We benchmarked coastal risks for 20 APAC cities to assess capital threats as billions of dollars and millions of lives will be impacted from climate change unless significant action is taken. Below are key findings pertaining to sovereigns:

- **Acute & chronic risks from coastal threats create a sizeable permanent overhang** that warrants a recalibration of tail risks in finance. APAC governments not protecting their capitals and key cities generating significant shares of GDP should face sovereign credit re-ratings. The finance sector has acknowledged such risk impacts on sovereigns but lag in adjusting valuations/ratings to reflect rising risks from coastal threats.

- **Japan, Taiwan, Hong Kong & Macao are on our watchlist.** Their lacklustre adaptation actions, despite higher levels of exposure to coastal threats, leave GDP and residents exposed. Analyses of our index scores with & without government adaptation action against various GDP metrics revealed no sense adaptation strategies. Tokyo’s GDP is 2x Shanghai’s but its adaptation efforts are half that of Shanghai’s; yet it generates 19% of Japan’s GDP. Taipei accounts for 27% of Taiwan’s GDP but makes the least adaptation efforts out of the 20 cities – Manila’s adaptation efforts are almost 3x Taipei’s despite having half the GDP per capita. Hong Kong & Macao generate 100% of their GDP with little “hinterland” to provide relief from coastal threats.

- **Locked-in APAC capital threats even at 1.5°C; outlying plausible SLR of 2.9m by 2100.** Ultimately, all 14 countries/territories analysed face capital threats through the 20 APAC cities in our index. At 1.5°C, 28mn or 14% of the cities’ population, 20/23 ports and 12/25 airports will be permanently submerged by sea level rise (SLR) we will lock-in by 2030. Given grim polar news, 2.9m of SLR is an outlying plausible reality by 2100.

- **4°C current path commits swathes of APAC to permanent submersion.** Impacts are dire: we estimate 102 million people, all ports and 23/25 airports, and 11 CBDs in the 20 cities will be permanently submerged by SLR locked-in by our current climate path. Impacts on trade and logistics infrastructure will disrupt APAC’s export-led growth economies. APAC banks and markets are not immune as they have significant exposure to vulnerable sectors such as trade and real estate – 39,683km² will be underwater; this is equivalent to 59 Singaporean. Governments and sectors must align their decarbonisation and adaptation strategies to waterproof these cities but are not as shown in our case studies.
Climate change will drastically redraw coastlines threatening capital cities, economic growth and livelihoods in the Asia-Pacific region. Locked-in chronic tail risks from such coastal threats should be factored into sovereign and corporate credit risk ratings as well as equity/project valuations, but have yet to be.

This report explores how APAC sovereigns could be absolutely and relatively impacted by physical coastal threats, plus benchmarks relative government preparedness in adapting to such threats. Such analyses were carried out for 14 APAC countries/territories through their 20 capitals and major cities using the CWR APACCT 20 Index.

Over 100 finance professionals from chairs/directors of bank boards to research analysts as well as financial industry associations, asset owners and financial regulators have provided feedback on the development of this index which benchmarks chronic risks from coastal threats as well as government adaptation action which can temper risks.

Given material capital threats from key coastal cities, sovereign credit re-ratings may be warranted unless governments take action to prepare their cities for locked-in chronic risks ahead. We hope that this report helps credit rating agencies, APAC governments, central banks and financial regulators to rethink and reprice risks to better prepare the region for capital threats and systemic shocks ahead.

This report is part of an integral part of the CWR Coastal Capital Threat Series and should be read alongside the other four reports in the series.

About China Water Risk (CWR)

CWR is a non-profit think tank that aims to create a world where water and climate risks are embedded in business & finance. Since its launch in 2011, it has worked from its Hong Kong base to engage with global business and investment communities in understanding and managing various types of water risks in China and across Asia. CWR's collaborative reports with financial institutions, IGOs, scientists as well as government related bodies have been considered ground-breaking and instrumental in understanding Asia’s water challenges. They have help inform better decision-making today for a water secure tomorrow. Join the conversation at www.chinawaterrisk.org

Acknowledgements

CWR is grateful to our sponsor: The ADM Capital Foundation and our core funders: Rockefeller Brothers Fund and the RS Group for their continued funding support which has enabled the publishing of this series of reports. We are also grateful to financial industry experts and regional scientists who have provided input into the CWR Coastal Capital Threat Series.
20 APAC cities in 14 countries/territories assessed for chronic tail risks

CWR APACCT 20 Index
20 APAC CITIES

26% OF GLOBAL SEA CARGO VOLUME
23% OF GLOBAL AIR CARGO VOLUME

US$5.7tm GDP

207mn

PEOPLE UNDERWATER
14% AT 1.5°C
49% AT 4°C

TRADE UNDERWATER
20 AT 1.5°C
23 AT 4°C
12 AT 1.5°C
23 AT 4°C

REAL ESTATE UNDERWATER
15,006km² AT 1.5°C
39,683km² AT 4°C

4 CBDs AFFECTED AT 1.5°C
11 CBDs AFFECTED AT 4°C

Note: Impacts illustrated are conservative as 1) 30m elevation data maps were used to benchmark coastal threats; 2) median of the locked-in SLR range was used and 3) local tide adjustments were not made.

Source: CWR report “Avoiding Atlantis : The CWR APACCT 20 Index”, 2020
Infographic © China Water Risk 2020, all rights reserved
Risk re-ratings: Japan, Taiwan, HK & Macao?

No sense climate strategies of key cities could affect sovereign credit ratings. Our analyses in this report of the 20 APAC cities in the CWR APACCT 20 Index clearly show that there are many cities with no-sense climate strategies. Moreover, many cities can do more to reduce risks through both adaptation measures as well as fast-tracking decarbonisation. Governments must be realistic about climate impacts to ensure climate strategies make sense; plus, finance and corporates need to incorporate these government policies into their own planning. The analysis contained in this report led us to put the four countries/territories below on our “watchlist” as their combination of relatively higher physical threats plus comparatively complacent adaptation attitudes is worrying – if this persists, re-ratings of sovereign credit may be warranted.

While we only analysed adaptation efforts in detail in this report, climate strategies need to be scrutinised holistically. For example, the recent pledge by China for carbon neutrality by 2060\(^1\) plus the relatively higher adaptation efforts of mainland Chinese cities signal a better grasp of climate risks ahead. In comparison, all cities and/or territories below, with the exception of Japan, have yet to make any pledges to achieve carbon neutrality.\(^2\):\(^3\):\(^4\):\(^5\) These lagging decarbonisation efforts together with lacklustre adaptation actions, despite higher levels of exposure to coastal threats, leaves GDP and residents exposed.

Re-ratings warranted? More vulnerable physical threats plus relatively complacent adaptation attitudes...
(The order of countries/territories below follows the size of their economies)

### Japan

Tokyo’s adaptation efforts disappoint when compared to other APAC governments despite it being the largest economy of the 20 cities in the CWR APACCT 20 Index. Tokyo does have significant flood defences, but these are already reaching capacity – for more see “Tokyo’s impressive flood defences work for now but may not be enough for the future” in Appendix. Tokyo accounts for 19% of Japan’s GDP, and along with Aichi/Nagoya and Osaka, the three generate a third of national GDP. Their relative pedestrian adaptation efforts are worrying as 68% of Japan’s total population is clustered in 19 large coastal cities. Japan’s ports are particularly vulnerable to SLR and around half of Asia’s port adaptation costs of US$28bn to US$47bn will be borne by Japanese ports; ~30% of the Nikkei 225 would likely be affected by port disruptions.\(^6\) Japan is the world’s fifth-biggest emitter of carbon dioxide, but its PM very recently pledged that the country will reach carbon neutrality by 2050. This is a marked improvement from previous pledges yet plans to roll out new coal stations continue.

### Taiwan

Given that Taiwan is exposed to typhoons/hurricanes and 27% of its GDP is generated by Taipei, you would expect Taipei to make serious adaptation efforts against coastal threats. But it disappoints – of the 20 APAC cities we analysed Taipei has made the least adaptation efforts. Worse still, it can afford to do more – when comparing it to cities with a similar physical risk profile such as Manila – Taipei is 2.3x richer in terms of GDP per capita but Manila’s adaptation efforts are 2.7x that of Taipei. Shenzhen and Tianjin also have comparable physical risk profiles to Taipei, but the two mainland cities’ adaptation efforts outperform – Shenzhen’s efforts are 3.7x of Taipei’s; and Tianjin’s are 3.3x of Taipei’s. If Taipei isn’t adapting, then it’s unlikely that other cities in Taiwan are, which is worrying given that 57% of Taiwan’s population is located in just eight large coastal cities (including Taipei). Key losers in Taiwan will be its large semiconductor industry, which may have to step up measures to offset government complacency.

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### GDP & people at risk in Japan

<table>
<thead>
<tr>
<th>GDP</th>
<th>Pop in rest of country</th>
<th>Pop of top 20 large* cities - non-coastal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tokyo 19%</td>
<td>31%</td>
<td></td>
</tr>
<tr>
<td>Aichi/Nagoya 7%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Osaka 7%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other 67%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### GDP & people at risk in Taiwan

<table>
<thead>
<tr>
<th>GDP</th>
<th>Pop in rest of country</th>
<th>Pop of top 20 large* cities - non-coastal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Taipei 27%</td>
<td>43%</td>
<td>0%</td>
</tr>
<tr>
<td>Other 73%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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\(^1\)Recent pledge by China for carbon neutrality by 2060
\(^2\)Manila
\(^3\)Shenzhen
\(^4\)Tianjin
\(^5\)Tokyo
\(^6\)Japan is the world’s fifth-biggest emitter of carbon dioxide.
Chronic risks posed by coastal threats have yet to be assessed by government and the financial sector. But such risks are only rising; grim news from our polar regions could point to multi-metre SLR by 2100. Such chronic risks will be dire for the APAC, but these can be avoided if action is taken to adapt and fast-track decarbonisation. Evidently this has implications for long-term sovereign credit ratings. We hope that credit rating agencies, APAC governments, central banks and financial regulators can use the findings in this report to rethink and reprice risks to better prepare the region for capital threats and systemic shocks ahead.

Please note that for consensus and benchmarking purposes, chronic SLR impacts were mapped using less granular data. Thus, impact analyses contained in this report are conservative, but our findings already reveal severe impacts from chronic SLR tail risks. We must start to recalibrate valuations to include chronic risks – read on for how we came to these conclusions.

*Large cities are defined as those with populations of over 300,000
Climate change will drastically redraw coastlines threatening capital cities, economic growth and livelihoods in the Asia-Pacific region (APAC). The CWR Coastal Capital Threat Series seeks to explore and assess the absolute and relative chronic tail risks from coastal threats for 20 APAC capitals and key cities so that they can be factored into sovereign and corporate credit risk ratings as well as equity/project valuations.

This series of reports includes 1) the development of the CWR APACCT 20 Index (CWR APAC Coastal Threat Index for 20 cities) that benchmarks cities for chronic risks presented by coastal threats of sea level rise (SLR) and storm surge as well as government adaptation action; 2) factsheets for each of the 20 cities illustrating at-a-glance exposure for various climate scenarios; 3) overviews of the latest science-based research on coastal threats and evolving financial regulatory landscape to avoid systemic shocks triggered by climate change; 4) implications for sovereign risk ratings of the 14 APAC countries/territories; and 5) recommendations for asset owners, asset managers and banks; central banks and regulators; and governments to address and adjust for such locked-in chronic tail risks.

Over 100 finance professionals from chairs/directors of bank boards to research analysts as well as financial industry associations, asset owners and financial regulators have provided feedback on the development of the index that underpins this series - we thank them for their invaluable and continued input to our work. We would also like to thank regional climate scientists for their guidance in helping us better understand coastal threats.

This series of reports represents our first attempt to unpack complex interlinked coastal water risks for the APAC region. Although by no means perfect, this finance-driven and practical index can be used to re-assess tail risks and re-think long term capital allocation decisions. We hope that it can help APAC governments, central banks and financial regulators better plan and prepare the region for capital threats and systemic shocks ahead. Together, we can waterproof Asia to avoid a new Atlantis in a changing climate.
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APAC economies driven by coastal cities

APAC is the most vulnerable region to coastal threats. According to Verisk Maplecroft 11 of the 15 cities most at risk from flooding due to SLR are in Asia.² And MSCI ESG Research estimates that of the 221,000 facilities from the 7,200 publicly listed companies in its MSCI All Country World Index, 14% of Asian facilities are located in coastal-flood-prone areas – nearly double the global average.¹⁰ This is because Asia has disproportionately more of its people and therefore economic activity located along the coast.

Besides Beijing, KL, Vientiane & Phnom Penh all other APAC capitals are coastal. All key APAC finance hubs are coastal – Hong Kong, Shanghai, Shenzhen, Singapore, Sydney, Seoul and Tokyo. Although Beijing is not by the sea, many other key economic hubs in China are coastal, such as Guangzhou, Shenzhen, Suzhou, Tianjin and so on. Over in Japan, other key cities such as Osaka and Aichi/Nagoya are also by the sea as is Seoul, South Korea.

Highly dense cities = significant clusters of population exposed to coastal threats. Large cities can be used as proxies for economic activity and growth. Examining top 20 large cities with populations of 300,000+, we find that almost 70% of Australia and Japan’s total population, and 57% of Taiwan’s are clustered in large coastal cities. In comparison, this share is only 21% for the US and as low as 5% for France, plus 3% for Germany - see charts later. APAC shares will be higher as smaller cities & rural coastal populations are excluded.

APAC export-led economies = high reliance on logistics. Asia has followed an export-led growth model which means countries are highly reliant on their logistics infrastructure. Trade-to-GDP ratios for the 20 APAC cities are as high as 312% for Hong Kong, 211% for Singapore and 202% for Seoul. Ports and airports that serve key capitals and cities are globally important as they handle significant cargo volume each year but almost all of APAC’s key ports and airports are low-lying thus vulnerable to both rising seas and storm surge threats. Ports and airports do not only drive GDP but are also vital for food and energy security.

We analysed coastal threats of 20 APAC capitals & key cities with US$5.7tn of GDP. We selected 20 coastal cities from 14 countries/territories in APAC to include in our CWR APACCT 20 Index (see box on next page) as they are coastal capitals or key cities that were heavily populated with significant contribution to country/territory GDP. These are Aichi/Nagoya, Auckland, Bangkok, Guangzhou, Ho Chi Minh, Hong Kong, Jakarta, Macao, Manila, Osaka, Seoul, Shanghai, Shenzhen, Singapore, Suzhou, Sydney, Taipei, Tianjin, Tokyo and Yangon. Together, these 20 APAC cities generated GDP of US$5.7tn in 2018. This means that the 20 APAC cities account for over a fifth of the GDP of the 14 countries/territories; their ports alone handled 26% of global sea cargo and the airports handled 23% of global air cargo in 2018.

CWR APACCT 20 Index results show significant chronic tail risks that reshapes APAC:

- **Best case**: only 28mn people, 20/23 ports and 12/25 airports will be submerged from SLR locked-in at 2030 when we reach 1.5°C of warming; impacts will be felt as early as 2100 if we continue on the current climate path.

- **Base case**: 102mn people, all ports and 23/25 airports will be submerged under the current climate path from SLR locked-in at 2100 when we warm by 4°C.

Sovereign credit re-ratings warranted unless governments take action. Obviously, such levels of chronic coastal threats pose significant risks and hamper the ability of the cities and therefore the country/territory to pay down their debt and generate income and/or recoup losses through taxes. Especially, since each city accounts for a sizeable share of their country/territory’s GDP – for example: around 25% (Taipei, Seoul, Sydney & Yangon), 38% (Auckland & Manila) to 100% (Hong Kong, Macao & Singapore). Given these material capital threats from key coastal cities, sovereign credit re-ratings may be warranted unless governments take action to prepare their cities for locked-in chronic risks ahead. Although we have four sovereigns on our watchlist, all cities should be assessed. We hope that this report helps credit rating agencies, APAC governments, central banks & financial regulators to rethink and reprice risks to better prepare the region for capital threats and systemic shocks ahead.
Submerged! Sea level rise we lock-in at 1.5°C vs 4°C

The CWR APACCT 20 Index - We have benchmarked 20 capitals & cities in the APAC region for chronic risks presented by coastal threats. Our index reflects mapped stacked SLR risks for four climate scenarios (1.5°C, 2°C, 3°C and 4°C) across key indicators (population, land area and key infrastructure assets) for each city. Storm surge threats from typhoons/tropical cyclones/hurricanes, subsidence plus government adaptation actions to reduce physical risks have also been assessed and benchmarked in the index. Over 100 finance professionals from chairs/directors of bank boards to research analysts as well as financial industry associations, asset owners and financial regulators have provided feedback on the development of this index through survey, one-on-ones and countless Zoom calls.

Source: CWR report “Avoiding Atlantis: The CWR APACCT 20 Index”, 2020  
Infographic © China Water Risk 2020, all rights reserved
Chronic risks we’ve ignored are rising

We are 70 years ahead of our 2100 target of 1.5°C. In July this year the WMO warned of a 20% chance that one of the next five years (2020-2024) will be at least 1.5°C warmer than the pre-industrial period.11 Already, we have warmed by at least 1.1°C with a high of 1.2°C in 2016.12 COVID-19 has provided reprieve but the estimated emissions reduction of only 4%-7% by the end of 2020 is not enough; another decade of coronavirus is needed to get us back on track for 1.5°C by 2100.13 So despite COVID, it is highly likely that we’ll reach 1.5°C by 2030.14

But we have yet to assess/adapt for locked-in chronic risks that accompany this. Already, we see a rise in the frequency & magnitude of extreme weather and wildfires. News from our polar caps is also grim. With our oceans warming at a rate similar to detonating five Hiroshima atomic bombs per second in the sea for the past 25 years,1516 Antarctica ice sheet melt has accelerated.17 Possible ice sheet collapses18 & ocean thermal expansion signal rapid SLR that would devastate the APAC. Locked-in SLR of 2.9m expected beyond 2100 could now be an outlying plausible reality by 2100.19 Yet many cities have not brought forward adaptation efforts to protect against this and finance has yet to adjust for impacts. So, start using our index to help assess both coastal physical risks plus see who’s doing more to protect their cities.

Still heading to 3°C-5°C; our base case index at 4°C shows a 3.6x impact on population vs. best case at 1.5°C. Paris Agreement pledges are not good enough. This year, the WMO warned we would reach 3°C-5°C by 2100.20 That said, some of the EU plus China have made carbon neutrality pledges. These won’t help us avoid reaching 1.5°C by 2030, but may help steer us to ~2.5°C by 2100; China’s 2060 pledge alone accounts for a 0.2°C-0.3°C drop.21 But saying is not the same as doing plus the US has pulled out. As emissions are still high (despite COVID) our base case is 4°C. Our indices at 1.5°C (best-case) & 4°C (base case) show that SLR impacts are magnified at 4°C; even at 1.5°C, ports & airports are hit for at least 12 cities.

APAC is also vulnerable to storm surge risks – storm tides can already be 5m+. Storm surge magnitudes are expected to rise by 15% by 2100 on our current climate pathway.21 Already, in Tokyo & Hong Kong, extreme storm tides can be over 5m+ today; our base case extreme storm tides for both cities are 7m+ by 2100.22 SLR will exacerbate storm surge risks. In our worst-case of 2.9m of SLR by 2100, just factoring in high tide (around 2m-2.5m), means we need to prepare for 5m+ of coastal flooding WITHOUT storm surges.22 So while storm surge risks are now assessed as acute risks, they will become chronic and should be treated as such because by then, insurers may no longer cover such risks. Some cities are already acting to protect their residents and assets; but others are not – find out who’s doing what later.

That sinking feeling – sinking cities accelerate SLR risk. Land subsidence is prevalent in many Asian cities due to poor planning and mismanagement of groundwater resources. But some cities are sinking more than others such as Jakarta, Bangkok and Manila. North Jakarta is most at risk – it has sunk 2.5m in 10 years.23 Our analysis reveals that subsidence could bring forward SLR impacts equivalent to 2.37m by 2050.24 Because both subsidence and storm surges could bring forward chronic SLR risks, they should be assessed as chronic risks – these are benchmarked in the CWR APACCT 20 Index.

Accidentally triggering temperature tipping points and locking-in 10m+ of SLR. IPCC projections typically focus on a 2100 timeline, but seas do not stop rising. At 4°C, our index reflects a locked-in SLR of 8.9m.25 Once we pass certain temperature tipping points impacts are locked-in – with coastal threats, key triggers to watch out for relate to unstoppable ice melt, permafrost thaw and the loss of Arctic sea ice. As temperatures exceed 1.5°C, we will trigger (amongst others) 1) the inevitable melt of the West Antarctica Ice Sheet which holds 3m-4m of SLR; 2) sea ice-free Arctic for at least 3-4 months every year; and 3) permafrost thaw resulting in an additional 40–50GtCO2e released by 2100 – these impacts are neither reflected in the IPCC’s SLR estimates nor carbon budget.26 All these impacts come with scary feedback loops.

It’s time to get on top of this new risk landscape. Finance is flying blind as latest science is not conveyed in “finance speak”. So we’ve summarised everything you need to know about scary feedback loops plus how-to build SLR scenarios in “Changing Risk Landscapes: Coastal Threats to Central Banks”. Regulators are acting, but not fast enough. Note, the last time we faced similar temperatures to that of today, our seas were 6m-9.3m higher.24
Time to re-rate sovereigns

Focus on 2100 timeframe + carbon transition risks = locked-in SLR impacts overlooked. The financial sector has overlooked such grave impacts from locked-in SLR as their climate projections/scenarios are usually limited to a 2100 timeline. Moreover, the sector has prioritised assessing carbon risks reflected by TCFD scenarios which have so far been largely carbon transition scenarios. While some have factored in acute (event-driven) storm surge risks, most have not explored locked-in SLR scenarios, which will definitely strand swathes of assets. Clearly sea levels will not stop rising by 2100. Our actions so far will have likely locked-in 2.9m of SLR by 2030; our current path will lock-in 8.9m by 2100.25

Governments’ ability to pay down their debt impaired = sovereign credit re-rating. Just 0.86m-1.8m of SLR could lead to annual flood costs of US$14-27trn (up to 2.8% of global GDP in 2100) unless additional adaptation efforts are made.26 Clearly, governments will have to foot larger damage bills that insurers might be unwilling to cover. In addition, tax income may be dented, reducing a government’s ability to recoup these losses. Given that this impairs governments’ ability to pay down their debt, sovereign credit ratings should be adjusted. Both the level of physical threats and appropriate government adaptation action taken should be considered in re-rating to include such chronic risks.

Moody’s warns that SLR threatens long-term credit of sovereigns. In January 2020, Moody’s published a report titled “Sea level rise poses long-term credit threat to a number of sovereigns”. The rating agency warned “Sea levels several decades from now will be largely determined by past greenhouse gas emissions and temperatures… Sovereigns in Asia, Middle East and North Africa and small islands are most exposed to rising sea levels”.27 This means the argument that these risks fall in a “timeframe beyond our lifetime” is no longer valid.

93% of 100+ finance experts surveyed “Strongly Agree/Agree” that sovereign credit ratings should be adjusted. The charts on the right show an overwhelming number “Agree” & “Strongly Agree”. This shifted with a higher proportion choosing “Strongly Agree” at the end of the survey.10

Sovereign re-ratings for locked-in tail risks will have wide implications. All valuations will be recalibrated as cash flows are discounted with a new cost of capital; plus terminal values will be discounted. This will help drive adaptation measures and fast-track decarbonisation.

68+ central banks also agree but SLR chronic risks are not yet assessed. A group of 68+ central banks under the Network for Greening Financial Systems (NGFS) has acknowledged that climate change is a source of financial risk. They are calling for action and warn “catastrophic impacts of climate change are already visible” and “if companies and industries fail to adjust to this new reality, they will fail to exist.”28 In 2020 alone, they have released 7 reports pertaining to these risks, yet even though SLR threats are more imminent than we think, the latest report on tools of environmental risk analysis did not include a SLR example.29

The question is not if/when but how to factor these tail risks into valuations. The exposure is significant, the longer the finance sector waits, the wider the gap becomes between assumptions and reality of underlying chronic tail risks, leaving it increasingly exposed. Valuation is an art, not a science so it should not matter that we don’t already have a tried and tested method. We have thus taken a first step to build consensus on how to value these chronic tail risks through our index. We hope that the finance sector uses it to reprice risks and reallocate capital to ensure financial system resilience. These risks are not going away and are rising with every year – a structural evolution in the fundamentals of finance is inevitable as the sector prepares for systemic shocks ahead. Indeed, BlackRock recently launched a climate risk-adjusted sovereign bond ETF; evidently there is demand for such products.30

By factoring in only carbon transition & acute risks, finance has overlooked severe threats from chronic SLR risks

Annual coastal flood costs of US$14-27trn + dented tax income = debt repayments will become difficult = re-rating of sovereigns

Moody’s already starting to consider SLR for sovereigns in Asia

Finance agrees according to 93% of finance experts from our survey

A sovereign re-rating will create a domino effect on all companies/projects/assets located there

Central banks/ regulators recognise risks but still don’t know how to value chronic SLR risks

If finance delays factoring in chronic risks, the gap between assumptions/provisions and reality will get larger = more exposed…

…our index is a first step to close the gap
CWR APACCT 20 Index implications for sovereigns

We developed the CWR APACCT 20 Index to assess absolute and relative risks of 20 key APAC cities to benchmark risks to provide a path forward in assessing the implications of coastal threats on sovereign credit ratings. The index thus reflects mapped stacked SLR risks for four climate scenarios (1.5°C, 2°C, 3°C and 4°C) across key indicators (population, land area and key infrastructure assets) for each city. Storm surge threats from typhoons/ tropical cyclones/ hurricanes, subsidence plus government adaptation actions to reduce physical risks have also been assessed and benchmarked in the index. We selected 20 coastal cities from 14 countries/ territories in APAC to include in our index. Over 100 finance professionals provided input on the challenges faced as well as on weightings for the different components of the index.

Index results and rankings have clear implications for sovereign ratings. The rest of this report discusses these implications in three distinct sections:

1. Absolute risks of 20 APAC cities which drive around US$5.7trn of annual GDP pose material risks for their country/territory: The 20 cities in our index pose material risks for their country/territory. Not only do they represent 22% of GDP for the 14 countries/ territories, each city accounts for a sizeable share of their country/territory’s GDP – for example: around 25% (Sydney, Seoul, Taipei & Yangon), 38% (Auckland & Manila) to 100% (Hong Kong, Macao & Singapore). Plus, key infrastructure is also exposed from our analysis of ports, airports, CBDs and stock exchanges.

   • Analysis of GDP at risk can be found in more detail later in “20 coastal cities drive GDP = sovereigns at risk”;
   • Implications for GDP through trade is explained in “Logistics infrastructure at risk from coastal threats”;
   • The need for finance to recalibrate to ensure bank balance sheets and all savings including pension funds are resilient is explored in “In the line of fire: banks & markets must recalibrate”; and
   • For more detail on each city’s climate threats, government actions, GDP and trade values at risk, plus maps of impacts at 1.5°C and 4°C please see “CWR APACCT 20 Index City Factsheets”.

2. Relative risks through changes in rankings with/without government action for two temperature scenarios: Relative risks are important to benchmark investments and their allocation. The CWR APACCT 20 Index provides rankings for cities against physical coastal threats plus government adaptation action that could temper the risks. We have also carved out government actions from our index so that you can see just the physical threats faced by all cities at 1.5°C and 4°C.

   • The best-case: 1.5°C CWR APACCT 20 Index reflects the coastal threat landscape we will likely lock-in by 2030;
   • The base case: 4°C CWR APACCT 20 Index reflects the risk landscape under the current climate pathway of 4°C by 2100.

   These are both set out in “CWR APPACT 20 Index Rankings”. For more on the creation of the index and weightings decided with input from finance, please see “Avoiding Atlantis: The CWR APACCT 20 Index”.

3. Deeper comparative analysis of government action/inaction for the 20 cities: Government adaptation action can protect cities from the worst of coastal threats to a degree. This will also help sovereigns to be financially resilient in the long-term as its residents and economy could be protected leading to lower costs. By carving out government action from the indices you can also see which governments are doing more than others, and conversely which are doing the least and so are more at risk.
How the finance sector can use the CWR APACCT 20 Index

- Recalibrate sovereign credit ratings for tail risks to ensure financial resilience. Financial mispricing of fundamentals has allowed no sense climate strategies to pervade across governments and all sectors – these must be adjusted. Our indices can be used to inform credit rating agencies on their re-rating of sovereigns as the 14 countries/territories are exposed through these 20 cities. And this does not even include other coastal economic hubs and cities.

- Drive APAC governments to step up adaptation for 1.5°C. The 1.5°C index shows that risks are still material at this level of warming with over a third of Aichi/Nagoya and Ho Chi Minh City and almost half of Macao and Suzhou submerged by locked-in SLR. Plus, with almost all the 20 cities’ ports and over half the airports impacted, trade and thus the economy will no longer be resilient, and all must be protected.

- Push APAC governments to decarbonise to avoid 4°C. Physical coastal threats rise significantly between 1.5°C and 4°C. As all cities are drastically impacted at 4°C, the APAC must fast track decarbonisation to avoid this at all costs.

- Drive innovation in adaptation finance. The focus has been on mitigation related investments however it is clear that we have no choice but to also invest in adaptation. By focusing on these investments, the finance sector can reap the benefits whether it’s through innovative instruments to help governments invest in adaptation or by investing directly in companies that will be at the forefront of adaptation innovations.

- Penalise governments for mitigation strategies that head to 4°C but adapting for 1.5°C. Currently, many cities’ climate (mitigation & adaptation) strategies don’t make sense including Singapore’s, who is leading the index – please see “No sense climate strategies – governments” in the Appendix for more. If governments have mismatched climate strategies, they should be penalised.

- Central banks/banks must check clustered risk spread across the 20 cities to ensure capital adequacy. The clustered nature of coastal threats means that tail risk impacts across the region must be well understood to ensure proper allocation of capital and spread of risk. Locational impact analysis will need to be performed due to clustered assets facing coastal threats and portfolio/asset reallocation decisions will have to be made to spread risks away from vulnerable locations. Worse still, as there will likely be a loss of insurance coverage for chronic coastal threats, the risks will fall squarely on banks, so capital adequacy will have to be raised to rebalance this.

- Work to resolve nitty gritty issues regarding data gaps through collaboration. How coastal threats and government adaptation actions are measured can be improved. Governments and finance have a part to play in solving some of these issues to ensure more cost-effective planning and investments.

Please refer to “Waterproofing APAC: Executive Summary & Next Steps”; we have detailed next steps for various stakeholders including asset owners/ managers, banks, central banks/ regulators, and governments.
Many of the 20 APAC cities are capitals & generated US$5.7trn of GDP in 2018

Capital infra most at risk threatening export-led economic growth...

...Malaysia excluded from index but not immune to coastal threats

Exposure points to stranded assets/abandoned cities will become a reality...

...will trigger shocks to the financial system if it’s not prepared + could result in adjustments to sovereign credit ratings

20 coastal cities drive GDP = sovereigns at risk

We analysed 20 large APAC cities representing 22% of GDP in 14 countries/territories against coastal threats. If key GDP cities are impacted, a country/territory will also be exposed.

As can be seen from the infographic on the next page, these 20 cities generated US$5.7trn of GDP in 2018. This means they drive over 1/5th of the GDP in 14 countries/territories. Many of them are capitals of the 14 countries/territories. They are also financial, manufacturing and trading hubs making them economically significant.

High share of GDP plus dense city = high clustered risk exposure. All these cities are significant to their country/territory from 13% of country/territory GDP for the 5 cities in Mainland China to 100% for island cities of Hong Kong, Macao, and Singapore. It is also significant for Auckland, Manila, the 3 Japanese cities and Bangkok, which all contribute between 30%-40% to their country’s/territory’s GDP and around a quarter for Taipei, Sydney, Seoul, Yangon and Ho Chi Minh City – please see infographic on the following page.

It’s not how much of the city, but what is underwater. In addition, even if only a part of a city is exposed the entire city could come to a standstill, especially if key infrastructure such as ports, airports and CBDs are affected. As Singapore’s Prime Minister explains “We cannot lose a big chunk of our city and expect the rest of Singapore to carry on as usual”.

Many will not survive locked-in SLR. Our analyses across four climate scenarios (1.5°C, 2°C, 3°C and 4°C) reveal that SLR risks stack up as temperatures rise for the 20 APAC cities across all key indicators as shown below for 1.5°C and 4°C. Notably logistics infrastructure is most at risk threatening the APAC export-oriented economic growth model unless governments take action – we expand on the magnitude of these threats later in “Logistics infrastructure at risk from coastal threats”. Please note that Malaysia was excluded as its capital, Kuala Lumpur, is not coastal. But do bear in mind that its export-oriented economy is not immune to coastal threats due to its strategic location in the key trade route of the Straits of Malacca – for more see “Malaysia’s capital city may not be coastal, but its ports are”.

Chronic SLR tail risks = adjustments to sovereign credit ratings. This significant exposure of people and assets points to stranded assets/abandoned cities and the upgrade/relocation of large infrastructure projects will become a reality. These will trigger shocks to the financial system if it is not prepared and could result in adjustments to sovereign credit ratings. Worse still, beyond these 20 cities, there are many more coastal economic hubs and cities where up to 70% of national populations reside – for more see “Coastal threat exposure beyond CWR APACCT 20 Index cities”. We also benchmarked government adaptation action for these cities and conducted “sensibility analyses” of their adaptation strategies vis-à-vis the GDP they generate... so please read on.

CWR APACCT 20 INDEX
EVEN AT 1.5°C, ALL 20 APAC CITIES HAVE MUCH AT RISK

1.5°C (guaranteed path)
- Even at 1.5°C we will lock-in 2.9m (range:1.6m-4.2m) of SLR
- Over a third of Aichi/Nagoya and Ho Chi Minh City and almost half of Macao and Suzhou will be flooded
- This could happen as early as 2100

4°C (current path)
- We will lock-in 8.9m (range: 6.9m-10.8m) of SLR
- Most of Shanghai, Suzhou, Bangkok & Tianjin will be flooded, plus HCMC, Yangon & Macao will have more than 50% of land submerged
- This could happen as early as 2200

Source: CWR report “Avoiding Atlantis: The CWR APACCT 20 Index”, 2020
Infographic © China Water Risk 2020, all rights reserved
20 APAC cities generate over 1/5th of GDP in 14 countries/territories

CWR APACCT 20 INDEX
20 APAC CAPITALS & CITIES DRIVE 22% OF GDP OF 14 COUNTRIES/TERRITORIES

US$5.7 trn  US$19.7 trn

Source: CWR, World Bank 2018 GDP data, Individual government sources
Infographic © China Water Risk 2020, all rights reserved
Country/territory GDP materially exposed through these 20 cities

**CWR APACCT 20 INDEX**

% of country/territory GDP generated by 20 APAC cities

**50%+**

- Hong Kong: 100%
- Macao: 100%
- Singapore: 100%

**30%-50%**

- Auckland: 38%
- Manila: 38%
- Bangkok: 33%
- Tokyo: 19%
- Aichi/Nagoya: 7%
- Osaka: 7%
- Other Japan: 67%
- Other Thailand: 67%
- Other New Zealand: 62%
- Other Philippines: 62%
- Other Mainland China: 73%
- Other Mainland China: 76%
- Other Mainland China: 77%

**15%-30%**

- Taipei: 27%
- Sydney: 24%
- Seoul: 23%
- Ho Chi Minh: 22%
- Jakarta: 18%
- Tokyo: 19%
- Osaka: 7%
- Other Mainland China: 73%
- Other Mainland China: 76%
- Other Mainland China: 77%
- Other Mainland China: 78%

**5%–15%**

- Yangon: 23%
- Other Myanmar: 77%
- Other Mainland China: 87%
- Shenzhen: 2.7%
- Shanghai: 2.6%
- Guangzhou: 2.6%
- Tianjin: 2%
- Suzhou: 2%

Source: CWR, World Bank 2018 GDP data, individual government sources

Infographic © China Water Risk 2020, all rights reserved
Coastal threat exposure beyond CWR APACCT 20 Index cities

Beyond the 20 cities in the CWR APACCT 20 Index, APAC has more top cities that are coastal than EU & US. Assuming that cities with large populations generate the highest GDP for a country/territory, we examined the top 20 large cities of various countries. Large cities are defined as those with populations of 300,000+. We find that APAC has a significant proportion of its population located along the coast compared to other regions. As shown in the chart below, coastal cities amongst the top 20 large cities account for almost 70% of Australia’s and Japan’s total population, and 57% of Taiwan’s. In comparison, this share is only 25% for the UK, 21% for the US and as low as 5% for France, plus 3% for Germany. Please note that Australia, Taiwan, Vietnam, Malaysia, Myanmar, Bangladesh, Cambodia, New Zealand and Canada have less than 20 large cities.

The higher the number of large coastal cities = the higher the GDP at risk. If a large number of a country’s/territory’s top cities are located in coastal areas, a greater share of its GDP is at risk to coastal threats. For example, out of Australia’s 11 large cities, 10 are coastal; for Japan 19 of its top 20 large cities are coastal; for Taiwan all of its 8 large cities are coastal; for New Zealand all of its 3 large cities are coastal; and for South Korea 8 of its top 20 large cities are coastal. As these five countries/territories have 40% or more of their population located in large coastal cities, all these cities must be assessed to adjust sovereign ratings.

US$5.7trn or 22% of GDP of the 14 countries/territories at risk to coastal threats is thus a conservative estimate of coastal threat exposure. GDP and population at risk could be much higher in Asia as smaller cities/towns and rural coastal populations in countries/territories such as Indonesia, Malaysia, Myanmar, Philippines, Thailand and Vietnam could be significantly more given their topography and have not been considered in this analysis.
Trade & logistics infrastructure at risk from coastal threats

Export-led economies = high trade-to-GDP ratios. Asia has followed an export-led growth model which means countries are highly reliant on their logistics infrastructure. Trade-to-GDP ratios for the 20 APAC cities are as high as 312% for Hong Kong, 211% for Singapore and 202% for Seoul as can be seen from the chart below. Almost half of the 20 cities analysed have Trade-to-GDP ratios greater than 100% - this includes Ho Chi Minh City, Auckland, Suzhou, Shenzhen, Shanghai and Taipei. Macao has the lowest at 23% as its economy is driven by the gaming and tourism industry. However, Macao’s economy is still at risk due to potential impacts on its airport and casinos – for more see “Macao’s sluggish climate resilience plan leaves economy unprotected” in the Appendix.

Almost all key infrastructure of the 20 cities are impacted. Unfortunately, a number of ports and airports are found in locations that are vulnerable to coastal threats. As the charts on the next page show at 1.5°C 20 of 23 ports and 12 of 25 airports will be submerged, and this increases to 100% of ports and 92% of airports at 4°C for the 20 APAC cities. Logistics disruptions could cost Asian ports US$28bn to US$47bn to adapt for just 1.6m-2.3m of SLR.

Beyond logistics – food & energy security impacts. It also won’t only be the logistics sector that is impacted but all sectors that rely on this infrastructure. In addition, food and energy security could be at risk as most countries are not self-sufficient in either of these so rely on imports. However, due to time and cost constraints our index does not factor in food and energy security implications from coastal threats.

For each city – detailed analysis on the economy at stake as well as maps showing people, land and economy (ports, airports, CBD and stock exchange) affected by locked-in SLR at 1.5°C and 4°C can be found in “CWR APACCT 20 Index City Factsheets”. 
At-a-glance APAC key trade & logistics infrastructure at risk

The charts on this page exclude Malaysia but that does not mean its logistics infrastructure is safe, please see the next page for more.

Note: Order of the ports and airports follows highest trade-to-GDP ratio to lowest

The charts on this page exclude Malaysia but that does not mean its logistics infrastructure is safe, please see the next page for more.
Malaysia's capital city may not be coastal, but its ports are

Malaysia was excluded from the CWR APACCT 20 Index as its capital Kuala Lumpur is not coastal. It would only be affected if flooding were to reach 30m-40m, which is much higher than current expected locked-in SLR even at higher temperature ranges.

However, this does not mean that Malaysia would not be affected by coastal threats because its ports are all located in areas vulnerable to coastal threats. At 4°C, locked-in SLR will fully impact Port Klang and the port in Penang and partially affect Port Tanjung Pelepas in Johor. These aren’t small ports either; Port Klang was the 13th biggest port in the world in 2018 in terms of volume according to Alphaliner, and Tanjung Pelepas was 18th.

As Malaysia’s merchandise trade was 130% of GDP in 2018 according to the World Bank this could impact the country’s economy unless emissions are reduced to slow down temperature rises, and port infrastructure is better protected. This is a costly endeavour because according to a report commissioned by HSBC, for Klang and Tanjung Pelepas to adapt to just 2.3m of SLR it could cost over US$800mn to elevate and move warehouses and other port infrastructure. But surely this is worth it given the importance of trade to Malaysia’s economy.
In the line of fire: banks & markets must recalibrate

Banks cannot avoid being hit by APAC chronic tail risks. The real estate sector and trade are clearly vulnerable to coastal threats. They are also a large part of APAC economies and thus a major part of APAC bank loan books. And it’s not only bank balance sheets and deposit savings under threat but all savings and pension funds due to sectorial clustering and bias in APAC indices – finance, real estate and sectors that rely on trade all make up a large part of our indices. Such exposure has been highlighted in our previous report with Manulife Asset Management and the Asia Investor Group on Climate Change detailed in the next page.

Not only are components at risk, the stock exchanges themselves are physically at risk.
Four stock exchanges will be submerged at our current path of 4°C; these are in Bangkok, Ho Chi Minh City, Osaka and Shanghai. Even though a stock exchange itself may be able to continue functioning when flooded due to business continuity plans and data centres located further inland, the finance sector as a whole could still be affected. This is because typically the large banks and investment houses are located close to the stock exchange and may not be able to so easily continue operations; thus, the entire finance centre will have to move.

Significant market risk as the stock exchanges in 7 cities in the APAC 20 accounted for US$29trn of equity trading value in 2019. The APAC is home to large financial centres that are also coastal – Hong Kong, Shanghai, Shenzhen, Singapore, Sydney, Seoul and Tokyo. The stock exchanges in these seven cities had an equity trading value of US$29trn in 2019, which is 1.8x the trading value of the Nasdaq, which was the largest stock exchange in terms of trading value globally in 2019 as the chart below shows.

11 CBDs in the 20 APAC cities will be submerged at 4°C. CBDs are the economic centres of a city with a large finance sector presence so if they are affected the entire city as well as the country/territory could be at risk. At 4°C the CBDs in Auckland, Bangkok, Guangzhou, Ho Chi Minh, Hong Kong, Macao, Osaka, Shanghai, Singapore, Suzhou and Tianjin will be submerged. Even at 1.5°C the CBDs in Guangzhou, Hong Kong, Macao and Singapore will be affected.

Continued financing of carbon intensive industries as focus is on carbon transition risks. The case study in “No sense climate strategies – sectors” shows since the Paris Agreement from 2016 to 2019, nine Asian banks lent US$632bn to the fossil fuels industry. This laissez-faire approach persists as the sector prioritised carbon transition risks over the assessment of chronic tail risks. On our current path carbon transition risks will be negligible but costs from chronic physical risks will be dire.

Whilst acute (event-driven) storm surge risks may be factored in, chronic locked-in SLR scenarios are yet to be assessed – as evidenced by the absence of examples of SLR risks in the latest NGFS report.28 Chronic risks are only mounting because when storms become more intense & start occurring annually, they should be accounted as chronic tail risks since insurers will no longer cover such risks. If banks actually valued these risks (which are inevitable on our current climate path) their support for carbon intensive industries would fast dwindle.
Pension Funds & savings face imminent threats from climate change

Below are exact excerpts taken directly from “Are Asia’s Pension Funds ready for Climate Change?” co-authored with Manulife Asset Management and the Asia Investor Group on Climate Change about imminent threats to asset owners’ portfolios from climate and water risks.

The brief reviewed 30 large public pension funds, sovereign wealth funds, and central banks from 12 Asian markets. The analysis in the brief highlights that Asian pension funds already face shortfalls due to an ageing population, and that this could be exacerbated by water and climate risks to their investments.

Asian banks and insurers inherit water and climate risks of clients

Global banks are currently preoccupied with transitional risks associated with carbon, but we argue that transitional risks regarding water and climate risks are more pervasive and disruptive. They also have the ability to cause much greater damage to value, yet they remain “hidden”.

The nature of locational risks will mean that banks will have to “adapt” the way they assess credit to ensure resilience. In turn, how banks are valued will also evolve. We are highlighting the financial sector in this brief specifically because:

1. Financial institutions are yet to fully embed water and climate risks, and the resultant regulations, into their insurance policy, credit policy and equity valuations;
2. They form a large part of equity indexes in Asia; and
3. Savings could be at risk.

Increasing risks from extreme weather events affecting dense areas

Credit ratings can be downgraded. Not only can climate change cause physical damage, it can also lead to a downgrade by ratings agencies. For example, S&P has stated that between 2015 and 2017 environmental and climate information affected 717 cases (~10% of corporate ratings assessments) and resulted in a ratings impact (an upgrade, downgrade, outlook revision, or CreditWatch placement) in 106 cases.

CWR APACCT 20 Index rankings

1.5°C CWR APACCT 20 Index (best-case)

We will likely reach 1.5°C by as early as 2030, 70 years ahead of schedule. Unfortunately, given that we are on track for 4°C, we will likely trigger feedback loops and uncontrollable melt so in the worst-case these locked-in impacts could actually be felt by as early as 2100. We have also carved out government adaptation actions from the CWR APACCT 20 Index (chart below left) so that you can see rankings by physical threat levels faced by each city at 1.5°C without government action (chart below right).

Key highlights from index at 1.5°C:

- Manila is most at risk at #20 from physical threats. However, since its government is taking action to reduce risks, it moves up six places from #20 to #14.
- Taipei underperforms the most – physically, it is relatively less exposed at #10 but lagging government adaptation action means it drops 10 places and is relegated to the bottom at #20.
- Tokyo gives up 6 places, falling from #11 to #17, placing it in the bottom quartile as well. Please see “CWR APACCT 20 Index City Factsheets” for more detail of what’s at risk in each city.

Please see “CWR APACCT 20 Index City Factsheets” for more detail of what’s at risk in each city.

1.5°C: Impacts locked-in for 20 APAC cities

- Lock-in 2.9m (range:1.6m-4.2m) of SLR
- Over a third of Aichi/Nagoya and Ho Chi Minh City flooded
- Almost half of Macao and Suzhou will be flooded
- 28mn people affected (14%)
- 15,066km² land submerged (16%)
- 20 of 23 ports affected
- 12 of 25 airports affected
- 4 of 20 CBD's submerged

Governments need to act now to adapt as this future is unavoidable. Capital still flows to carbon intensive sectors hampering decarbonising efforts and guaranteeing substantial chronic risks. As these chronic risks are being mispriced, capital is also still being driven to vulnerable cities/locations which amplifies physical clustered risk exposure. In addition, as the finance sectors' focus is on assessing carbon transition risks in mitigation, they are not evaluating government adaptation efforts, which can significantly reduce the physical risks faced by cities. These efforts vary from city to city and are discussed in detail later.
4°C CWR APACCT 20 Index (base case)

Our current path is at least 3.5°C to 5°C of warming by 2100. Many cities in the APAC will not be able to survive this future as they are located in low-lying coastal regions as shown in the box on the right. In addition, on our current path if we trigger uncontrollable glacial melt, *in the worst-case these impacts will be felt as early as 2200.* Government adaptation actions have been carved out from the CWR APACCT 20 Index (chart below left) so that you can see rankings by physical threat levels at 4°C without government action (chart below right).

**Key highlights from index at 4°C:**

- The ranking of cities differs at 1.5°C and 4°C as SLR risks “stack up” differently at various climate scenarios due to their unique geographic and elevation characteristics.
- Shanghai is the most at-risk city at #20 accounting for physical risks alone, but it moves to #11 due to significant government action. That said, its score increases dramatically between 1.5°C and 4°C.
- Some cities are worse off in terms of the rankings when government action is included, notably Taipei (again the worst performer) dropping from #9 to #19.

For more detailed analysis of the index results, please see “Avoiding Atlantis: The CWR APACCT 20 Index”.

**4°C Impacts locked-in for 20 APAC cities**

- Lock-in 8.9m (range:6.9m-10.8m) of SLR
- Most of Shanghai, Bangkok and Ho Chi Minh City will be flooded
- 102mn people affected
- 39,683km² land submerged
- 23 of 23 ports affected
- 23 of 25 airports affected
- 11 of 20 CBD’s submerged
- 4 of 16 stock exchanges affected

**Ranking shifts are important as it allows us to gauge the relative performance of the 20 city governments** in protecting their residents from coastal threats. Properly repriced risks should drive governments to step-up adaptation and make more sensible climate strategies.

Benchmarking adaptation action to reduce risk profiles as well as “sensibility analysis” on their adaptation strategies are explored next. However, if you would like to deep-dive into what cities are doing please see various case studies set out in our “Case Study Appendix”, where you will find case studies on government action that will protect and others that make no sense.
Government adaptation to protect cities

Government adaptation actions matter as they can reduce impacts from physical coastal threats. Government action to tackle the risks from climate change can greatly alleviate the pressure on corporates and investors. Whether it’s by implementing disaster management policies with plans to ensure food and energy security as well as building sea walls, growing mangrove forests, increasing the capacity of reservoirs, strengthening and building canals or expanding the drainage capacity of the sewer system. The private sector may still have to plan for multiple scenarios and take precautionary measures, but governments can relieve pressure.

CWR APACCT 20 Index cities face varying physical threats but government action/inaction changes cities’ risk profiles & index rankings. Our deeper comparative analysis of government action/inaction for the 20 cities in our index showed that government action/inaction on adaptation will change physical threat profiles of each city and thus move their rankings (either up or down) for both 1.5°C (best-case) and 4°C (base case) scenarios. At-a-glance charts of relative government adaptation action and their changes to the physical risk profiles of each city are set out in the following pages; key points to note for each scenario are also discussed there. This is not to say that cities where governments are acting are completely safe, but cities’ plans and actions can significantly alleviate economic and social pressures in the face of climate change.

Benchmarking government action was a challenge as they are unique to each city, making it difficult to compare, but comparative analysis still useful. While we encountered many challenges with benchmarking government action and further in-depth analysis needs to be carried out to determine the exact level of absolute risks faced (see “No sense adaptation strategies” later), analysis of the relative adaptation actions by the cities can help the financial sector gauge relative risk, a key tool in benchmarking investments and their allocation. For more details on indicators used as proxies for government action, their weighting and finance sector opinions and comments, please see “Avoiding Atlantis: The CWR APACCT 20 Index”.

Given capital threats represented by key cities if left unprotected, we expected governments to take sensible action, but they are not. Government climate strategies must be sensible if they are to be effective. While we did not score government adaptation actions for effectiveness, we did carry out “sensibility tests” – where we assume the greater the GDP at risk, the greater the action by governments to protect the city and key infrastructure assets against coastal threats. Such analysis of index scores (with/without government action) against various GDP metrics of 1) city GDP; 2) city’s GDP as a percentage of country/territory GDP; and 3) GDP per capita revealed a slew of no sense adaptation strategies – please see charts and analysis in “No sense adaptation strategies”.

Cities you expect to do a lot of adaptation to protect people & assets are not. The lack of action being taken by multiple cities especially Tokyo, Taipei, Hong Kong and Macao do not make sense given how much of their economy is at stake. This begs the question: why are some governments doing so little? This is especially galling as we are currently heading for 3°C-5°C by 2100 and climate threats are already here. Some cities/governments are clearly doing more than others, and many can afford to do much more. While we have provided an overview of various aspects of government action/inaction in the following pages, we felt compelled to compile case studies from our research of both stellar and no sense strategies – these can be found in “Case studies of cities adapting to coastal threats” and “No sense climate strategies – governments” in the Appendix of this report. At-a-glance city assessments can be found in “CWR APACCT 20 Index City Factsheets”.

We hope you find this comparative analysis of government action/inaction useful & engage with governments to accelerate adaptation & decarbonisation efforts. Do push governments to step up adaptation efforts at 1.5°C as impacts can already be severe for some cities. CWR indices can also be used to persuade governments to fast track decarbonisation to avoid 4°C; plus align mismatched adaptation and mitigation strategies of planning to adapt for 1.5°C but heading for 4°C with decarbonisation strategies – even top-scoring and adaptation proactive Singapore is still the world’s top marine oil bunkering port. As the CWR indices show inconsistencies in adaptation efforts across cities within a country, they can also be useful in helping governments manage climate strategies across cities.
Benchmarking city adaptation action to reduce risk profiles

The chart below shows cities’ index scores - the CWR APACCT 20 Index (in blue) and the CWR APACCT 20 Index - ex-Govt Action (in red). The latter just scores physical coastal threats from SLR, storm surge and subsidence. By carving out government action from the indices you can also see which governments are doing more than others, and conversely which are doing the least and so are more at risk. Please note that the 20 APAC cities in the charts below are ranked in order of exposure to physical risks, rather than the risks scores adjusted for government adaptation.

**Benchmarking impact of government action/inaction at 1.5°C**

**1.5°C CWR APACCT 20 INDEX**

BENCHMARKING GOVT ACTION IN REDUCING PHYSICAL COASTAL THREATS THROUGH ADAPTATION

Key points of note from the chart above are:

- **Taipei and Macao show least adaptation effort** – these cities need to do significantly more in terms of adaptation as they both face high physical risks and are doing very little in comparison to the other cities. Consequently, they rank #20 and #19 respectively in our index. Please see our Macao case study for more in “No sense climate strategies – governments” in the Appendix.

- **Most government effort** – Regardless of their physical risk exposure Shanghai, Shenzhen, Jakarta, Singapore and Auckland have made the most adaptation efforts.

- **Same country but degree of adaptation effort differs in Japan** – three Japanese cities have similar physical risk profiles but their adaptation actions differ – Osaka is doing the most, but Tokyo should be as its GDP is almost 3x that of Osaka’s; plus its population is almost 2x larger. Clearly Tokyo should be doing more and the three cities should collaborate further to ensure the country is safe.

- **Same region but degree of adaptation effort differs in the GBA** - the GBA cities (Hong Kong, Macao, Guangzhou and Shenzhen) are all vulnerable to coastal threats. Significant action is being carried out in the mainland, but Hong Kong and Macao show relative complacency - so mainland action lifts rankings for Guangzhou (#17 to #11) and Shenzhen (#12 to #8) but Hong Kong and Macao’s relative complacency causes them to stay in Quartile 4 in the 1.5°C CWR APACCT 20 Index. Other mainland Chinese cities of Shanghai and Tianjin are also carrying out significant government adaptation efforts as can be seen from the wide gap in scores. For more on China’s coastal defences in the GBA, see “Case studies of cities adapting to coastal threats” in the Appendix.

- **Japan vs. China** – all mainland cities are more adaptation proactive than Japanese cities despite smaller share of national GDP – more on this analysis later in “No sense adaptation strategies”.

Source: CWR, CWR report “Avoiding Atlantis: The CWR APACCT 20 Index”, 2020
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Benchmarking impact of government action/inaction at 4°C

4°C CWR APACCT 20 INDEX
BENCHMARKING GOVT ACTION IN REDUCING PHYSICAL COASTAL THREATS THROUGH ADAPTATION

Key points of note from the chart above are:

- **Physical risk exposure changes rankings at 4°C** – Physical risk rankings at 4°C change as the physical risks differ. Some cities are more low lying than others, have more key infrastructure along the coast and therefore have more to lose. Shanghai is now the most at risk as opposed to Manila at 1.5°C as per the chart on the previous page; and Sydney moves ahead of Auckland to be the least vulnerable city. However, it is important to remember that all cities’ physical risks increase. Note that adaptation scores do not change for both scenarios as we did not score effectiveness but with higher physical risks government adaptation efforts become more important.

- **Some cities facing higher relative risks should do more** – Although all index scores rise at 4°C, some rise more than others. Suzhou, Macao, Osaka, Hong Kong, Aichi/Nagoya and Taipei face relatively higher physical risks yet their governments are not doing as much as Shanghai, Guangzhou and Shenzhen. Clearly, they need to step up their adaptation actions. See what Tokyo and Shanghai are doing to adapt in “Case studies of cities adapting to coastal threats”. For more on city risk gaps between 1.5°C and 4°C please see our other report “Avoiding Atlantis: The CWR APACCT 20 Index”.

- **Jakarta, Singapore and Auckland make significant adaptation efforts despite relatively lower risks** – Jakarta, Singapore and Auckland face comparatively less risks but their government adaptation plans are amongst the highest, ensuring that they stay at the top of the index. For more colour on what Jakarta and Singapore are doing please see “Case studies of cities adapting to coastal threats”.

- **Island financial hubs take divergent actions** – Both Hong Kong and Singapore are island cities and vulnerable to coastal threats yet it is clear that Hong Kong is taking significantly less adaptation action. This is especially surprising as Hong Kong faces significant typhoon threats. Singapore's proactive action and Hong Kong’s complacency has meant that they move in opposite directions when it came to our index rankings. Naturally, Singapore ranks #3 but its top-down, Prime Minister-led government action has moved it into pole position in the 4°C CWR APACCT 20 Index. Meanwhile, Hong Kong’s complacency in adaptation has relegated it from Quartile 3 to 4. That said, Singapore does need to improve its emissions trajectory – see what Singapore and Hong Kong are doing on adaptation and mitigation in the Appendix in “Cities adapting to tackle climate impacts” and “No sense climate strategies – governments”.

Besides action by governments, we have included a case study of no-sense climate strategies for corporates (finance & real estate examples) as governments will not be able to protect people and the economy alone.
No sense adaptation strategies

Conducting “sensibility analysis” to gauge government adaptation action. Evidently, while some cities are doing more than others, all cities must step up their climate action to ensure their citizens and economic activities are protected. Although the CWR APACCT 20 Index does not assess adaptation action for effectiveness, in this section we assess them for common sense – do the adaptation actions that governments are taking make sense. Here, we assume that governments are more incentivised to protect cities that are economic hubs – the greater the GDP it generates, the more likely the city and key infrastructure will be protected. We used three common sense metrics to gauge the actions of the 20 city governments:

1. The higher the GDP, the greater the adaptation efforts;
2. The greater the city's share of the country/territory GDP, the more adaptation efforts are prioritised; and
3. The richer the citizens of the city, the more they will want adaptation especially since they can afford it.

Various GDP metrics were used. We therefore analysed our index scores (with/without government action) against various GDP metrics of:

1. City GDP;
2. City’s GDP as a percentage of country/territory GDP; and
3. GDP per capita.

No-sense adaptation strategies pervade. The results laid out in the following three pages reveal that many governments are following no-sense climate strategies compared to the physical coastal risks they face. Broad trends exposed by the analyses are:

- Smaller GDP cities outperform large GDP cities;
- Governments should do more to protect cities with high country/territory GDP exposure but are not; and
- Cities that can afford to do more underperform.

In addition to using the CWR APACCT 20 Index and the ensuing analysis to gauge risks across the APAC region, we encourage you to also consider the following additional analysis in the box below

Are governments taking action to protect your assets/city?

- Know which cities/regions governments are prioritising for adaptation, if any. Investors and businesses need to understand that targeted adaptation action will vary by city and by location as governments are more likely to protect high GDP and densely populated areas for the best return on investment. As can be seen from the ensuing analysis, this may not even be true for some large cities – so do not assume that city/government adaptation strategies are sensible. Investors and businesses thus need to understand what governments are or are not doing in key cities as well as other locations beyond these where assets/portfolios are located. This will require further analysis beyond this report.

- Evaluate adaptation effectiveness with in-depth analysis for hotspots & high-value assets. Evaluating the effectiveness of adaptation measures would require in-depth analysis of actions by location within a city. Ideally, such analysis will need to be carried out on an asset-by-asset basis. While this will be more accurate, it would also be extremely costly and time consuming for one city let alone 20. Given time and cost constraints, we did not do this for the index, but we recommend that in-depth analysis be done for hotspots where there are a number of high value assets as well as important infrastructure such as ports and airports.

- Watch out for mismatched climate strategies – heading for 4°C but adapting to 1.5°C is sure to fail. Government mitigation actions to stay at 1.5°C instead of 4°C also play a role in protecting cities. Fast-tracking mitigation action will help keep threats at more manageable levels. At 4°C, large swathes of the APAC will be underwater from SLR. Government mitigation efforts however are not evaluated in the CWR APACCT 20 Index as it was created to gauge chronic tail risks and finance expert consensus led to only adaptation measures being considered. This is because adaptation can directly reduce the risks locally, whereas mitigation measures should be analysed in the global context as a city's own actions may not change the risks it's facing. Nevertheless, the level of commitments under the Paris Agreement (or not in the case of the US) can help gauge the cohesiveness of the government’s climate strategy. There is no point planning and investing in adaptation measures to protect against 1.5°C risks when planning for carbon transition to 4°C – that is just planning to fail. If you don’t know what scenarios to use, get on top of everything you need to know about coastal threats in "Changing Risk Landscapes: Coastal Threats to Central Banks".
1. Smaller GDP cities outperform large GDP cities

The chart below shows the city’s CWR index scores (with/without government action) plotted against the city’s absolute GDP for 20 APAC cities. The CWR APACCT 20 Index is denoted in blue whereas the CWR APACCT 20 Index - ex-Govt Action (physical risks only) is denoted in red:

**Key points of note from the chart above are:**

- **Trend line shows higher GDP cities are more vulnerable to coastal threats** – this is reflected by the red trend line sloping upwards with GDP and index scores ex-govt action.

- **Opposing trend lines expected but cities disappoint** – since we expect governments to invest more on adaptation efforts in higher GDP cities, we expect the two trend lines to go in opposite directions. The blue line representing the index with government action should slope downwards as GDP increases but it does not.

- **Tokyo disappoints** – the city has the highest GDP by far; at US$950bn, it is almost double that of the next highest GDP generator Shanghai but its adaptation efforts do not even beat the average efforts of the 20 cities represented by the blue trend line. **Tokyo vs. Shanghai** – Shanghai is more vulnerable to coastal threats than Tokyo, but it has less GDP at risk, yet its adaptation efforts are greater than that of Tokyo. This places Shanghai close to the average.

- **Cities with US$300-400bn of GDP have different adaptation strategies** – whereas Sydney, Singapore & Shenzhen have adaptation strategies that beat the average, the rest (Guangzhou, Osaka, Hong Kong, Aichi/Nagoya and Seoul) do not. Of the latter group, Seoul faces materially less physical risks and its adaptation efforts puts it slightly near the blue trend line. Out of the others (Guangzhou, Osaka, Hong Kong, Aichi/Nagoya) Guangzhou has done the most & Hong Kong the least.

- **Tianjin & Suzhou – same country, similar GDP but different adaptation efforts** – Tianjin is doing much more than Suzhou despite lower risks. Indeed, Suzhou underperforms all other mainland Chinese cities in terms of government adaptation action in our index.

- **Yangon, Auckland & Jakarta are doing a lot despite lower GDP and lower risks** – their significant action means that they beat the average.
2. Governments should protect cities with high country/territory GDP, but they are not

The chart below shows the city’s CWR index scores (with/without government action) plotted against the city’s contribution to the country/territory’s GDP for 20 APAC cities. The CWR APACCT 20 Index is denoted in blue whereas the CWR APACCT 20 Index - ex-Govt Action (physical risks only) is denoted in red:

**CWR APACCT 20 INDEX**

**GOVERNMENTS SHOULD DO MORE TO PROTECT CITIES WITH HIGH COUNTRY/TERRITORY EXPOSURE, BUT ARE NOT**

Key points of note from the chart above are:

- **With 100% of GDP at risk, Singapore, Hong Kong & Macao should prioritise adaptation, but only Singapore is** – Singapore is taking top down action with PM noting that “climate change defences are existential for Singapore” – they are “life and death matters”. The government has not only set up its own climate research centre back in 2013, it has also indicated a spend of SG$100bn or more on adaptation. All critical infrastructures will be raised by 5m above sea levels. As such Singapore tops our index.

- **Hong Kong & Macao disappoint despite imminent storm tides of 5m+** – Hong Kong has yet to form a department dedicated to tackling climate risks and has not published a comprehensive adaptation plan (they are still working on it). The words “climate change” did not even make it into the 2019 Policy Address by the Chief Executive signalling that it is not one of the top priorities of the SAR’s (Special Administrative Region) top leadership. Macao’s adaptation also lags yet almost half of its 39 casinos could be impacted by extreme storm tides of 5.87m as early as 2030. Note that neighbouring GBA cities are doing so much more – please see GBA case studies for Shenzhen and Guangzhou in the Appendix.

- **Taipei generates 27% of Taiwan’s GDP but makes the least adaptation effort of the 20 cities** – In fact, adaptation should be prioritised in cities which generate more than 10% of a country/territory’s GDP.

- **Country coordination is important: China is ahead of Japan** – on average, adaptation efforts of the 5 mainland Chinese cities are ahead of the 3 Japanese cities even though they make up a much smaller share of their country’s GDP – 13% compared to 33% for the 3 Japanese cities. Such complacency does not bode well for Japan – remember 68% of its total population is clustered in 19 large coastal cities.

- **Lacklustre government adaptation action above has implications for sovereign credit risk ratings of Japan, Hong Kong, Macao & Taiwan** – The high percentage share of country/territory GDP from their key cities plus high vulnerability to coastal threats warrant a rethink of their credit ratings. Corporates and investors should lobby governments to take more action to reduce risks, especially those with a large percentage of assets in at-risk cities. Corporates should also be carrying out their own adaptation efforts, especially in cities where government adaptation action is lacking.

Source: CWR; CWR report “Avoiding Atlantis: The CWR APACCT 20 Index”, 2020; World Bank 2018 GDP data; Individual government sources

Infographic © China Water Risk 2020, all rights reserved
3. Macao, Tokyo and HK can afford to do more but underperform

The analysis below is based on the premise that the richer the citizens of the city, the more they will want their homes/assets protected, especially since they can afford it. Thus, the chart below shows the city’s CWR index scores (with/without government action) analysed against the city’s GDP per capita. The CWR APACCT 20 Index is denoted in blue whereas the CWR APACCT 20 Index - ex-Govt Action (physical risks only) is denoted in red:

Key points of note from the chart above are:

- **It does not matter if cities are richer/poorer they are still exposed to physical coastal threats** – the flat red trend line indicates that there is no correlation between GDP per capita and the CWR APACCT 20 Index - ex-govt action scores.

- **Divergent trend lines expected but they converge as richer cities disappoint** – the trend line with government action should slope downwards as richer cities should act to reduce physical risks as GDP per capita increases. Instead the trend is reversed as cities with high GDP per capita are complacent.

- **Rich cities: complacent vs. proactive** – cities with around per capita GDP of US$50,000 are no doubt “rich”. Here, it is evident that there are two distinct groups: the complacent – Macao, Tokyo & Hong Kong and the proactive – Sydney, Singapore and Auckland. This clearly makes no sense as the complacent group face higher risks than the proactive group plus both Macao and Tokyo have higher GDP per capita than all three cities in the proactive group. Moreover, there is no hinterland to move to for Macao and Hong Kong which represent 100% of their SAR GDP whereas Tokyo accounts for almost 20% of Japan’s national GDP. Governments of these complacent rich cities must clearly step up action.

- **Even poorer cities of Yangon & Jakarta are doing more than the complacent rich cities** – despite lower GDP per capita as well as lower physical risk profiles, Jakarta and Yangon are making more efforts to adapt and protect their cities from coastal threats.

- **Taipei also disappoints amongst its peers in this analysis** – Taipei, Manila, Tianjin & Shenzhen have similar physical risk scores, but the adaptation efforts vary considerably – Taipei has a GDP per capita of US$23,000 but makes the least efforts to adapt. In fact, Taipei’s GDP per capita is more than double that of Manila, but Manila's efforts to adapt are almost 3x that of Taipei. Tianjin & Shenzhen outperform in this group – both cities manage to beat the average.
It is important to note here that this analysis is not without flaws - there is disclosure bias as all data was gathered from publicly available sources for each city to ensure consistency and transparency so there will be bias towards cities which are more transparent. The cities’ adaptation efforts were also not assessed for effectiveness and execution. However, this is not all bad as benchmarking could help push governments to make more adaptation efforts and to be more transparent with their climate risk management. For more on what government indicators were included plus finance sector feedback on their weightings please refer to “Avoiding Atlantis: The CWR APACCT 20 Index”.

The level of trust in governance structures should also be considered as planning is not the same as implementing the adaptation plans. For example, Jakarta scores well on government adaptation as it plans to build a US$40bn sea wall and artificial islands to protect the city as well as move its administrative capital. Yet the length of time for this to be implemented and the quality of it has not been considered in this index. That said, levels of trust in governments are already factored into sovereign credit ratings so in essence, not scoring for effectiveness should not be a stumbling block to using the CWR APPACT 20 Index to help gauge absolute and relative risks faced by countries/territories through their key cities.

Grim news coming out of our polar regions this year points to an ominous future: 2.9m of SLR is an outlying plausible reality by 2100; this is 2.6x that of IPCC’s worst-case (RCP8.5) high-end SLR projections of 1.1m of SLR by 2100. The IPCC has always been conservative with its SLR estimates and we worry, as do multiple scientists who say IPCC’s focus on the likely range “may be misleading and will lead to a poor evaluation of true risks” and that they have “a conservative bias that could potentially impede risk management”. You get the picture – yet many governments use IPCC SLR estimates for adaptation planning; worse still, they use IPCC’s low/mid-range, not even the high-end for planning. For more colour on these adaptation efforts and no sense climate strategies, please see case studies of various cities in the Appendix.

Please note that for consensus and benchmarking purposes, chronic SLR impacts were mapped using less granular 30m grids. Thus, impact analyses contained in this report are conservative, but our findings already reveal severe impacts from chronic SLR tail risks. Population flooded using a more granular 5m grid is 1.3x for Tokyo and 2x for Hong Kong by locked-in SLR in our 4°C base case scenario. For Taipei impacts worsen significantly with increasing granularity – switching analysis to a 20m grid, Taipei’s population inundated is 2.5x that of using a 30m grid. Clearly, this level of materiality calls for urgent granular analysis and recalibration of valuations. For more mapping deep dives for these three cities please see “Avoiding Atlantis: The CWR APACCT 20 Index”.

These chronic risks are not going away, if anything they will increase with every year. We all need to get this right if we want to waterproof our assets/ portfolios/ cities/ territory/ country/ region against capital threats and systemic shocks triggered by climate risks. Recommended actions and next steps for various stakeholders such as rating agencies, asset owners/managers, banks, central banks/regulators and governments can be found in “Waterproofing APAC: Recommendations & Next Steps”.
CWR Resources to help assess coastal threats

**Best, base and worst case CWR APACCT 20 Index and rankings to benchmark chronic risks:**

- The best-case: 1.5°C CWR APACCT 20 Index reflecting the coastal threat landscape we will likely lock-in by 2030;
- The base case: 4°C CWR APACCT 20 Index reflecting the risk landscape locked-in under the current climate pathway of 4°C by 2100; and
- Worst-case scenarios for 2100 and 2200: how to use the 1.5°C and 4°C CWR APACCT 20 Index for the worst-case scenario by shifting timelines.

**How the CWR APACCT 20 Index was created with input from 100+ finance professionals on:**

- The base case climate scenario;
- Which physical threat factors and proxy indicators to use;
- Weightings of different indicators;
- Main challenges regarding data issues; and
- How to incorporate government action and which type to include.

**Tools that already exist:**

- What these tools are missing and how they can be improved to be more useful for finance;
- Mitigation vs. adaptation governments efforts in the index; and
- How to change terminal value calculations to adjust for coastal threats.

**20 City factsheets:**

- At-a-glance GDP & trade values at risk + rankings;
- Overview of city’s climate threats & govt actions; and
- Maps of locked-in SLR at 1.5°C & 4°C showing impacts on people, land & key assets.

**8 things you must know about SLR:**

1. Vanishing ice from Switzerland to Himalayas = SLR + freshwater threats;
2. Our oceans are taking the heat = steric SLR + oxygen production at risk;
3. Greenland & Antarctica melting 6x faster = rapid SLR from MISI & MICI;
4. On the brink! Know key tipping points to avoid locking-in 10m+ of SLR;
5. Scary feedback loops! Arctic ice loss + permafrost thaw = rapid SLR;
6. SLR estimates are conservative = get on top of latest projections!
7. SLR does not rise evenly = APAC SLR is higher than global average; and
8. SLR + storm surge & subsidence = exacerbate risks + bring forward impacts.

**How to build coastal threat scenarios:**

- 5 tips to assess asset-level SLR and storm tides;
- How to build base & worst-case SLR projections; and
- How to build base & worst-case extreme storm tides.

**The latest on how finance plays catch up to new risk landscape:**

- The new risk landscape for finance;
- Latest regulatory action;
- Widening valuation gaps from mispriced & clustered chronic coastal risks; and
- Negative finance feedback loop explained

**Waterproofing APAC to Avoid Atlantis**

- CWR’s Survival Guide to Avoiding Atlantis
- Executive summary
- Key infographics & maps
- Recommendations for:
  - Asset owners & managers
  - Banks
  - Financial Regulators
  - Governments
Case Study Appendix

Case studies of cities adapting to coastal threats

- Singapore ranks #1 on our index – it has a plan & expects to spend SG$100bn to protect itself
- Indonesia is moving its capital and building sea walls
- Tokyo’s impressive flood defences work for now but may not be enough for the future
- China’s coastal defences takes a sea walls + sponge city approach

No sense climate strategies – governments

- Singapore admits climate risks yet continues to pollute with large maritime sector
- Hong Kong has multiple adaptation strategies that make no sense
- Macao’s sluggish climate resilience plan leaves economy unprotected

No sense climate strategies – sectors

- Finance is exposed to climate vulnerable Asia yet continues to lend to fossil fuels sector
- The property sector thinks green credentials = safe
Case studies of cities adapting to coastal threats

Some cities are doing more than others; below are a few examples of government adaptation action in the APAC. Here, we provide case studies of such action. We do not deem any of these to be perfect or all-encompassing, but it gives a brief overview of what a few governments are doing (or not doing) to protect their major cities.

**Singapore ranks #1 on our index – it has a plan & expects to spend SG$100bn to protect itself**

Singapore is a small low-lying island and as much as 30% of its land is less than 5m above sea level. With much of its people and economic activity based in these areas the government is acting. Prime Minister Lee Hsien Loong proclaimed climate threats to be “life and death matters” at his National Day address in August 2019 and announced Singapore would need to spend at least SG$100bn over 100 years to tackle climate change and rising sea levels.

“Both the SAF (Singapore Armed Forces) and climate change defences are existential for us. These are life and death matters … Because we are a low-lying island, Singapore is especially vulnerable to one grave threat, and that is rising sea levels… Not only will property values be affected, but safety and liveability. And it will affect not only these particular areas, but the whole city.”

Action has already started as explained by him further: “We also require new developments to be built on higher platforms, instead of building three metres above mean sea level like before, they must now be at least four metres above mean sea level. For critical infrastructure like Changi Airport Terminal 5 and Tuas Port, we are raising the platforms even higher, at least five metres above mean sea level.” This is significant as Singapore is not even in the path of typhoons.

In addition, construction of walls and stone embankments covering 70%-80% of Singapore’s coastline has already started and the use of plants such as mangroves and sea grasses as natural barriers to inundation are being researched. It has also earmarked SG$5bn for the newly established Coastal and Flood Protection Fund in its recent 2020 Budget to devise more efficient long-term resilient strategies. For low-lying areas that cannot be lifted up, they are considering building polders to protect them. It is also clear from strategies explained by the PM that adapting to coastal threats are seen holistically – managing sea level rise with increasingly heavy rainfall as well as water security.

Indeed, adapting to flooding from heavy rainfall has started. For example, Orchard Road, the retail hub, has been raised by 30cm and storm water diversion tanks that can temporarily store 15 Olympic sized swimming pools of stormwater have been added. The latter cost US$157mn but as Orchard Road is the 16th most expensive shopping street globally where rents averaged US$312 sf/year in 2019, this is less than the annual rent for the all lettable area at ION Orchard, the most iconic shopping mall along Orchard Road. But the work is not over as Singapore will spend a further SG$400mn in the next two years to upgrade and maintain the country’s drains and strengthen flood resilience.

Back in 2013, Singapore established the Centre for Climate Research Singapore (CCRS), a dedicated research centre. Its 2100 SLR projections range from 0.29m (low-end of IPCC’s AR RCP4.5) to 2m (high-end of their H++ scenario). The raising of critical infrastructure to at least 5m implies that Singapore is adapting to the high-end of the H++ scenario – 2m SLR + 2m high tide + 1m buffer for heavy rains. This signals that the government is prudent with managing coastal risks – adapting for the high-end worse scenario. Others are not - in the case of Hong Kong, the government is making plans to adapt for flooding to the low-end of “low-and-medium case” range estimates – see Hong Kong case study later.

Going forward, we expect Singapore to refine its research with its National Sea Level Programme. Launched in December 2019, the SG$10mn five-year programme will fund pioneering research proposals & collaborations to help better understand long-term SLR and its variability, regional patterns, and extreme weather events. Singapore is clearly trying to futureproof today’s investments for the inevitabilities of tomorrow’s sea levels but, it can improve on the emissions front - see “No sense climate strategies – governments” for more.
Indonesia is moving its capital and building sea walls

Jakarta is in a precarious position. Urbanisation has led to a congested capital with a population of over 10 million people. The mismanagement of urban development has meant that it doesn’t have a comprehensive piped water network, which has led industry and homes to tap into the city’s aquifers. This has caused severe subsidence; since the early 1970’s major parts of Jakarta have sunk by 2m to 4m and the northern part is especially at risk which has sunk by 2.5m in the last decade alone, two times the global average of coastal megacities. Rising sea levels will only compound the problem.

The government’s solution is to two-fold:

1) Reduce pressure on current infrastructure by moving the capital to East Kalimantan, on Borneo. This will see the government’s administrative functions moved, but Jakarta will continue to be the nation’s commercial and financial centre. The move will cost US$33bn; and

2) Launch the NCICD (National Capital Integrated Coastal Development) where a giant 32km wide sea wall is the primary project and will be supplemented by strengthening existing coastal dikes plus constructing 17 artificial islands in the bay of Jakarta. The sea wall, which will take 10-15 years to build, will house an airport, harbour, toll road, residential and industrial areas, waste treatment, water reservoir, and green areas. It is hoped that this additional available land will attract private investors as the government will not be able to foot the US$40bn bill itself.

These plans are not perfect; they will take time, require significant investment and will have significant environmental repercussions of their own. They have also already been delayed with the timeline extended in late 2019 when private developers of 13 reclaimed islands plus a 13.4km sea wall segment (phase A of the NCICD) departed from the project and forced the government to takeover, delaying the completion date by a further two years.

However, the first solution does highlight that not all impacts of climate change can be reduced through hard or natural infrastructure. It may not make economic and social sense to fully protect some areas that will be extremely vulnerable. Thus, moving could be the best option, so that less people and GDP are at risk and to reduce pressure on resources. However, this is difficult to accept by governments, industries and citizens.

Giant Sea Walls: an effective fortification that has its drawbacks

A sea wall can be a controversial solution when it comes to dealing with SLR and storm surge risks as it requires significant investment, can impact the valuation of coastal properties and the financial return may not be clear unless risk modelling has been carried out with the results disclosed. In addition, environmentalist can oppose this type of hard infrastructure as it can hurt the local ecosystem. However, it is the most direct and effective infrastructure to fortify and protect coastal areas, but social issues may persist.

A good example is the US$12bn giant sea wall along the northern coast of Japan. It was built to a height of 12.5m and stretches across 395km to protect coastal regions from another “Fukushima disaster” where a tsunami killed over 18,000 people. However, what should have soothed residents’ minds instead provoked backlash that the wall blocked sea views and was deteriorating their living standards.

This offers a glimpse into why a giant sea wall directly along the coast may not always be the first option for a city unless it is already facing severe risks (e.g. Jakarta). However, with the world on track for at least 3°C-4°C most coastal cities may require different levels of this inelegant solution. It is therefore important for governments to balance the concerns from different stakeholders and seek a sustainable solution that could include the use of nature-based solutions – please see box on “Mangroves: a solution that many overlook” for more.

However, it may also be inevitable, that some areas become too costly to inhabit and so governments may have to make the difficult decision to permanently move populations and economic activity from these areas, which may be the safest but least popular option. And in the long-term insurers may force migration away from these extremely vulnerable areas if they refuse to insure homes and businesses located there.

Source: CWR; Reuters article. Seven years after tsunami, Japanese live uneasily with seawalls. Megumi Lim. 9 Mar 2018
Typhoon Hagibis cost Japan US$15bn in 2019 but it could have been higher without Tokyo's underground tunnels…

…but tunnels were almost at capacity & need to be expanded

3.5m-7m sea walls are being built to better protect Tokyo

But this might not be enough as flood simulations show that 1/3rd of wards in central Tokyo are at risk

Another simulation in 2019 expects a 5.58m storm tide…

…which would flood 1/3rd of Tokyo...

To test its flood resilience, the Tokyo Metropolitan Government in 2018 released results of a flood simulation based on a worst-case scenario involving a massive typhoon simultaneously causing heavy rains and tidal flooding. This showed that one-third of the 23 wards of central Tokyo would be submerged – including Marunouchi, Shinbashi and Ginza downtown business districts.50

In 2019, the Bureau of Port and Harbour of the Tokyo Metropolitan Government produced a further Storm Surge Inundation Area Map51, simulating the potential impacts of a 1 in 1,000-5,000 year typhoon (the strongest intensity ever to hit Tokyo) which will cause a 5.58m storm tide.

As illustrated in the map below left, one-third of Tokyo is inundated. But things could be much worse by 2100 as the sea level is projected to rise by 2.1m. Hit by the same typhoon that was used in the simulation, Tokyo will ravaged by a 7.64m storm tide (map below right). Note - the maps may appear to look the same but an additional 2m of storm tides will cause much more devastating damage. Given Tokyo’s vulnerability clearly there is much more to do.
Shanghai is sinking & is in the path of typhoons

But the government has implemented a variety of plans...

.... from a levee, to sea walls, drainage systems, better communication and sponge city...

...important actions as 97% of the city could be submerged at 4°C

The GBA is home to economic, financial & manufacturing hubs but is highly vulnerable to coastal threats

35% of China's typhoons land on Guangdong & on average cause US$2.2bn of annual losses

7/12 regions in Guangdong identified as very vulnerable to typhoons are Mainland GBA cities including Shenzhen & Guangzhou

China's coastal defences takes a sea walls + sponge city approach

Shanghai's sea walls and levees to protect it for now

Shanghai is one of the most vulnerable cities to flooding; annual rainfall in the city is expected to be 20% higher than the global average by 2050. Unfortunately, it's also sinking and is in the path of typhoons. In order to adapt the government has implemented different strategies, which include five levels of protection:

1) Huangpu River Levee: built to withstand a once in 1000 years flood and had reached 511 km by 2013;

2) Sea walls: the current sea walls are designed to withstand sustained wind speeds of 118-149km/h (equivalent to a Category 2 hurricane and T10 in Hong Kong) with a 100-year return period. The sea walls are 523km long and protect 2,600km² of land;

3) Drainage Systems: billions of dollars have been spent on upgrading the municipal drainage system. In 2011, an estimated 14,000km of pipes were maintained and 310,000 m³ of mud was evacuated;

4) Advanced Flood Information Control System: a warning system for the public has been set up using social media and other forms of communication, such as Weibo and text messages; and

5) Sponge City: Shanghai has the largest “sponge city” pilot zone (Lingang in Pudong New Area) in China which aims to collect & process up to 70% of rainwater by 2020. Examples of measures are water-permeable/absorbable pavements, garden rooftops and wetlands.

Whilst all these actions are positive, a lot of the figures and forecasts are outdated. Therefore, further investment may be necessary to ensure Shanghai is protected because in a 4°C scenario, 97% of the city currently faces permanent flooding according to our calculations.

Greater Bay Area (GBA) key cities of Shenzhen & Guangzhou also protected

“According to our estimates, Guangzhou will have 1,000m² of land under water and PRD area [Pearl River Delta] will have 5,000m² of land under water if sea levels rise by 0.3 metres.”

Jiang Kejun, Director, Energy Research Institute
National Development and Reform Commission, China
November 2014

China's Greater Bay Area (GBA) brings together Hong Kong, Macau and nine cities in Guangdong to form an “integrated economic and business hub”. It is home to financial services powerhouses like Hong Kong, Shenzhen & Guangzhou, strong manufacturing bases like Foshan & Dongguan as well as the region's main entertainment hub Macao. The GBA is vulnerable to extreme weather risks like floods, typhoons & storm surges.

According to researchers from the Sun Yat-sen University, around 35% of China's typhoons landed on Guangdong Province and have already incurred an annual average economic loss of US$2.2bn (RMB15.13bn) for the past decade. The intensity of these typhoons means that in some years the damage from just one typhoon alone can lead to these losses. For example, Typhoon Mujigae in 2015 affected 3.5 million provincial residents and caused a direct economic loss of US$3.4bn (RMB23.2bn) for the province.

What makes things worse is that in recent years, storm tides along the Guangdong Province have become more unpredictable in terms of frequency, magnitude and landing locations & time which makes it more difficult for governments to implement precautionary measures. Some regions are especially at risk. By analysing metrics such as population density, GDP distribution, roads network density and land utilisation rate, 12 regions have been identified as particularly vulnerable to typhoons and storm tides. 7 of them are Mainland GBA cities - Zhuhai, Zhongshan, Dongguan, Shenzhen, Mid-eastern Foshan, south-western Guangzhou and mid-southern Jiangmen.
The infographic below shows all 7 airports and 50 ports in the Greater Bay Area and how they could be affected by storm tides due to a typhoon as early as 2030. Clearly much is at risk; nearly all container ports and airports in Hong Kong, Shenzhen, and Guangzhou are affected. Hong Kong’s status as a transport and logistics hub could thus be diminished if no action is taken, as will Shenzhen’s and Guangzhou’s.

This is especially important for Hong Kong because in 2018 merchandise trade was 312% of GDP. Plus, about 90% of the total food supply in Hong Kong is imported, with Mainland China the most important source, especially for fresh food. In 2011, 94% of fresh pork, 100% of fresh beef, 100% of live chickens, 97% of live freshwater fish, 92% of vegetables and 66% of eggs came from the Mainland. Although these numbers have fallen since, Hong Kong’s food supply will still be severely disrupted if key roads, airports and ports are impacted – more on Hong Kong and Macao’s actions later.

By 2030 storm tides could impact 4/7 airports and 43/50 ports in GBA…

…this is especially important for Hong Kong which imports 90% of its total food supply

Sea walls already exist in many coastal areas in the Pearl River Delta (PRD) and vary by height as they are built to withstand surges brought on by storms of varying return periods. Even Guangdong’s 13th Five Year Plan (FYP – 2016-2020) has sea wall targets – 80% of sea walls must be reinforced to withstand storm tides with 20-year return periods by 2020. According to the 13FYP, there are 88 projects at the planning stage for the construction and reconstruction of sea walls which in total will be over 1,166km long requiring a total investment of RMB11.3bn (US$1.6bn) – the map on the following page highlights the sea walls built or under construction in the PRD.

As can be seen more important areas or assets have higher sea walls; for example, high GDP regions such as Guangzhou and Shenzhen are heavily protected by sea walls of up to 100 or 200-year return periods of tide levels, and the Daya Bay Nuclear Plant is protected by a sea wall that is able to withstand a tide level with a 1,000-year return period, with a height of 13m (denoted in red).

This network of sea walls appears impressive, but a word of warning, such planning based on storm return periods is backward looking, as storms are now increasing in intensity and frequency. Therefore, current sea walls may not be enough. Moreover, it is unclear if this adaptation planning considers the new base case of 3°C-4°C by 2100 which will have severe implications. Also, it’s not just about sea walls, governments need to be thinking about nature-based solutions, elevating assets and infrastructure along the coast such as ports and airports, or even relocating citizens and business activities to less risky areas.

The PRD is protected by over 1,166km of sea walls

The highest walls protect the most important areas

But we don’t know if the sea walls are sufficient if we are on target for 3°C-4°C by 2100
The highest walls protect the high GDP areas…

… and key infrastructure such as the nuclear plant

Unfortunately, the GBA is also vulnerable to heavy rainfall & the govt is implementing plans to utilise at least 70% of it

In addition to seawalls, the Guangdong provincial government has also implemented the “Blue Bay” remediation action plans which include conserving coastal mangroves and establishing a coastal ecological belt to mitigate coastal threats – please see box below for more.

But coastal threats are not the only concern for GBA cities as they also face more rain thereby flash floods in the future. As such, China has been actively implementing “Sponge cities” as the countermeasure. 30 cities were in the pilot scheme as of 2016 and they target to consume and utilise at least 70% of the precipitation on the spot.

It also has the advantage of being less costly and disruptive to the local community than other policies such as retrofitting existing drainage systems.

Mangroves: a solution that many overlook

Mangrove forests can play a crucial role in protecting coastal areas from SLR by preventing soil erosion and seawater intrusion. According to a 2015 study led by University of Southampton, a network of Mangroves can fortify the coastline against 0.5mm of annual SLR.

Mangroves can also reduce the destructive impacts of storm surges by reducing the intensity of the waves if planted appropriately. In addition, they can help decelerate global warming as research shows that per hectare, mangroves held up to four times more carbon than other tropical rainforests.

For southern China, the Central government wants more cooperation in ecological and environmental protection among Guangdong, Hong Kong and Macao specifically to “strengthen the protection and restoration of wetlands, comprehensively protect key wetlands of international and national importance in the region, and join hands to introduce measures to protect cross-boundary coastal wetlands”. In Auckland, despite its recently loosened rule to allow the removal of mangrove seedings in permitted area due to rapid spreading, the government nevertheless prohibits any destructive behaviours in ecologically sensitive areas and continues to use mangroves for erosion control and shoreline protection. Singapore and Jakarta are also growing and rehabilitating mangroves to protect their cities.

However, we do need to bear in mind that mangroves cannot be planted in all coastal areas – for example Hong Kong’s Victoria Harbour is extremely vulnerable and valuable but mangroves would not be able to protect this area as the harbour is too deep and rocky for a mangrove forest to thrive.

No sense climate strategies – governments

We have already reached 1.2°C of global warming today which has been damaging. Yet the current base case is 4°C by 2100 as carbon emissions continue to rise unabated and the risks are not being fully dealt with. It’s exasperating to see this continued lack of action, or wilful ignorance in no-sense climate strategies by governments, finance and corporates. Here are some examples of these idiosyncrasies.

Singapore admits climate risks yet continues to pollute with large maritime sector

As shown in “Cities adapting to tackle climate impacts”, Singapore plans to spend billions of dollars on adaptation as it recognises it’s vulnerable to climate threats. But it can also reduce its emissions as it is the 27th biggest carbon emitter in the world on a per capita basis, even ahead of China which is 39th. Industries contribute ~60% of this amount, and three-quarters of industries’ emissions are from the refining and petrochemicals sector. The maritime sector contributes 7% of GDP as Singapore’s geographic position has made it into the world’s 3rd largest oil refining centre. Plus it has the largest and most important bunkering port in the world, supplying 49.8 million metric tonnes (MT) to refuel ships in 2018. No other port comes close; Rotterdam and Fujairah, the world’s 2nd and 3rd largest bunker ports, each sold less than 10 million MT in the same year.

The problem is two-fold: first, bunker oil is highly carbon intensive; the International Maritime Organization (IMO) estimated that maritime transport emitted 961 million tonnes of CO2e in 2012 and was responsible for 2.8% of world emissions on average between 2007-2012. If shipping were a country it would be the world’s 6th largest emitter in 2017, ahead of Germany, Australia, the UK and France as shown in the chart below. And this is even though the maritime emission data is from 2012 and has of course grown since. Plus, under a business-as-usual scenario IMO expects these figures to increase by 50% to 250% by 2050.

Second, emissions from the maritime industry have been excluded from government obligations under UN climate agreements, including the 2015 Paris accord. The IMO has a long-term aim to halve carbon from shipping by 2050, but it has few concrete plans to achieve it.

Singapore has made a number of commitments to reduce its carbon emissions, but Climate Action Tracker deems them “Highly Insufficient” as its “climate commitments in 2018 are not consistent with holding warming to below 2°C, let alone limiting it to 1.5°C as required under the Paris Agreement, and are instead consistent with warming between 3°C and 4°C.”

Given the government accepts Singapore’s climate vulnerability and expects to spend SG$100bn to protect itself, it might be prudent for Singapore to also green its entire economy to reduce the risks it faces and thus cut its adaptation budget. The government has started by giving incentives for ships to install engines that use alternative fuels with lower carbon content such as LNG. However, according to new research LNG may not be the answer as some types of LNG-powered ships leak so much methane that the environmental damage they cause over a 20-year period could be worse than similar ships run on conventional fuels.
Hong Kong has multiple adaptation strategies that make no sense

2018 Typhoon Mangkhut’s storm tide could have been 5.65m yet HK has no published adaptation plan

Super Typhoon Mangkhut brought storm tides of 3.88m into Hong Kong’s Victoria Harbour in 2018. But things could have been much worse according to research carried out by CWR for the 2019 CLSA U® report “Thirsty and Underwater: Rising Risks In Greater Bay Area”. Mangkhut could have caused 4.85m of storm tides at Quarry Bay/Victoria Harbour if it had coincided with the astronomical high tide period (storm surge 2.35m + astronomical high tide of 2.50m = 4.85m); if Mangkhut had taken a slightly different path, it would have brought an additional 0.8m of storm surge.70

This means that the maximum impact of Mangkhut could have been 5.65m at Quarry Bay/ Victoria Harbour instead of 3.88m.57 The difference is significant as illustrated in the maps below. Central, Hong Kong’s financial district would have been inundated; storm tide levels would have reached past Des Voeux Road, which would have been extremely costly and disruptive.

RMS, a leading catastrophe risk modelling organisation, estimates that Mangkhut, which has a return period of 30 to 40 years in Hong Kong, caused total insured losses of US$448mn just in Hong Kong, and this only represents losses reported by insurance companies.71 It estimates that a “1-in-200-year insured loss from a typhoon in Hong Kong would be in the region of HKD 15 billion to 18 billion (US$1.9 billion to US$2.3 billion)”. And according to the HKO, the storm tide brought by Mangkhut could become an annual occurrence due to SLR by 2100.72
Hong Kong’s building flood resilience to a “low-and-medium case” = planning to fail?

The current climate path is 3°C-4°C by 2100 and much of Hong Kong’s assets and people can be found close to the coast. Yet the government is using the “low-and-medium case” climate scenario in its new projects and development sites.

For example, levels used by the Drainage Services Department (DSD) for future drainage design planning to deal with coastal flooding are still based on a low emissions path. Its “mid-21st century (2041-2060)" projection is only 0.23m whereas the HKO’s low-case RCP2.6 projections are 0.26m-0.46m. Surely, the DSD should be preparing drainage to manage seawater levels at the high-end of the range and not the low-end? This discrepancy widens for 2081-2100 where the DSD is preparing for 0.49m when HKO is projecting a range of 0.44m-0.79m.73,74

As lamented in a CWR article in 2019, DSD’s preparations are a far cry from HKO’s RCP8.5 projections (which we recommend being used as the new base case given the current emissions path) which has a high of 1.16m by 2100. Hong Kong is clearly not prepared.75

Also, if the DSD is so far off protecting against the HKO’s projections, you have to ask the question – is the rest of the Hong Kong government also in denial when it comes to preparing Hong Kong for climate change?

HKIA might be safe, but if the roads and trains are not, can the airport still function?

The airport may also be exposed as the sea wall being built to a height of +6.5m above sea-level to protect the third runway may not protect the road and rail links which will leave the airport vulnerable. The Construction Engineering Development Department (CEDD) has now commissioned a study into the impacts of coastal hazards on Hong Kong; but the findings are not expected until late 2020, they may not be made public and no detail has been provided if it is planning for a 2°C/3°C/4°C future.

This is worrying as Hong Kong is a financial and logistics centre and there are no robust plans to protect Victoria Harbour which is home to trillions of dollars of assets. And the banks are yet to price in these escalating physical water risks75 and continue to lend to carbon intensive industries – please see “No sense climate strategies – corporates” for more.

But not only is Hong Kong not fast enough in adaptation, it also lags in reducing its carbon emissions. Civic Exchange recently collaborated with the World Resources Institute (WRI) to develop an Energy Policy Stimulator, forecasting Hong Kong’s future emissions by 2050. Under Hong Kong’s current mitigation policy, outlined in the Hong Kong Climate Action 2030+ published by the government in 2017, Hong Kong will reduce energy-related emissions to 23 million tonnes by 2050, a 38% reduction compared to 2017.77 However, Civic Exchange and WRI propose that for Hong Kong to achieve much deeper decarbonisation to limit global warming to below 1.5°C-2°C by 2100 as per the Paris Agreement, these should reduce to 5 million tonnes and require further carbon offsetting measures.77

Even if we evaluate a shorter time frame and benchmark Hong Kong’s mitigation policies with C40 Cities pathway, which Hong Kong is a member of, it still falls 78% short of the 2030 carbon emissions target in this group, according to Carbon Care InnoLab.78 This unanimously points to the slow actions taken by the government to reduce emissions, which will directly contribute to stronger typhoons and faster SLR that will devastate the city in years to come as it is currently not prepared.

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<th>DSD planning vs HKO low-case sea level rise projections</th>
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<td><strong>Source:</strong> CWR article “No-Sense Climate Strategies: From DSD To HSBC”. Dharsna Mirando and Debra Tan, 20 September 2019</td>
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<td><strong>Note:</strong> The DSD numbers do not include subsidence, whereas the HKO numbers do</td>
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<th>2041-2060</th>
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The govt is using the “low-and-medium case” scenario to plan adaptation

Even at this scenario it's using the low-end SLR projection...

...so DSD is using an SLR projection of 0.49m by 2100, but it should be using 1.16m as we are heading for 3°C-4°C...

So, how safe is HK?

The airport may also be exposed as the sea wall being built may not protect the road/rail links

As a financial & logistics hub this is worrying – trillions of dollars of assets could be exposed

And it’s not only adaptation, HKs mitigation strategies also need to improve...

...even compared to the C40 Cities plan, HK falls short by 78% of the 2030 carbon emissions
Macao's sluggish climate resilience plan leaves economy unprotected

Macao has been severely impacted recently by typhoons; Super Typhoons Hato (2017) and Mangkhut (2018) brought with them storm tides into the Inner Harbour of 5.58m and 5.21m respectively and caused billions of dollars in damage and economic losses. Hato was the worst typhoon that Macao had seen since 1968; ten people lost their lives, 240 people were injured and total economic losses of US$1.6bn were recorded, which is almost 3% of Macao's annual GDP.

To reduce the reoccurrence of this damage, Macao's government planned to build a tidal gate across the Inner Harbour in the second half of 2019. According to the government, the tidal gate is envisaged to protect against storm tides of 5.8m brought on by a one in 200-year storm. However, an NGO, Synergy of Macao (Associação da Sinergia de Macau) revealed in April 2019 that the height of the new proposed tidal gate had been reduced from 5.80m to 5.65m. This is only 7cm higher than the storm tide level of Hato, allowing Macao a very small margin of error.

Last year when CLSA U® published “Thirsty and Underwater: Rising Risks in the Greater Bay Area” authored by CWR, analysis in the report showed that areas including Taipa, Coloane and the airport were left unprotected by the government's plans and could be affected by storm tides by as early as 2030 as the map below illustrates.
These areas are home to key Vegas staples that make a significant percentage of their revenue in Macao; for Las Vegas Sands and Wynn Resorts at that time it was as high as 63% and 75% respectively as per the chart below:79

Since the report was published, the government made plans to reduce the risks from coastal flooding according to its “Ten Year Plan for Disaster Prevention and Mitigation in the Macao Special Administrative Region (2019-2028)”80, published at the end of 2019. Acknowledging that climate change and SLR will create stronger tropical cyclones and storm tides, the Macao government devised numerous new measures to fortify the city. The most prominent initiative is to build 31.4km of sea walls with a height of 3.71m, surrounding Macao, and the north, east & west sides of Taipa/Coloane island. Together with storm/flood drainage systems and pumping station construction and reinforcement, the government believes the city should be able to withstand storm tides with 200-year return periods.

However, progress on these projects have been slow as both the inner harbour sea walls and tidal gate have been put on hold until more feasibility studies are completed. In particular, the tidal gate has been delayed multiple times since the completion of the environment impact assessment in June 2019. While we acknowledge the importance of thorough investigations prior to embarking on any major infrastructure projects, these prolonged delays and inefficiencies are certainly not going to help protect Macao from another super typhoon.

What makes matters worse is that the Macao government does not have a comprehensive strategy against more intense physical climate risks. All current adaptation measures are based on historical records. Yet, as summarised succinctly by Blackrock, “New climate patterns mean long-dated historical data are a poor guide to the future. Investors using models overly reliant on the past are missing the big picture”.82 And the same goes for governments – they need to adapt at least for the current base case, which is 3°C-4°C by 2100 as that’s the direction we are heading in, which will lead to more intense typhoons in the future – please see “Changing Risk Landscapes: Coastal Threats to Central Banks” for more.

In Macao, despite the formation of an interdepartmental working group of climate change, the government has not published any official research about future climate risks. Therefore, despite clear improvement, Macao still needs to devote more resources and focus to holistically manage long-term typhoon and SLR risks as its economy and people are very vulnerable to coastal threats.
No sense climate strategies – sectors

Finance is exposed to climate vulnerable Asia yet continues to lend to fossil fuels sector

A group of NGOs analysed and ranked the fossil fuel lending of 35 global banks between 2016 and 2019, since the Paris Agreement; nine Asian banks lent US$632bn to the industry and three of them were in the “Dirty Dozen” as the chart below shows. Plus that chart also shows that Asia makes up a significant percentage of revenue for these banks, and we know that Asia is extremely vulnerable to coastal threats. This continued lending to carbon intensive industries makes no sense considering the risks, which means bank balance sheets are exposed.

The two biggest lenders in Asia are Japanese, and more than 50% of their revenue is generated in Asia. Their home market, Japan, is persistently hampered by typhoons, droughts and floods each year and it’s only getting worse. These have caused billions of dollars in losses, yet lending continues to flow to carbon intensive sectors that exacerbate these risks.

HSBC is also on this list as the 3rd largest Asian lender and 12th overall. It also had the 4th highest increase in lending to the industry from 2018 to 2019. This is surprising given HSBC has spent years developing its “green bank” image and was named the ‘World’s Best Bank for Sustainable Finance’ in 2019 by Euromoney. Even its TCFD (Task Force on Climate-related Financial Disclosures) disclosures in its 2019 Annual Report identifies and quantifies its loan exposure to six sectors that are vulnerable to the carbon transition risks. Yet the loan book’s vulnerability to physical risks is not quantified in any manner, even though almost 84% of HSBC’s profits in 2018 were made in climate vulnerable Asia. In addition, our analysis shows that even the HSBC head office in Hong Kong could be affected by extreme storm tides by 2030.

This carbon intensive lending trajectory is obviously short-sighted as it will affect non-performing loan ratios for the rest of the banks’ lending portfolio as well as deposits. Has this lending continued as the sector doesn’t expect significant government carbon policies and so hasn’t spent enough time understanding just how material and imminent water risks are to their entire balance sheet? Or are banks being short-sighted and expect insurance to cover these losses – but how long will the insurance industry be able to bear these losses?

The regulators may drive this change as the Network of Central Banks and Supervisors for Greening the Financial System (NGFS) recognises that there’s “a strong risk” that climate-related financial risks (from extreme weather events) are not fully reflected in asset valuations. Their next steps may leave banks with no choice but to re-think their lending strategies – please see “Time to recalibrate sovereign credit ratings for climate tail risks” for more.
The property sector thinks green credentials = safe

We need to move beyond considering environmental risks as being solely about how companies impact the environment through carbon emissions, water use etc. The environment can also impact company operations and assets, whether it’s through floods and storm surges or heatwaves. These are real risks and disruptions that are happening today.

The property sector is vulnerable to these risks, yet it tends to focus on how it impacts the environment and uses this as a great marketing opportunity. But multiple green certificates do not indicate that a company/asset is safe; climate and water risks don’t work that way unfortunately.

For example, Hongkong Land (HKL) has been awarded several different awards and certificates for its efforts in sustainability. These include its Central Hong Kong portfolio, which received the “Carbon Less” Certificate under the Hong Kong Awards for Environmental Excellence. In addition, it is reducing its water use with a 4.6% reduction in water consumption over 2017 in Singapore and Hong Kong. Although these are commendable and the least it should do to help accelerate decarbonisation, it is still exposed to clustered risks. Analysis carried out by CWR in “Thirsty and Underwater: Rising Risks in the Greater Bay Area” for CLSA U® shows that one typhoon can adversely affect most of its Hong Kong portfolio by as early as 2030. This is significant as Hong Kong accounted for 76% of the group’s assets and 54% of its operating profit in 2018.

New World Development (NWD) is another example. It reports extensively on its efforts on being “green”, which includes measures on water and energy efficiency, circular economy to reduce waste, green architecture, green finance and TCFD reporting. Again commendable.

Hong Kong accounts for two-thirds of NWD’s revenue and non-current asset value. Yet as the map below shows by 2030 22% of its Hong Kong property portfolio could be affected by storm tides. This increases to 63% by 2100. In both cases, this includes its flagship sustainable building K11 ATELIER King’s Road which received three of the highest sustainable building certifications.

Clearly green credentials are not enough. This is about risk mitigation as well as adaptation. However, NWD is carrying out scenario analysis to assess asset level risks related to 2.5°C and 4°C by 2100. So, we hope the findings will be disclosed along with action being taken to reduce the risks so that investors as well as tenants can make their own risk-weighted decisions.
The cut-off date for all research referenced in this report is 9th October 2020


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