of return required on a project or investment. Hurdle rates give companies insight into whether they should pursue a specific project.
17. SBTi stands for Science Based Targets Initiatives, and it guides organizations how much and how quickly they need to reduce their GHG to help prevent the worst effect of climate change, see https://sciencebasedtargets.org/.
18. See https://www.dunwellgroup.com/.
19. For details, see http://www.olympuscap.com/en/about-us/.
20. For the report, see https://hkust.edu.hk/news/teaching-and-learning/hkust-study-outlines-blueprint-green-and-sustainable-finance-talent.
21. For details of the Kong Ha Wai project, see https://sustainability.hld.com/en/highlights-achievements/stories/transitional-housing.
22. For details, see https://architecture2030.org/why-the-building-sector/#:~:text=The%20built%20environment%20generates%2040,for%20an%20additional%2013%25%20annually.
23. For details, see https://mic.cic.hk/en/AboutMiC.
24. For details on PAG, see https://www.pag.com/en/.
25. For details, see https://www.imo.org/en/MediaCentre/PressBriefings/pages/DecadeOfGHGAction.aspx.
26. For details, see https://freeelectrons.org/.
27. See https://www.miotech.com/en-US.
28. See https://ww.bis.org/.
29. See https://www.bis.org/press/p211104.htm.
30. For details, see https://asiacarboninstitute.org/.
31. For details, see https://www.hkgreenfinance.org/association-overview/.
32. VERRA and The Gold Standard are two well-known organizations that set the standard for climate interventions to quantity, certify and maximise their impacts.

OBSERVATIONS

1. Cross-cutting collaboration is seen as essential across public and private sector stakeholders because climate change and sustainability are complex and require the fusion of different knowledge fields to understand how to achieve strong performance in the economy.
2. Hong Kong's economy needs to expand talent and capability in sustainability, not just with respect to green finance since finance complements other activities in the economy.
3. Data and digital go together. The drive to achieve Net Zero and sustainability requires organizations to handle data through digital means. Technology is evolving and fusing "Green-Climate-Prop-FinTech" with implications across the economy, including the government sector.
4. Traditional industries, such as energy, property, manufacturing, shipping, banking etc are becoming digital companies, and digital companies are becoming consulting services to helping others make sense of using data and digital technologies.
5. Standard setting and best practices could come out of Asia, as the circumstances of Asia's development going forward are different from those in developed economies.

RECOMMENDATIONS

1. Mainstreaming of climate and sustainability within the government bureaucracy would help the HKSAR Government to enable officers in science, environment, housing, planning and development, as well as infrastructure to work more closely with those in industry, commerce, I&T, transport, and finance because climate and sustainability represent a powerful, long-term global and national overarching driver of change (see also Chapters 3 and 4).
2. Improve internal mainstreaming could be complemented by external communication to enable the work of the HKSAR Government to be better communicated to the pubic and to private sector stakeholders (see Chapter 3).
3. The soon-to-be created role of Commissioner for Climate Change under EEB could be the government unit that coordinate the mainstreaming and proper communication of the government's climate related work in a broad and compelling way.

CHAPTER 7

Workshop: Scholars' Day

Exchange of scholarship

WATCH VIDEO https://care.hkust.edu.hk/Video_Ch7

The purpose of Day 2 of CARE2022 was for university scholars to present their research work and to exchange views in areas that have relevance to climate adaptation and resilience. The topics of exchange aligned with adaptation challenges most relevant to Hong Kong and the GBA.

KEYNOTE:

Landslide and Slope Safety

by Prof. Charles Ng (CLP Holdings Professor of Sustainability, Department of Civil and Environmental Engineering, HKUST)

The presentation was based on public sector funded research done in collaboration with GEO/CEDD to understand the critical aspects of debris flows. Debris flows are a type of fast-moving landslides on hillsides that are particularly threatening because they are highly destructive and often strike without warning (have poor temporal prediction). They generally occur during periods of heavy rainfall, and they can travel at high speed, carrying boulders and trees, sweeping everything else on its way. Studies in Hong Kong aim to use the knowledge to design and create effective ways that could mitigate their destructive capabilities through constructing multiple, flexible barriers that could act as brakes.

Charles Ng, HKUST

SESSION 1

Dealing with Excess Water Challenges

1. **Sponge cities in China – advances and challenges**
   Prof. Haifeng Jia (School of Environment, Tsinghua University, Beijing, CUHK)

Haifeng Jia, Tsinghua University

A consequence of urbanisation is increased urban run-off that contribute to urban flooding all over the world. The traditional way to deal with urban run-off is to build concrete channels to carry the excess water away as quickly as possible. The new sponge city concept takes a completely different approach by 'living with nature' and requires fundamentally different design and implementation techniques. China's approach has gained international attention. While the central government promote sponge city since 2013, local authorities have been responsible for implementation. The major challenges include insufficient knowledge, coordinating many disciplines and agencies for a project, how to quantify cost effectiveness, obtaining enough finance, and training of talent.

2. **Clustering catastrophic weather events from India to China to Canada during COP27**
   Prof. Mengqian Lu (Department of Civil and Environmental Engineering, HKUST)

The presentation explained a new phenomenon of extreme precipitation events that occurred in October-November 2021 that brought floods and blizzards across the world. Those events were connected to an intraseasonal/Asian/North American (ANA) teleconnection (climate variability links between non-contiguous geographic regions) consisting of the South Asia High, East Asia Low, Okhotsk-Bering Sea High, Gulf of Alaska Low, and California High. The ANA teleconnection is a new route by which El Niño-Southern Oscillation (ENSO) and Madden-Julian Oscillation (MJO) may affect North America. It differs from Pacific/North American (PNA) teleconnection that is strongly influenced by ENSO-induced central Pacific precipitation anomalies. PNA features the anomalous Gulf of Alaska and Aleutian Low (High) during El Niño (La Niña). Thus, the Gulf of Alaska Low in ANA eminent during the 2021 La Niña is not a PNA response to the central Pacific heating associated with ENSO. Instead, the ANA teleconnection is coerced by the "wet India-dry Philippines" dipolar heating resulting from the multi-scale interaction between the rapidly developing La Niña and the quasi-stationary MJO. Numerical experiments affirmed that the "wet India-dry Philippines" dipolar precipitation heating fortifies ANA teleconnection by generating two cross-Pacific wave trains. Indian heating induces a subtropical cross-Pacific wave train along the jet stream. In contrast, the Philippine heat source stimulates a midlatitude circum-Pacific wave train under November mean state. The combined effects of the dipolar heating during late Fall are demonstrated for the first time. The study of clustering extreme precipitation events provides a new perspective on examining future precipitation variability by emphasizing the clustering extreme precipitation events with escalated compound impact beyond their simple addition. Besides, the sequential clustering of extreme events might offer a predictability source because their favourable atmospheric precursors stem from the tropics associated with the rapid La Niña cooling. It also poses a question of whether there are ongoing changes in the routes of how the tropics and extratropics interact.

3. **Accelerated intensification of extreme rainfall at urban scales**
   Prof. Shaoming Shi, (Division of Environment and Sustainability, HKUST)

Precipitation extremes can cause flooding and landslides, which bring substantial economic and societal losses. Under global warming, the intensity of precipitation events is expected to be generally strengthened, but quantitative prediction remains challenging, especially in tropical regions. This uncertainty is challenging for city authorities to make the most cost-benefit-and effectiveness decisions regarding climate adaptation. The challenges are rooted in the multiscale nature of convective weather systems and the limitation of computing resources for resolving all scales.


Shaoming Shi, HKUST

Using flexible modelling tools for producing regional climate predictions with a cloud-resolving resolution, scientists found that the strengthening of tropical cyclone precipitation due to warming may be several times higher than previous estimations at spatial and temporal scales relevant to cities. More research are needed to understand this accelerated intensification at urban scales and its implications for urban infrastructures.

4. **Sea level rise and storm surge risks**
   Prof. Zhenning Li (Division of Environment and Sustainability, HKUST)

With a long and meandering shoreline and well-developed economy, Hong Kong is highly vulnerable to tropical cyclone (TC)-caused storm surges. The current global warming is expected to continue or even worsen in the rest of the 21st century. Therefore, the warmer sea surface temperature (SST) and lifted mean sea level tend to fuel much more ferocious storm surges. We use regional air-wave-ocean coupled simulations to reproduce three severe landfalling TCs affecting Hong Kong. The present-day and global warming context mimicking the 2090s has been simulated to investigate the effect of climate change. The 2090s status will effectively increase the intensity of the severe TCs and related storm surges. On average, the maximum storm surges are lifted by 0.3-0.8 meters over the open sea while aggravating much higher along the coastline, especially for narrowing estuaries where the maximum surge level can be elevated up to 2 meters. Changes in maximum significant wave height show more complicated patterns due to their sensitivity to TC tracks. For Typhoon Vicente (2012), a more than 2-meter wave height increase is observed both in the open sea and along the coastline. In the 2090s context, a combination of mean sea level rise, storm surge, and wave height can reach more than 4 meters increase in total water level at certain coastal hot spots. This will cause much more severe damage and losses at the end of the 21st century.


Zhenning Li, HKUST

SESSION 2

Forestry, Heat Stress, Infrastructure and Health

1. **Forests in climate mitigation, adaptation and resilience**
   Dr. Billy Hau (School of Biological Sciences, HKU)


Billy Hau, HKU

Hong Kong's Climate Action Plan 2050 does not include nature-based solutions among its decarbonisation strategies. In fact, a growing forest absorbs carbon. In years past, Hong Kong was wholly covered by tropical forests, which over time have become degraded through human settlement and urbanisation. Today, only ~29% of the total land area is forested. It is estimated that this is equivalent to about 48.2 million tonnes of carbon. The secondary vegetation is made up of grassland (15%) and shrubland (21%). It is possible to reforest these areas. Estimates show that if these areas were reforested, in 15 years i.e., by 2038, there could be a gain of 6.97 million tonnes of carbon. It is not yet possible to estimate accurately the annual carbon capture by Hong Kong's forest because of lack of information on wood density and diameter-height relationship of the diverse tree species in Hong Kong.

On-going research will enable better estimation to show what annual contribution there could be from wider reforestation of all undeveloped areas in Hong Kong, which also have other benefits, such as disaster risk reduction (landslides); improving the natural environment for outdoor activities; capturing more rainwater for our reservoirs and restoring degraded environment for the benefits of biodiversity, and public enjoyment, as planting trees is also a popular community activity."

2. **Hot and dry extremes under different emissions scenarios**
   Prof. Eun-soon Im (Department of Civil and Environmental Engineering, HKUST)

Eun-soon Im, HKUST

Amid the faster-than-expected pace of global warming, a higher probability of concurrent hot and dry extremes is expected because warmer temperatures tend to aggravate surface drying due to enhanced atmospheric moisture demand. In particular, south-eastern China has witnessed concurrent hot and dry extremes increasing over the past few decades. Its foreseeable intensification will aggravate economic losses and people's well-being. The presentation focussed on a study assessing the joint probability of concurrent hot and dry extremes in China based on fine-scale future climate projections. It showed that uncommonly high hot and dry extremes characterised by 80-year return period under the current climate will become a new normal if fossil-fuelled development were to continue. In addition, a comparative analysis of future projections under different emission scenarios clearly illustrated the benefits of climate change mitigation.

3. **Overheating and energy insecurity in Hong Kong's vulnerable population**
   Prof. Laurence Delina (Division of Environment and Sustainability, HKUST)

Laurence Delina, HKUST

Energy demand, especially for cooling, will continue to increase with more frequent and prolonged hot days and hot nights. Already vulnerable persons, households, and social groups are at risk of being energy insecure in their homes or at places they work at. Energy insecurity – which is about lack of access to and unaffordability of safe and sustainable energy – occurs across several forms of energy services from lighting to cooking to cooling, as well as for technological, medical, and other life-sustaining devices. Yet, the HKSAR Government does not recognize this type of deprivation in its official statistics and energy policy. With little attention given to energy insecurity in the city's research and policy landscapes, this talk discussed an RGC-funded project that uses mixed-method research to address these gaps. The study's outputs will lead to novel insights that can provide inputs into future decision- and policymaking aimed at recognizing and addressing energy insecurity in Hong Kong.

4. **Temperature, air quality and health – implication for future climate**
   Prof. Xiang-qian Lao (JC School of Public Health and Primary Care)


Xiang-qian Lao, CUHK

Climate change and air pollution may have serious impacts on public health. The presentation discussed the individual and combined health impacts of temperature and air pollution based on previous studies. Two studies conducted in Guangdong Province showed that temperature extremes (including cold spells and heat waves) could significantly increase the risk of death, especially in elderly people. Air pollution is one of the greatest environmental risks to health in the world, accounting for 7 million deaths annually; and that there is a clear connection between air pollution and climate change. One of the studies showed that climate and weather had strong influences on the spatial and temporal distribution of air pollution concentrations, causing indirect impacts on public health. Scientific evidence worldwide showed that climate change was impacting humans. Establishment of warning systems could be adopted as short-term strategies but in the long run, the aim should be to reduce emissions, improve air quality and ultimately mitigate climate change.

5. **Infrastructure planning for a more climate resilient urban system**
   Prof. Zhongming Lu (Division of Environment and Sustainability, HKUST)


Zhongming Lu, HKUST

The presentation showcased a study of green infrastructures and how they help to prevent flooding as well as 'cool' the city, using Kowloon as the focus. The study used a systems-level understanding of urban infrastructures with respect to climate adaptation and resilience. Such an understanding could only be achieved through transdisciplinary and converging research that integrated knowledge about the functionalities of technology, people and the environment. The study presented new analytical tools and findings that could hopefully contribute to stakeholder discussions and decisions about transforming the urban infrastructure systems.

6. **City-level and international collaborative projects for climate adaptation in China**
   Ye Pan (Division of Public Policy, HKUST)


Ye Pan, HKUST

Managing climate change risks requires not only long-term mitigation efforts, but also immediate adaptation actions. However, climate adaptation and risk management remain much lower on China's domestic policy agenda than climate mitigation. With their lack of experience, expertise, and resources for climate change adaptation, many municipal governments in China try to establish partnerships with international institutions, which may bring a variety of governance resources, including financial support, technical assistance, and capacity building. By collecting over 200 international collaboration projects on climate adaptation in China and classifying them based on five dimensions: implementation level, adaptation area, function of international collaboration, form of international collaboration, and spatial distribution, this study provides a general landscape of China's international collaboration related to climate adaptation.

CLOSING KEYNOTE

Preparing for the Unknown

by Prof. Alexis Lau (Division of Environment and Sustainability, HKUST)

Alexis Lau, HKUST

Climate change adaptation as an iterative risk management process. There are known climate risks and there are unknown risks. Models are useful to assist thinking about the range of possibilities. Other methods are needed because models are unable to predict every risk that might happen. This presentation discussed tertiary climate risks that are indirect and nonlinear with unpredictable consequences because of climate change, and hence hard to prepare for. Examples discussed included wildfires, potholes, and deaths from heatwaves. A study is underway at HKUST to create an adaptation and resilience database that contains global news items using AI/Natural Language Processing to understand the consequences of what happened in different locations and cases from around the world. The presentation discussed the methodology used to collect data and information, and concluding that there could be co-learning and collaboration from around the world to adapt and build resilience.

Abbreviations

ACI	Asia Carbon Institute
AFCD	Agriculture, Fisheries and Conservation Department
APEC	Asia Pacific Economic Cooperation
AR5	IPCC Fifth Assessment Report
AR6	IPCC Sixth Assessment Report
ArchSD	Architectural Services Department
AVA	Air Ventilation Assessment
BEA	The Bank of East Asia, Limited
BISIH	Bank of International Settlement Innovation Hub
CARP	Climate Adaptation and Resilience Plan of Hong Kong International Airport
CCEX	China Emissions Exchange
CCWGI	Climate Change Working Group on Infrastructure
CEDD	Civil Engineering and Development Department
CGSF	Centre for Green and Sustainable Finance
CLP	CLP Power Hong Kong Limited
COP	Conferences of the Parties
DEVB	Development Bureau
DSD	Drainage Services Department
DWG	Data Working Group of Centre for Green and Sustainable Finance
EEB	Environment and Ecology Bureau
EHWE	Extreme Hot Weather Event
FSD	Fire Services Department
GBA	Greater Bay Area
GEO	Geotechnical Office
GGA	Global Goal on Adaptation
GHG	Greenhouse gases
HA-HD	Housing Authority-Housing Department
HKEX	Hong Kong Exchanges and Clearing Limited
HKGFA	Hong Kong Green Finance Association
HKIA	Hong Kong International Airport
HKMA	Hong Kong Monetary Authority
HKO	Hong Kong Observatory
HKSTP	Hong Kong Science and Technology Park
HN	Hot Night
IFRC	International Federation of Red Cross and Red Crescent Societies
IMO	International Maritime Organization
IPCC	Intergovernmental Panel on Climate Change
ISSB	International Sustainability Standards Board
I&T	Innovation and Technology
MiC	Modular Integrated Construction
NDA	New Development Area
OHL	Overhead Lines
PlanD	Planning Department
RCP	Representative Concentration Pathway
Shui On	Shui On Management Limited
SFC	Securities and Futures Commission
UHI	urban heat island
UNFCCC	United Nations Framework Convention on Climate Change
WCPS	Wetland Conservation Parks System
WMO	World Meteorological Organization
WSD	Water Supplies Department
VHD	Very Hot Day

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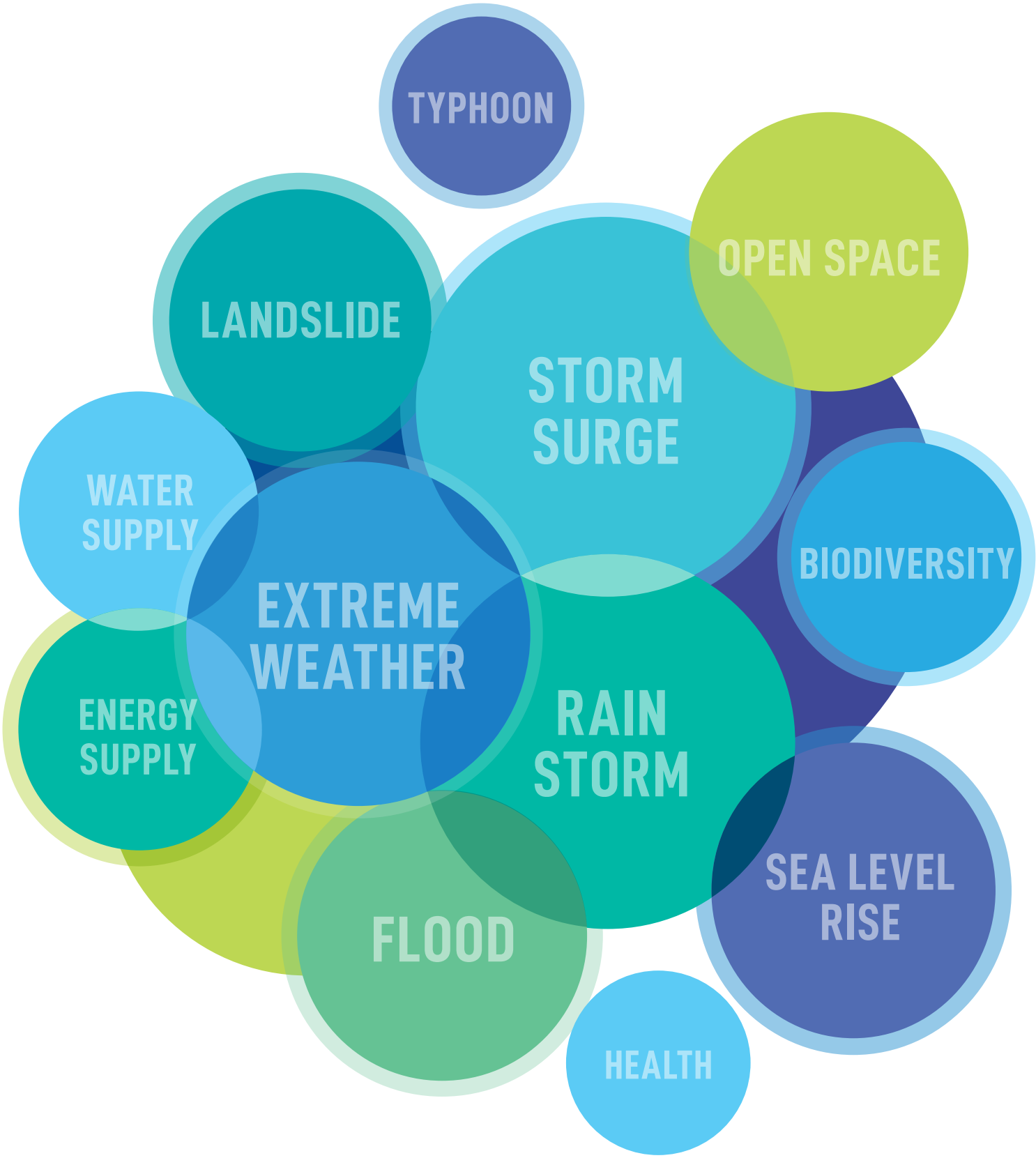

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