

# China ICT running dry?

## The rise of AI & climate risks amplify existing water risks faced by thirsty data centres

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- **Thirsty & power hungry data centres contribute to & are vulnerable to rising water stress.** ICT is one of the fastest growing power hungry & carbon intensive sectors. If left unchecked, rising carbon emissions from data centre expansion will accelerate global warming & exacerbate water scarcity. Data centres are also water intensive; they typically require water for cooling so operational risks will increase for the ICT sector along with water stress.
- **We estimate China's data centre water consumption to be ~1.3bn m<sup>3</sup> today but can rise to >3bn m<sup>3</sup> by 2030.** For perspective, ~1.3bn m<sup>3</sup> is 1.9x the water use for households & services in Tianjin, a city of 13.7mn people. By 2030, China's data centre racks are expected to be 2.6x that of 2020, growing from 4.3mn racks in 2020 to 11.3mn by 2030. This will put pressure on already stressed water resources, especially as the **rise of AI & chatbots can increase water use by 20x.**
- **"Eastern-Data, Western-Computing" doesn't solve all water problems.** China is shifting data centres from its populous coastal provinces to the resource-abundant inland western region. The state planner has outlined 8 Computing Hubs & 10 Data Centre Clusters spread over 14 provinces, autonomous regions & municipalities. **These house 72% of China's data centre racks but over half of these lie in regions that are as dry as the Middle East. Plus 9/14 regions have 40-100% of their respective areas facing 'Extremely High' or 'High' water stress.**
- **Already, before the explosion of AI & chatbots, national exposure across various types of water risks are high:**
  - 46% of China's national data centre racks are located in the Dry 10, which are as dry as the Middle East.
  - Competition for water in the Dry 10 will rise & ICT may not be the #1 priority as demands from agri, households & industry must also be met.
  - At least 41% of China's national data centre racks are located in regions that are highly prone to drought while at least 28% are in areas that are highly prone to floods; at least a fifth are very prone to both.
  - 56% of China's data centre racks are located in coastal regions vulnerable to storm surge & sea level rise.
  - Over three-quarters of China's data centre racks lie in 3 river basins: The Yellow, Yangtze & Pearl making them vulnerable to river basin risks as well as tighter regulations, especially for the Yangtze & Yellow.
  - Water risks can also disrupt power generation and data centres will face double whammy risks especially in hydropower reliant provinces.
- **ICT sector related water regulations will likely tighten.** China has yet to issue national standards for Water Usage Effectiveness but the MIIT/ local governments are moving to close the regulatory gap. Regulations regarding water usage may also be imposed in the Dry 10 regions.
- **5 to-do's – take action to rein in ICT water risks.** With accelerated warming, acute risks such as floods and droughts as well as chronic risks related to freshwater availability and sea level rise will only grow. Take action to waterproof your assets/ portfolio with our 5 to-do checklist from disclosure, stewardship strategies, cooling tech to tackling ICT supply chain water risks.

## Why we are writing this...

Did you know that with the rise of AI and chatbots, global data centre emissions could balloon from 2-4% of global annual GHG emissions today to ~23% by 2030? But data centres are not just carbon intensive, they can also be water intensive. With data centres set to boom, how will their expansion impact already scarce water resources? How exposed are existing data racks to rising water scarcity and extreme weather risks? This report analyses the exposure of China’s thirsty data centres to rising water stress – will China ICT expansion be stranded by water?

Data centres also face a vicious cycle. As our 2023 China ICT transition report shows, the majority of China’s data centres are still running on coal-fired power, if left unchecked emissions from these alone could grow from 96MTCO<sub>2</sub> in 2020 to 340MTCO<sub>2</sub> by 2030 – this is more than the annual energy related CO<sub>2</sub> emissions of the United Kingdom. So, in addition to the water that they consume, fast growing emissions from data centres will accelerate warming and exacerbate water scarcity. Power hungry and thirsty data centres are thus contributing to and impacted by rising water stress and scarcity.

This report therefore hopes that the ICT sector, as a dual-high industry in China, not only fast tracks transition but will also manage rising water risks and improve their stewardship of the nation’s precious water resources. Addressing these challenges are ever more urgent as breaching 1.5°C of warming above the pre-industrial levels for the year-to-date to January 2024 (some 70 years ahead of the Paris Agreement target date of 2100) has only intensified, compounded and accelerated climate threats.

With the majority of China’s data centres located in provinces, municipalities and autonomous regions that comprise the Yellow and Yangtze River Economic Belts, it is crucial that water is well managed to ensure the longevity and vitality of China’s Mother Rivers. As President Xi Jinping said: *“if we do not fail Nature, Nature shall never fail us.”*

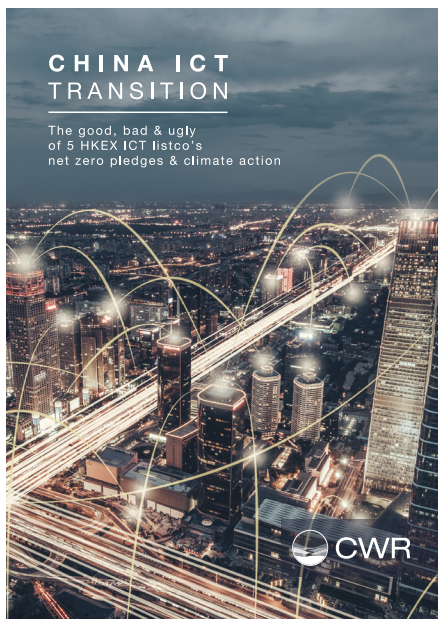


**Xi Jinping**  
**President of the People’s Republic of China**  
 2022 New Year address

*“From the Yellow River and the Yangtze River, two “mother rivers” of the Chinese nation, to the limpid Qinghai Lake and the mighty Yarlung Zangbo River; from the South-North Water Diversion, known as a project of the century, to the Saihanba forest, shown as a patch of green on the map; from the northward trek and homecoming of elephants in Yunnan Province, to the migration and return of Tibetan antelopes — all these remind us that “If we do not fail Nature, Nature shall never fail us”.*

## Recommended reading...

If you would like to dive deeper, we recommend you read this report together with the following:



### China ICT transition: The good, bad & ugly of 5 HKEX ICT listco's net zero pledges & climate action

September 2023

The report highlights tremendous opportunities in carbon cuts and green finance – it revealed that emission cuts from just five companies listed on the Hong Kong Stock Exchange (HKEX) can be as much as 2.5x Hong Kong’s annual greenhouse gas emissions and green finance to be tapped for this transition can amount to billions of dollars.

Th five ICT giants analysed – Alibaba, Baidu, China Mobile, Tencent and Xiaomi (HSI 5) – account for over 1/5th of the Hang Seng Index, yet lag their NASDAQ counterparts of Alphabet, Amazon, Apple, Meta & Netflix in the race to net zero. Check out listco factsheets plus more ...



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## Abbreviations & Definitions

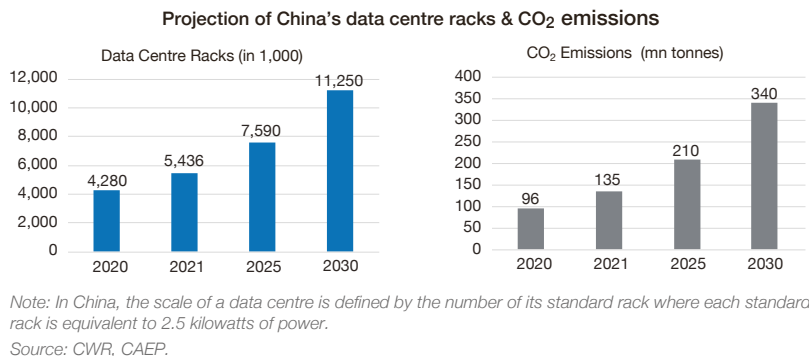
AI	Artificial Intelligence	
AMI	Ambition on Melting Ice	
CAEP	China Academy of Environmental Planning	
CNY	Chinese Yuan	
CO <sub>2</sub>	Carbon dioxide	
ESG	Environmental, Social and Governance	
GDP	Gross Domestic Product	
GHG	Greenhouse gas	
HKH	Hindu Kush Himalayas	
HKEX	Hong Kong Exchange	
ICCI	International Cryosphere Climate Initiative	
ICIMOD	International Centre for Integrated Mountain Development	
ICT	Information and communication technology	
IPCC	Intergovernmental Panel on Climate Change	
Jing-Jin-Ji	The Beijing (Jing)-Tianjin (Jin)-Hebei (Ji) Region	
MEE	Ministry of Ecology and Environment	
MEM	Ministry of Emergency Management	
MIIT	Ministry of Industry and Information Technology	
NBSC	National Bureau of Statistics of China	
NDRC	National Development and Reform Commission	
PUE	Power Usage Effectiveness	
SLR	Sea Level Rise	<b>Units:</b>
SSP	Shared Socioeconomic Pathway	bn      Billion
UNDP	United Nations Development Programme	GtCO <sub>2</sub> e    Gigatonnes of CO <sub>2</sub> equivalent
UNEP	United Nations Environment Programme	GW      Gigawatt
WMO	World Meteorological Organization	kWh     Kilowatt hour
WRI	World Resources Institute	mL      Milliliter
WUE	Water Usage Effectiveness	mn      Million
YREB	Yangtze River Economic Belt	MtCO <sub>2</sub> Million metric tonnes of CO <sub>2</sub>
14FYP	China’s 14 <sup>th</sup> Five Year Plan (2021 – 2025)	

**Data centre racks:** In China, the scale of a data centre is defined by the number of its standard rack where each standard rack is equivalent to 2.5 kilowatts of power.

**Total Internal Renewable Water Resources:** Long term average annual flow of rivers and recharge of aquifers generated from endogenous precipitation, expressed in terms of cubic metres.

## Data centres are thirsty! Demand for water will only increase...

- Data centres use water for cooling as running IT equipment generates significant heat.** If heat builds up, it can damage the equipment, shorten its lifespan and even cause safety accidents – water is still the dominant cooling medium for its high efficiency and low cost. Water efficient data centres are therefore key in a rising water stress environment. For example: Google’s global data centre fleet consumed 4.3bn gallons of water in 2021 which amounts to around 16.2mn m<sup>3</sup> – this is equivalent to more than 6,500 Olympic-size swimming pools. This means that data centres are Google’s single biggest water-consuming activity, accounting for nearly 70% of the company’s total operational water use.<sup>1,2</sup> Put it another way, water to run Google’s global data centre fleet is 3.5x the Maldives’ total annual freshwater withdrawals ... or from a city perspective, this amount can satisfy the yearly domestic water consumption for 300,000 Singaporeans.<sup>2,3</sup> Please refer to the infographic on the following page for more context.
- In China, data centre water consumption can be around 1.3bn m<sup>3</sup> of water; this is 1.9x the water use for households & services in Tianjin.** According to Guangxi Information Centre, data centres in the province consumed close to 19mn m<sup>3</sup> of water in 2021<sup>4</sup> and Guangxi was only home to about 1.4%<sup>5</sup> of China’s data centres in 2020. Based on this and accounting for varying water efficiency across data centres and weather conditions in China, we estimate that China’s data centres consume approximately 1.3bn m<sup>3</sup> of water annually. This is 1.9x the water use for household and services of Tianjin, which has a population of 13.7mn – so based on this, 1.3bn m<sup>3</sup> will be able to provide for 26mn people.<sup>6</sup> Please refer to the infographic on the following page for more context.
- By 2030, China’s data centre racks are expected to be 2.6x that of 2020 = demand for water can rise to >3bn m<sup>3</sup>.** Currently, China’s digital economy contributes 40% to the country’s GDP and is set to grow as the 14<sup>th</sup> Five Year Plan 2021-2025 (14FYP) sets annual revenue growth at 10% for the ICT sector.<sup>7,8</sup> This signals an explosion of data centres in the future and researchers from China Academy of Environmental Planning (CAEP) expect the number of data centre racks in China to grow from 4.3mn in 2020 to 11.3mn by 2030.<sup>9</sup> Already, CAEP researchers noted that the number of data centre racks in China grew by 27% from 4.3mn in 2020 to 5.4mn in 2021<sup>9</sup> - see chart below left. This means that data centre water use could be well over 3bn m<sup>3</sup> by 2030 – imagine the rising water demand adding to water stress with an exponential growth of data centres!



- Ballooning data centre emissions can also add to water stress.** If transition is not accelerated, CAEP researchers expect data centre emissions to balloon 2.5x from 135MtCO<sub>2</sub> in 2021 to 340MtCO<sub>2</sub> by 2030 – see chart above right.<sup>9</sup> This is a sizeable amount – for perspective, this is similar to the energy-related emissions of the United Kingdom today of 338MtCO<sub>2</sub>.<sup>10</sup> Clearly, if data centre emissions were not reined in, they will only accelerate global warming which will in turn exacerbate water scarcity. This clearly increases water risks for thirsty data centres.
- Rise of AI & ChatGPT also increase water use by 20x.** Along with its huge computational power, AI chatbots drink staggering amounts of water to cool themselves down. A recent study notes that ChatGPT drinks 500mL of water for every 20-50 Q&A conversation you have with it;<sup>11</sup> that’s 20x more water compared to 50 Google searches.<sup>12</sup> It might not seem like much, but ChatGPT was the fastest growing app of all time, with over 100mn users in just two months after its launch.<sup>13</sup> If 100mn users each had a conversation, ChatGPT would consume 50,000m<sup>3</sup> of water – the same as 20 Olympic-sized swimming pools whereas the equivalent in Google searches would only consume one swimming pool – see infographic on the following page for more context. Imagine when all the other tech companies jump on the AI chatbot hype – indeed, China’s tech giants launched their AI chatbots last year – for example, ‘Ernie Bot’ (Baidu), ‘HunYuan’ (Tencent) and ‘Tongyi Qianwen’ (Alibaba).

Source:  
The above was sourced from CWR article:  
“Killing Us Faster? Power Hungry Thirsty AI Chatbots”  
by Sophie Lam published in September 2023.

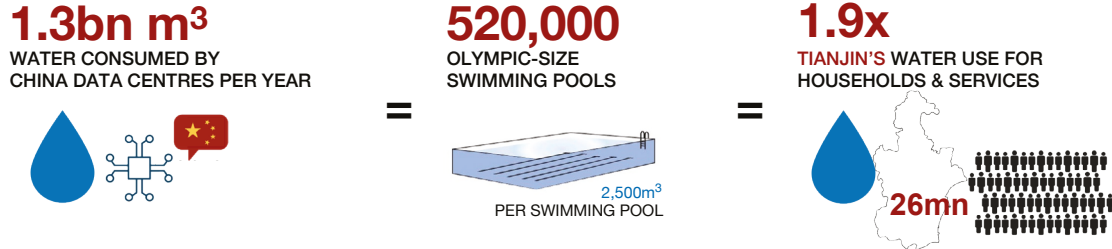
Read the full article here:

<https://chinawaterrisk.org/resources/analysis-reviews/killing-us-faster-power-hungry-thirsty-ai-chatbots/>

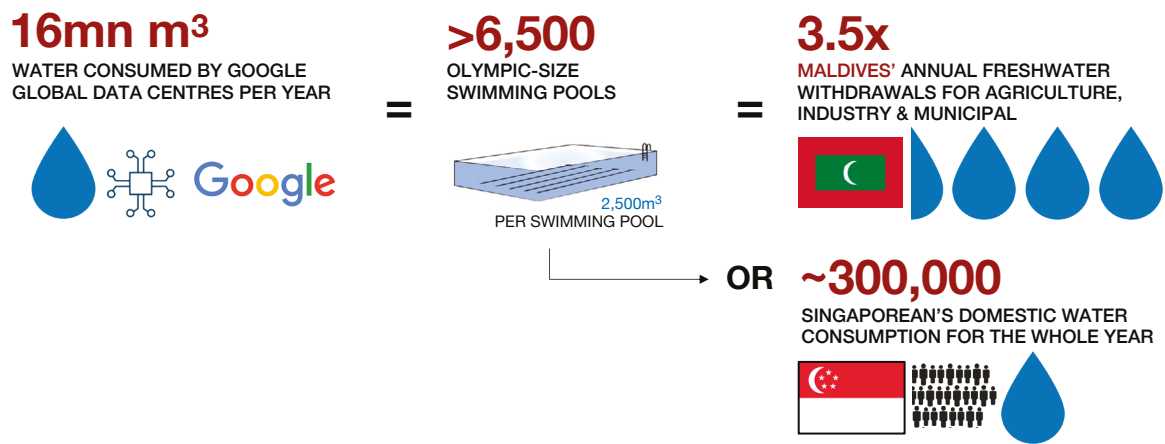


**CWR | DATA CENTRES ARE THIRSTY**

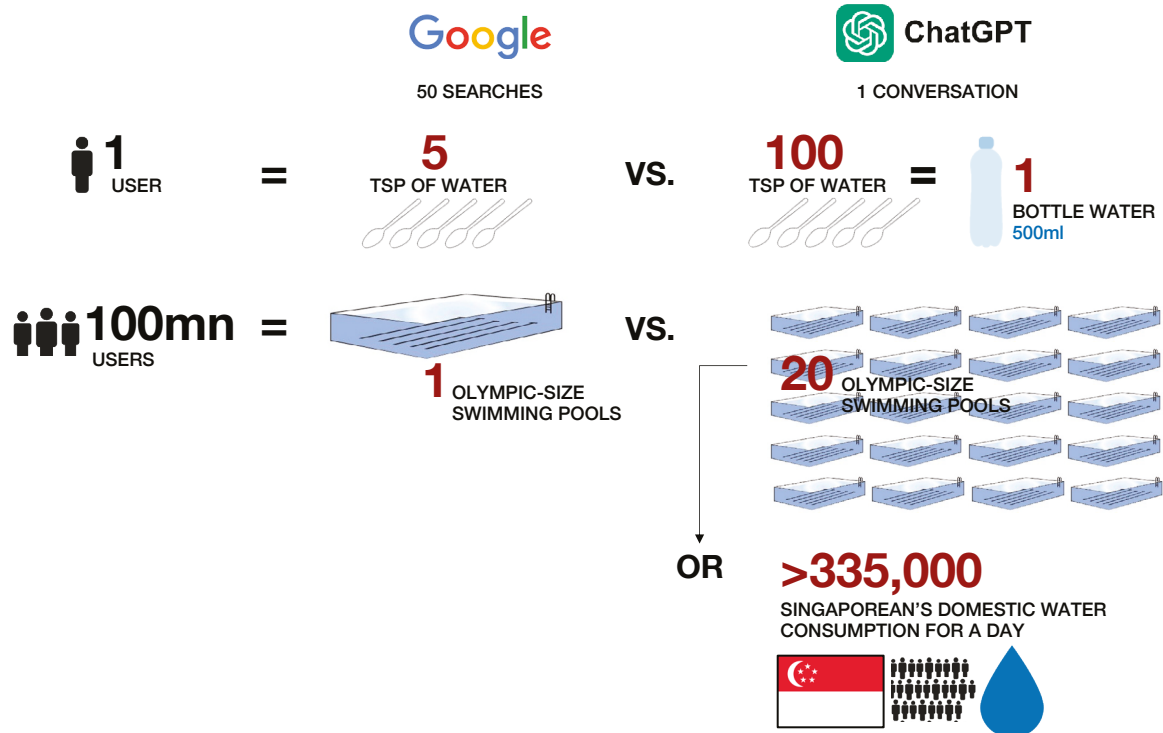
**Estimated water consumed by China data centres...**



**Estimated water consumed by Google's data centres...**



**Google search vs ChatGPT conversation | 1 user vs. 100mn users**



Source: CWR, NBSC, Guangxi Big Data Research Centre, Fluidra, Independent, Li et al. (2023) "Making AI Less "Thirsty". Uncovering and Addressing the Secret Water Footprint of AI Models", Google. The World Bank, Our World in Data, FAO, Public Utility Board (Singapore). Infographic © China Water Risk 2024, all rights reserved.

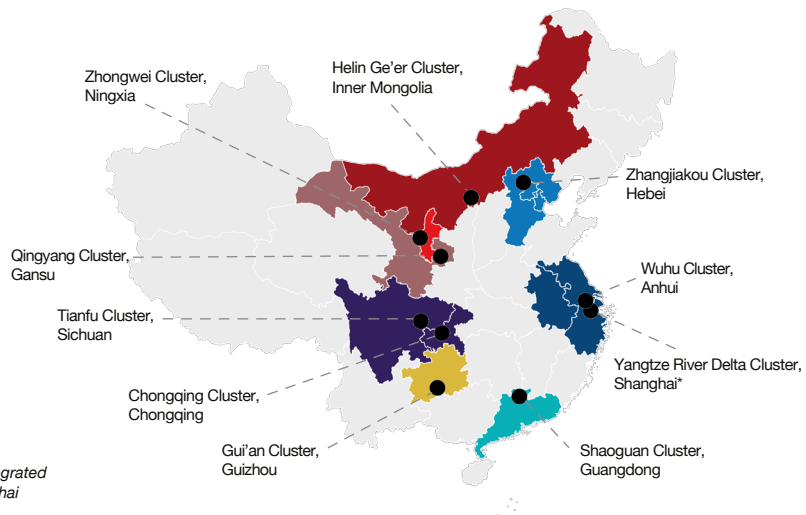
## “Going west” doesn’t solve all water problems!

- “Eastern-Data, Western-Computing” – China is reshuffling its computing resources.** In 2020, China launched a new national initiative: “Eastern-Data, Western-Computing” (“Dong Shu Xi Suan”), to shift data centres from China’s populous coastal provinces to the resource-abundant inland western region. The map below shows the 8 computing hubs and 10 data centre clusters nationwide outlined by the state planner National Development and Reform Commission (NDRC). The initiative aims to channel computing resources from data centres that produce massive amounts of data in the “Eastern Hubs” (Beijing-Tianjin-Hebei; Yangtze River Delta; Guangdong–HK–Macao Greater Bay Area; and Chengdu-Chongqing), to the “Western Hubs” (Guizhou; Inner Mongolia; Gansu; and Ningxia) that are greener and more energy-efficient for processing and storage.
- The 8 Computing Hubs are spread over 14 provinces; 6 of which are as dry as the Middle East.** The 8 computing hubs are spread across 14 provinces, municipalities and autonomous regions – these are Anhui, Beijing, Chongqing, Gansu, Guangdong, Guizhou, Hebei, Inner Mongolia, Jiangsu, Ningxia, Shanghai, Sichuan, Tianjin and Zhejiang. As can be seen from the chart below, 6 of these provinces have per capita annual Total Internal Renewable Water Resources that are similar to Middle Eastern countries. **The 14 provinces are home to 72% or 3.1 million of China’s data centre racks – over 50% of this or 1.6 million racks are located in provinces which are as dry as the Middle East.**

### CWR | CHINA’S EASTERN-DATA, WESTERN-COMPUTING (东数西算) LOCATION OF 10 DATA CENTRE CLUSTERS & 8 COMPUTING HUBS

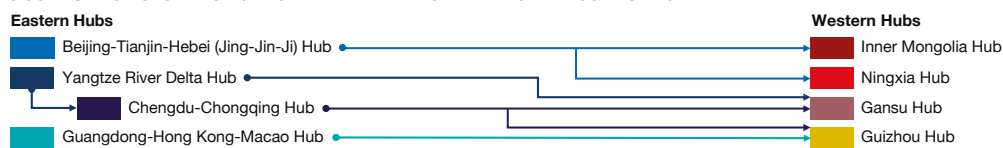
#### 10 DATA CENTRE CLUSTERS

- Zhongwei Cluster
- Qingyang Cluster
- Tianfu Cluster
- Chongqing Cluster
- Gui’an Cluster
- Shaoguan Cluster
- Yangtze River Delta Cluster
- Wuhu Cluster
- Zhangjiakou Cluster
- Helin Ge'er Cluster

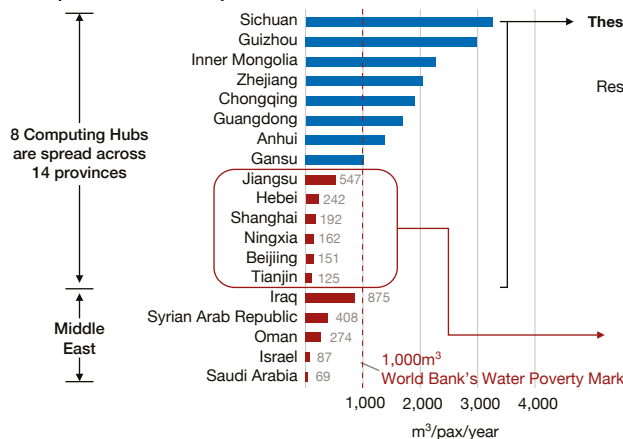


\*Yangtze River Delta Ecological Green Integrated Development Demonstration Zone, Shanghai

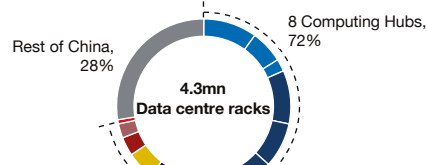
#### 8 COMPUTING HUBS – EASING EASTERN-DATA NEEDS WITH WESTERN-COMPUTING



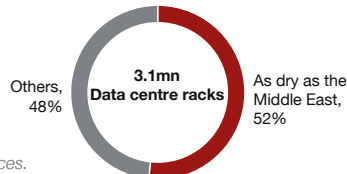
#### Per capita water resources p.a.



These 14 regions are home to 72% of China data centre racks



52% of this is located in regions as dry as the Middle East “Dry 10”



Note: Data centre racks numbers as of 2020.

Water resources in this chart is defined as the total internal renewable water resources.

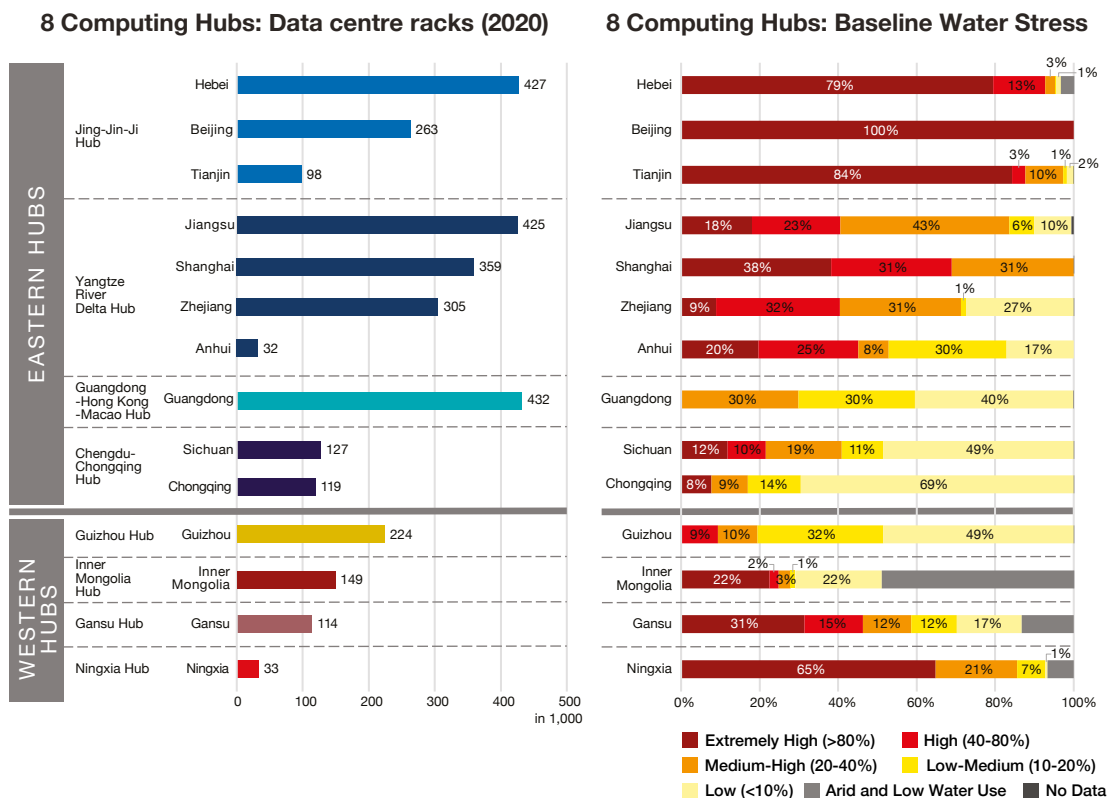
Source: CWR, Greenpeace and CEPREI Calibration & Testing Centre, NBSC, The World Bank. Infographic © China Water Risk 2024, all rights reserved.

- Rising water demand in the west could add pressure on China's most water-stressed regions; Eastern Hubs are also at risk.** Due to the lack of detailed information as to the specific locations of the over 4mn data centre racks in China, we can only provide an overview of exposure to water stress by region. However, as can be seen from the charts below, apart from Guangdong, Sichuan, Chongqing & Guizhou, the rest of the 14 regions, where the 8 Computing Hubs and 10 Data Centre Clusters are located, face 'Extremely High' to 'High' water stress, where water cooling will be a luxury choice.

Key points to note are:

- Hebei, Jiangsu and Guangdong house over 400,000 data centre racks each. Besides Guangdong, both Hebei and Jiangsu face high water stress as per WRI's Aqueduct 4.0: 92% of Hebei province is exposed to 'Extremely High' or 'High' water stress whereas in Jiangsu, the percentage albeit lower than Hebei, is still high at 41%.
- Supplementing the Eastern Hubs of Jing-Jin-Ji (Beijing-Tianjin-Hebei) with "Western-Computing" from Inner Mongolia may make sense from a water perspective as Inner Mongolia, albeit arid, is far less exposed to water stress than Beijing, Tianjin, and Hebei. But this is not the case for Ningxia where almost two-third of the region faces 'Extremely High' water stress.
- The Yangtze River Delta Hub houses the most number of racks – at 1.1mn, this region accounts for over 26% of the national share. Supplementing this hub with Gansu which has a similar water stress profile will not resolve water issues. Also, as these are regions comprising the Yangtze & Yellow River Economic Belt, they may also face tighter regulations – more on this later in **"Regulatory risks – government may introduce ICT sector regulations to protect water resources"**.
- Booming data centres will only add to provincial water stress in Ningxia and Gansu, two of the driest provinces in China, which have already struggled to balance food, energy and industry water use. The stark reality is that, **the sector faces high water risk as 9 out of 14 of the provinces, municipalities & autonomous regions have around 40% or more of their respective areas facing 'Extremely High' or 'High' water stress.** This could explain why **the state planner requires local governments to first "secure land and water resources" for data centres.**

CWR | BASELINE WATER STRESS OF DATA CENTRE RACKS IN CHINA'S 8 COMPUTING HUBS

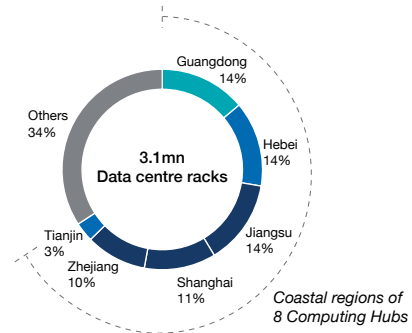


Source: CWR, Greenpeace and CEPREI Calibration & Testing Centre, WRI Aqueduct 4.0. Infographic © China Water Risk 2024, all rights reserved.

- Sizeable data centre clusters are still exposed to coastal flood risks & sea level rise (SLR).** It is clear from the above analyses that relocating data centres to “the West” alone won’t solve all water problems. That said, moving new data centres inland, is an excellent countermeasure to address coastal flood risks. As per the chart on the right, around two-thirds of the data centre racks of the 14 regions that house the 8 Computing Hubs are located in coastal regions. Coastal provinces with the highest risk of coastal flooding and SLR risk are Shanghai, Jiangsu, and Zhejiang in the Yangtze River Delta and Guangdong – these house almost half of the 3.1mn racks.

Coastal exposure is lower if we include other regions beyond the 8 Computing Hubs and 10 Data Centre Clusters – more on this later in **“Coastal threats – storm surges & SLR can impact data centers located along the coast”**.

8 Computing Hubs: Coastal Exposure



Source: CWR, Greenpeace and CEPREI Calibration & Testing Centre.

- Higher-than-average dependency on thirsty & dirty coal power could up climate risks.** According to the implementation policy, natural cooling, lower electricity tariff, access to green electricity, and cheaper land cost in the remote west are the main rationales behind the “going west” strategy for data centres. Indeed, the Eastern Hub regions’ renewable power supply ranges from 3% in Shanghai to 23% in Hebei; except for Sichuan and Chongqing, all other Eastern Hub provinces’ power supply from renewables are lower than the national average of 27% in 2021. That means these provinces are more dependent on thirsty & dirty coal-fired power and using more of this could not only accelerate climate change but also add to water stress as coal-fired power generation can also be water intensive. As for Western Hub regions, only Inner Mongolia and Ningxia fall below the national average in renewable power generation; nevertheless, these rates are still higher than most of the Eastern Hub regions.
- Spreading data centre resources from the Chengdu-Chongqing Hub can counter hydropower disruptions from extreme weather events.** Sichuan (province to Chengdu) and Chongqing are reliant on hydropower which accounted for 82% and 29% of electricity generated in 2021. Due to severe extreme weather events experienced in the Yangtze River, it is not difficult to imagine why China has decided to relocate the data centre capacity from Sichuan and Chongqing to Gansu and Guizhou. Already, extreme floods and droughts have disrupted power output in Sichuan, which is a heartland for manufacturing and bitcoin mining.<sup>14,15</sup> So it’s hardly surprising that China cracked down on bitcoin mining even in the water-abundant regions like Sichuan.<sup>16</sup> – more on this later in **“Extreme weather – floods & droughts can damage assets and interrupt operations”**.
- Very modest ambition to increase renewable energy consumption, which reduces water footprints in energy consumption.** Despite the fully demonstrated feasibility of running data centres on 100% renewable energy, the “Eastern-Data, Western-Computing” plan only encourages data centres to “strive” to achieve the incentive targets on renewable energy consumption at the provincial level, which are usually 2-3% higher than the mandatory targets in these provinces. That said, in March 2023, the Ministry of Ecology & Environment (MEE) and the Ministry of Industry & Information Technology (MIIT) introduced a public sector pilot to procure from 100% renewables powered data centres by 2032.<sup>17</sup> Generally, as the public sector leads the charge in China, this pilot could indicate that renewable sourcing targets for data centres will rise sooner rather than later. Indeed, this was confirmed in December 2023, when a new implementation plan required newly constructed data centres at national hubs to achieve a renewable energy ratio of more than 80%.<sup>18</sup>

For more on regulatory pressure in China to fast track ICT transition, please refer to our report **“China ICT Transition – The good, bad & ugly of 5 HKEX ICT listco’s net zero pledges & climate action”**.

- The time to tackle water risks is now as accelerated warming brings accelerated water threats.** While “Eastern-Data, Western-Computing” may resolve some water issues such as coastal threats, it could add to water stress in western regions. As the following page **“Reality Check! Accelerated warming = accelerated freshwater threats”** shows, we have already breached 1.5°C – this means that acute and chronic water risks will only rise, increasing the exposure of the ICT sector. It is therefore important to get a ‘big picture’ of the national data centre exposure to water risks – so next, we explore 5 key areas of water risks beyond the 8 computing hubs and 10 data centre clusters ...



## Reality Check! Accelerated warming = accelerated freshwater threats...



**We have breached 1.5°C of warming in 2024.** The global mean temperature in 2023 ended up being 1.45°C warmer than the pre-industrial period, making it the hottest year ever. Then, an abnormally hot January in 2024 pushed us to 1.52°C for the rolling 12-month period, surpassing the Paris Agreement of 1.5°C. Warmer temperatures persisted throughout February 2024 and monthly warming soared to 1.77°C with highs of 2°C over four consecutive days. This raised year-to-date global temperatures for February 2024 to 1.56°C. It's worth noting here that warming only stood at 1.15°C above pre-industrial levels for 2022 and 1.12°C for 2021. **So warming is not inching but accelerating due to our inability to rein in growing emissions; with El Niño, expect 2024 to be even hotter** – this is clear from the chart below.



**Emissions are still going up, not down – IPCC's SSP3 or 3.6°C of warming by 2100 is likely our base case and not worst case scenario.** Global GHG emissions increased 1.2% from 2021 to 2022 to reach a new record of 57.4GtCO<sub>2</sub>e. According to the UN's "Emissions Gap Report 2023", current policies track a 3°C path while delivering on all unconditional & conditional pledges by 2030 will only lower this estimate to 2.5°C. Sadly, the report also noted that key countries are not on track to meet their pledges. With wars escalating and continuing tense global geopolitics, the current base case we are arguably tracking is the IPCC's SSP3-7.0 "Regional Rivalry Scenario – A Rocky Road" (SSP3). Under SSP3, the best estimate for warming by 2081-2100 is 3.6°C.



**Accelerated warming signals that we may well be tracking IPCC's SSP5 or 4.4°C of warming.** Worryingly, while the G7 calls for a reduction in coal in Asia, it is continuing to invest in fossil fuels. According to analysis by Oil Change International, between 2020 and 2022 the G7 provided US\$78bn in public finance for fossil fuel projects – this was 2.6x their support for clean energy. Given the explosion in fossil fuels, could we be tracking SSP5-8.5 "Fossil-fueled Development – Taking the Highway" (SSP5)? If so, this means we will see warming of 4.4°C by 2081-2100. **Indeed, the actual growth in CO<sub>2</sub> levels indicates that we are tracking 4-5°C.**



**Every degree of warming threatens water security and intensifies both acute and chronic risks.** Water is one of the most vulnerable resources to climate change – from ice melt, snowfall, rainfall to monsoons; every aspect of the water cycle/river flow is affected – amplifying water scarcity. Moreover, water is also primarily how we "feel" climate impacts – floods, storms, droughts, fires, sea level rise and so on – all of these can also disrupt water supply, and widening extremes due to global warming will make water management more difficult and costly. According to the report "IPCC Climate Change 2022: Impacts, Adaptation and Vulnerability", "if we don't rein in carbon emissions, 3bn and 4bn people could face chronic water scarcity at 2°C and 4°C of warming". Already today, 3.6bn people lack access to sufficient water at least one month per year.



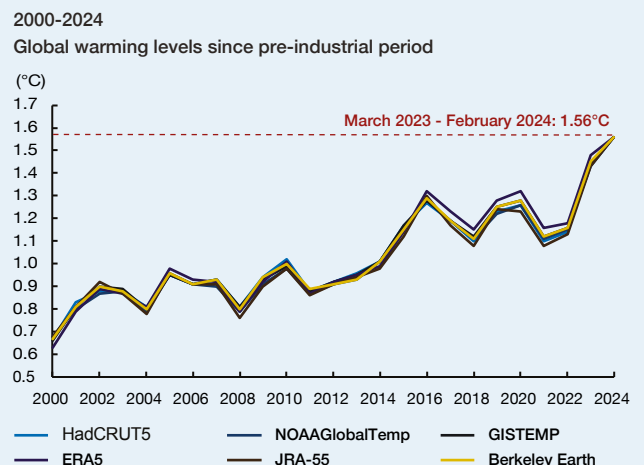
**Asia is especially vulnerable – Himalayan Water Towers are melting & experts warn of peak water by 2050.** Over 420 large Asian cities with a population of over 250,000 and by extension data centres which serve them are located in 10 major river basins such as the Yangtze, Ganges, Indus & Mekong. All these rivers flow from the Hindu Kush Himalayas ("HKH"), an important source region with its vast ice reserves. Already at 2°C, projections of snowfall and river flow are expected to fall significantly for some rivers – for more see CWR's report "No Water No Growth". Also ICIMOD has warned of "peak water" by 2050 for the HKH river basins. Moreover, the State of Cryosphere 2023 report updates HKH glacier losses to be 70-80% by 2100 on the current emissions path. All these point to rivers running dry sooner rather than later which can also disrupt the electricity supply. According to CWR's "No River, No Power" report, more than 94% of the 865GW of power assets located in the 10 major HKH river basins are vulnerable as they require water to generate electricity. So data centres could face double whammy risks from disruptions from uncertainty in both water & power supplies. Worst still, one in two Asians or 1.9 billion people live in these 10 HKH river basins.

For coastal threat impacts, please see "2°C is too hot for ice! 1.5°C is the only option...or face rapid ice melt & SLR".

Source: CWR article "Soaring High Or Scorched Earth? 5 Trends For The Year Of The Dragon" (22 February 2024); WMO; The Meteorological Office (Met Office); Copernicus; IPCC Climate Change 2021: The Physical Science Basis; UN Water; IPCC Climate Change 2022: Impacts, Adaptation and Vulnerability; CWR report "No Water No Growth – Does Asia have enough water to develop?" (2018); ICIMOD; CWR report "No River No Power – Can Asia's rivers power growth in a changing climate?" (2023).

### Recommended Reading

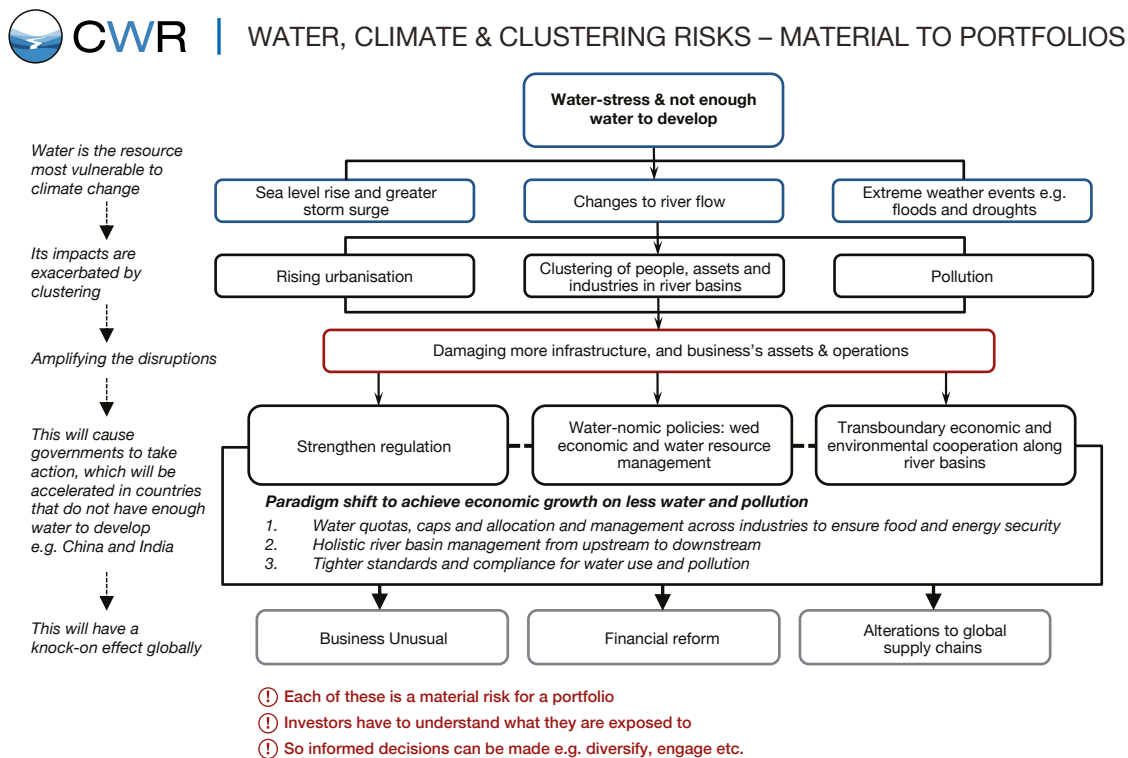
- CWR (2024) Soaring High Or Scorched Earth? 5 Trends For The Year Of The Dragon
- UNEP (2023) Emissions Gap Report 2023: Broken Record – Temperatures hit new highs, yet world fails to cut emissions (again)
- WMO (2022) State of Global Water Resources 2022
- ICIMOD (2023) Water, ice, society, and ecosystems in the Hindu Kush Himalaya: An Outlook
- IPCC (2022) Climate Change 2022: Impacts, Adaptation and Vulnerability



Source: CWR, The Meteorological Office (Met Office), Copernicus.

## Overview of 5 key areas of water risks faced by data centres...

- Water risks can impact the balance sheet as the value of data centres could be at risk + P&L due to operational disruptions.** China's data centres face multiple escalating water risks – here we highlight 4 key categories of water risks.
  - Rising water scarcity & stress – operational risks due to industry-wide dependency on water-cooling
  - Extreme weather – floods & droughts can damage assets and interrupt operations
  - Coastal threats – storm surge & SLR can impact data centres located along the coast
  - Power generation – can be affected by water risks disrupting electricity supply to data centres
  - Regulatory risks – government may introduce ICT sector regulations to protect water resources
- These risks should not be considered in isolation but holistically – they are interlinked & can compound.** Underlying chronic risks can exacerbate acute risks, so these risks should be considered together. There are also compounding risks to consider as multiple events could happen at the same time or with higher frequency, making recovery difficult. Physical risks should also be considered together with regulatory risks. The diagram below indicates how some of these risks may be interlinked:



Source: CWR Big Picture: Water Risk Valuation, www.chinawaterrisk.org; Infographic © China Water Risk 2024, all rights reserved.

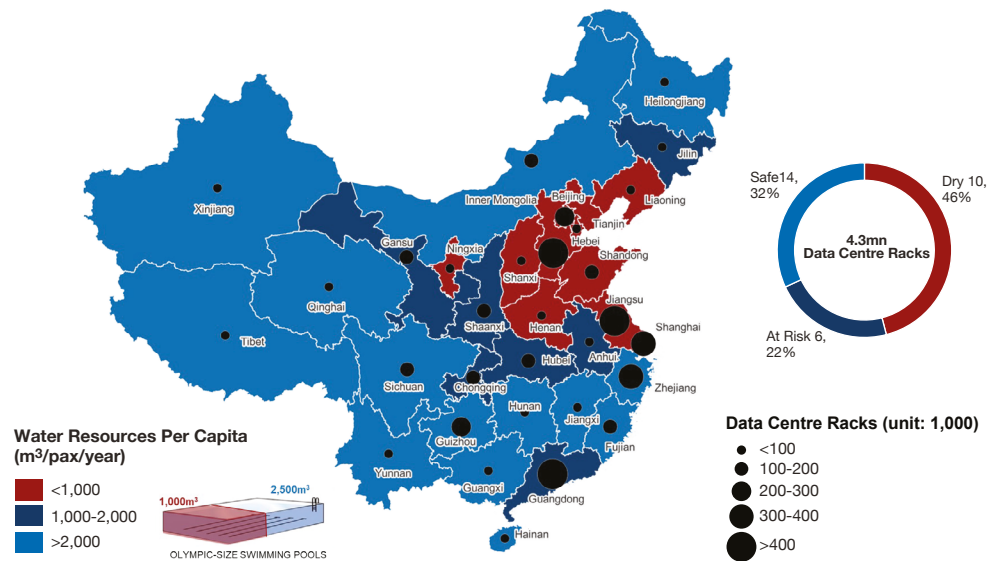
- Assess water risks in the ICT sector to identify clustered risks as well as surface opportunities.** We encourage asset owners to get on top of such complexities in order to ensure portfolios are resilient and to take advantage of the transition, as opportunities as well as risks can be significant. For this report, as we did not have access to the exact location of each data rack, we were only able to conduct analyses at a provincial, municipal and autonomous region level thanks to data gathered by Greenpeace in its report “China 5G and Data Center Carbon Emissions Outlook 2035”.

**Where possible, more granular analysis is recommended.** While this report provides a good at-a-glance overview of the water risks faced by China's national data centre fleet, we recommend that locational analysis be conducted on a per data centre basis for a fuller picture of water risk exposure; especially when analyzing water risks from a corporate perspective. If you do not know where do start, do contact us at [info@chinawaterrisk.org](mailto:info@chinawaterrisk.org)

## 1. Rising water scarcity & stress – operational risks due to industry-wide dependency on water-cooling

- 46% of China's data centre racks are located in the Dry 10 water scarce provinces.** China has limited water resources – its national renewable water resources per capita averaged 2,100m<sup>3</sup> for the last decade (2012-2021).<sup>19</sup> This is just above the 2,000m<sup>3</sup> level below which the UNDP, UNEP, the World Bank, and the World Resources Institute define as “water stress”; whereas “water scarcity” is defined as below 1,000 m<sup>3</sup> threshold.<sup>20</sup> However, water is not evenly distributed across China's provinces, municipalities and autonomous regions; and 10 of these have per capita water resources below the scarcity threshold level of 1,000 m<sup>3</sup> per year (Dry 10) – this is denoted in red in the map below. What's also clear from the map below is that a large portion of China's data centre racks are located in the Dry 10.

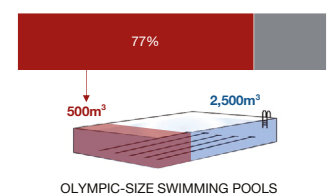
### CWR | WATER RESOURCES OF DATA CENTRE RACKS IN CHINA



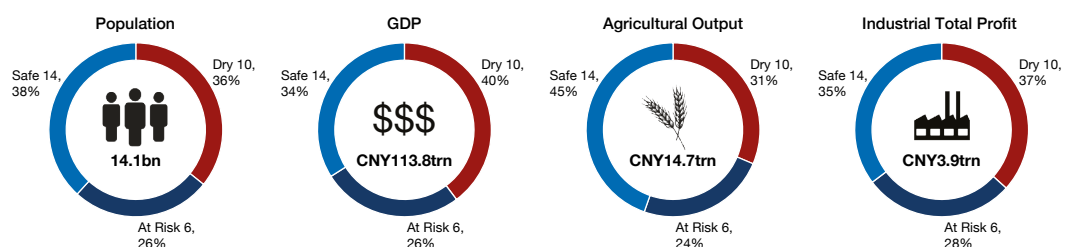
Source: CWR, Greenpeace and CEPREI Calibration & Testing Centre, NBSC, The World Bank. Infographic © China Water Risk 2024, all rights reserved.

- Only 32% of data centre racks are in water rich regions.** As per the chart above, the Safe 14 (14 regions with per capita water resources of over 2,000m<sup>3</sup> p.a.) hold only 32% of the national data centre racks. This means that the remaining 22% of the racks are located in the At Risk 6 (6 water stress regions with per capita water resources of 1,000-2,000m<sup>3</sup> p.a.)
- Worst still, three-quarters of the Dry 10 racks are located in extreme water scarce regions.** The situation is more critical as 8 out of the Dry 10 have per capita water resources of less than 500m<sup>3</sup> per annum – in short, these regions face extreme water scarcity. For perspective, 500m<sup>3</sup> is merely a fifth of the water held in an Olympic-size swimming pool. Unfortunately, 77% of the Dry 10's data centre racks are located in these 8 regions. This means that 35% of the nation's thirsty data centre racks are located in extreme water scarce regions.
- Competition for water in the Dry 10 will rise and data centres may not be the #1 priority.** As chronic water scarcity rises with rising temperatures, thirsty data centres will face stiff competition for water from households, agriculture and industry. As can be seen from the charts below, significant shares of these, as well as GDP, is generated in the Dry 10.

1.5mn or 77% of the Dry 10's data centre racks are located in extreme water scarce regions



Source: CWR, Greenpeace and CEPREI Calibration & Testing Centre, The World Bank.

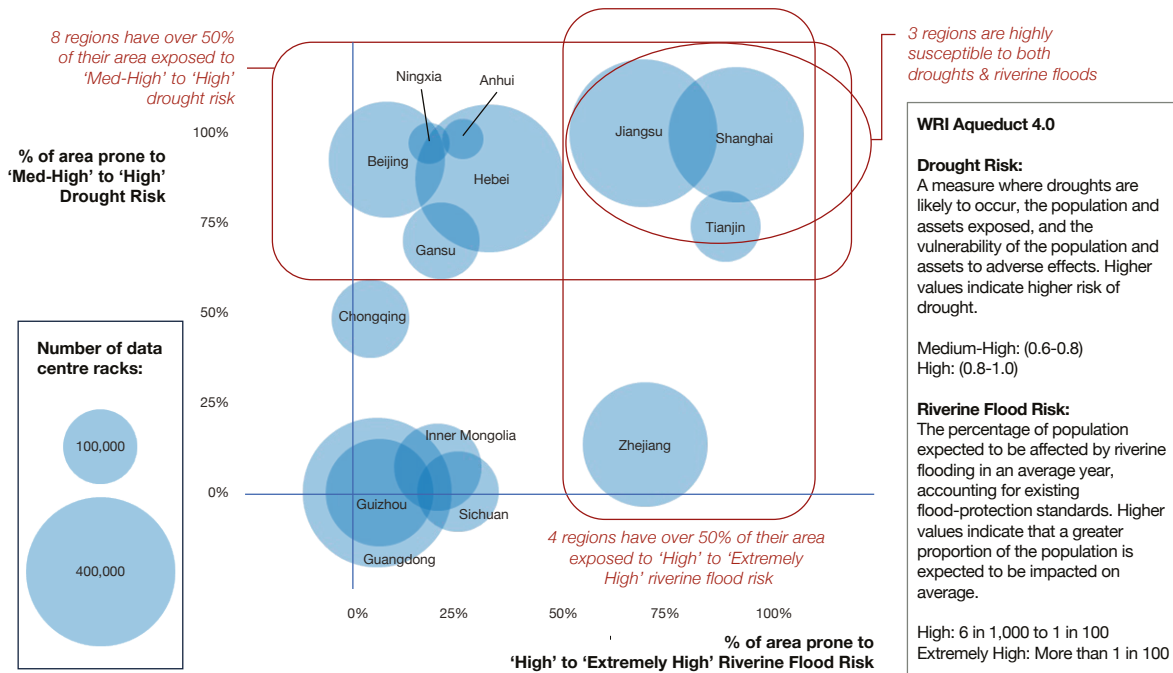


Source: CWR, Greenpeace and CEPREI Calibration & Testing Centre.

## 2. Extreme weather – floods & droughts can damage assets and interrupt operations

- **Data centres are also highly vulnerable to extreme rainfall and floods.** According to the Ministry of Emergency Management of China, 626 rivers in 28 provinces experienced flooding above the warning level in 2022; several rivers recorded the highest flood in the last century.<sup>21</sup> In the same year, China also faced severe drought along the Yangtze River which caused disruptions in Sichuan and Chongqing – see box below.
- We therefore took a closer look at the exposure of the 14 regions which host the 8 Computing Hubs and 10 Data Centre Clusters to both flood and drought risk. The results are set out in the chart below which shows the extent of each region’s exposure to the floods (x-axis) and droughts (y-axis) while the size of the circles represents the number of data racks in the respective regions. Please note that only riverine flood risk is evaluated in this section, for coastal flood risk read on.

### CWR | AT-A-GLANCE EXPOSURE TO RIVERINE FLOOD & DROUGHT RISKS 14 REGIONS HOUSING THE 8 COMPUTING HUBS & 10 DATA CENTRE CLUSTERS



Source: CWR, Greenpeace and CEPREI Calibration & Testing Centre, WRI Aqeduct 4.0. Infographic © China Water Risk 2024, all rights reserved.



### Yangtze River Drought 2022

“The Yangtze River faced the lowest summer rainfall in six decades. According to the People’s Daily, in Chongqing, 24 reservoirs and 51 rivers have dried up due to searing temperatures of >40°C for eight consecutive days. Record heatwaves and low rainfall meant that electricity demand for air-conditioning rose whilst hydropower generation fell due to drought conditions lending complexity to drought management.

With 80% of its electricity derived from hydropower, the Sichuan province was particularly affected. It’s hydropower generation plunged by 50% and a large number of industrial enterprises and factories were told to suspend production for 6 days to ensure that public basic needs of power and water were met. The Guardian reported that Tesla, Toyota, and Foxconn were among companies reported to have temporarily suspended operations at some plants, disrupting the global supply chains.

On top of this, the extreme drought had affected at least 830,000 people along the river as well as close to 1.5 million acres of farmland. For perspective, the YREB grows around 65% of China’s rice. The drought has no doubt tested China’s water management policies which must remain flexible to cope with the volatility of extreme weather (remember last year, everyone was worried about severe Yangtze floods). The good news is that China has been undertaking various measures to protect the Yangtze from mountains-to-the-oceans.”

Source:  
The above is an extract from CWR article “Rivers are Running Dry Today” by Debra Tan & Sophie Lam published in October 2022 on CWR website



Read the full article here:

<https://chinawaterrisk.org/resources/analysis-reviews/rivers-are-running-drytoday/>

Key points to note are:

- **41% of China's data centres are located in regions that are highly prone to drought.** These are spread across 8 regions that have over 50% of their area exposed to 'Medium-High' to 'High' drought risk. These are Gansu, Tianjin, Hebei, Beijing, Ningxia, Anhui, Shanghai & Jiangsu – together, they house 41% of China's national data centre racks.
- **A fifth of China's data racks are highly prone to both droughts and floods** as Tianjin, Shanghai & Jiangsu are also highly prone to floods. Each of these regions has over 50% of their area exposed to 'High' to 'Extremely High' flood risk as well as 'Medium-High' to 'High' drought risk. In addition to these, Zhejiang is also prone to floods – this means that **28% of China's national data centre racks are located in areas that are very prone to flooding.**
- While there are no parts of Guangdong, Guizhou nor Sichuan which face 'Medium-High' to 'High' drought risk as per WRI Aqueduct 4.0, that's not to say they have zero drought risk. Indeed, all three have faced severe droughts in recent years. In 2021-2022 parts of Guangdong like Shenzhen experienced the worst drought since 1963 and required water rationing and conservation<sup>22,23</sup> whereas as seen from the box above Sichuan was crippled by severe droughts during the summer of 2022. As for Guizhou, some areas faced droughts in 2022-2023, requiring extensive efforts from the government to ensure the supply of drinking water and agricultural irrigating water.<sup>24,25</sup>
- Although Jiangsu and Shanghai are more prone to droughts than Chongqing or Sichuan, the latter suffered more than Jiangsu & Shanghai during the 2022 Yangtze River droughts. As can be seen from the box above, this was largely due to the large share of hydropower in both Sichuan and Chongqing as compared to Jiangsu & Shanghai where 81-97% of their power generation comes from thermal power such as coal, gas & oil.
- NOTE: As we have only analysed the 14 regions that house the 8 Computing Hubs & 10 Data Centre Clusters, the national data centre exposure to drought and floods will be much higher if the other 17 regions were also factored in.
- **The above chart should be only used as a guide of the risk exposure to floods and droughts.** It is evident that even regions with 'Low' to 'Low-Medium' drought risks can face severe disruptions from droughts and more granular analysis at a facility level should be performed. It is also important to note that floods and droughts will only intensify as global warming accelerates – this will result in a widening of extremes, making water management more difficult and costly.
- **The good news is that China is taking action to build resilience with its first ever 14 YP for Water Security.** Issued in 2022, the first-ever 14FYP for Water Security sets out an 'overall comprehensive plan' for water in the next five years. Besides incorporating all previous key water policies, it also recognizes future water shocks: *"With economic and social development and the impact of global climate change, existing challenges for water security still need to be addressed, yet new emerging issues are becoming more and more urgent."* More on the 14FYP in the box below. China is also adding coal-fired power plants in Guangdong & Sichuan as just-in-case power should severe droughts disrupting power output occur again – more on this later in **"Power generation – can be affected water risks disrupting electricity supply to data centres"**.



**First-ever 14 FYP for Water Security:  
Ramping up resilience for water shocks with inland & coastal flood defences**

"In 2021, record-high rains in Zhengzhou, Henan brought huge losses to China. Not surprising then that the Water 14FYP includes adaptation measures such as reinforcing flood control infrastructure, strengthening embankments of key rivers, lakes and reservoirs and realising adequate flood plains.

The new flood protection targets have also been set to withstand one in 100-200 years flood levels to *"ensure the safety of people's lives, property and stable operation of economy and society"*. Building flood resilience in the Water 14FYP starts from the mountain source regions, rural areas to large urban areas along the rivers to coastal cities; again, echoing a mountains-to-oceans approach. On top of this, the extreme drought had affected at least 830,000 people along the river as well as close to 1.5 million acres of farmland. For perspective, the YREB grows around 65% of China's rice.

Coastal regions that *"are economically developed, densely populated, with high social wealth"* will be prioritised for defences against coastal flooding including storm surges. These include important cities, economic zones and critical infrastructure in coastal areas."

Source:

The above is an extract from CWR article *"First-ever 14FYP for Water Security – 8 Key Thoughts"* by Debra Tan & Chien Tat Low published in March 2022 on CWR website

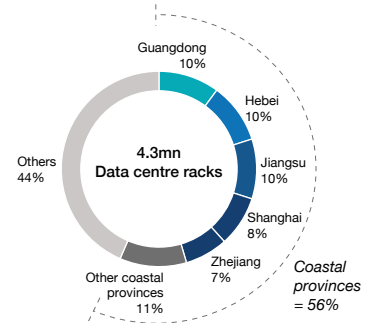
Read the full article here:  
<https://chinawaterrisk.org/resources/analysis-reviews/first-ever-14fyp-for-watersecurity-8-key-thoughts/>



### 3. Coastal threats – storm surge & SLR can impact data centres located along the coast

- 56% of China's data centre racks are located in coastal regions vulnerable to storm surge & sea level rise (SLR).** China's data centres are disproportionately located in developed and populous coastal areas plagued by flooding, typhoon and rising seas. Five coastal provinces – Guangdong, Hebei, Jiangsu, Shanghai and Zhejiang – comprise 45% of China's data centres. **Coastal megacities, where data centres are clustered, face high SLR risk.**
- Seas have already risen at a faster rate!** In the past four decades, China's sea levels have increased by an above-global-average rate of 3.4mm/year, according to the Blue Book on Climate Change in China published in 2022.<sup>26</sup> The year 2021 hit a record high of 84mm, compared to the 1993-2011 average.<sup>26</sup>
- Ground subsidence in coastal cities such as Tianjin and Shanghai amplifies SLR risks.** Cities also face subsidence which can occur naturally but is accelerated by human activities such as groundwater extraction and urbanisation with heavy/large buildings which can compress the earth. Subsidence is prevalent in many Asian cities due to poor planning and mismanagement of groundwater resources. The rate of subsidence can bring forward the impacts of SLR and as some cities are more at risk of land subsidence than others, each city will be impacted differently. For an idea of which APAC city is more at risk from various SLR factors including subsidence, please refer to the CWR report **"Avoiding Atlantis: CWR APACCT 20 Index – Benchmarking coastal threats for 20 APAC cities with finance sector input"**.
- Already the coast of Hangzhou Bay in Zhejiang province is hit by storm surges; Alibaba's headquarters is located there.** During Typhoon In-fa in the summer of 2021, the Zhejiang coast experienced a record-high storm surge of 0.94m, more significant than the predicted SLR in 2010 under the "high emission scenario" that we are likely tracking.<sup>27</sup> Besides Zhejiang, Guangdong and Jiangsu are the "most threatened" provinces by coastal flood risks in all climate scenarios.<sup>28</sup>
- Warning! Vanishing ice & rising seas are happening too fast, too soon.** According to cryosphere experts, 1.5°C of warming puts ice in the danger zone whereas 2°C is too hot for ice. As we are likely tracking warming of 3°C+, we may likely face rapid sea level rise a lot sooner rather than later – for more – see **"2°C is too hot for ice! 1.5°C is the only option...or face rapid ice melt & SLR"** on the following page.

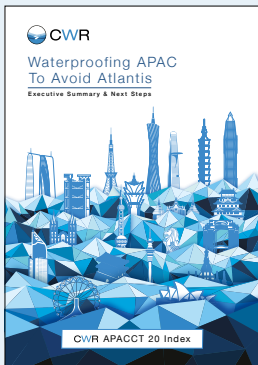
Data centres: disproportionately located in coastal areas



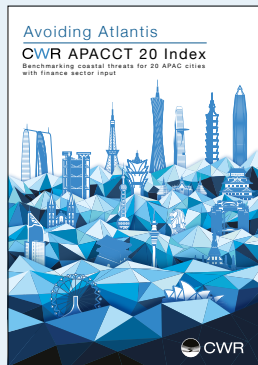
Source: CWR, Greenpeace and CEPREI Calibration & Testing Centre.

#### Recommended reading on coastal threats...

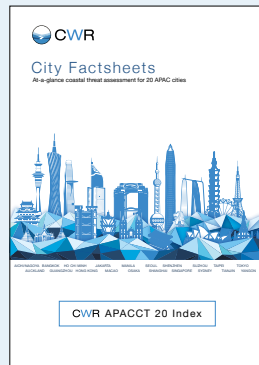
## CWR APACCT 20 Index CWR Survival Guide to Avoiding Atlantis



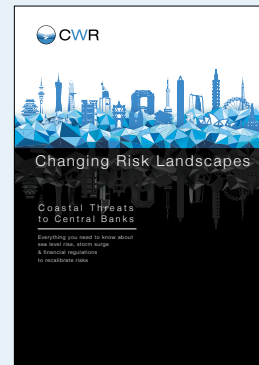
**Waterproofing APAC To Avoid Atlantis**  
Executive Summary & Next Steps



**Avoiding Atlantis: CWR APACCT 20 Index**  
Benchmarking coastal threats for 20 APAC cities with finance sector input



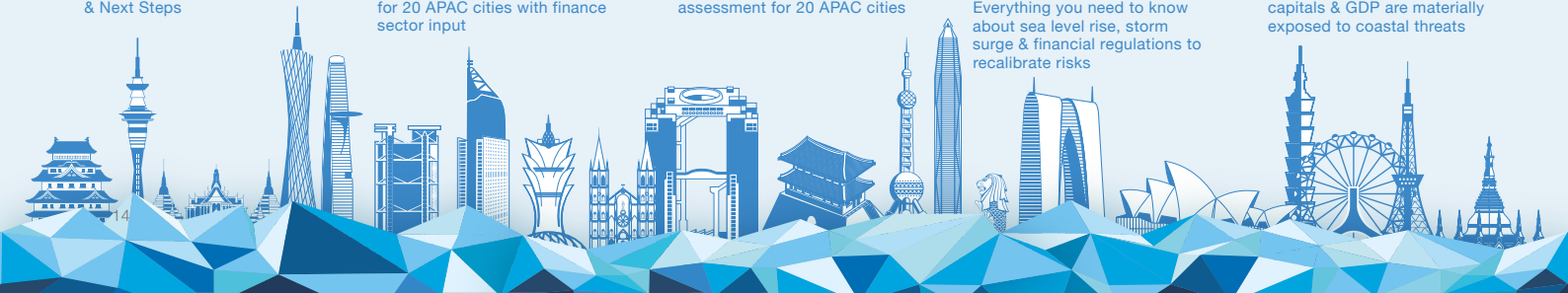
**The CWR APACCT 20 Index City Factsheets**  
At-a-glance coastal threat assessment for 20 APAC cities



**Changing Risk Landscapes: Coastal Threats to Central Banks**  
Everything you need to know about sea level rise, storm surge & financial regulations to recalibrate risks



**Sovereigns at Risk - APAC Capital Threats**  
Re-ratings warranted as city capitals & GDP are materially exposed to coastal threats



## 2°C is too hot for ice! 1.5°C is the only option...or face rapid ice melt & SLR



**Too fast, too soon! Vanishing Ice & rising seas will redraw coastlines = existential threats to coastal populations unless adapted.** Accelerated global warming means that ice in our polar regions is melting too fast and too soon. If such unprecedented ice loss continues, it will unleash devastating SLR. Not only will this be existential for small island states but cities from London, New York to Shanghai will also be significantly impacted. Rising seas can sink our futures; it is not just a threat but a threat multiplier. Faster and higher SLR can throw off other adaptation efforts against too much rain/ floods as it will impact drainage as well as raise storm surge levels. Rising seas is not a one-off event but a permanent submersion redrawing our coastlines and triggering mass migration and systemic shocks across financial systems. **We are simply not ready for the impacts as warming has significantly outpaced adaptation efforts so far – we have breached 1.5°C of warming some 70 years sooner than the Paris target year of 2100.**

*“Mega-cities on every continent will face serious impacts including Lagos, Maputo, Bangkok, Dhaka, Jakarta, Mumbai, Shanghai, Copenhagen, London, Los Angeles, New York, Buenos Aires and Santiago. The danger is especially acute for nearly 900 million people who live in coastal zones at low elevations – that’s one out of ten people on earth. Some coastlines have already seen triple the average rate of sea-level rise.”*

António Guterres, The UN Secretary-General  
UN Security Council Debate on “Sea-level Rise: Implications for International Peace and Security”, February 2023



**2°C is too hot for ice! Already at 1.5°C, ice is in the danger zone.** Previously, we thought that as long as we kept global warming below 2°C, that ice would be “safe”. But that’s not the case anymore. It turns out, that top cryosphere scientists are warning that 2°C is too hot for ice and that even reaching 1.5°C will put ice in the danger zone. **Leading global scientists and policymakers were so worried that they formed a new group at COP27 – the AMI (Ambition on Melting Ice) to sound the alarm on the scale & speed of melting ice and permafrost thaw.** Pam Pearson, the Founder & Director of the International Cryosphere Climate Initiative (ICCI) as well as the Director of the AMI Secretariat, does not mince words: *“based on what we have seen in the past 20 years, loss from both ice sheets is running well ahead of earlier projections”*. How fast it is melting is scary, Pearson said that *“many ice sheet scientists never thought they would see this level of melt in their lifetimes”*. If you want a dose of ice cold facts, read our interview with her – it is terrifying – click on the image below.



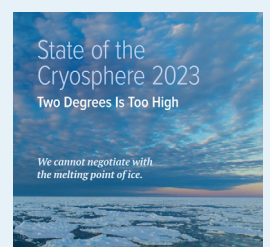
**We cannot overshoot 2°C as SLR is irreversible; at today’s temperatures, we’ve already locked in 6-9m of SLR – it’s not a matter of ‘if’ but ‘when’.** According to the report “IPCC Climate Change 2021: The Physical Science Basis”, even if we stopped emitting, *“it is virtually certain that global mean sea level will continue to rise over the 21st century”*. Indeed, the IPCC notes that many changes due to past and future greenhouse gas emissions are irreversible for centuries to millennia, especially changes in the ocean, ice sheets and global sea level. In fact, at today’s temperatures, we have already likely locked in 6-9m of SLR; even more worrying is that seas were 20m+ higher the last time the world experienced CO<sub>2</sub> levels of today. So, it’s not a matter of ‘if’ but ‘when’ this will happen – and ‘when’ depends on how fast we are warming. Here, it is worth noting that **SLR does not rise in a linear manner; abrupt jumps in SLR can occur due to abrupt ice melt. The only way to slow down the melt is to cut emissions** – this is why it is important to cut fossil fuels now not later – this decade rather than the next as *“we cannot negotiate with ice”*. As Pearson warned: *“Thinking we can turn back the clock in 2040 or 2050 or 2060 without causing extensive global loss and damage is a fantasy; and we need to face physical reality”*.



**Underestimated the rate of ice melt & projected SLR! Multi-metre SLR may be a reality by 2100; it has happened before.** Previously, we thought Antarctica will not melt and contribute to SLR within this century; we were wrong. The harsh truth is that we’ve underestimated polar climate impacts. Scientists now find that irrespective of efforts to limit emissions, the melting of the West Antarctic ice shelf over the 21st century is *“unavoidable”* due to committed rapid ocean warming (3x faster). This ice shelf is holding back the precarious Thwaites Glacier, the collapse of which could result in around 0.6m of SLR; whereas the West Antarctic Ice Sheet holds 3-4m of SLR. Over in Greenland, scientists now say that warming of 1.7-2.3°C above pre-industrial levels will trigger abrupt Greenland ice-sheet loss; the Greenland ice-sheet holds 7m of SLR. Given these current observations, when assessing risk and planning adaptation, it pays to heed the “IPCC Climate Change 2021: The Physical Science Basis”: *“Approaching 2-5m by 2100 and 2150 cannot be ruled out due to deep uncertainty in ice sheet processes”*; especially as we’ve breached 2°C of warming for four consecutive days in February 2024 – see **“Reality Check! Accelerated warming = accelerated freshwater threats”**. Multi-metre SLR has happened before - the last time, sea levels rose between 3-4m per century was ~14,500 years ago.

Source: CWR article “Too Fast, Too Soon – Vanishing Ice Rising Seas” (21 November 2023); CWR interview “2°C Too Hot For Ice Rising Seas – A Conversation with ICCI Director Pearson” (21 November 2023); IPCC Climate Change 2021: The Physical Science Basis; Copernicus.

### Recommended Reading



Futureproofing APAC Banks & Savings  
Stress test right today, avoid hard landing from rising seas

State of the Cryosphere 2023  
Two Degrees Is Too High

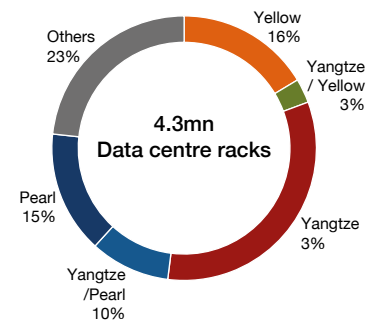
CWR

#### 4. Power generation – can be affected by water risks disrupting electricity supply to data centres

- Extreme weather events exacerbated by climate change have also increased the risks of power cuts or rationing, a significant operational risk for data centres.** During the unprecedented extreme rainfall events in the summer of 2021, several data centres, cloud computing, and communications services in the Chinese province of Henan were interrupted for hours or intermittently for days due to severe disruption in local power infrastructure.<sup>29</sup> The backup power – usually diesel-powered generators – only mitigated operational risks to a limited degree, as some facilities were flooded or inadequately prepared for such extreme events.
- Hydropower-reliant provinces such as Guangdong, Chongqing & Sichuan hold 16% of China's data centre racks.** The 2022 summer drought in the Yangtze River Basin highlighted power generation's exposure to a liquidity crunch. Sichuan was the most affected as around 80% of the province's annual power needs are met by hydropower. Prolonged heatwaves and drought led to what the State Grid called a "dual shortage": 1) Failing to meet peak demand: temperatures between 4-6°C above normal led to high use of air-conditioning resulting in the province setting new records six times in August; and 2) Failing to generate power: poor rainfall and drought conditions curtailed hydropower production as the Yangtze River faced the lowest summer rainfall in six decades.<sup>30</sup> The Lantau Group estimates that Sichuan's hydropower fleet was operating at an average capacity factor of roughly 20%, around half that of 2021 but a quarter of that in 2020.<sup>31</sup>
- Data centres are also indirectly affected by the water risks embedded in China's thirsty coal power fleets.** As per our report "China ICT Transition", renewables only contributed to 23% of China's data centre electricity consumption in 2018;<sup>10</sup> the majority are still powered by coal. In response to the "energy crunch" in the past two summers, coal power stations were mobilised to secure electricity supply, driving daily coal use to new record highs. This does not bode well for water resources in the future as cooling down the coal power plants running at "full capacity" requires water. More on the interlinkages between coal-fired power and water please refer to CWR & IRENA joint brief "Water Use in China's Power Sector: Impact of Renewables & Cooling Technologies to 2030".
- Over three-quarters of China's data centre racks lie in 3 river basins: The Yellow, Yangtze & Pearl** – see chart on the right. The Yellow & Yangtze rivers are key to powering China's economy as well as providing water for food security, industrial growth and municipal use. Together, they house almost half of China's power capacity – the Yangtze has 27% of national installed capacity, the Yellow has 21%.<sup>30</sup> The Yangtze also carries a significant share of hydropower with just under two-thirds of national hydropower capacity as well as a fifth of the nation's coal fleet; the Yellow has just over a quarter of China's coal capacity.<sup>30</sup>

Because of this, it is important to understand the water risks as well as the water-related power generation risks of each of these river basins – see recommended readings below.

China's data centre racks & key rivers



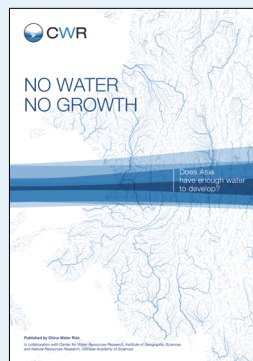
Source: CWR, Greenpeace and CEPREI Calibration & Testing Centre.

#### Recommended reading on the water-energy-climate nexus ...



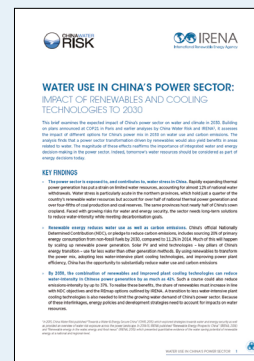
**No River, No Power**  
Can Asia's rivers power growth in a changing climate?

- A third of global power generation capacity (1.9TW) across 16 countries in Asia analysed
- Rivers running dry can strand sizeable portions of national power generation assets
- Sizeable trifecta exposure to water risks across Asia's 10 key rivers identified



**No Water No Growth**  
Does Asia have enough water to develop?

- Cited by IPCC AR6 WG2: "Climate Change 2022: Impacts, Adaptation & Vulnerability"
- Led to a wateromics chapter in a 2021 Nature Springer book: "Water Security Under Climate Change" launched by Scotland's Minister of Net Zero ahead of COP26 in Glasgow



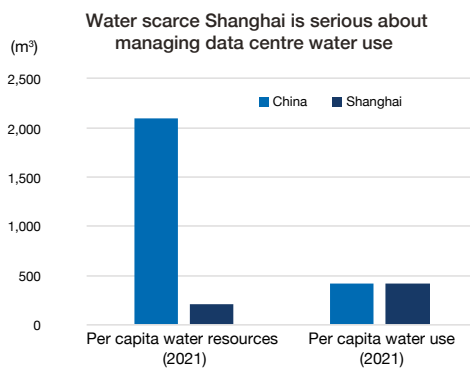
**Water Use in China's Power Sector**  
Impact of Renewables & Cooling Technologies to 2030

- Joint publication with IRENA
- Findings were presented by IRENA in the Clean Energy Ministerial (CEM) 7 Preparatory Meeting in Beijing in March 2016 as well as the 12th Council of the International Renewable Agency

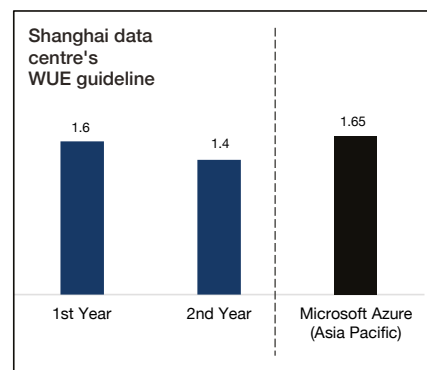


## 5. Regulatory risks – government may introduce ICT sector regulations to protect water resources

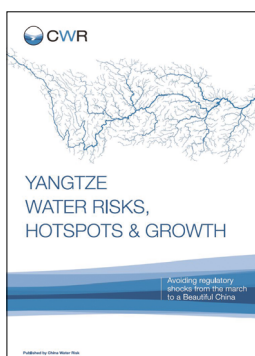
- Future summer heat & droughts could result in more frequent and stringent power restrictions for power-intensive data centres.** During the summer of 2022, unprecedented extreme heat and drought led to soaring demand for cooling. Plus underperforming hydropower output led to widespread power rationing in developed coastal provinces like Shanghai and Zhejiang and hydropower-rich inland provinces like Sichuan and Hubei. The so-called “dual high” industries, such as the production of electrolytic aluminium, were among the first to limit or even cease production to guarantee sufficient power supply for “people’s livelihoods” (residential, agricultural and other essential services). As power-intensive data centres **are now classified as a “dual high sector”** alongside other “dual high” industries such as cement and steel, **the ICT sector may also face increasing regulations on energy and water consumption. Similar power rationing measures may well be posed to data centres in the future.**
- China has yet to issue national standards for Water Usage Effectiveness (WUE), but local governments are moving to close the regulatory gap.** In 2021, the Shanghai government put forward a voluntary guideline, recommending new data centres to keep WUE within 1.6 in the first year and reduce it to no higher than 1.4 in the second year.<sup>32</sup> It is worth noting that this recommendation is slightly stricter than the averaged WUE of Microsoft’s Azure cloud service in Asia Pacific in 2021 (1.65).<sup>33</sup> Also noteworthy is Beijing municipal government’s proposal to introduce water quota management for data centres alongside issuing relevant standard systems and technical specifications to regulate water use.<sup>34</sup>



Source: CWR, NBSC, Shanghai Municipal Bureau of Economy and Information Technology.



- Water intensive nature = “unsuitable for use in water scarce areas”, despite water savings.** Even if some water cooling technologies are labelled “green” by China’s Ministry of Industry and Information Technology (MIIT) and Ministry of Ecology & Environment (MEE), **MIIT notes that some cooling technologies, despite a significant 50% water-saving performance, are “unsuitable for use in water-scarce areas”**.<sup>35</sup> So not all of China’s provinces can afford water cooling – location is key when it comes to water risks. Regulations regarding water usage may also be imposed in the Dry 10 regions; plus ‘High’ and ‘Extremely High’ water stressed areas could also face higher regulatory risk in the future.
- Exposure to basin regulatory risks for the Yangtze & Yellow.** As the “Mother Rivers” of China, these rivers as well as provinces along these two rivers face stricter water standards/ targets. For example while the national target for Grade I-III surface water is 70%, the Yangtze’s was to reach 85% by 2020 and the Yellow’s was to be greater than 81.9% by 2025. Here, it’s worth noting that both the Yangtze & Yellow reached these levels before the target date.<sup>36,37,38</sup> As water is essential for development, China’s development plans also take into account the management of these rivers from the source-to-sea. The Yangtze River Economic Belt Development Plan was issued in 2016 while the Yellow River Basin Development Plan was issued in 2021.<sup>39,40</sup>



For an idea of how river related regulations may impact sectors, please see our report:

[Yangtze Water Risks, Hotspots & Growth](#)  
Avoiding regulatory shocks from the march to a Beautiful China



## 5 to-do's – take action to rein in ICT water risks...

1. **Water threats ahead! Corporates, institutional investors and lenders should assess exposure to water risks.** This is easier said than done as water is a locational risk and reading this report is likely the first time stakeholders are made aware of the extent of the ICT sector's water risk exposure. It is thus imperative that corporates, institutional investors and lenders start piecing together their water risk exposure so that they can come up with strategies to reduce water threats ahead. The time is now as the convergence of the following trends below makes water blindspots even more worrying:



**Disclosure on water use by location is limited or non-existent = take action to get more data to assess risks.** Water, the element most impacted by climate change, appears to be marginalised at the same time that the momentum of global climate action continues to push for corporate carbon disclosure. While it is already challenging to locate reliable information on energy and emissions in the ESG reports of Chinese ICT companies, it is even more difficult to find data on water, let alone biodiversity and nature.

Water disclosure is either limited or non-existent – for example, Alibaba provides some descriptive information on the deployment of water recovery and reuse technologies in their data centres in their ESG reports, but they omit to provide corporate-wide or data centres' water consumption or the WUE of its data centres.



**DO:** ICT companies should start analyzing their water risk by facility and investors/ lenders should start engaging the companies on stress testing against various types of water risks.



**Divergent trends – demand for water is rising yet water supply may fall due to climate change = water resilience strategies are needed.** Notably, in the ICT sector, according to their limited disclosure, Baidu and Xiaomi increased their water consumption in 2021 by 23% and 53%, respectively. Tencent saw water consumption and water intensity (water consumption per unit of revenue) levels increase by an impressive 31% and 32% respectively in 2022. China Mobile, on the other hand, saw a 17% drop in water consumption and a 25% decline in water intensity. However, due to a lack of disclosure, we are unable to identify the specific reasons behind the changes in water consumption and water intensity.

Yet despite rising water use, water supply may fall due to the mismanagement of the increased volatility from extreme weather events as well as a rise in chronic risks such as water scarcity and sea level rise. While some leading ICT companies have started to map their transition plans, many have yet to formulate comprehensive water risk mitigation and stewardship strategies. Even those that are aware are likely to be caught off-guard by the fast-evolving water risk landscape due accelerated warming as previous steps to ensure climate resilience may now not be good enough.



**DO:** ICT companies should start formulating strategies to build resilience to waterproof their assets/ portfolios post stress testing for various types of water risks. Investors/ lenders should start engaging the companies on the climate readiness of key assets.



**The rise of AI chatbots will put more pressure on power as well as water supply = transition & waterproofing strategies must be cohesive.** Our lifestyles are only becoming more digital and there is no doubt that AI chatbots will become a firm part of our lives. However, they are extremely thirsty plus need massive amounts of power to train and run. If explosive ICT emission growth from AI expansion is not reined in with significant renewables or clean power expansion, the ICT sector will end up shooting itself in the foot as climate change will threaten the water supply it desperately needs.



**DO:** ICT companies should be realistic about the current climate trajectory and align waterproofing strategies to the current climate path and not what they are aiming for in their transition strategies because even if the company is 1.5°C aligned, the rest of the world is not.

**2. It's possible! Cooling tech can bring water & power savings + adaptation finance opportunities.** Water is the most efficient means of cooling and can play an important role in reducing emissions. According to Google, water-cooled data centres use about 10% less energy and thus emit roughly 10% less carbon emissions than many air-cooled data centres – this helped Google cut emissions by roughly 300,000 tons of CO<sub>2</sub> in 2021.<sup>2</sup> However, where water resources are scarce/stressed, using water to lower energy usage can magnify water risks.

**✓ DO:** We therefore recommend switching from water-cooling to other less water-intensive technologies in water stressed locations. However, do be careful as using less water can sometimes lead to worse Power Usage Effectiveness (PUE). So do select cooling technologies wisely – as shown in the table below, China's MEE has identified a few cooling technologies that could be good for water, energy, and climate. It is worth clarifying that introducing high-efficient cooling technologies to data centres is not just for the sake of improving PUE, reducing energy consumption or bringing down emissions; there can also be a direct impact on the water!

As shown in our report “China ICT Transition”, there is much room for improvement in PUE standards. Also, the transition to best-in-class PUE is possible as leading ICT companies such as Alibaba, Baidu & Tencent are already running world class data centre units comparable to best-in-class units run by their Silicon Valley counterparts of Alphabet & Meta.

**MEE-endorsed cooling technologies for data centres**

Technology	Energy efficiency improvement	Payback period (year)	Marginal abatement cost (US\$ per tCO <sub>2</sub> )	Market prospective ( 2022-2027)		
				Market share (%)	Avoided emissions (tCO <sub>2</sub> /y)	Total investment (US\$ mn)
Spray liquid cooling	PUE ≤1.1	2	48-51	3%	900,000	975
Vertical cooling	5-15% reduction in PUE	2-3	13.5-34.5	5%	550,000	225

Source: CWR, MEE.

**3. Go water positive! ICT leaders like Meta & Google are taking the lead.** In recent years, several global companies including some from the ICT sector like Meta and Google have announced goals to become water neutral or water positive. This means that companies will at least offset (also called “replenish” or “compensate”) their water footprint that cannot be avoided and in the case of being water positive, replenish more than the footprint; ideally after reducing water use as much as possible. The water is replenished through water restoration projects.

The majority of companies setting such targets are in heavily water reliant sectors, so in addition to the ICT sector, other sectors are food & beverage and agriculture. These companies are setting water targets for a variety of reasons and benefits, a key one of which is business continuity. Water can make or break reputations and impact operations as Meta knows first-hand, having experienced people protesting outside their data centres over water concerns. Below is a high level overview of Meta's vs Google's water positive targets:

**Overview of Meta & Google's 2030 water targets**

**Meta**

Water Positive by 2030

*“will return more water to the environment than we consumed for our global operations”*

Direct water use (offices & data centres)  
Target set in 2021  
Reports progress in Sustainability Report

**Google**

Water Positive by 2030

*“will replenish 120% of the water we consume, on average, across our offices and data centers and help restore and improve the quality of water and health of ecosystems in the communities where we operate”*

Direct water use (offices & data centres)  
Target set in 3Q 2021  
Reports progress in Sustainability Report

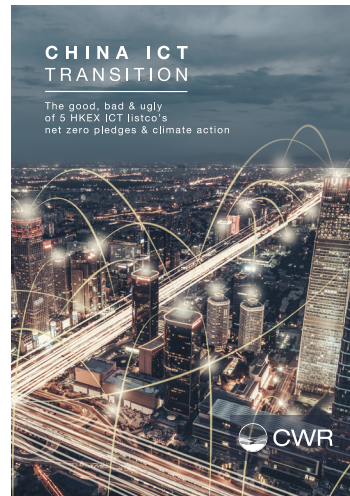
Source: CWR, company disclosure, discussions with Meta & Google

**✓ DO:** Start formulating a water stewardship strategy. Given the high reliance on water, do aim high – either go water neutral or like Meta & Google, go water positive! This trend is not going away, if anything, water will only become more topical as warming accelerates which brings us to the next point.

4. **Fast track transition to “slow down” climate change & rising water risks.** Water is now fast becoming a rising threat with climate change. Many impacts especially those relating to the cryosphere have already been locked-in. For example, at today’s temperatures sea level rise is inevitable and we have likely already locked in 6-9m of SLR – the only question is therefore not if but when this will occur.

To slow down rising water risks, we have to fast track emissions. The ICT sector can not only facilitate efficiency gains through AI but it can also significantly fast track its own transition – as our report showed, decarbonizing 5 ICT listco’s can net zero HK’s emissions 2.5x.

For more on why it’s time to take action, please read **“China ICT Transition – the good, bad & ugly of 5 HKEX ICT listco’s net zero pledges & climate action”**.



5. **Don’t forget the data centre supply chain! Also map downstream water risks.** We have only been talking about the water needs for the operations of data centres, but water is also an essential ingredient in the manufacture of electronics and the equipment necessary to run data centres. The manufacture of these may be both highly water polluting as well as water intensive.

✓ **DO:** Map out the exposure to water risks in the data supply chain. Start by reading up on the water risks in our reports on rare earths, critical raw minerals and semiconductors – all of which are critical data centre components and require water to mine and process. Click on the images below to start reading.



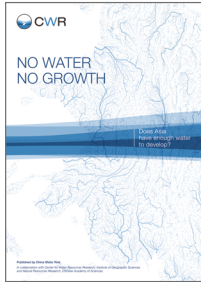
**Too complicated? Call us to help futureproof your assets!** Climate science and the water risk landscape are fast-evolving. If you don’t have time to read up on the latest, contact us and we will provide an update. We have helped listcos, MNCs, institutional investors and banks unpack the complex web of water risks; write commissioned reports; conduct stress tests; prioritise action as well as assist in developing water risk mitigation strategies and curating water stewardship/neutrality programmes.



**DO** contact us at [info@chinawaterrisk.org](mailto:info@chinawaterrisk.org) – together we can help you adapt and thrive.

# CWR

Over a decade of unpacking & valuing interlinked water-nomic risks in the water-energ-climate nexus ...



**No Water No Growth – Does Asia have enough water to develop?**  
*CWR with CAS-IGSNRR, 2018*

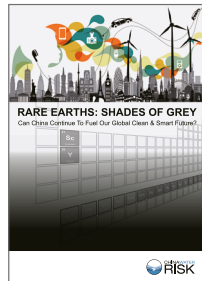
Notably:

- Cited by IPCC AR6 WG2: “Climate Change 2022: Impacts, Adaptation & Vulnerability”
- Led to a wateromics chapter in a 2021 Nature Springer book: “Water Security Under Climate Change” launched by Scotland’s Minister of Net Zero ahead of COP26 in Glasgow

**Rare Earths: Shades Of Grey Can China continue to fuel our clean and smart future?**  
*CWR, 2016 (EN/中文)*

Institutional investor highlighted CWR’s report in the 2016 PRI in persons meeting

The PRI tabled rare earths as an emerging risk along with cybersecurity and antibiotics

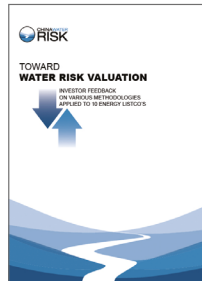


**Toward Water Risk Valuation: Investor Feedback on Various Methodologies Applied to 10 Energy ListCo’s**  
*CWR, 2016 (EN/中文)*

Methodologies included in:

- 1<sup>st</sup> ever book on “Environmental Risk Analysis by Financial Institutions” by Dr Ma Jun (Chinese only)
- Palgrave MacMillan 2021 Textbook: “Water Risk and Its Impact on the Financial Markets and Society”

The report is “Recommended Reading” in the 2021 CDSB (now IFRS) Framework: “Application guidance for water-related disclosures”

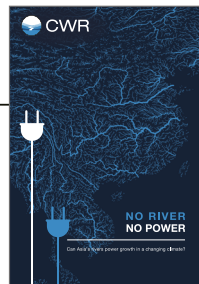


**Water for Coal – Thirsty miners will feel the pain**  
*CWR for CLSA U, 2013*

Unpacking water risks in the power sector in sell side research (institutional investors only)

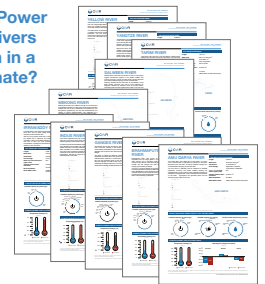


**No water, no power Does China have enough power to fuel expansion?**  
*CWR for HSBC, 2012*

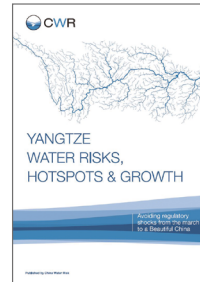


**No River, No Power - Can Asia’s rivers power growth in a changing climate?**  
*CWR, 2023*

Includes at-a-glance stats in 10 River Briefs



**Yangtze Water Risks, Hotspots & Growth – Avoiding regulatory shocks from the march to a Beautiful China**  
*CWR, 2019*



**长江经济带水资源环境指标评估及对策**  
*Journal of Beijing Normal University (Natural Science), 2019 (Chinese only)*



**Water-nomics of the Yangtze River Economic Belt**  
*CWR with MEP-FECO, 2016 (EN/中文)*

Findings were:

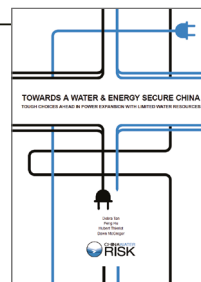
- Distributed internally as “red-heading” communication to central & provincial government bodies & environmental authorities of China
- Published in national academic journal “Environmental Protection” (Issue 15, 2016), one of the most influential environmental journals in China



**Water Use in China’s Power Sector: Impact of Renewables & Cooling Technologies to 2030**  
*CWR & IRENA, 2016 (EN/中文)*

Findings were presented by IRENA in:

- Clean Energy Ministerial (CEM) 7 Preparatory Meeting in Beijing in March 2016
- The 12<sup>th</sup> Council of the International Renewable Agency



**Towards A Water & Energy Secure China – Tough choices ahead in power expansion with limited water**  
*CWR, 2015*

Unpacking water risks for different power types – coal, hydro, nuclear & renewables (open source)



**Water Risk Analysis & Recommendations for Water Resource Management in Ningxia WRI with CWR, 2015 (EN/中文)**

Provincial case study on water use permit trading between the power sector & agriculture

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## About

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# WATER MATTERS

## DECISIONS TODAY FOR WATER TOMORROW

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