

# Resilient city: Hong Kong

Extreme heat as a result of climate change



# Foreword

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Businesses worldwide are facing an increasingly complex and interconnected risk landscape as a result of natural and man-made perils, such as climate change, extreme weather, globalisation and urbanisation – how they respond can be business critical. Currently, approximately 55% of the world's population live in urban areas. This number is expected to increase to 68% by 2050.<sup>1</sup>

Clyde & Co is committed to supporting initiatives which facilitate greater resilience in the developed world and emerging markets. Clyde & Co's Resilience Campaign examines a number of these complex issues, helping businesses understand the latest thinking on risk management, the regulatory landscape and what the future may hold.

This report is part of a series looking at how cities around the world are responding to three seismic megatrends: climate change, urbanisation and globalisation. It is increasingly acknowledged that cities will have to be at the forefront of adapting to change.

This report discusses the challenges faced by Hong Kong, in particular extreme heat as a result of global warming exacerbated by urbanisation and population density. It examines some of the measures that are being taken to help tackle the problem of extreme heat in order to build greater resilience.

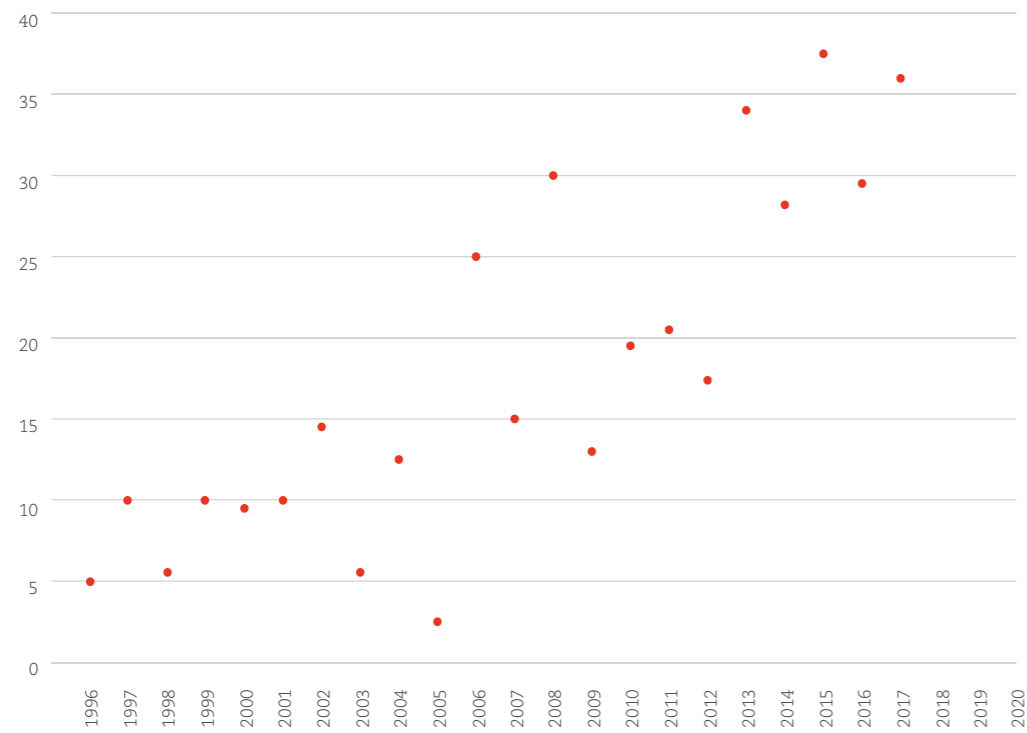
<sup>1</sup> <https://www.un.org/development/desa/en/news/population/2018-revision-of-world--prospects.html>



The gradual increase in days designated by the HKO to be “very hot” can be observed in the table below.

The recent change in climate in Hong Kong is alarming and measures need to be taken to address this issue.

**Number of very hot days by year<sup>7</sup>**  
1996 to present



<sup>7</sup> Data obtained from HKO at [https://www.hko.gov.hk/cis/statistic/vhotday\\_statistic\\_e.htm](https://www.hko.gov.hk/cis/statistic/vhotday_statistic_e.htm)





# Causes of extreme heat

Climate change is one of the defining issues of our time. Its effects are already being felt around the world. In both the 2018 and 2019 Global Risks Report, the World Economic Forum listed “extreme weather events” as the top global risk.<sup>8</sup>

The location of Hong Kong means that it already has a sub-tropical climate. However due to climate change and an increase in population density, it means that hotter summers are on the rise.

Over the last 100 years the annual number of very hot days and hot nights has increased significantly: by six times and 35 times respectively.

– Lee Sai-ming, Senior Scientific Officer of the HKO

### 1. LOCATION

Hong Kong is located at the south-eastern point of China and is also a coastal port with a long coastline. More importantly, Hong Kong is situated south of the Tropic of Cancer and experiences subtropical climate throughout the year. This means that summers are generally hot and humid and winters are mild. Coupled with the fact of being surrounded by water, Hong Kong is located on traditional typhoon tracks which make it particularly susceptible to the possibility of increased and more severe typhoons as a result of climate change.

Typhoons, or tropical cyclones, are formed and derive their energy from large areas of warm seawater. The HKO notes that “sea surface temperatures of at least 26°C would favour the formation of tropical cyclones.”<sup>9</sup> This phenomenon occurs as evaporation causes warm water vapour to release heat (“latent heat”) that in turn provides energy for the formation of tropical cyclones. The increase in moisture in the air (as water evaporates more quickly due to an increase in air temperature) over the ocean creates an area of low air pressure and results in heavier air swirling above this area. The HKO further highlighted that super typhoons were more common now than they were between 1961 and 2010.<sup>10</sup> Rising sea surface temperature is expected to intensify both the frequency and intensity of tropical cyclones in Hong Kong.



<sup>9</sup> [https://www.hko.gov.hk/education/article\\_e.htm?title=ele\\_00151](https://www.hko.gov.hk/education/article_e.htm?title=ele_00151)

<sup>10</sup> <https://www.scmp.com/news/china/society/article/2164262/how-climate-change-could-cause-more-mega-storms-super-typhoon>

## 2. CLIMATE CHANGE / GLOBAL WARMING

The underlying cause of extreme heat is global warming caused by heat being trapped in the Earth's atmosphere and thereby increasing the temperature.

The primary greenhouse gas which contributes to global warming is carbon dioxide, which is emitted through plant and animal respiration as well as human activities like the burning of fossil fuels for power and emissions from shipping, aircrafts and motor vehicles. Human activities play the largest role in generating greenhouse gases. It is estimated that 1°C of global warming since the industrial revolution is attributable to human activities.<sup>11</sup>

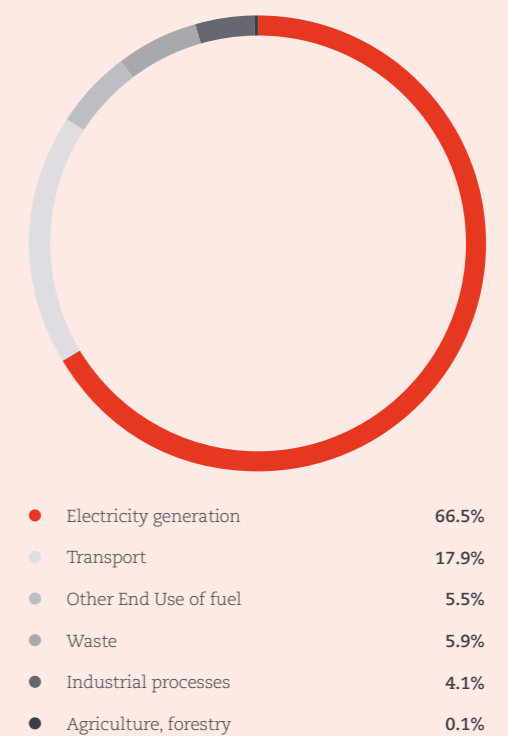
Scientists have noted that "severe heatwaves will become more frequent because of global warming."<sup>12</sup> Attribution scientists have compared and analysed today's climate with those of the natural climate and are of the opinion that intense heatwaves are more likely to occur as a result of climate change.<sup>13</sup>

The Special Report: Global Warming of 1.5°C (published by the International Panel on Climate Change) sets out the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways. The adverse effects resulting from climate change on Hong Kong, particularly extreme heat, will be further discussed in this report.

## GREENHOUSE GAS EMISSION IN HONG KONG

Since 1999, there has been a steady rise in Hong Kong's greenhouse gas emissions across different sectors. The Legislative Council Secretariat noted that the greenhouse gas emissions increased by a total of 35% in 14 years to a record high of 45 million tonnes in 2014.<sup>14</sup> In Hong Kong, the major source of greenhouse gas emission is electricity generation. In 2016, electricity generation accounted for 66.5% of the total greenhouse gas emission in Hong Kong,<sup>15</sup> outweighing the next largest emission source (transport sector) by approximately 40%. Other sources such as waste treatment, industrial processes and product use, agriculture, forestry and other land use are also major contributors to the rising temperature and greenhouse gas emissions in Hong Kong.

Greenhouse gas emissions in Hong Kong by sector, 2016<sup>16</sup>



**41,900**

total emissions, kilotonnes CO<sub>2</sub>-e

11 Special Report: Global Warming of 1.5°C (published by the International Panel on Climate Change)

12 <https://www.nature.com/articles/d41586-018-05849-9>

13 <https://www.metoffice.gov.uk/about-us/press-office/news/weather-and-climate/2018/2018-uk-summer-heatwave>

14 <https://www.legco.gov.hk/research-publications/english/1617ishh21-greenhouse-gas-emissions-of-hong-kong-20170314-e.pdf>

15 [https://www.climate.gov.hk/files/pdf/HKGHG\\_Sectors\\_2016.pdf](https://www.climate.gov.hk/files/pdf/HKGHG_Sectors_2016.pdf)

16 [https://www.climate.gov.hk/files/pdf/HKGHG\\_Sectors\\_2016.pdf](https://www.climate.gov.hk/files/pdf/HKGHG_Sectors_2016.pdf)

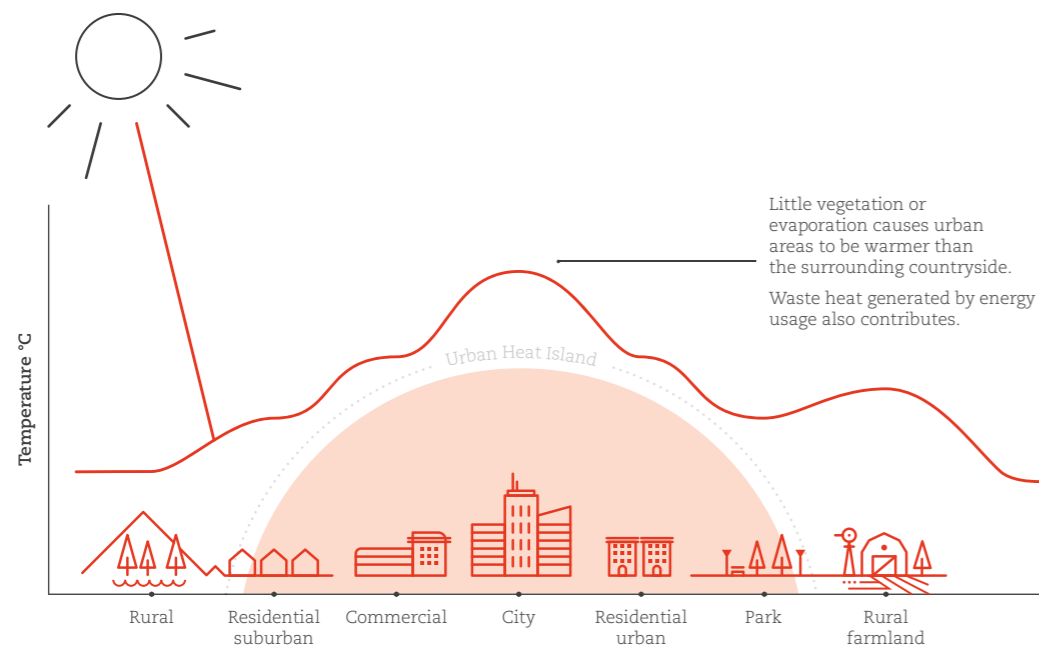
### 3. URBANISATION / POPULATION DENSITY

The “urbanisation effect”<sup>17</sup> is a broad term which encompasses many areas including human activities, land use changes, as well as dense building developments (closely related to the wall effect in Hong Kong as discussed below). A consequence of urbanisation is the creation of the Urban Heat Island effect (“UHI effect”), which describes the situation where the cooling rate in urban areas is slower than that in rural areas.

Not only do high-rise, high-density buildings in Hong Kong block and hinder heat release to higher atmospheres, the high heat capacity of these buildings also absorbs and stores heat energy. Furthermore, high-rise buildings reduce wind speed and slow down the cooling process within the vicinity of Hong Kong. These factors result in higher temperatures in urban areas than that of rural areas.

A further impact of the high population and building density in the city is the “wall effect”. This generally refers to high density and compact building bulk affecting ventilation to residents living in the vicinity.<sup>18</sup> The wall effect results in heat being trapped in urban areas, leading to a hot and stifling environment.

#### Urban Heat Island effect



17 [https://www.hko.gov.hk/climate\\_change/urbanization\\_e.htm](https://www.hko.gov.hk/climate_change/urbanization_e.htm)

18 <https://www.legco.gov.hk/yr07-08/english/panels/plw/papers/dev0122cb1-605-4-e.pdf>

### HONG KONG HOUSING MARKET

Hong Kong possesses the most expensive housing market in the world<sup>19</sup> and it is increasingly difficult for the elderly to find and afford acceptable living conditions due to financial constraints. In many cases, the elderly and those with low income live in small, subdivided flats. The small size of these subdivided flats, inadequate cooling mechanisms and poor ventilation systems result in the hot conditions, which is compounded by heat emitted from cooking and electrical appliances. The temperature within these subdivided flats is usually much higher than the recorded temperature outside. For example, a 100 square foot subdivided flat in Kwun Tong recorded a temperature of 35.7°C whilst the recorded temperature of the region at the time was measured to be 30.7°C by the HKO.<sup>20</sup>

The high electricity fees charged also mean that people are reluctant to turn on their air conditioning units, thereby further preventing cooling within a flat. A solution to this problem is public housing flats, however, available public housing flats are limited and the waiting time is often very long. On average, elderly applicants are faced with a waiting time of 2.9 years, whereas families are expected to wait for 5.5 years as of March 2019.<sup>21</sup>

19 <https://www.scmp.com/business/article/2182980/nothing-be-proud-hong-kong-tops-table-worlds-most-expensive-housing-market>

20 <https://www.scmp.com/news/hong-kong/article/1295980/poor-forced-outside-subdivided-flats-sizzle>

21 <https://www.housingauthority.gov.hk/en/about-us/publications-and-statistics/prh-applications-average-waiting-time/index.html>



# Effects of extreme heat

The rise in temperature does not simply mean a reduction in winter clothing or an increase in demand for air-conditioning units/fans, but also brings about serious health risks and economic repercussions.

## 1. HEALTH

Heat stress is a condition which occurs when heat causes pressure/discomfort to the human body and is influenced by air temperature, relative humidity, wind speed as well as solar radiation.<sup>22</sup> The human body generates heat energy and a healthy temperature is maintained through the process of sweating and evaporation. An extreme heat environment is linked to serious health issues such as heat cramps, dizziness, nausea, fainting, as well as deaths from heat exhaustion, stroke, and cardiovascular disease. To highlight the seriousness of extreme heat, research jointly conducted by researchers from the Hong Kong Polytechnic University and the Chinese University of Hong Kong found that in a full week with at least five hot days and nights, there was a 15.6% increase in deaths.<sup>23</sup>

The likelihood of these heat-related conditions is increased in Hong Kong where the air temperature and humidity levels are particularly high. Both high temperature and humidity can affect the rate of sweat evaporation and hinder the human body's ability to cool down.

Additionally, climate change increases the rate of transmission and geographical range of various infectious diseases. For example, incidences of dengue fever have risen in Hong Kong as well as some other Asian countries. Dengue fever is an acute mosquito-borne infection caused by the dengue viruses, which leads to symptoms including high fever and severe headache. In serious cases, it may cause circulatory failure, shock and even death.<sup>24</sup> According to experts, dengue fever is becoming more prevalent as a result of climate change because the rise in temperature reduces the time required for mosquitoes to mature, increases their biting activity, shortens their dormancy period and shortens the rate at which the dengue virus matures within them.<sup>25</sup>

<sup>22</sup> [https://www.hko.gov.hk/education/edu01met/wxphe/ele\\_heat-stress\\_e.htm](https://www.hko.gov.hk/education/edu01met/wxphe/ele_heat-stress_e.htm)

<sup>23</sup> <https://www.scmp.com/news/hong-kong/health-environment/article/2105568/hot-summer-nights-could-be-bigger-killers-daytime>

<sup>24</sup> <https://www.chp.gov.hk/en/healthtopics/content/24/19.html>

<sup>25</sup> <http://www.enb.gov.hk/sites/default/files/pdf/ClimateChangeEng.pdf>

## 2. MENTAL WELL-BEING

Rising temperatures may also have a negative impact on mental health. A study conducted by Red Cross Hong Kong on the consequence of heat on the low-income and elderly population shows that extreme heat affects people's everyday life. It often reduces the time they can spend outdoors and makes them feel lonely.<sup>26</sup> Another recent study led by the University of Hong Kong revealed a link between higher temperatures and the rate of suicide among senior citizens aged 65 or above.<sup>27</sup>

## 3. ECONOMIC LOSS

The increase in heat not only affects the health and well-being of people in Hong Kong, but also brings about potential economic loss. A number of research papers have been published on the relationship between climate and productivity. According to a 2015 study published in the journal *Nature*, human productivity is the highest at around 13°C and “declines strongly” at higher temperatures.<sup>28</sup> Another study in 2016 suggested that people simply get tired more easily and accomplish less the hotter it gets.

The loss in productivity negatively impacts the gross domestic product in nations across the globe.<sup>29</sup>

In Hong Kong, the Guidelines on Site Safety Measures for Working in Hot Weather published by the Construction Industry Council sets out recommended measures and procedures that different personnel should follow during hot weather. According to the guidelines, when the UV Index is “high” as designated by the HKO, the weather is humid and “very hot” weather warning is issued, employers are advised to reschedule works to cooler periods or places, reduce the physical demands on workers and allow workers to take regular breaks in order to cool down. Such adjustments may reduce efficiency and productivity, thereby leading to economic loss.

Hong Kong is well-known as a regional aviation hub. The Hong Kong International Airport (“HKIA”) is one of the busiest airports and has consistently been ranked as one of the best airports in the world. Due to the vast land surface with little vegetation, air temperature over the HKIA can be very high, especially in summer. According to the HKO, there is an increasing trend in the number of “very hot” days at the HKIA over the past two decades.<sup>30</sup>

For an aircraft to take off, the lift has to be greater than its total weight. As temperatures increase, air density decreases, which results in less lift and makes it more difficult for aircrafts to take off. To address this issue, airlines may sometimes have to reduce airplane weight by loading fewer passengers and less fuel or cargo in order to take off.<sup>31</sup> If temperatures continue to increase, the cost of air travel may potentially increase as a result of the reduction in loading capacity of aircrafts.

Extreme heat also leads to extra air-conditioning costs. Air-conditioning units can be found almost everywhere in Hong Kong, from small residential units to large-scale shopping malls, and from public facilities to commercial buildings.

Statistics show that air-conditioning accounts for about 30% of all electricity consumption in Hong Kong, by far the largest end-use.<sup>32</sup> While air-conditioning units keeps people within the air-conditioned space cool, it exacerbates the problem of extreme heat because air-conditioning units often have a heating effect on the surrounding environment. More importantly, air-conditioning units are powered by electricity and electricity generation produces significant greenhouse gas emissions. Therefore, in the long run, air-conditioning has to be replaced by more sustainable methods of cooling which, however, can be costly to develop.

Other potential financial expenses that may be incurred as a result of climate change include money spent on mitigation investment, or adaptation measures to make existing infrastructure resilient to the effects of climate change or to minimise its impacts on human health and the economy.

Climate change will affect infrastructure, transportation systems, energy, food, water supplies and public health. The consequences are felt by all strata of society but may be particularly serious for the poor and vulnerable. Government departments need to be well-coordinated to deal with climate change, and we must also collaborate with the community as a whole to face a variety of socio-economic challenges with a positive attitude.

– Carrie Lam, Chief Executive of Hong Kong SAR<sup>33</sup> (2015)

<sup>26</sup> <https://www.rcrcmagazine.org/2018/10/hk-megacities-megaheat>

<sup>27</sup> <https://www.scmp.com/news/hong-kong/health-environment/article/3012704/hotter-weather-linked-increase-suicide-among>

<sup>28</sup> Burke, Hsiang & Miguel, Global non-linear effect of temperature on economic production, *Nature*, 21 October 2015. Available at <https://www.nature.com/articles/nature15725>.

<sup>29</sup> <https://www.washingtonpost.com/news/energy-environment/wp/2016/07/19/as-the-world-grows-hotter-some-workers-are-becoming-less-productive/>

<sup>30</sup> [https://www.hko.gov.hk/education/article\\_e.htm?title=ele\\_00462](https://www.hko.gov.hk/education/article_e.htm?title=ele_00462)

<sup>31</sup> <https://www.nytimes.com/2017/06/20/business/flying-climate-change.html>

<sup>32</sup> <https://www.scmp.com/comment/opinion/article/3023249/dealing-hong-kongs-other-serious-hot-problem>

<sup>33</sup> This quote was given in the Hong Kong Climate Change Report 2015 published by the Environment Bureau. Carrie Lam was then Chief Secretary of Administration. The report is available at <http://www.enb.gov.hk/sites/default/files/pdf/ClimateChangeEng.pdf>.



# Building resilience to extreme heat

## THE PARIS AGREEMENT

The Paris Agreement came into force on 4 November 2016 and Hong Kong was a signatory.

Pursuant to the Paris Agreement, Hong Kong is required to stop increasing greenhouse gas emissions as soon as possible and pursue efforts to implement the goal of keeping global average temperature increase below 2°C (relative to pre-industrial levels) and no more than 1.5°C.

## RESILIENCE IN HONG KONG

As stated at the outset of this report, extreme weather events, including severe heat, are exacerbated by climate change and are increasing in frequency and intensity. In view of the potentially significant losses resulting from such disasters, it is critical for cities to increase their preparedness by building resilience. Resilience refers to the capacity of systems (from national, local or household economies to businesses and their supply chains) to anticipate, absorb or buffer losses and to recover.<sup>34</sup> A resilient city is a city that can reduce the damage and risk incurred from disasters, accompanied with the ability to bounce back to a stable state.<sup>35</sup>

<sup>34</sup> United Nations Global Assessment Report on Disaster Risk Reduction 2015. Available at [https://www.preventionweb.net/english/hyogo/gar/2015/en/gar-pdf/GAR2015\\_EN.pdf](https://www.preventionweb.net/english/hyogo/gar/2015/en/gar-pdf/GAR2015_EN.pdf)

<sup>35</sup> Planning Department (2016) Hong Kong 2030+: A Smart, Green and Resilient City Strategy. Available at [https://www.hk2030plus.hk/document/Hong%20Kong%202030+%20A%20S%20GR%20City%20Strategy\\_Eng.pdf](https://www.hk2030plus.hk/document/Hong%20Kong%202030+%20A%20S%20GR%20City%20Strategy_Eng.pdf)

Resilience is not a new concept in Hong Kong. The strategies of mitigation and adaptation have been implemented in order to build resilience against extreme heat and combat climate change in Hong Kong:

1. Mitigation – mitigation refers to efforts to reduce or prevent emission of greenhouse gases. Mitigation can mean using new technologies and renewable energies, making older equipment more energy efficient, or changing management practices or consumer behaviour.<sup>36</sup>
2. Adaptation – adaptation means anticipating the adverse effects of climate change and taking appropriate action to prevent or minimise the damage they can cause, or taking advantage of opportunities that may arise. It has been shown that well planned, early adaptation action saves money and lives later.<sup>37</sup>

### MITIGATING EXTREME HEAT

The underlying cause of extreme heat is climate change resulting from global warming. Greenhouse gas emissions, in particular carbon dioxide emissions lead to global warming. Therefore, reducing greenhouse gas emissions is the prerequisite of mitigating the risk of even more extreme heat in the future.

#### Transition to renewables

According to a report published by the Environment Bureau in 2017, about 70% of Hong Kong's carbon emissions come from electricity generation.<sup>38</sup> The government has been trying to reduce coal-fired electricity generating plants in a bid to reduce carbon emissions. Some of the alternatives being explored include natural gas and renewable energy sources. It is anticipated that natural gas will generate about 50% of electricity in Hong Kong while coal will be reduced to 25%. Experts estimate that this will result in a 20% reduction of carbon emissions (using 2005 as the base).<sup>39</sup>

The government has taken the lead to adopt renewable energy in public infrastructure. For example, photovoltaic cells which capture solar energy are being installed in more and more public facilities such as roofs of footbridges and walkways, roofs of public piers and lights in parks and public housing. Solar hot water systems are also increasingly being adopted in sport centres managed by the government. Apart from solar energy, the potential of generating energy from waste is also being actively explored.

The first waste-to-energy (“WTE”) generator in Hong Kong, T-Park, which captures energy generated from sewage sludge treatment, became operational in April 2016. A second WTE plant is being commissioned for 2021, and another large-scale WTE plant to treat general municipal solid waste is expected to come into operation by 2024. It is anticipated that renewable energy is going to be an increasingly important element in the design of construction projects in Hong Kong.

#### Transportation

Another key source of carbon emission is transportation, which makes up about 16% of the total emissions in Hong Kong.<sup>40</sup> For years, the government has been implementing measures to cut vehicular emissions from motor vehicles. Apart from strengthening regulations in order to control emissions, economic incentives have been offered to promote the use of more environmentally friendly means of transportation such as electric vehicles.

Measures have also been taken to regulate emissions by marine vessels in Hong Kong. A recent news report highlighted that marine vessels, especially container ships, are the leading source of air pollution in Hong Kong, producing most of the harmful sulphur dioxide (SO<sub>2</sub>), nitrous oxides (NO<sub>x</sub>) and particulate matter (PM) locally.<sup>41</sup> The Air Pollution Control (Fuel for Vessels) Regulation (Cap. 311AB) (“APCR”) was enacted recently in order to control SO<sub>2</sub> emissions. Under the APCR, starting from 1 January 2019, all ocean-going vessels within Hong Kong waters are required to use a marine fuel with sulphur content not exceeding 0.5% by weight. Breach of the APCR carries heavy criminal consequences. The owner and master of any vessel using non-compliant fuel within the waters of Hong Kong will be liable to a maximum fine of HK 200,000 and imprisonment for six months.

<sup>36</sup> <https://www.unenvironment.org/explore-topics/climate-change/what-we-do/mitigation>

<sup>37</sup> [https://ec.europa.eu/clima/policies/adaptation\\_en](https://ec.europa.eu/clima/policies/adaptation_en)

<sup>38</sup> Environment Bureau (2017) Hong Kong's Climate Action Plan 2030+. Available at <https://www.enb.gov.hk/sites/default/files/pdf/ClimateActionPlanEng.pdf>

<sup>39</sup> Environment Bureau (2017) Hong Kong's Climate Action Plan 2030+. Available at <https://www.enb.gov.hk/sites/default/files/pdf/ClimateActionPlanEng.pdf>

<sup>40</sup> Environment Bureau (2017) Hong Kong's Climate Action Plan 2030+. Available at <https://www.enb.gov.hk/sites/default/files/pdf/ClimateActionPlanEng.pdf>

<sup>41</sup> <https://www.scmp.com/news/hong-kong/health-environment/article/2175592/why-hong-kongs-air-so-polluted-and-what-can-we-do>

The APCR is certainly a positive development. However, the new regulation fails to deal with other pollutants including NOx and PM. Both pollutants are known to be extremely harmful to the human respiratory system. Studies have confirmed that inhalation of these pollutants can lead to asthma attacks, respiratory infection and even premature death.<sup>42</sup>

At the regional level, the introduction of the Greater Bay Area (“GBA”) initiative is expected to result in increased economic activity in the region, which already has three of the top-10 busiest ports in the world (Shenzhen, Hong Kong and Guangzhou). The GBA initiative is a long term strategic development plan which comprises the two Special Administrative Regions of Hong Kong and Macao together with nine municipalities of China. The GBA covers a total area of 56,000 square kilometres and has a combined population of approximately 70 million at the end of 2017. On 18 February 2019, the State Council promulgated the Outline Development Plan for the Guangdong-Hong Kong-Macao Greater Bay Area (“the Plan”). The Plan outlines the Central Government’s vision to transform the GBA into a globally competitive hub for innovation and commerce, rivalling Silicon Valley and Tokyo Bay Area.

Hong Kong together with Macao, Guangzhou and Shenzhen are named core cities under the Plan and are expected to be core engines for development in the region. Among other things, the Plan pledged to consolidate and enhance Hong Kong’s status as an international transportation and trade centre.

The GBA initiative creates a wealth of opportunities for businesses in Hong Kong but also presents a real threat to the city’s mitigation efforts. As a result of the GBA initiative, it is estimated that fuel consumption of ships in the region will grow by 80% above 2015 levels by 2030.<sup>43</sup> Hong Kong has been collaborating with the governments in the region to explore measures to reduce vessel emissions and promote clean shipping but the effectiveness of such measures remains to be seen.

#### Buildings and infrastructure

According to statistics, buildings in Hong Kong consume almost 90% of the city’s electricity. Over 60% of carbon emissions are attributable to generating energy for buildings.<sup>44</sup> Reducing energy consumption of buildings and infrastructure is therefore critical to addressing the problem of climate change and extreme heat in Hong Kong.

The construction industry has developed labelling schemes to identify low carbon construction materials. For example, the Carbon Labelling Scheme for Construction Products administered by the Construction Industry Council verifies the carbon footprint of four categories of construction products: cement, reinforcing bars, structural steel and ready-mixed concrete. Such labelling schemes encourage the use of environmentally-friendly building materials and contribute to the reduction of carbon emission.

Separately, there is a growing (albeit slow) acceptance of the practice of retro-commissioning (“RCx”) by the building sector. RCx is a highly technical process but it in essence involves upgrading existing buildings to render them more energy efficient. The government has taken the lead in advocating RCx by publishing various guidelines which set out technical approaches that can be adopted to retro-commission air-conditioning, lighting and electrical distribution systems in existing buildings.

#### Green building

Green building is another practice actively promoted by the Hong Kong government in recent years as a means to mitigate climate change. In a narrow sense, green building means the literal “greening” of buildings by planting more vegetation. However, green building is a much broader concept which encompasses the idea of reducing the environmental impact of buildings in order to enhance the health and well-being of the building occupants.

Green building is not a new concept in Hong Kong. The Hong Kong Green Building Council (“HKGBC”) was established back in 2009 in order to promote and raise awareness of green building amongst the public and promote the standards and developments of sustainable buildings in Hong Kong. The HKGBC administers BEAM Plus, which is a recognised system setting out the performance criteria for a wide range of sustainability issues relating to the planning, design, construction, commissioning, management, operation and maintenance of a building. BEAM Plus independently assesses building sustainability performance, and sets out listed criteria which allow building organisations and companies to review their performance as well as demonstrate their commitment to sustainable development.

<sup>42</sup> <https://www.scmp.com/magazines/post-magazine/long-reads/article/3011607/hong-kong-air-pollution-and-deadly-impact>

<sup>43</sup> <https://www.scmp.com/magazines/post-magazine/long-reads/article/3011607/hong-kong-air-pollution-and-deadly-impact>

<sup>44</sup> Environment Bureau (2017) Hong Kong’s Climate Action Plan 2030+. Available at <https://www.enb.gov.hk/sites/default/files/pdf/ClimateActionPlanEng.pdf>

The concept of green building has been embraced by various construction projects in both the public and private sectors. The on-going Hung Shui Kiu New Development Area (“NDA”) located in the New Territories is a good illustration of how the concept of green building can be incorporated into large scale development projects. One of the guiding principles of the NDA is “Creating a Green Living and Working Environment”, which places emphasis on green building and environmentally-friendly technologies. Among other things, the NDA provides environmentally-friendly transport modes and incorporates an efficient and safe pedestrian walkway and cycling networks. It also capitalises on existing landscape resources such as river channels and green mountain backdrops, and promotes sustainable waste and water management.

In preparation for this report, Clyde & Co had the chance to discuss with Mr. Derrick H.C. Ho, Research Assistant Professor in the Department of Urban Planning and Design at the University of Hong Kong on the topic of green building. Mr. Ho highlighted a number of challenges in relation to green building in Hong Kong. Hong Kong is known for having a high building density which measures the concentration of building mass in a given geographical area. This means that there is limited space available in Hong Kong for new green buildings to be constructed.

Safety is another important concern. In May 2016, the whole rooftop of a sports centre at the City University of Hong Kong collapsed.<sup>45</sup> Fortunately, only three people were injured. This incident could have been catastrophic. Notably, the rooftop was green and covered by extensive vegetation. In a press report regarding the collapse, it was stated that there were discrepancies between data on the original loading capacity of the roof. It is believed that the collapse was due to the rooftop being overloaded as contractors relied on inaccurate data in adding green features to the existing rooftop. As can be seen, one of the key challenges in developing green buildings is to ensure the stability and safe construction of different structures.

Another practical challenge of promoting green building in Hong Kong is the costs and expenses that are involved. Sustainable materials which help reduce carbon emission are costly and may make any implementation difficult. Effective sustainable development also requires careful planning by knowledgeable individuals (e.g. surveyors, experts). In addition to being a time-consuming process, engaging knowledgeable individuals can be expensive.

## ADAPTING TO EXTREME HEAT

### Extreme heat warning

The HKO maintains a Hong Kong Heat Index in order to assess and monitor the severity of extreme heat. Where necessary, the HKO will issue “very hot” weather warnings (temperatures in excess of 33 °C with humidity of over 80%) to enable the public to take necessary precautions. According to the HKO guidelines, when a “very hot” weather warning is issued, the public is recommended to drink plenty of water and avoid over-exertion when engaged in outdoor work or activities. The HKO also advises the public to pay attention to the health and wellbeing of elderly persons or persons with chronic medical conditions staying alone.

Additionally, in order to minimise the adverse impact of extreme heat, the Home Affairs Department maintains air-conditioned community centres which are open to the public on extremely hot days.

### Infrastructure resilience

Hong Kong has generally been performing well in terms of infrastructure resilience. In particular, given Hong Kong experiences tropical cyclones and rainstorms on a regular basis, it has developed robust infrastructure and management systems to deal with heavy rain, strong winds, landslides and flooding.

In view of rising temperatures, extreme heat has increasingly been taken into account in designing infrastructure in Hong Kong. A prime example is Verbena Heights, a public housing project in Tseung Kwan O, which is well-known for its extensive use of greenery and specific design to enhance air circulation. This mitigates the wall effect and ensures residents enjoy natural ventilation, thus reducing the need to rely on air conditioning as a means of cooling. Verbena Heights received a silver medal from the Hong Kong Institute of Architects for its environmentally-conscious design.

<sup>45</sup> <https://www.bd.gov.hk/en/whats-new/press-releases/2017/0531A-buildings-department-releases-final-investigation-report-on-roof-structure-collapse-at-cityu-sports-hall.html>

# Conclusion

Extreme heat as a result of climate change is a growing concern in Hong Kong. Both the government and private sector have been taking active steps to mitigate the adverse impact brought about by rising temperatures. However, there are limitations to these efforts. In view of the anticipated surge in economic activity in the region as a result of the GBA initiative, cooperation between governments and different stakeholders is crucial to ensure the environment is not compromised by economic development. The building sector remains one of the largest sources of emissions in Hong Kong, and although RCx and green buildings are gaining gradual acceptance, more can still be done. In light of Hong Kong's obligations under the Paris Agreement, more has to be done in order to achieve the common goal of limiting temperature rise. In this regard, cooperation between parties in the private sector, civil society, financial institutions, cities and regions are to be encouraged.

Climate change is both a local, regional and national issue. Cross-boundary sharing of knowledge and solutions will help and I anticipate there will be more such dialogue going forward.

– Raymond Tam, then Secretary of Constitution and Mainland Affairs (2015)<sup>46</sup>

Meanwhile, Hong Kong must continue strengthening resilience towards extreme weather events including severe heat, which are increasing in frequency and intensity. Many cities including Singapore, Melaka, Chennai and Jakarta have a chief resilience officer. Some commentators and lawmakers have suggested that Hong Kong may consider creating a similar official post to coordinate efforts across the public and private sectors in order to better respond to climate-related disastrous events.<sup>47</sup>

<sup>46</sup> This quote was given in the Hong Kong Climate Change Report 2015 published by the Environment Bureau. The report is available at <http://www.enb.gov.hk/sites/default/files/pdf/ClimateChangeEng.pdf>.

<sup>47</sup> <https://www.scmp.com/news/hong-kong/health-environment/article/2166380/typhoons-and-other-major-incidents-hong-kong-needs>

In a globalised world, no industry or business can avoid the physical effects of climate change. From reliability of supply chains, physical damage to infrastructure, interruption to water and electricity supplies, through to a greater need for cooling and refrigeration, to an increased likelihood of extreme weather events, companies need to be aware of the key physical risks to their business and to the economy generally.

Climate change is now a critical board room issue; boards have responsibilities to shareholders and other stakeholders to understand, measure, mitigate and report on those risks. A broad spectrum of businesses are at risk of climate related litigation, from claims against corporations whose activities may have contributed to climate change or for alleged failure to protect assets and investments against the impact of physical or transition risks. Not only the corporations themselves but also their directors and officers are at risk of being held to account.

Clyde & Co is committed to supporting initiatives that facilitate greater resilience in the developed and developing world. Helping businesses deal with the multifaceted effects of urbanisation and climate change is an area where Clyde & Co is particularly active, with extensive experience advising a range of clients in many sectors on the complex issues it raises and how to adapt to these disruptive forces. We can assist companies and their insurers in navigating loss and identifying opportunities, such as green investment and green finance.

In the face of climate change, the risk management challenges facing corporates, governments and communities are considerable. As a leading law firm in the insurance, construction, marine and aviation sectors, Clyde & Co Hong Kong is well-placed to assist clients in mitigating and adapting to the risks resulting from climate change as highlighted in this report.

# Clyde & Co's climate change consultancy

Clyde & Co is offering a consultancy service to (re)insurers and other PRA-regulated entities in relation to the following projects:

- Reviewing corporate governance, disclosure and reporting;
- Identifying exposure to underwritten risks in specific sectors and/or jurisdictions;
- Locating 'silent environmental' exposures in policy wordings; and
- Developing new products such as parametric insurances and bonds.

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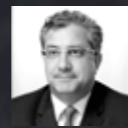
We would like to thank

Mr. Derrick H.C. Ho, whom we had the pleasure to interview twice, for his valuable comments and input into this report. Mr. Ho is a Research Assistant Professor in the Department of Urban Planning and Design at the University of Hong Kong.

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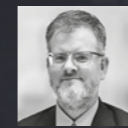


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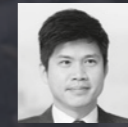
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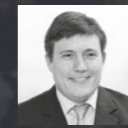
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