Climate change will drastically redraw coastlines threatening capital cities, economic growth and livelihoods in the Asia-Pacific region. Locked-in tail risks from such coastal threats should be factored into sovereign and corporate credit risk ratings as well as equity/project valuations. We have thus developed the CWR APACCT 20 Index to benchmark coastal threats to help multi-stakeholders understand and assess these complex risks.

These city factsheets are an integral part of the CWR APACCT 20 Index and provide an at-a-glance coastal threat assessment for 20 APAC cities of Aichi/Nagoya, Auckland, Bangkok, Guangzhou, Ho Chi Minh, Hong Kong, Jakarta, Macao, Manila, Osaka, Seoul, Shanghai, Shenzhen, Singapore, Suzhou, Sydney, Taipei, Tianjin, Tokyo & Yangon. They should thus be read with our report “Avoiding Atlantis: The CWR APACCT 20 Index”.

These factsheets form a part of the CWR Coastal Capital Threat Series which seeks to explore and assess the absolute and relative tail risks from coastal threats for 20 APAC capitals and key cities. We hope that they can help APAC governments, central banks and financial regulators better prepare the region for capital threats and systemic shocks ahead.

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.
CWR APACCT 20 Index City Factsheets

The CWR APACCT 20 Index City Factsheets are an integral part of the CWR APACCT 20 Index and provide an at-a-glance coastal threat assessment for each of the 20 APAC cities. They are in fact Appendix 1 of our report “Avoiding Atlantis: The CWR APACCT 20 Index” which expands on the development of the index that benchmarks coastal threats for 20 APAC cities. The city factsheets should thus be read alongside the results and rankings discussed in Avoiding Atlantis.

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 CWR APACCT 20 Index.

This is 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-calibrate tail risks and re-think long term capital allocation decisions. We hope that the index along with these factsheets can help APAC governments, central banks and financial regulators better prepare the region for capital threats and systemic shocks ahead.

Each factsheet includes:
- At-a-glance city GDP share
- Overview of government actions
- City rankings in CWR APACCT 20 Index at 1.5°C & 4°C
- Overview of the economy at stake including trade exposure
- Maps of locked-in SLR at 1.5°C & 4°C showing people, land & key infrastructure affected

For further information on the rationale behind the index, its development, methodologies used and finance sector feedback, please see “Avoiding Atlantis: The CWR APACCT 20 Index”
- In-depth analysis of absolute & relative chronic tail risks from coastal threats for 20 APAC cities
- Index reflects impacts on land area, population & key infrastructure – stacked locked-in SLR risks for 1.5°C, 2°C, 3°C & 4°C assessed for each indicator; subsidence + storm surge + government action also included
- Ranking of 20 cities for 1.5°C & 4°C with & without government adaptation efforts
- Feedback from 100+ finance professionals on methodology/ challenges faced in the development of the index

For GDP at risk and implications for sovereign credit ratings for 14 countries/territories, recommendations as well as an overview of the latest financial regulations and coastal threats, please see the rest of the reports in the CWR Coastal Capital Threat Series:
1.5°C CWR APACCT 20 INDEX

Macao (20)
Taipei (19)
Aichi/Nagoya (18)
Manila (17)
Tokyo (16)
Hong Kong (15)
Osaka (14)
Seoul (13)
Shenzhen (12)
Guangzhou (11)
HCMC (10)
Shanghai (9)
Shenzhen (8)
Bangkok (7)
Tianjin (6)
Yangon (5)
Sydney (4)
Jakarta (3)
Auckland (2)
Singapore (1)

4°C CWR APACCT 20 INDEX

Macao (20)
Taipei (19)
Suzhou (18)
Hong Kong (17)
Aichi/Nagoya (16)
Osaka (15)
Tokyo (14)
Guangzhou (13)
Manila (12)
Shanghai (11)
Seoul (10)
Bangkok (9)
HCMC (8)
Tianjin (7)
Shenzhen (6)
Yangon (5)
Sydney (4)
Jakarta (3)
Auckland (2)
Singapore (1)

Source: CWR report "Avoiding Atlantis: The CWR APACCT 20 Index", 2020
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AICHI/NAGOYA

Climate Threats
- High storm surge risks due to high frequency of strong typhoons
- Typhoon Hagibis (2018) flooded a Toyota factory in the Aichi prefecture, forcing a halt to all operations
- The prefecture is also at risk from flash flooding - a torrential rain in 2017 forced 74,000 to evacuate
- High SLR risks as around 336 km² along the Ise Bay (located in Nagoya) are in the “zero-meter zones”, meaning they are below sea level

Government Actions
- Formulated a climate adaptation plan that laid out strategies to 2030
- The plan stipulated measures such as installing more rainwater infiltration facilities and develop sewage & rainwater storage system that can handle 50-60mm of rainfall per hour
- The port of Nagoya is protected by a 26.4km sea wall, with height varying from 6.8-8.8m above sea level
- But existing >50yr seawalls may collapse without renovation plans according to Head of Aichi University of Technology

CWR APACCT 20 INDEX – BENCHMARKING COASTAL THREATS FOR 20 APAC CITIES

Locked-in SLR Impacts

CWR APACCT 20 Ranking

4°C CWR APACCT 20 Index
Full Index
ex. Govt Action

Most Threats
18/20
Least Threats

Most Threats
16/20

For impacts on key infrastructure, see maps on the next page
The CWR APACCT 20 Index benchmarks city exposure to locked-in SLR, storm surge & subsidence plus factors in government adaptation action

THE ECONOMY AT STAKE

GDP by Sector

Economy Overview
Home to leading manufacturers such as Toyota Motor and Mitsubishi Aircraft Company, Aichi is the manufacturing heartland of Japan. It ranked 1st in Japan for value of manufactured good shipments (US$383bn in 2015) 39 years in a row (1977-2015). It was also ranked 1st in 10 out of 24 manufacturing categories, including transportation equipment (40%), business-oriented machinery (15%), iron & steel (13%), and rubber products (13%). In terms of foreign trade, the Nagoya (the capital of Aichi) Port has the highest container handling volume in Japan, which made the port the 66th largest globally. Its major export items are automobile, automobile parts, industrial machinery and steel materials. The key industries in Aichi in terms of GDP are manufacturing, wholesale & retail, and real estate.

Import & Export
= 75% of GDP

Airport Ranking
(Cargo volume in metric ton)

Port Ranking
(Cargo volume in TEU)

Sources: Aichi Prefecture Government, All About news, Alphaliner, Business Insurance, Chubu Centrair International Airport, Japan Government, Japan Times, Nagoya Customs, Nagoya Port Authority

This factsheet is part of the CWR Coastal Capital Threat Series. For methodologies see Avoiding Atlantic: The CWR APACCT 20 Index – Benchmarking coastal threats for 20 APAC cities with finance sector input © China Water Risk. All rights reserved, 2020 | Contact: info@chinawaterrisk.org
PEOPLE, LAND & ECONOMY Affected BY LOCKED-IN Sea Level Rise (SLR)

LOCKED-IN SLR IN AICHI PREFECTURE AT 1.5°C - GLOBAL ELEVATION DATA (SRTM - 30M)

1.5°C Warming: 2.9m SLR

What's at risk...

- 1.5mn Affected (21%)
- 658km² Affected (13%)
- Airport (NGO)
- Port
- Stock Exchange
- CBD

Note: There are 3 ports in Aichi Prefecture. All 3 identified ports (one of which has 2 port terminals) will be flooded.
Infographic © China Water Risk 2020, all rights reserved.

LOCKED-IN SLR IN AICHI PREFECTURE AT 4°C - GLOBAL ELEVATION DATA (SRTM - 30M)

4°C Warming: 8.9m SLR

What's at risk...

- 2.7mn Affected (36%)
- 1,102km² Affected (21%)
- Airport (NGO)
- Port
- Stock Exchange
- CBD

Note: There are 3 ports in Aichi Prefecture. All 3 identified ports (one of which has 2 port terminals) will be flooded.
Infographic © China Water Risk 2020, all rights reserved.

Note: The NASA SRTM-30m elevation data maps were used to benchmark coastal threats across the 20 cities to build the CWR APACCT 20 Index. Since our analyses show that impacts worsen when higher granularity maps (5m) are used, for more in-depth analysis, please use such maps where available. The median level of the locked-in SLR range was used for both the 1.5°C and 4°C scenarios above so impacts could be worse at the higher end of the ranges. To see SLR low/median/high range impacts and differences in mapping granularity – please see our report "Avoiding Atlantis: The CWR APACCT 20 Index". Such permanently submerged areas have implications for financial tail risks – for more on this see "Sovereigns at Risk: APAC Capital Threats". Local tide adjustments were not made.
AUCKLAND AUCKLAND REGION

Climate Threats
- Vulnerable to SLR risk as 13% of land (i.e. 137,000 buildings) is prone to coastal and inland flood risks according to the Auckland Council
- Low storm surge risks due to the low frequency of strong typhoons
- 4% of total land area is vulnerable to 1-in-100 year flooding
- Experienced its longest-ever dry spell recently with dams’ storage reduced to 67% capacity, significantly below the historical average of 82%

Government Actions
- Commissioned a coastal inundation risks study and published the findings in 2017
- Updated the expected SLR from 0.5m to 0.8m for the coming century
- Released the Coastal Management Framework for the Auckland Region in 2017 that includes initiatives such as ensuring new infrastructure is climate-proof and conducting climate compatibility assessments
- Created an online GeoMaps for property buyers to assess flood risks

CWR APACCT 20 INDEX – BENCHMARKING COASTAL THREATS FOR 20 APAC CITIES

Locked-in SLR Impacts

CWR APACCT 20 Ranking

4°C CWR APACCT 20 Index
Full Index
ex. Govt Action

For impacts on key infrastructure, see maps on the next page

The CWR APACCT 20 Index benchmarks city exposure to locked-in SLR, storm surge & subsidence plus factors in government adaptation action

THE ECONOMY AT STAKE

Economy Overview
Auckland is the economic powerhouse of New Zealand as it contributes 38% of the nation’s GDP. Its GDP increased by 6.6% Y-o-Y in 2018 and was led by financial and insurance services; professional, scientific, and technical services; and construction. The government also identified several sectors of focus such as commercial services, technology, and screen and creative. Its business-friendly environment was well recognised – ranked first in the world for ease of doing business according to the World Bank. Auckland is also famous for its tourism industry which contributed US$2bn to the GDP in 2018.

GDP by Sector

Import & Export
= 177% of GDP

Airport Ranking
(Cargo volume in metric ton)

Port Ranking
(Cargo volume in TEU)


This factsheet is part of the CWR Coastal Capital Threat Series. For methodologies see Avoiding Atlantic: The CWR APACCT 20 Index – Benchmarking coastal threats for 20 APAC cities with finance sector input © China Water Risk. All rights reserved, 2020 | Contact: info@chinawaterrisk.org
PEOPLE, LAND & ECONOMY AFFECTED BY LOCKED-IN SEA LEVEL RISE (SLR)

LOCKED-IN SLR IN AUCKLAND REGION AT 1.5°C - GLOBAL ELEVATION DATA (SRTM - 30M)

1.5°C Warming: 2.9m SLR

What’s at risk...

- 2,385 Affected
- 61km² Affected


Infographic © China Water Risk 2020, all rights reserved

LOCKED-IN SLR IN AUCKLAND REGION AT 4°C - GLOBAL ELEVATION DATA (SRTM - 30M)

4°C Warming: 8.9m SLR

What’s at risk...

- 39,462 Affected
- 294km² Affected


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Note: The NASA SRTM-30m elevation data maps were used to benchmark coastal threats across the 20 cities to build the CWR APACCT 20 Index. Since our analyses show that impacts worsen when higher granularity maps (5m) are used, for more in-depth analysis, please use such maps where available. The median level of the locked-in SLR range was used for both the 1.5°C and 4°C scenarios above so impacts could be worse at the higher end of the ranges. To see SLR low/median/high range impacts and differences in mapping granularity – please see our report “Avoiding Atlantis: The CWR APACCT 20 Index”. Such permanently submerged areas have implications for financial tail risks – for more on this see “Sovereigns at Risk: APAC Capital Threats”. Local tide adjustments were not made.
BANGKOK

City % of GDP

- High SLR risks as it is sinking by 2cm/yr; the city is built on alternating layers of soft clay and sand which exacerbates the impacts from groundwater over-extraction and built-up urbanisation
- World Bank predicted that ~70% increase in flooding costs in 2050 will be due to land subsidence
- US$5bn annual flood damages predicted by Royal Irrigation Department of Thailand
- High drought risks and experienced the worst drought in 40 years in early 2020
- Low frequency of strong typhoons

Climate Threats

Government Actions

- Earmarked US$421mn in 2019 to combat floods & droughts by improving infrastructure such as drainage & canals
- Committed to measures such as widening canals, constructing new waterways and building large flood barriers
- Propose to build a US$6.5bn river that bypasses Bangkok entirely to facilitate rainwater removal
- Working with Japan International Cooperation Agency to set up its mitigation effort

CWR APACCT 20 INDEX – BENCHMARKING COASTAL THREATS FOR 20 APAC CITIES

Locked-in SLR Impacts

<table>
<thead>
<tr>
<th>Sector</th>
<th>Pop</th>
<th>Land</th>
</tr>
</thead>
<tbody>
<tr>
<td>7%</td>
<td>9%</td>
<td>72%</td>
</tr>
</tbody>
</table>

CWR APACCT 20 Ranking

Least Threats - 7/20

Most Threats

4°C CWR APACCT 20 Index

Full Index

ex. Govt Action

Most Threats - 9/20

For impacts on key infrastructure, see maps on the next page

CWR APACCT 20 Index benchmarks city exposure to locked-in SLR, storm surge & subsidence plus factors in government adaptation action

THE ECONOMY AT STAKE

GDP by Sector

- Manufacturing: 22%
- Wholesale & retail trade: 20%
- Financial & insurance services: 11%
- Transportation & storage: 9%
- Other: 39%

US$165bn

Economy Overview

Aside from being the powerhouse of Thailand’s economy, Bangkok is also the major financial hub as it hosts nearly one-third of all banks and three-fourths of deposits in Thailand. With manufacturing being the largest sector in the city, it contributes a significant proportion to Thailand’s export sector; the most significant goods are electronic products (40% of global hard disk drives in the last 20 years) and automotive (15% of Thailand’s total export). The city is also famous for its tourism industry and it was ranked the most visited city (23mn) by the Mastercard Global Destination Cities Index 2019.

Import & Export

- Import: US$81bn
- Export: US$125bn

= 99% of GDP

Airport Ranking

(Cargo volume in metric ton)

Port Ranking

(Cargo volume in TEU)

Hong Kong
Shanghai
Tokyo
Beijing
Singapore
Bangkok
Shenzhen
Osaka
Wuhan
Jakarta
Ho Chi Minh
Dalian
Auckland
Aports
Yantian
Yantian

1.5mn

2.1mn


This factsheet is part of the CWR Coastal Capital Threat Series. For methodologies see Avoiding Alliances: The CWR APACCT 20 Index – Benchmarking coastal threats for 20 APAC cities with finance sector input

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PEOPLE, LAND & ECONOMY AFFECTED BY LOCKED-IN SEA LEVEL RISE (SLR)

LOCKED-IN SLR IN BANGKOK AT 1.5°C - GLOBAL ELEVATION DATA (SRTM - 30M)

1.5°C Warming: 2.9m SLR

What’s at risk...

- 0.5mn Affected (7%)
- 146km² Affected (9%)

- Airport (BKK)
- Airport (DMK)
- Port
- Stock Exchange
- CBD

Note: Suvarnabhumi Airport (BKK) is located outside of the Bangkok administrative boundary. It will be flooded at 1.5°C of warming.


Infographic © China Water Risk 2020, all rights reserved.

LOCKED-IN SLR IN BANGKOK AT 4°C - GLOBAL ELEVATION DATA (SRTM - 30M)

4°C Warming: 8.9m SLR

What’s at risk...

- 7.1mn Affected (72%)
- 1,358km² Affected (84%)

- Airport (BKK)
- Airport (DMK)
- Port
- Stock Exchange
- CBD

Note: Suvarnabhumi Airport (BKK) is located outside of the Bangkok administrative boundary. It will be flooded at 4°C of warming.


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Note: The NASA SRTM-30m elevation data maps were used to benchmark coastal threats across the 20 cities to build the CWR APACCT 20 Index. Since our analyses show that impacts worsen when higher granularity maps (5m) are used, for more in-depth analysis, please use such maps where available. The median level of the locked-in SLR range was used for both the 1.5°C and 4°C scenarios above so impacts could be worse at the higher end of the ranges. To see SLR low/median/high range impacts and differences in mapping granularity – please see our report “Avoiding Atlantis: The CWR APACCT 20 Index”. Such permanently submerged areas have implications for financial tail risks – for more on this see “Sovereigns at Risk: APAC Capital Threats”. Local tide adjustments were not made.
GUANGZHOU

Climate Threats
- High storm surge risks due to high frequency of strong typhoons
- Typhoon Mangkhut (2018) killed 3 people and triggered heavy flooding along the pearl river in Guangzhou
- US$29mn of direct economic losses were recorded in the Guangdong area
- The city is vulnerable to flash floods; suffered the most serious floods in 20 years after intense rainstorms in 2017 - houses collapsed and ~7,000 people evacuated
- High SLR risks especially for the area within the Pearl River Delta as most of it lies within only 1m of sea level

Government Actions
- Allocated US$10nm in the 13FYP to build 600km of sea walls to supplement existing sea walls that already withstand 1-in-200 year storm tides
- Launched the Sponge City initiative in 2017
- Mandatory requirement - metropolitan construction projects to include 50% sunken green belt and facilities that can drain water within 24 hours
- Largest emission trading scheme in China is in Guangdong Province (where Guangzhou is the capital)

CWR APACCT 20 INDEX – BENCHMARKING COASTAL THREATS FOR 20 APAC CITIES

Locked-in SLR Impacts

CWR APACCT 20 Ranking

0% 50% 100%

4°C CWR APACCT 20 Index

Full Index

Least Threats

Most Threats

11/20

Least Threats

Most Threats

13/20

For impacts on key infrastructure, see map on the next page

The CWR APACCT 20 Index benchmarks city exposure to locked in SLR, storm surge & subsidence plus factors in government adaptation action

THE ECONOMY AT STAKE

Economy Overview
With 120 of the Fortune Global 500 top companies’ headquarters/regional headquarters in 2018, Guangzhou was designated as a national commercial distribution node under the 2015-2020 China Commercial Distribution node Cities Layout Plan. It is the 5th economically most competitive city in China according to the Chinese Academy of Social Sciences. It was also the 7th best city for foreign trading business in China, according to China General Administration of Customs. With its world-leading airport & port, it is expected to play a prominent role in the Greater Bay Area by becoming an international commerce and industry centre and integrated transport hub. The four key industries in Guangzhou in terms of GDP are industrial & manufacturing (25%), wholesale & retail trade (15%), real estate (9%) and finance (9%).

GDP by Sector

Import & Export = 43% of GDP

Import US$68bn

Export US$80bn

1.9mn

Port Ranking

Cargo volume in metric ton

22mn

Airport Ranking

Cargo volume in TEU

19

Sources: Alibaba, Asia Development Bank, ASWC, Chinese Academy of Social Science, China Daily, China General Administration of Customs, Eurasia’s Maritime Rim and Global Security, Guangdong Government, South China Morning Post, The Standard
PEOPLE, LAND & ECONOMY AFFECTED BY LOCKED-IN SEA LEVEL RISE (SLR)

1.5°C Warming: 2.9m SLR

What's at risk...
- 4.6mn Affected (28%)
- 1,566km² Affected (22%)

Airport (CAN)
Port
CBD

Note: Port of Guangzhou will be flooded (6 out of the 7 identified port terminals affected).
Infographic © China Water Risk 2020, all rights reserved

4°C Warming: 8.9m SLR

What's at risk...
- 7.9mn Affected (49%)
- 2,259km² Affected (32%)

Airport (CAN)
Port
CBD

Note: Port of Guangzhou will be flooded (all 7 identified port terminals affected).
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Note: The NASA SRTM-30m elevation data maps were used to benchmark coastal threats across the 20 cities to build the CWR APACCT 20 Index. Since our analyses show that impacts worsen when higher granularity maps (5m) are used, for more in-depth analysis, please use such maps where available. The median level of the locked-in SLR range was used for both the 1.5°C and 4°C scenarios above so impacts could be worse at the higher end of the ranges. To see SLR low/median/high range impacts and differences in mapping granularity – please see our report "Avoiding Atlantis: The CWR APACCT 20 Index". Such permanently submerged areas have implications for financial tail risks – for more on this see "Sovereigns at Risk: APAC Capital Threats". Local tide adjustments were not made.
**HO CHI MINH CITY**

**City % of GDP**

- **US$54bn**
  - Other Vietnam 78%
  - Vietnam 22%

**Climate Threats**

- **High SLR risks** - sunk by 0.4m over past 25 years due to groundwater over-extraction
- **The southern hub is particularly at risk** as it has an elevation of less than 1.6m while the highest tide (2018) was 1.72m
- **Low storm surge risk due to low frequency of strong typhoons yet rains** from passing typhoons can still bring catastrophic damages as 50-68% of flood sites are affected by rainfall (Typhoon Usagi in 2018 caused the worst flood in its history)

**Government Actions**

- **Its flood strategy was one of the C40 best practice strategies** – relocated harbour infrastructures and required all new development to be 2-2.5m above mean sea level
- **A US$430mn anti-flood project** that includes building 6 major tidal gates and 7km embankments along the Saigon river to protect ~6.5mn people started in 2016 and expected to be completed by 2019
- **Yet by 2019, only 64km out of 149km of dykes were built and 80km out of 4,369km of rivers/canals/creeks were upgraded for flood management; the deadline has now been further delayed to the end of 2020**

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**CWR APACCT 20 INDEX – BENCHMARKING COASTAL THREATS FOR 20 APAC CITIES**

**Locked-in SLR Impacts**

- **Pop**
  - 19% USK
  - 38%

- **Land**
  - 68%
  - 76%

**CWR APACCT 20 Ranking**

- **Least Threats**
  - 10/20

- **Most Threats**

**4°C CWR APACCT 20 Index**

- **Full Index**
- **ex. Govt Action**
  - Least Threats

---

**THE ECONOMY AT STAKE**

**GDP by Sector**

- **US$54bn**
  - Services 61%
  - Industry & construction 25%
  - Agriculture, forestry & fishing 1%
  - Others 13%

**Import & Export**

- **196% of GDP**

**Airport Ranking**

<table>
<thead>
<tr>
<th>Airport</th>
<th>Cargo volume in metric ton</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hong Kong</td>
<td>412,021</td>
</tr>
<tr>
<td>Shanghai</td>
<td>1,000,000</td>
</tr>
<tr>
<td>Singapore</td>
<td>900,000</td>
</tr>
<tr>
<td>Guangzhou</td>
<td>800,000</td>
</tr>
<tr>
<td>Tokyo</td>
<td>700,000</td>
</tr>
<tr>
<td>Beijing</td>
<td>600,000</td>
</tr>
<tr>
<td>Jakarta</td>
<td>500,000</td>
</tr>
<tr>
<td>Ho Chi Minh</td>
<td>400,000</td>
</tr>
<tr>
<td>Osaka</td>
<td>300,000</td>
</tr>
</tbody>
</table>

**Port Ranking**

<table>
<thead>
<tr>
<th>Port</th>
<th>Cargo volume in TEU</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shanghai</td>
<td>6.3mn</td>
</tr>
<tr>
<td>Singapore</td>
<td>5.0mn</td>
</tr>
<tr>
<td>Guangzhou</td>
<td>4.0mn</td>
</tr>
<tr>
<td>Hong Kong</td>
<td>3.5mn</td>
</tr>
<tr>
<td>Tokyo</td>
<td>3.0mn</td>
</tr>
<tr>
<td>Jakarta</td>
<td>2.0mn</td>
</tr>
<tr>
<td>Ho Chi Minh</td>
<td>1.5mn</td>
</tr>
<tr>
<td>Osaka</td>
<td>1.0mn</td>
</tr>
</tbody>
</table>

**Economy Overview**

Ho Chi Minh City is the economic centre of Vietnam. In 2018, it was responsible for 22% and 29% of Vietnam's GDP and financial capital respectively. The four key industries identified by the government were electronic equipment & machinery sector, mechanical sector, food & beverage processing sector, and chemical industry sector. In 2018, the production of electronic equipment & machinery sector grew by 17%. Also, the total export of electronic equipment reached US$88bn, an Y-o-Y increase of 18% and making up 31% of HCMC's total exports. Tourism is also a growing industry as it saw a 22% Y-o-Y increase of revenue in 2018. Together with seven neighboring provinces, they comprise the Southern Key Economic region – making up 60% of government’s revenues and attracting 50% of FDI capital. The government is also underway to merge 3 HCMC eastern districts to build the “Silicon Valley of Vietnam”.

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PEOPLE, LAND & ECONOMY AFFECTED BY LOCKED-IN SEA LEVEL RISE (SLR)

LOCKED-IN SLR IN HO CHI MINH CITY AT 1.5°C - GLOBAL ELEVATION DATA (SRTM - 30M)

1.5°C Warming: 2.9m SLR

What’s at risk...

- 2mn Affected: 19%
- 807km² Affected: 38%
- Airport (SGN): ☑️
- Port: ☑️
- Stock Exchange: ☐
- CBD: ☐

Note: Port of Ho Chi Minh will be flooded (all 4 identified port terminals affected).

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LOCKED-IN SLR IN HO CHI MINH CITY AT 4°C - GLOBAL ELEVATION DATA (SRTM - 30M)

4°C Warming: 8.9m SLR

What’s at risk...

- 7mn Affected: 68%
- 1,612km² Affected: 76%
- Airport (SGN): ☑️
- Port: ☑️
- Stock Exchange: ☑️
- CBD: ☑️

Note: Port of Ho Chi Minh will be flooded (all 4 identified port terminals affected).

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Note: The NASA SRTM-30m elevation data maps were used to benchmark coastal threats across the 20 cities to build the CWR APACCT 20 Index. Since our analyses show that impacts worsen when higher granularity maps (5m) are used, more in-depth analysis, please use such maps where available. The median level of the locked-in SLR range was used for both the 1.5°C and 4°C scenarios above so impacts could be worse at the higher end of the ranges. To see SLR low/median/high range impacts and differences in mapping granularity – please see our report “Avoiding Atlantis: The CWR APACCT 20 Index”. Such permanently submerged areas have implications for financial tail risks – for more on this see “Sovereigns at Risk: APAC Capital Threats”. Local tide adjustments were not made.
HONG KONG

City % of GDP

Climate Threats
- High storm surge risks due to high frequency of strong typhoons; on average hit by 6 typhoons per year
- Typhoon Mangkhut (2018), the strongest typhoon ever to hit Hong Kong, induced severe floods and led to US$400mn of insurance claims
- Heng Fa Tsuen, a top housing estate, was flooded to at least 100m inland due to Mangkhut
- The 3.88m storm tide brought by Mangkhut, which could have been 5.65m, will become an annual occurrence by 2100 according to HKO

Government Actions
- Commissioned a coastal risks study but completion is not expected until late 2020
- Plan to build a 6.5m sea wall to protect the airport’s 3rd runway but it may not protect transport links
- Not a single mention of “climate change” nor “adaptation” in the Chief Executive 2019 Policy Address, signaling that it is not a top priority
- The Hong Kong Climate Action Plan 2030+ is highly insufficient as it exceeds the C40 Cities carbon emission pathway by around 80%

CWR APACCT 20 INDEX – BENCHMARKING COASTAL THREATS FOR 20 APAC CITIES

Locked-in SLR Impacts

CWR APACCT 20 Ranking

4°C CWR APACCT 20 Index

Most Threats

Full Index

ex. Govt Action

Least Threats

Most Threats

16/20

17/20

For impacts on key infrastructure, see maps on the next page

THE ECONOMY AT STAKE

Economy Overview
Home to regional headquarters of many international financial companies such as Goldman Sachs and J.P. Morgan, Hong Kong was ranked the 3rd most competitive economy in 2019 by the World Economic Forum. The global financial centre has the largest offshore RMB market, the biggest IPO market and its stock exchange has 2,449 listed companies with a combined market capitalisation of US$4.9tm, making it the 5th largest stock exchange in the world. It is also the 7th largest destination of global FDI inflows (US$68.4bn) in 2019 and the biggest source for China’s FDI. According to the WTO, Hong Kong was the 8th largest exporter of merchandise trade and 17th largest exporter of commercial services in 2019 globally. It was rated as the 2nd most competitive economy in China by the Chinese Academy of Social Science.

GDP by Sector

Import & Export = 312% of GDP

Import US$301bn

Export US$362bn

Source: Alphaliner, Chinese Academy of Social Science, Hong Kong Government, Hong Kong Trade Development Council, Hong Kong Observatory, Securities & Future Commission, World Bank, World Economic Forum, World Trade Organization

This factsheet is part of the CWR Coastal Capital Threat Series. For methodologies see Avoiding Alliances: The CWR APACCT 20 Index – Benchmarking coastal threats for 30 APAC cities with finance sector input
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PEOPLE, LAND & ECONOMY AFFECTED BY LOCKED-IN SEA LEVEL RISE (SLR)

1.5°C Warming: 2.9m SLR

What's at risk...
- 0.5mn Affected (7%)
- 75km² Affected (7%)
- Airport (HKG)
- Stock Exchange
- CBD


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4°C Warming: 8.9m SLR

What's at risk...
- 1.5mn Affected (22%)
- 167km² Affected (15%)
- Airport (HKG)
- Stock Exchange
- CBD

Source: CWR based on NASA SRTM-30m elevation data maps were used to benchmark coastal threats across the 20 cities to build the CWR APACCT 20 Index. Since our analyses show that impacts worsen when higher granularity maps (5m) are used, for more in-depth analysis, please use such maps where available. The median level of the locked-in SLR range was used for both the 1.5°C and 4°C scenarios above so impacts could be worse at the higher end of the ranges. To see SLR low/median/high range impacts and differences in mapping granularity – please see our report “Avoiding Atlantis: The CWR APACCT 20 Index”. Such permanently submerged areas have implications for financial tail risks – for more on this see “Sovereigns at Risk: APAC Capital Threats”. Local tide adjustments were not made.

Note: The NASA SRTM-30m elevation data maps were used to benchmark coastal threats across the 20 cities to build the CWR APACCT 20 Index. Since our analyses show that impacts worsen when higher granularity maps (5m) are used, for more in-depth analysis, please use such maps where available. The median level of the locked-in SLR range was used for both the 1.5°C and 4°C scenarios above so impacts could be worse at the higher end of the ranges. To see SLR low/median/high range impacts and differences in mapping granularity – please see our report “Avoiding Atlantis: The CWR APACCT 20 Index”. Such permanently submerged areas have implications for financial tail risks – for more on this see “Sovereigns at Risk: APAC Capital Threats”. Local tide adjustments were not made.

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JAKARTA

Climate Threats
- High SLR risks as it has sunk by 4m in the last 30 years due to groundwater over-extraction
- Northern Jakarta has already sunk by 2.5m in last 10 years and could sink by a further 2m by 2050
- High food risks – it was hit by the deadliest flood in early 2020 that cost insurers US$72bn and took 60 lives
- Annual flood damage costs will increase by between 322% - 402% by 2050
- Low storm surge risks due to low frequency of strong typhoons

Government Actions
- Announced plan to relocate its capital and all government administrative functions from Jakarta to Kalimantan; estimated to cost US$33bn
- In planning stage to build a 32km giant sea wall that will take 10-15 years to complete. The surface will become a centre of urban development in order to attract investors; estimated to cost US$40bn
- Intend to construct new coastal dikes and 17 artificial islands but plans delayed for 2 CWR APACCT 20 INDEX – BENCHMARKING COASTAL THREATS FOR 20 APAC CITIES

Locked-in SLR Impacts

CWR APACCT 20 Ranking

4°C CWR APACCT 20 Index
Full Index
ex. Govt Action

The CWR APACCT 20 Index benchmarks city exposure to locked-in SLR, storm surge & subsidence plus factors in government adaptation action

For impacts on key infrastructure, see maps on the next page

THE ECONOMY AT STAKE

GDP by Sector

Economy Overview
Home to major Indonesian conglomerates such as Salim Group and Astra International, Jakarta is the economic and political centre of Indonesia. The economy of the city is largely made up of wholesale & retail trade, manufacturing, construction and financial services. In particular, Jakarta experienced a massive construction boom in the last decade (which also accelerated the land subsidence). Also, as Indonesia has one of the fastest growing digital economies in South East Asia with over 150 million internet users, Jakarta has also shared the growth with the latest development of Google building its cloud zones in the city in June 2020.

Import & Export = 36% of GDP

Airport Ranking
(Cargo volume in metric ton)

Port Ranking
(Cargo volume in TEU)


614,821

Hong Kong
Shanghai
Tokyo
Bueno
Singapore
Guangzhou
Bengkulu
Shenzhen
Osaka

Jakarta
Sydney
Ho Chi Minh City
Tangier
Auckland
Athens
Rotterdam
Taipei
Manila

Shanghai
Singapore
Shenzhen
Guangzhou
Hong Kong
Tokyo
Bueno
Auckland
Osaka

Jakarta
Sydney
Ho Chi Minh City
Tangier
Auckland
Athens
Rotterdam
Taipei
Manila

6.9mn

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1.5°C Warming: 2.9m SLR

What’s at risk...

- 0.3mn Affected
- 25km² Affected

4°C Warming: 8.9m SLR

What’s at risk...

- 3.5mn Affected
- 227km² Affected

Note: Soekarno–Hatta International Airport (CGK) is located outside of the Jakarta administrative boundary. It will not be flooded at 1.5°C of warming.

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MACAO

Climate Threats
- High storm surge risks due to high frequency of strong typhoons
- Highest sea level seen during Hato of 5.58m caused severe flooding & triggered a power outage
- 20% faster annual SLR than the global rate
- Largest land reclamation in the Pearl River Delta, which means it faces a higher risk in a shorter period

Government Actions
- Released the “10 Years Disaster Management Plan 2019-2028” that involves seawalls with 3.71m height surrounding Macao Peninsula & part of Taipa/Coloane, plus a 1.8m height sea wall along the inner harbour
- Yet, the originally planned 5.7m inner harbour tidal gate and inner harbour sea wall might not be built due to concerns over effectiveness
- Also, the interdepartmental working group of climate change has not released any major research or strategies for building resilience

CWR APACCT 20 INDEX – BENCHMARKING COASTAL THREATS FOR 20 APAC CITIES

Locked-in SLR Impacts

CWR APACCT 20 Ranking

4°C CWR APACCT 20 Index

For impacts on key infrastructure, see maps on the next page

The CWR APACCT 20 Index benchmarks city exposures to locked-in SLR, storm surge & subsidence plus factors in government adaptation action

THE ECONOMY AT STAKE

Economy Overview
Home to the biggest casino resort (Venetian Macau) in the world, Macao’s service economy, which is 95% of the city’s GDP, is dominated by gaming and tourism which accounted for over half of GDP. Tourism is also a prominent industry as it received around 35m tourists in 2018 and enjoyed a 10% growth (US$35.8bn) from 2017 to 2018. It also ranked 3rd globally in terms of GDP per capita, after Luxembourg and Switzerland. Macao along with Hong Kong and nine other Mainland cities (including Shenzhen and Guangzhou) form China’s Greater Bay Area. This region has key strategic meaning for China’s development blueprint and has great significance in China’s implementation of innovation-driven development and commitment to reform and opening-up.

CWR APACCT 20 Index – Benchmarking coastal threats for 20 APAC cities with finance sector input

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PEOPLE, LAND & ECONOMY AFFECTED BY LOCKED-IN SEA LEVEL RISE (SLR)

LOCKED-IN SLR IN MACAO AT 1.5°C – GLOBAL ELEVATION DATA (SRTM - 30M)

1.5°C Warming: 2.9m SLR

What’s at risk...

- 59,455 Affected: 10%
- 15km² Affected: 44%


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LOCKED-IN SLR IN MACAO AT 4°C – GLOBAL ELEVATION DATA (SRTM - 30M)

4°C Warming: 8.9m SLR

What’s at risk...

- 0.3mn Affected: 40%
- 20km² Affected: 59%


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Note: The NASA SRTM-30m elevation data maps were used to benchmark coastal threats across the 20 cities to build the CWR APACCT 20 Index. Since our analyses show that impacts worsen when higher granularity maps (5m) are used, for more in-depth analysis, please use such maps where available. The median level of the locked-in SLR range was used for both the 1.5°C and 4°C scenarios above so impacts could be worse at the higher end of the ranges. To see SLR low/median/high range impacts and differences in mapping granularity – please see our report “Avoiding Atlantis: The CWR APACCT 20 Index”. Such permanently submerged areas have implications for financial tail risks – for more on this see “Sovereigns at Risk: APAC Capital Threats”. Local tide adjustments were not made.
MANILA

Climate Threats
- High storm surge risks due to high frequency of strong typhoons; Philippines on average hit by 20 typhoons annually
- Typhoon Kammuri (2019), a category 4-equivalent typhoon, cost the city 17 lives and US$110+mn in economic losses according to AON
- High SLR risks as Manila Bay’s sea level is rising 4x the global average
- Manila sank on average by 3cm/year (as much as 6cm in some areas) between 2003-2018 due to groundwater over-extraction and urbanisation

Government Actions
- Completed a US$5.8mn coastal protection project to protect Manila Bay that consists of a sea wall, storm drains and armour rocks
- Plan to construct and modernise urban pumping stations at a cost of US$500mn with funding assistance from the World Bank and Asia Infrastructure Investment Bank, yet it will take 25 years to complete
- Established the Climate Change Commission that is directly under the President’s office

CWR APACCT 20 INDEX – BENCHMARKING COASTAL THREATS FOR 20 APAC CITIES

Locked-in SLR Impacts
For impacts on key infrastructure, see maps on the next page

THE ECONOMY AT STAKE

Economy Overview
Manila is the economic powerhouse of the Philippines and accounts for 38% of the country’s GDP. Its major industries are trade and repair (of motor vehicles, motorcycles, personal & household goods), real estate & renting & business activities, financial intermediation, and manufacturing. As for growth rates, construction, public administration & defence & compulsory social security, and financial intermediation grew the fastest in 2018. Tourism is also a key industry in the Philippines, receiving a record high 8mn foreign tourists in 2019 and Manila has been a huge recipient as it is one of the main gateways into the country.
1.5°C Warming: 2.9m SLR

What's at risk...

- 62,121 Affected
- 3km² Affected


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4°C Warming: 8.9m SLR

What’s at risk...

- 2.3mn Affected
- 101km² Affected


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Note: The NASA SRTM-30m elevation data maps were used to benchmark coastal threats across the 20 cities to build the CWR APACCT 20 Index. Since our analyses show that impacts worsen when higher granularity maps (5m) are used, for more in-depth analysis, please use such maps where available. The median level of the locked-in SLR range was used for both the 1.5°C and 4°C scenarios above so impacts could be worse at the higher end of the ranges. To see SLR low/median/high range impacts and differences in mapping granularity – please see our report “Avoiding Atlantis: The CWR APACCT 20 Index”. Such permanently submerged areas have implications for financial tail risks – for more on this see “Sovereigns at Risk: APAC Capital Threats”. Local tide adjustments were not made.
OSAKA

City % of GDP
- Other Japan 93%
- US$347bn

Climate Threats
- High storm surge risks due to high frequency of strong typhoons
- Typhoon Jebi (2018) killed 7 people and induced a max. wave height of 5m+
- Jebi’s stormwave breached Kansai airport’s sea wall; only resumed full operation after 17 days
- Damages and disruptions to the airport led to US$500mn economic losses in Kansai region
- The airport is also sinking by 6cm/yr
- High SLR risks as 124 km² around Osaka Bay are “zero-meter zones”
- Ranked 10th most vulnerable city in the world to flooding by World Bank

Government Actions
- Developed a 3-step strategy for the airport – investing US$468mn to reinforce flood prevention capabilities (raising sea wall & runway, installing watertight doors); expected to be completed by 2020
- Released the Global Warming Action Plan of Osaka City in 2017 to step up its emission reduction policies and promote renewable energy
- Published an Osaka storm surge inundation map that assumed a max. tide level of 3m on top of the historical highest tide during Typhoon Jebi

CWR APACCT 20 INDEX – BENCHMARKING COASTAL THREATS FOR 20 APAC CITIES

Locked-in SLR Impacts

CWR APACCT 20 Ranking

4°C CWR APACCT 20 Index

Full Index

ex. Govt Action

Most Threats

Least Threats

13/20

15/20

4°C

For impacts on key infrastructure, see maps on the next page

The CWR APACCT 20 Index benchmarks cities exposure to locked in SLR, storm surge & subsidence plus factors in government adaptation action

THE ECONOMY AT STAKE

Economy Overview
Osaka is the hub of technological and biomedical innovation in Japan. It currently hosts one of the world’s largest testing facilities for large-scale battery energy storage systems and has the highest national ratio (Kansai region: 27%) in shipping value of medical & pharmaceutical products in 2016. It also has the 3rd largest export & import volume in 2017 (after Aichi & Tokyo) which made its port rank 75th globally. Osaka is also famous for its tourism industry as it has been ranked the 12th most visited city (10mn) by the Mastercard Global Destination Cities Index 2019. Manufacturing, wholesale & retail trade and real estate are the three key economic activities that contribute to city GDP.

GDP by Sector
- Manufacturing 17%
- Wholesale & retail trade 17%
- Real estate 12%
- Other 48%

Import & Export
- 312% of GDP

Airport Ranking
(Cargo volume in metric ton)

Port Ranking
(Cargo volume in TEU)

811,218

Osaka 2.4mn

Sources: Alphaliner, ACNI, Climate Change Resilience Strategy – Redefining Flood Protection at Kansai International Airport, Coastal Engineering Committee, Japan government, Kansai Airport, Mastercard, O-BIC, Osaka government, Straits Times, World Bank

This factsheet is part of the CWR Coastal Capital Threat Series. For methodologies see Avoiding Atlantic: The CWR APACCT 20 Index – Benchmarking coastal threats for 20 APAC cities with finance sector input

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PEOPLE, LAND & ECONOMY AFFECTED BY LOCKED-IN SEA LEVEL RISE (SLR)

LOCKED-IN SLR IN OSAKA PREFECTURE AT 1.5°C - GLOBAL ELEVATION DATA (SRTM - 30M)

1.5°C Warming: 2.9m SLR

- 1.5mn Affected: 17%
- 176km² Affected: 9%

What’s at risk...

- Airport (KIX) ✅
- Port ✅
- Stock Exchange
- CBD


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LOCKED-IN SLR IN AICHI PREFECTURE AT 4°C - GLOBAL ELEVATION DATA (SRTM - 30M)

4°C Warming: 8.9m SLR

- 3.5mn Affected: 41%
- 447km² Affected: 24%

What’s at risk...

- Airport (KIX) ✅
- Port ✅
- Stock Exchange ✅
- CBD


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Note: The NASA SRTM-30m elevation data maps were used to benchmark coastal threats across the 20 cities to build the CWR APACCT 20 Index. Since our analyses show that impacts worsen when higher granularity maps (5m) are used, for more in-depth analysis, please use such maps where available. The median level of the locked-in SLR range was used for both the 1.5°C and 4°C scenarios above so impacts could be worse at the higher end of the ranges. To see SLR low/median/high range impacts and differences in mapping granularity – please see our report “Avoiding Atlantis: The CWR APACCT 20 Index”. Such permanently submerged areas have implications for financial tail risks – for more on this see “Sovereigns at Risk: APAC Capital Threats”. Local tide adjustments were not made.

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Climate Threats
- High storm surge risks due to high frequency of strong typhoons that hit South Korea – hit by 13 typhoons in 2019
- Ling Ling (2019), a category-4 equivalent typhoon, was the strongest ever to hit South Korea – killed 8 people and knocked out power for 180,000 homes; AON estimated US$24bn of economic losses for South Korea
- The country experienced more extreme hot and cold days, and the highest number of typhoons in 2019

Government Actions
- Published the “Promised of Seoul: Taking Actions Against Climate Change” in 2015 to promote actions such as eliminating all flood vulnerable regions by building pumping stations and rainwater recycling facilities
- The national government also released Korea’s Adaptation Strategy to Climate Change in 2011, focused on improving the urban drainage system and create a climate disaster insurance scheme...yet, no follow-up actions could be found

THE ECONOMY AT STAKE

Economy Overview
Home to well-known global brands such as Samsung and LG, Seoul is the economic powerhouse and technological hub of South Korea. It was ranked by the OECD as first in terms of R&D investments as a percentage of GDP in 2017. It is also the 6th largest business centre and real estate market according to JLL Global 300 Cities 2016. The major industries identified by the Seoul government are ICT, biotechnology, research and development, digital contents, and fashion. Tourism is also a major sector as Seoul was ranked the 10th most visited city (11mn) by the Mastercard Global Destination Cities Index 2019. In addition, the Korea stock exchange, which is located in Seoul, has 2,359 listed companies with a combined market capitalisation of US$1.3tn, making it the 15th largest stock exchange in the world.

GDP by Sector
- Wholesale & retail trade 16%
- Business Services 16%
- Financial & insurance services 12%
- Information & communication 13%
- Others 40%

Import & Export = 202% of GDP
- Export US$423bn
- Import US$376bn

Airport Ranking (Cargo volume in metric ton)
- Hong Kong
- Singapore
- Shanghai
- Tokyo
- Seoul
- Hong Kong
- Incheon
- Shanghai
- Tokyo
- Seoul
- Jakarta
- Hong Kong
- Incheon
- Shanghai
- Tokyo
- Seoul

Port Ranking (Cargo volume in TEU)
- Hong Kong
- Shanghai
- Singapore
- Incheon
- Jakarta
- Incheon
- Singapore
- Tokyo
- Shanghai
- Incheon
- Tokyo
- Shanghai

1.5°C Warming: 2.9m SLR

What's at risk...

- 0.2mn Affected
- 2%
- 203km² Affected
- 2%
- Airport (ICN)
- Airport (GMP)
- Port
- Stock Exchange
- CBD


Infographic © China Water Risk 2020, all rights reserved.

4°C Warming: 8.9m SLR

What's at risk...

- 1.7mn Affected
- 20%
- 942km² Affected
- 8%
- Airport (ICN)
- Airport (GMP)
- Port
- Stock Exchange
- CBD


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Note: The NASA SRTM-30m elevation data maps were used to benchmark coastal threats across the 20 cities to build the CWR APACCT 20 Index. Since our analyses show that impacts worsen when higher granularity maps (5m) are used, for more in-depth analysis, please use such maps where available. The median level of the locked-in SLR range was used for both the 1.5°C and 4°C scenarios above so impacts could be worse at the higher end of the ranges. To see SLR low/median/high range impacts and differences in mapping granularity – please see our report “Avoiding Atlantis: The CWR APACCT 20 Index”. Such permanently submerged areas have implications for financial tail risks – for more on this see “Sovereigns at Risk: APAC Capital Threats”. Local tide adjustments were not made.
SHANGHAI

Climate Threats
- High storm surge risks due to high frequency of strong typhoons; on average hit by 3 typhoons per year
- Typhoon Lekima (2019) triggered the evacuation of >1mn people in Shanghai & Zhejiang – AON estimated a US$10bn economic loss in China
- Typhoon Ling Ling (2019) caused severe flooding – AON estimated a combined economic loss of US$165mn
- High SLR risks as the city is only 0-3m above sea level and is sinking by 1-3mm/yr

Government Actions
- Already built a 520km sea wall in 2002 that can withstand a category-2 equivalent hurricane
- Improved the Huangpu River levee in 2013 to withstand 1-in-1000 year floods
- Built the largest sponge city pilot zone in China that aims to collect and process up to 70% of rainwater by 2020
- Earmarked US$5mn in 2020 for new sea walls & flood prevention measures
- Covered 60% of city emissions with its emission trading scheme

CWR APACCT 20 INDEX – BENCHMARKING COASTAL THREATS FOR 20 APAC CITIES

Locked-in SLR Impacts

<table>
<thead>
<tr>
<th>Pop</th>
<th>Land</th>
</tr>
</thead>
<tbody>
<tr>
<td>21%</td>
<td>33%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Pop</th>
<th>Land</th>
</tr>
</thead>
<tbody>
<tr>
<td>87%</td>
<td>97%</td>
</tr>
</tbody>
</table>

4°C CWR APACCT 20 Index

Full Index

ex. Govt Action

The CWR APACCT 20 Index benchmarks city exposure to locked-in SLR, storm surge & subsidence plus factors in government adaptation action

THE ECONOMY AT STAKE

Economy Overview
Home to over 700 regional headquarters of multinational corporations, including well-known brands such as Nike and Porsche, Shanghai is China’s largest financial centre – its stock exchange has 1,534 listed companies with a combined market capitalisation of US$4.6trn, making it the 4th largest stock exchange in the world. It also accounted for about 13% of China’s total utilised FDI in 2017. It was the 3rd most competitive city and 2nd most competitive city for foreign trades in China in 2018, ranked by the Chinese Academy of Social Science and China General Administration of Customs respectively. It ranks 1st in China in terms of total export & import volume and is also an important heavy industry hub that leads the production of plastics, microcomputers and mobile phones. The key industries in Shanghai in terms of GDP are industrial (manufacturing), finance and wholesale & retail trade.

GDP by Sector

<table>
<thead>
<tr>
<th>Industry (manufacturing)</th>
<th>Financial services</th>
<th>Wholesale and retail trade</th>
<th>Real estate</th>
<th>Others</th>
</tr>
</thead>
<tbody>
<tr>
<td>28%</td>
<td>16%</td>
<td>14%</td>
<td>6%</td>
<td>38%</td>
</tr>
</tbody>
</table>

Import & Export

Import US$309bn
Export US$207bn
Import & Export = 104% of GDP

Airport Ranking

Shanghai

Port Ranking

Shanghai

Sources: Aalinter, ACR, Asia Development Bank, ASIX, Business Insider, China Daily, China General Administration of Customs, China Mail, Chinese Academy of Social Sciences, Georgetown Climate Centre, Shanghai Government, Hong Kong Trade Development Council, Securities & Futures Commission, South China Morning Post, World Bank, World Economic Forum, Xinhua

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PEOPLE, LAND & ECONOMY AFFECTED BY LOCKED-IN SEA LEVEL RISE (SLR)

LOCKED-IN SLR IN SHANGHAI AT 1.5°C – GLOBAL ELEVATION DATA (SRTM - 30M)

1.5°C Warming: 2.9m SLR

What’s at risk...

- 6.7mn Affected (21%)
- 2,256km² Affected (33%)

- Airport (PVG)
- Airport (SHA)
- Port
- Stock Exchange
- CBD

Note: Port of Shanghai will be flooded (at 2 identified port terminals affected).
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LOCKED-IN SLR IN SHANGHAI AT 4°C – GLOBAL ELEVATION DATA (SRTM - 30M)

4°C Warming: 8.9m SLR

What’s at risk...

- 27.3mn Affected (87%)
- 6,659km² Affected (97%)

- Airport (PVG)
- Airport (SHA)
- Port
- Stock Exchange
- CBD

Note: Port of Shanghai will be flooded (at 2 identified port terminals affected).
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SHENZHEN

Climate Threats
- High storm surge risks due to high frequency of strong typhoons
- Typhoon Mangkhut (2018) caused over US$20bn in insurance claims, forced around 1,500 people to evacuate & forced seawater to surge into Dapeng & Yantian Districts
- Experiences occasional urban flooding from heavy downpours – a flood in 2019 killed 11 drainage workers
- Ranked 9th most vulnerable city in the world by the World Bank in terms of overall cost of flood damage

Government Actions
- Began to “Typhoon-proof” the 135km east coast with 6m sea walls that can withstand 1-in-200 year storm tides after experiencing Mangkhut’s damages. The project is expected to be completed by 2021
- Launched the Sponge City initiative which aims to recycle at least 70% of rainwater
- The Working Group on Climate Change & Emission Reduction was established in 2011 to coordinate actions between different departments

CWR APACCT 20 INDEX – BENCHMARKING COASTAL THREATS FOR 20 APAC CITIES

Locked-in SLR Impacts
- Pop: 4%
- Land: 3%

CWR APACCT 20 Ranking
- Least Threats: 8/20
- Most Threats: 12/20

4°C CWR APACCT 20 Index
- Full Index
- ex. Gov’t Action

For impacts on key infrastructure, see maps on the next page

THE ECONOMY AT STAKE

GDP by Sector
- High-tech industries: 34%
- Logistics: 11%
- Financial services: 13%
- Cultural & related industries: 6%
- Others: 36%

Economy Overview
Home to Tencent’s headquarters, Shenzhen is regarded as one of China’s most important high-tech R&D and manufacturing bases. As the first “special economic zone” in China, Shenzhen is the most economically competitive city in China according to the Chinese Academy of Social Sciences. Its GDP surpassed Hong Kong for the 1st time in 2018 with a total of US$366bn. Its stock exchange has 2,221 listed companies with a combined market capitalisation of US$3trn, making it the 8th largest stock exchange in the world. It was also the best city for foreign trading business in China, according to China General Administration of Customs. From 2015-17, Shenzhen filed the 2nd most patent applications (only behind Tokyo) according to JLL Innovation Geographies (2019) and 51% of city exports were derived from the high-tech sector. Its key industries in terms of GDP are high-tech (34%), finance (13%), and logistics (11%).

Import & Export = 124% of GDP

Airport Ranking (Cargo volume in metric ton)

Port Ranking (Cargo volume in TEU)

Sources: Alibaba, ASFA, China General Administration of Customs, Chinese Academy of Social Sciences, Dapeng Xin Gu Government, Dutch Water Sector, JLL, HKTDCC, Shenzhen Municipal Government, South China Morning Post, United Nations, World Bank, World Economic Forum, Securities & Future Commission

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PEOPLE, LAND & ECONOMY AFFECTED BY LOCKED-IN SEA LEVEL RISE (SLR)

LOCKED-IN SLR IN SHENZHEN AT 1.5°C – GLOBAL ELEVATION DATA (SRTM - 30M)

1.5°C Warming: 2.9m SLR

What’s at risk...

- 0.6mn Affected
- 49km² Affected

Note: Port of Shenzhen will be flooded (2 out of the 10 identified terminals affected).

Infographic © China Water Risk 2020, all rights reserved

LOCKED-IN SLR IN SHENZHEN AT 4°C – GLOBAL ELEVATION DATA (SRTM - 30M)

4°C Warming: 8.9m SLR

What’s at risk...

- 2.1mn Affected
- 160km² Affected

Note: Port of Shenzhen will be flooded (8 out of the 10 identified terminals affected).

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Note: The NASA SRTM-30m elevation data maps were used to benchmark coastal threats across the 20 cities to build the CWR APACCT 20 Index. Since our analyses show that impacts worsen when higher granularity maps (5m) are used, for more in-depth analysis, please use such maps where available. The median level of the locked-in SLR range was used for both the 1.5°C and 4°C scenarios above so impacts could be worse at the higher end of the ranges. To see SLR low/median/high range impacts and differences in mapping granularity – please see our report “Avoiding Atlantis: The CWR APACCT 20 Index”. Such permanently submerged areas have implications for financial tail risks – for more on this see “ Sovereigns at Risk: APAC Capital Threats”. Local tide adjustments were not made.
SINGAPORE

City % of GDP

100%

US$364bn

Climate Threats
- High SLR risks as the majority of land lies <15m above sea level and 30% (including the CBD) is <5m above sea level
- Experiencing 2x the speed of global SLR due to its location; its sea level rose 4.6mm/yr between 1993-2009 versus the 2.8mm/yr rise globally
- Low storm surge risk due to extremely low frequency of strong typhoons

Government Actions
- “Life or death matters” was how the Prime Minister Lee Hsien Loong described climate change in 2019
- SG$100bn to be spent over the next 100 years to mitigate SLR and related physical risks such as flooding
- Established the National Climate Change Secretariat in 2010 which is directly controlled by the PM’s Office
- Mandated constructions above mean sea level e.g. raised the min. land reclamation from 3m to 4m & new terminals at airport and port to be built 5.5m above mean sea level

CWR APACCT 20 INDEX – BENCHMARKING COASTAL THREATS FOR 20 APAC CITIES

Locked-in SLR Impacts

CWR APACCT 20 Ranking

4°C CWR APACCT 20 Index

Full Index

ex. Govt Action

Most Threats

Least Threats

1/20

Most Threats

Least Threats

1/20

For impacts on key infrastructure, see maps on the next page

The CWR APACCT 20 Index benchmarks city exposure to locked-in SLR, storm surge & subsidence plus factors in government adaptation action

THE ECONOMY AT STAKE

Economy Overview
Home to most of the technology MNC headquarters in Asia such as Google and Facebook, Singapore was the most competitive economy according to the World Economic Forum in 2019. It was the world’s 14th largest export economy in 2018. Also, Singapore is the 3rd largest exporter of refined petroleum, making up 8.6% of the global market in 2018 and has the largest bunkering port in the world. Tourism is also a key industry as Singapore was ranked the 5th most visited city (14.67 million) by the Mastercard Global Destination Cities Index 2019. Singapore is also the 4th largest global exporter of high-tech products and its manufacturing sector contributes 21% to its GDP. It invests heavily in innovation thus has attracted well-known brands such as Accenture & Siemens to set up their manufacturing labs locally.

GDP by Sector

Import & Export = 211% of GDP

Airport Ranking

(Cargo volume in metric ton)

Port Ranking

(Cargo volume in TEU)

Hong Kong
Shanghai
Tokyo
Beijing
Singapore
Guangzhou
Bangkok
Shenzen
Osaka
Melbourne
Jakarta
Sofia
Ho Chi Minh
Dalian
Accra
Beijing
Oslo
Rotterdam
Nakorn Ratchasima
Bucharest
Yangon
Mersin

Sources: Alibaba, Mastercard, Singapore Government, Strait Times, The Diplomat, World Bank, World Economic Forum

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PEOPLE, LAND & ECONOMY Affected by Locked-in Sea Level Rise (SLR)

1.5°C Warming: 2.9m SLR

What’s at risk…

- 13,895 Affected (0.2%)
- 311km² Affected (5%)

Airport (SIN) ☑️
Port ☑️
Stock Exchange ☑️
CBD ☑️

Note: Port of Singapore will be flooded (2 out of the 5 identified port terminals affected).
Infographic © China Water Risk 2020, all rights reserved.

4°C Warming: 8.9m SLR

What’s at risk…

- 133,675 Affected (2%)
- 911km² Affected (14%)

Airport (SIN) ☑️
Port ☑️
Stock Exchange ☑️
CBD ☑️

Note: Port of Singapore will be flooded (all 5 identified port terminals affected).
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Note: The NASA SRTM-30m elevation data maps were used to benchmark coastal threats across the 20 cities to build the CWR APACCT 20 Index. Since our analyses show that impacts worsen when higher granularity maps (5m) are used, for more in-depth analysis, please use such maps where available. The median level of the locked-in SLR range was used for both the 1.5°C and 4°C scenarios above so impacts could be worse at the higher end of the ranges. To see SLR low/median/high range impacts and differences in mapping granularity – please see our report “Avoiding Atlantis: The CWR APACCT 20 Index”. Such permanently submerged areas have implications for financial tail risks – for more on this see “Sovereigns at Risk: APAC Capital Threats”. Local tide adjustments were not made.
SUZHOU

Climate Threats
- High storm surge risks due to high frequency of strong typhoons
- It was hit by Typhoon Lemina (2019), which induced USD10bn in economic losses in China, according to AON
- Lemina forced Suzhou’s government to relocate ~20,000 people and >120,000 households in Jiangsu Province (where Suzhou is located) suffered power outages
- Suzhou is also at risk to floods – in 2015 a torrential rain led to floodwater reaching 0.5m high and caused a USD111mn economic loss in Jiangsu province

Government Actions
- Already reinforced its 8.7km sea walls & built six flood gates along the Yangtze River
- Started raising flood defense standards – 1-in-100 year standard for river flood defense & 1-in-50 to 200 year standard for city flood defense
- The Energy Star Index Scheme successfully reduced 5.6mn tons of CO2 emissions from 483 companies
- Released the Suzhou Climate Change & Carbon Emission Working Plan 2020 to promote low carbon development

CWR APACCT 20 INDEX – BENCHMARKING COASTAL THREATS FOR 20 APAC CITIES

Locked-in SLR Impacts
- 38% Pop
- 53% Land

CWR APACCT 20 Ranking
- Least Threats
- Most Threats
- 15/20

4°C CWR APACCT 20 Index
- Full Index
- 18/20

For impacts on key infrastructure, see maps on the next page

The CWR APACCT 20 Index benchmarks city exposure to locked-in SLR, storm surge & subsidence plus factors in government adaptation action

THE ECONOMY AT STAKE

Economy Overview
As the 7th most economically competitive city in China according to the Chinese Academy of Social Science, Suzhou is a hub for manufacturing & high-tech industries. Designated as a pilot free trade zone in Jiangsu, Suzhou has now become one of the most popular investment destinations for foreign companies. It has attracted more than 17,000 foreign-funded enterprises and been ranked as the 4th best city for foreign trading business in China by the China General Administration of Customs. Of note, technology research & development projects, commercial services projects and high-end manufacturing businesses accounted for more than 75% of the total foreign investments. The result from these investments are significant - the output values of emerging industries and high-tech industries accounted for 57% and 79% of the gross industrial output value respectively. It is also the 4th largest total export & import city in China.

GDP by Sector
- Primary Industry 1%
- Secondary Industry 48%
- Tertiary Industry 51%

Import & Export = 127% of GDP
- Import US$147bn
- Export US$207bn

Airport Ranking (Cargo volume in metric ton)
Suzhou 123,800

Port Ranking (Cargo volume in TEU)
Suzhou 6.4mn

Sources: Alphaliner, ADB, Asia Development Bank, ASKC, China Daily, China General Administration of Customs, Chinese Academy of Social Science, People’s China, Sina, Suzhou Government, Xinhuas

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PEOPLE, LAND & ECONOMY AFFECTED BY LOCKED-IN SEA LEVEL RISE (SLR)

1.5°C Warming: 2.9m SLR

What’s at risk...
- 4.1mn Affected (36%)
- 4,478km² Affected (53%)
- Airport (WUX)
- Port
- CBD

Note: Port of Suzhou will be flooded (all 3 identified port terminals affected). Suixun Shuolong International Airport (WUX) is located outside of Suzhou administrative boundary. It will not be flooded at 1.5°C of warming.


Infographic © China Water Risk 2020, all rights reserved.

4°C Warming: 8.9m SLR

What’s at risk...
- 11.5mn Affected (100%)
- 8,123km² Affected (96%)
- Airport (WUX)
- Port
- CBD

Note: Port of Suzhou will be flooded (all 3 identified port terminals affected). Suixun Shuolong International Airport (WUX) is located outside of Suzhou administrative boundary. It will also be flooded at 4°C of warming.


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Note: The NASA SRTM-30m elevation data maps were used to benchmark coastal threats across the 20 cities to build the CWR APACCT 20 Index. Since our analyses show that impacts worsen when higher granularity maps (5m) are used, for more in-depth analysis, please use such maps where available. The median level of the locked-in SLR range was used for both the 1.5°C and 4°C scenarios above so impacts could be worse at the higher end of the ranges. To see SLR low/median/high range impacts and differences in mapping granularity – please see our report “Avoiding Atlantis: The CWR APACCT 20 Index”. Such permanently submerged areas have implications for financial tail risks – for more on this see “ Sovereigns at Risk: APAC Capital Threats”. Local tide adjustments were not made.
Climate Threats
- Low storm surge risks due to low frequency of strong typhoons
- Low short-term SLR risks thanks to the protected location within Sydney harbor and its topography
- Still, the government estimates a 0.9m SLR plus storm surges would inundate key infrastructure along the coast by 2100
- Vulnerable to heatwaves & droughts – in 2019, bushfires caused over US$139bn in economic losses in Australia and severe droughts forced Sydney’s dams levels to fall to 40% capacity

Government Actions
- Published a long-term adaptation strategy of Sydney, which included plans for a wide range of threats up to 2070
- For SLR, developing a SLR adaptation plan, assessing SLR & storm surge impacts, developing timeline for sea walls and prioritising adaptation for key infrastructure
- Promised to achieve net zero emissions by 2050 – the most ambitious target among Australian local governments

CWR APACCT 20 INDEX – BENCHMARKING COASTAL THREATS FOR 20 APAC CITIES

Locked-in SLR Impacts
- 1% Pop
- 1% Land

CWR APACCT 20 Ranking
- Least Threats
- Most Threats
- 4/20

4°C CWR APACCT 20 Index
- Full Index
- ex. Govt Action

The CWR APACCT 20 Index benchmarks city exposure to locked-in SLR, storm surge & subsidence plus factors in government adaptation action

THE ECONOMY AT STAKE

Economy Overview
Although Sydney contributes 24% of Australia’s GDP, its growth rate in 2018-19 has dropped to 3%. The five priority industries in Sydney are retail, tourism, international education, tech startups, and financial & professional services. The latter two are the two main drivers of the growth in 2018. Finance is particularly important as it represented 15% of the economy in 2018-19. The Sydney Stock Exchanges has 2,185 listed companies with a combined market capitalisation of US$1.4tm, making it the 14th largest stock exchange in the world. Its top industries of export & import are financial & insurance services and manufacturing respectively. Tourism is also a prominent pillar as half of all international visitors to Australia visit Sydney.

Import & Export
- 35% of GDP


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PEOPLE, LAND & ECONOMY AFFECTED BY LOCKED-IN SEA LEVEL RISE (SLR)

1.5°C Warming: 2.9m SLR

What’s at risk...

- 59,526 Affected
- 132km² Affected


Infographic © China Water Risk 2020, all rights reserved

4°C Warming: 8.9m SLR

What’s at risk...

- 0.3mn Affected
- 399km² Affected


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Note: The NASA SRTM-30m elevation data maps were used to benchmark coastal threats across the 20 cities to build the CWR APACCT 20 Index. Since our analyses show that impacts worsen when higher granularity maps (5m) are used, for more in-depth analysis, please use such maps where available. The median level of the locked-in SLR range was used for both the 1.5°C and 4°C scenarios above so impacts could be worse at the higher end of the ranges. To see SLR low/median/high range impacts and differences in mapping granularity – please see our report “Avoiding Atlantis: The CWR APACCT 20 Index”. Such permanently submerged areas have implications for financial tail risks – for more on this see “Sovereigns at Risk: APAC Capital Threats”. Local tide adjustments were not made.
Climate Threats
- High storm surge risks due to high frequency of strong typhoons; on average hit by 3-4 typhoons per year
- Typhoon Dujuan (2015), a category-4 equivalent typhoon made landfall in northern Taiwan and killed 3 people, injured more than 300 and put 0.5mn out of electricity
- Higher than average temperature increase – a 1°C increase in global average will lead to a 1.7°C increase in Taipei, according to AirCleanTaiwan
- Also, Taipei lies in a basin, which means flood waters will be more difficult to discharge

Government Actions
- Published the “Adaptation Strategy to Climate Change in Taiwan” in 2012 that focuses on building climate resilience for high-risk areas/infrastructure and to promote holistic flood management, yet no follow-up action can be found
- The Taipei government implemented the sponge city initiative to increase flood resilience of urban areas
- Taiwan was ranked bottom 3rd in the Climate Change Performance Index by German Watch in 2019

THE ECONOMY AT STAKE

Economy Overview
Home to some of the world’s largest hardware producers such as Asus and Acer, Taiwan was the 13th most digitally competitive economy in the IMD World Digital Competitiveness Ranking in 2019 and most tech companies, such as Microsoft, IBM, Google and Cisco have chosen Taipei to set up their Taiwan offices. The 7,896 registered ICT companies in Taipei city generated production revenue of US$20bn in 2019. It is also a famous destination for foreign investments – as of 2019, over 74% of FDI and 345 out of 521 foreign businesses that came to Taiwan settled in Taipei, in which electronic component manufacturing attracted the most investors. Taipei is also famous for its tourism with 59mn people visiting its prominent tourism spots in 2019. Overall, Taipei’s government identified the following as focused industries: ICT (hardware and software), biotechnology, general merchandising (wholesale and retail), and MICE industries.

Import & Export = 102% of GDP

Airport Ranking (Cargo volume in metric ton)

Port Ranking (Cargo volume in TEU)

Sources: AIBC News, Alphabet, Country Economy, Earth Observatory, German Watch, IMD, Invest Taiwan, Taiwan Government, Taiwan International Airport, Taiwan News

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PEOPLE, LAND & ECONOMY AFFECTED BY LOCKED-IN SEA LEVEL RISE (SLR)

CWR | LOCKED-IN SLR IN GREATER TAIPEI 1.5°C – GLOBAL ELEVATION DATA (SRTM - 30M)

1.5°C Warming: 2.9m SLR

What’s at risk...

- 0.3mn Affected
- 47km² Affected

Note: There are 2 ports in the Greater Taipei Metropolitan (Taipei-New Taipei-Keelung). All 2 ports will be flooded. Taoyuan International Airport (TPE) is located outside of the Greater Taipei Metropolitan area. It will not be flooded at 1.5°C of warming.


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CWR | LOCKED-IN SLR IN GREATER TAIPEI 4°C – GLOBAL ELEVATION DATA (SRTM - 30M)

4°C Warming: 8.9m SLR

What’s at risk...

- 1.1mn Affected
- 130km² Affected

Note: There are 2 ports in the Greater Taipei Metropolitan (Taipei-New Taipei-Keelung). All 2 ports will be flooded. Taoyuan International Airport (TPE) is located outside of the Greater Taipei Metropolitan area. It will not be flooded at 4°C of warming.


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Note: The NASA SRTM-30m elevation data maps were used to benchmark coastal threats across the 20 cities to build the CWR APACCT 20 Index. Since our analyses show that impacts worsen when higher granularity maps (5m) are used, for more in-depth analysis, please use such maps where available. The median level of the locked-in SLR range was used for both the 1.5°C and 4°C scenarios above so impacts could be worse at the higher end of the ranges. To see SLR low/median/high range impacts and differences in mapping granularity – please see our report “Avoiding Atlantis: The CWR APACCT 20 Index”. Such permanently submerged areas have implications for financial tail risks – for more on this see “Sovereigns at Risk: APAC Capital Threats”. Local tide adjustments were not made.
**TIANJIN**

**City % of GDP**
- Other Mainland: 98%
- US$284 bn

**Climate Threats**
- High SLR & storm surge risks despite low frequency of strong typhoons
- For the shared coastline of Tianjin & Hebei, >100km² is already below sea level
- According to a study in Chinese Geology in 2019, 31% of existing sea walls cannot withstand a 1-in-100 year storm surge
- Even with the low case scenario (i.e. 0.5m SLR), all existing sea walls will not be able to withstand a 1-in-100 year storm surge in 2030

**Government Actions**
- Began reinforcing its 148km sea wall in August 2020 in order to withstand 1-in-200 year storm tides
- Launched the sponge city initiative to alleviate city flooding from heavy rains
- Established the Working Group of Climate Change & Emission Reduction to coordinate policies between departments
- The emission trading scheme covers 60% of the city’s total emissions

**CWR APACCT 20 INDEX – BENCHMARKING COASTAL THREATS FOR 20 APAC CITIES**

**Locked-in SLR Impacts**
- Pop: 26%
- Land: 35%

**CWR APACCT 20 Ranking**
- Least Threats
- Most Threats
- 6/20

**4°C CWR APACCT 20 Index Full Index ex Govt Action**
- Least Threats
- Most Threats
- 7/20

**THE ECONOMY AT STAKE**

**Economy Overview**
Tianjin is Northern China’s most prominent port city as well as one of the high-tech manufacturing hubs. In 2017 the new tech industry accounted for about 65% of total gross output value and 37% of the city’s total exports. Overall, Tianjin ranked 8th in terms of total export & import in China. Its port, the largest in Northern China, provides services to 400 ports in more than 200 countries, making it the 9th largest port in the world in terms of port volume. The government has also invested a substantial amount of effort to turn Tianjin into an AI innovation centre and a hub of AI industries. In general, Tianjin was ranked the 9th best city for foreign trading business in China according to the China General Administration of Customs and was also the 16th most competitive economy in China according to the Chinese Academy of Social Science.

**Import & Export**
- 43% of GDP

**GDP by Sector**
- Primary Industry: 1%
- Secondary Industry: 40%
- Tertiary Industry: 59%

**Import: US$74 bn**
**Export: US$49 bn**

**Airport Ranking**
- Cargo volume in metric ton
- 258,700

**Port Ranking**
- Cargo volume in TEU
- 16mn

**Sources:** Alphaliner, Chinese Academy of Social Science, China Daily, China General Administration of Customs, China Geology, Hong Kong Trade Development Council, Tianjin Municipal Government, World Bank, World Economic Forum

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PEOPLE, LAND & ECONOMY AFFECTED BY LOCKED-IN SEA LEVEL RISE (SLR)

1.5°C Warming: 2.9m SLR

What’s at risk...
- 4.3mn Affected (26%)
- 4,063km² Affected (35%)
- Airport (TSN) ✔
- Port ✔


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4°C Warming: 8.9m SLR

What’s at risk...
- 14.3mn Affected (87%)
- 9,682km² Affected (63%)
- Airport (TSN) ✔
- Port ✔


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Note: The NASA SRTM-30m elevation data maps were used to benchmark coastal threats across the 20 cities to build the CWR APACCT 20 Index. Since our analyses show that impacts worsen when higher granularity maps (5m) are used, for more in-depth analysis, please use such maps where available. The median level of the locked-in SLR range was used for both the 1.5°C and 4°C scenarios above so impacts could be worse at the higher end of the ranges. To see SLR low/median/high range impacts and differences in mapping granularity – please see our report “Avoiding Atlantis: The CWR APACCT 20 Index”. Such permanently submerged areas have implications for financial tail risks – for more on this see “Sovereigns at Risk: APAC Capital Threats”. Local tide adjustments were not made.
**Climate Threats**
- Japan on average is hit by 20 typhoons per year but Tokyo is less exposed
- Typhoon Hagibis (2019), the worst storm in 60 years, caused US$15bn of economic losses in Japan
- Hagibis also raised sea levels in Tokyo Bay by 1m; filled Tokyo’s underground retarding basin to 95% of its capacity; and almost overflowed Tama river levees (which can withstand a 1-in-200 year flood)
- High SLR risks as >1.5mn people live below sea level

**Government Actions**
- Built sea walls with 3.5m-7m height along Tokyo Bay that can withstand the worst storm surge in its history
- Installed new flood gates, drainage pump stations & a 2nd storm surge management centre for Tokyo Bay
- Has Japan’s largest underground retarding basin that can hold up to 170mn tonnes of water but already filled to 95% in 2019 by typhoon Hagibis
- 1st city in the world to have an emissions cap-and-trade program and achieved in 20% reduction since 2010

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**CWR APACCT 20 INDEX – BENCHMARKING COASTAL THREATS FOR 20 APAC CITIES**

**Locked-in SLR Impacts**
- Pop: 9%
- Land: 5%

**CWR APACCT 20 Ranking**
- Least Threats: 17/20
- Most Threats: 1/20

**4°C CWR APACCT 20 Index**
- Full Index: ex. Govt Action

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**THE ECONOMY AT STAKE**

**Economy Overview**
Home to well-known names such as Sony, Honda and Mizuho, Tokyo is the biggest economy in terms of GDP according to the World Economic Forum. Its stock exchange, the Japan Exchange Group, has 3,706 listed companies with a combined market capitalisation of US$5.8trn, making it the 3rd largest in the world. It is also the 2nd largest exporter in Japan with major products such as semiconductors and electronic devices. Tokyo is also famous for tourism and it was ranked the 9th most visited city (13mn) by the Mastercard Global Destination Cities Index 2019. The service industry accounts for over 90% of its GDP and specific economic activities that generate most GDP in Tokyo are wholesale & retail trade, real estate, professional, scientific & technical activities and information & communication.

**GDP by Sector**
- Wholesale & retail trade: 20%
- Real estate: 12%
- Professional, scientific & technical activities: 11%
- Information & communication: 10%
- Others: 47%

**Import & Export**
- GDP US$950bn
- Export US$161bn
- Import US$242bn
- 42% of GDP

**Airport Ranking**
- Cargo volume in metric ton
- Hong Kong: 3.4mn
- **Singapore**
- **Tokyo**
- **Shanghai**
- **Bangkok**
- **Shenzhen**
- **Osaka**
- **Jakarta**
- **Seoul**
- **São Paulo**

**Port Ranking**
- Cargo volume in TEU
- **Shanghai**
- **Shenzhen**
- **Guangzhou**
- **Hong Kong**
- **Tokyo**
- **São Paulo**
- **Seoul**
- **Jakarta**
- **São Paulo**
- **São Paulo**
1.5°C Warming: 2.9m SLR

What’s at risk...

- 1.2mn Affected: 9%
- 99km² Affected: 5%

- Airport (NRT)
- Airport (HND)
- Port
- Stock Exchange
- CBD

Note: Narita International Airport (NRT) is located outside of the Tokyo area. It will not be flooded at 1.5°C of warming.

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4°C Warming: 8.9m SLR

What’s at risk...

- 3.4mn Affected: 25%
- 257km² Affected: 12%

- Airport (NRT)
- Airport (HND)
- Port
- Stock Exchange
- CBD

Note: Narita International Airport (NRT) is located outside of the Tokyo area. It will not be flooded at 4°C of warming.

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Note: The NASA SRTM-30m elevation data maps were used to benchmark coastal threats across the 20 cities to build the CWR APACCT 20 Index. Since our analyses show that impacts worsen when higher granularity maps (5m) are used, for more in-depth analysis, please use such maps where available. The median level of the locked-in SLR range was used for both the 1.5°C and 4°C scenarios above so impacts could be worse at the higher end of the ranges. To see SLR low/median/high range impacts and differences in mapping granularity – please see our report “Avoiding Atlantis: The CWR APACCT 20 Index”. Such permanently submerged areas have implications for financial tail risks – for more on this see “Sovereigns at Risk: APAC Capital Threats”. Local tide adjustments were not made.
YANGON

City % of GDP

US$16bn

Other Myanmar 77%

23%

Climate Threats

- Poor infrastructure with little resilience towards typhoons – Cyclone Nargis (2008) took 140,000 lives alone and was responsible for >95% damages of extreme weather events in Myanmar from 1999-2018.
- According to the UN, Yangon is one of the most vulnerable cities to risks such as floods, droughts & cyclones.
- Dramatic shift in climate in coming decades according to WWF – temperature will rise between 1.3°C to 2.7°C and SLR by 20-41cm by 2050

Government Actions

- Received US$118mn from World Bank in 2018 to upgrade its drainage
- Published the Myanmar Climate Change Master Plan which prioritised below activities (expected timeline)
  - Undertake climate risk assessments for essential public buildings (8 years)
  - Integrate disaster resilience into building regulations (3 years)
  - Carry out studies to explore national, regional & district linkages and potential mechanisms for climate risks management (3 years)

CWR APACCT 20 INDEX – BENCHMARKING COASTAL THREATS FOR 20 APAC CITIES

Locked-in SLR Impacts

Locked-in SLR Impacts

CWR APACCT 20 Ranking

Locked Threats

Most Threats

5/20

Least Threats

4°C CWR APACCT 20 Index

Full Index

ex. Govt Action

Most Threats

Least Threats

For impacts on key infrastructure, see maps on the next page

The CWR APACCT 20 Index benchmarks city exposure to locked in SLR, storm surge & subsidence plus factors in government adaptation action

THE ECONOMY AT STAKE

Economy Overview

Yangon is the economic powerhouse of Myanmar, recording a 9.3% Y-o-Y increase in GDP in 2018. It drove 7.3% of annual GDP growth of Myanmar and contributed 23% of the country’s GDP in 2018. Yangon is also home to the Thilawa Special Economic Zone (SEZ), one of three such zones across the country. In 2018, Yangon recorded a 13% increase in vessels calling at its port over the past 4 years and a 14% Y-o-Y increase in handled container volume. Yangon has ambitions to become an international logistics hub with an international port, inland water transport system, economic corridors, SEZ and industrial development.

Import & Export = 51% of GDP

Import US$4bn

Export US$4bn

GDP US$16bn

Sources: ADB, NCA, Myanmar Department of Statistics, World Bank, UN

Port Ranking

(Cargo volume in TEU)

Shanghai
Shenzhen
Guangzhou
Hong Kong
Tokyo
Johor
Incheon
Tianjin
Yoichi
Yangon

55,000

1mn

Airport Ranking

(Cargo volume in metric ton)

Hong Kong
Shanghai
Tokyo
Beijing
Singapore
Guangzhou
Bangkok
Shenzhen
Osaka
Marina
PEOPLE, LAND & ECONOMY AFFECTED BY LOCKED-IN SEA LEVEL RISE (SLR)

LOCKED-IN SLR IN GREATER YANGON AT 1.5°C - GLOBAL ELEVATION DATA (SRTM - 30M)

1.5°C Warming: 2.9m SLR

What's at risk...

- 0.2mn Affected
- 117km² Affected


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LOCKED-IN SLR IN GREATER YANGON AT 4°C - GLOBAL ELEVATION DATA (SRTM - 30M)

4°C Warming: 8.9m SLR

What's at risk...

- 4.5mn Affected
- 5.652km² Affected

Note: Port of Yangon will be flooded (all 2 identified port terminals affected).


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Note: The NASA SRTM-30m elevation data maps were used to benchmark coastal threats across the 20 cities to build the CWR APACCT 20 Index. Since our analyses show that impacts worsen when higher granularity maps (5m) are used, for more in-depth analysis, please use such maps where available. The median level of the locked-in SLR range was used for both the 1.5°C and 4°C scenarios above so impacts could be worse at the higher end of the ranges. To see SLR low/median/high range impacts and differences in mapping granularity – please see our report “Avoiding Atlantis: The CWR APACCT 20 Index”. Such permanently submerged areas have implications for financial tail risks – for more on this see “Sovereigns at Risk: APAC Capital Threats". Local tide adjustments were not made.
Access Avoiding Atlantis
Building the CWR APACCT 20 Index | Finance feedback | Results & Rankings
http://www.chinawaterrisk.org/notices/avoiding-atlantis-cwr-apacct-20-index

Access Sovereign Impacts
14 countries/territories | GDP at risk | Government climate strategy case studies

Access Next Steps & Executive Summary
Asset owners & managers | Banks | Financial Regulators | Governments
http://www.chinawaterrisk.org/notices/waterproofing-apac-to-avoid-atlantis
The CWR Coastal Capital Threat Series…

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 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.
Disclaimer

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