

**The Arcadis Data Center
Location Index 2021
Greater China Cities' Spotlight**

Introduction

Asia-Pacific is very well represented in the Data Center Location Index. 13 Asian markets made the list and nine of them are in the top half, with strong performances by Singapore, Japan, Taiwan, and Hong Kong. Asia-Pacific is amongst the fastest growing regions of the global economy but there are large differences between markets in terms of GDP per capita and energy security. Historically a destination for major IT outsourcing projects, Asia has increasingly become a leader across many cutting-edge industries. A significant share of the largest technology companies is now based in China, not surprising given the size of the market and its highly skilled workforce. In addition to domestic providers, Asia-Pacific is undergoing significant data center growth driven by large-scale international cloud providers, as they expand aggressively across the major hubs in the region.

Keep an eye on Hong Kong

Hong Kong ranked as twelve in the Index, the demand for data center services from users of cloud computing, e-commerce and high-frequency trading has never been greater.

The Hong Kong government has a favourable policy supporting the data center industry. This includes a dedicated unit focused on data center development, a favourable land supply policy to facilitate new data center development, and favourable policies to support the redevelopment of existing industrial buildings as data centers.

Moreover, the telecom infrastructure in Hong Kong is among the best in Asia. There are 11 submarine optical fibre cable systems, 20 overland optical fibre cable systems and 11 satellite systems. Broadband quality and download speed are among the highest in Asia.

There is continuous access to and availability of electricity and water. Most new build data centers in Hong Kong are Tier 4 ready. The difficulty to build Tier 4 data center is available of land within the site to storage fuel for continuous power supply. If Arcadis can help to balance the Tier 4 requirements to take into account of Hong Kong high reliability of power supply (over 99%) that will help new build data center to achieve Tier 4 and modify existing data centers to the classification.

Data center opportunities have become an area of focus for developers and investors in Hong Kong over the past two years, the provision of suitable land for data center development will be important if Hong Kong wants to establish itself as a data center hub in Asia





Unlock China's potential

China's population and economic growth over the last decades make it become the world's largest internal market for data technology and services. It is in the midst of a digital transformation on a massive scale. China is a pioneer in the adoption of smart city initiatives, which has increased use of cloud-based services in the country. The hi-tech sector is experiencing phenomenal growth. More than 70% of the population is using e-commerce for commercial and non-commercial activities. All of this is driving high demand for data centers. Ultimately, China remains a challenging market, especially for foreign investors, due to the difficulties in obtaining construction permits and the country's relatively low score on energy security.

The Chinese government has clarified the important position of data centers in this year's new infrastructure strategy and will increase investment. According to data from the Ministry of Industry and Information Technology, in 2020, China's big data-related product and service business revenue will exceed 1 trillion yuan, with an average annual compound growth rate of about 30% in the past five years. In addition to the three major data center operators of China Telecom, China Unicom and China Mobile, leading Internet companies are also accelerating the deployment of data centers. Alibaba Cloud announced that another 200 billion yuan will be invested in core technology research and development and data center construction in the next three years. Baidu Announcing that more than 5 million smart cloud servers will be built in the next ten years, Tencent will invest 500 billion yuan in new infrastructure in the next five years, focusing on data centers. In the future, these data centers will further lead the market in China and even the world in terms of scale, AI intelligence, new energy applications, and net zero carbon emissions.

At present, Beijing, Shanghai and Guangzhou are still the most concentrated places for data centers. Shenzhen, Harbin, Hohhot, Tianjin, Qingdao, Zhengzhou, Hangzhou, Xiamen, Guiyang, Chongqing and other cities are also the key layouts of data centers due to their geographical advantages, favorable government policies and investment areas. But for foreign investors, China is still a challenging market because it is very difficult to obtain construction permits, and energy security needs to be improved.

During the construction of the data center in China, it is first necessary to focus on the energy consumption assessment of the project and the establishment of the National Development and Reform Commission, because the data center is a high-energy project; Secondly, the most built A-level computer room in China corresponds to the international Uptime Tier 3+. We also need to be focused the redundancy and high reliability of power supply, cooling and water supply; Thirdly, the data center needs to be debugged and tested by a third party after the process equipment is completed to ensure the environmental temperature and humidity requirements of the server and the power supply area. There is a preliminary assessment than PUE to comprehensive energy efficiency.

From selecting a location, to planning and permitting, construction and ultimately over the life of the new asset. Arcadis due diligence experts, engineers and project and cost managers help our clients avoid unexpected costs and delays, ensuring the project successful delivery.



Looking Forward

Data centers are a core integral requirement for the facilitation of 5G network capabilities, cloud computing, big data analytics and artificial intelligence.

Worldwide public cloud forecasts revenue grows 17% to US\$266.4 billion in 2020 and 56% to US\$354.6 billion by 2022. In Hong Kong, the data center market was worth US\$883 million in 2018 and is projected to grow at a five-year compound annual growth rate of 14% to reach US\$1.7 billion by 2023.

Data has to move for data to make money. Data flow is critical for the IT industry. Asia has traditionally been at the forefront of data center activity. That's likely to continue, but in a different shape and form. The flow will not stop, but the direction of flow might be different. Arcadis are ready to help.



CASE STUDIES



Key highlights

- High proportion in MEP cost (40% to 70% to project cost)
- Quantity and capacity of computer racks to be built in Day 1
- High headroom, long span and high loading density structure
- Long Testing and Commissioning programme

The largest data center provider

Cost and Commercial Management | Hong Kong

About project

- This project comprises construction of two towers.
- 2 Towers each consists of 10-storey and 1 storey of semi-basement carpark.
- Two towers comprise data floors and plant rooms floor, entrance lobby and NOC.

Our solution

- Define clearly the infrastructure and the interfacing of the E&M works
- Alternative water tanks arrangement to save basement space and facilitate the construction programme
- Construction of internal dry wall compartmentation to allow flexibility for alteration for future and upgrading works
- Balance the budget cost of external façade against aesthetic appearance

CASE STUDIES



Key highlights

- Baidu Yangquan Data Center is the largest single data center in Asia. At present, 120,000 square meters have been built and put into production. There are more than 150,000 online servers, more than 3 million CPU cores, and the amount of information that can be stored is equivalent to the total collection of more than 300,000 National Libraries of China.
- Using Baidu's fourth-generation data center infrastructure module architecture. Based on the AI control system developed by Baidu Paddle Paddle, the energy consumption of infrastructure is reduced 70%, and the annual power saving is expected to exceed 100 million KWH, equivalent to the annual power consumption of 50,000 households.

IDC Baidu Yangquan

Cost Consultant | Yangquan Shanxi

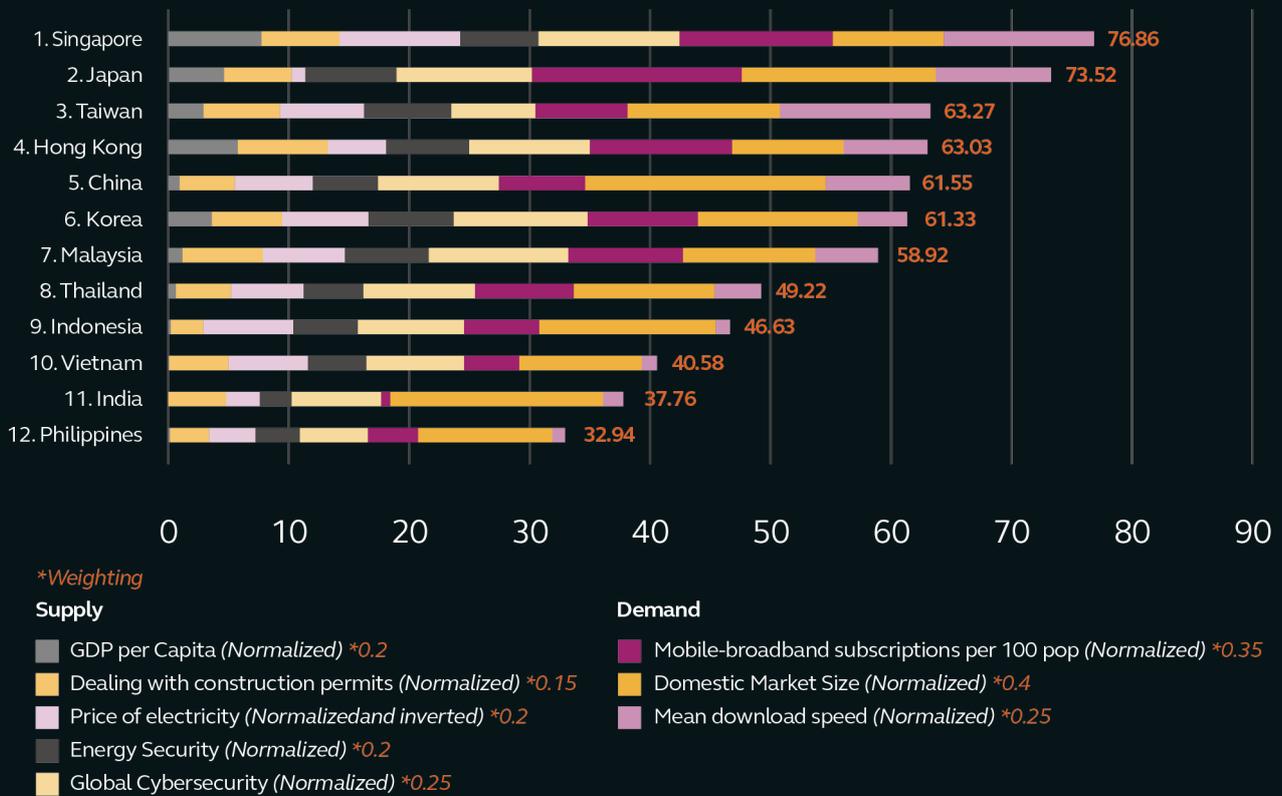
About project

- Baidu (Yangquan) Cloud Computing Data Center is located in Yangquan Economic and Technological Development Zone, Shanxi Province. The project provides strong computing power for Baidu intelligence cloud, Baidu App, Baidu map, smart city, Duer, Apollo and other internal and external Baidu products and suppliers. Arcadis provides services for 4 data room buildings and one warehouse, covering a total construction area of approx. 86000 sq meters.

Project Features

1. The mode of mains power +UPS(ECO)+ high voltage diesel power supply has greatly improved the power supply efficiency and ensured the maximum utilization of resources;
2. Indirect evaporative cooling system (IDCE) and “zero power consumption” air conditioning terminal OCU make full use of natural cold sources and optimize three operation modes of mechanical refrigeration, precooling and natural cooling depending on high-temperature server technology and new air distribution, so that the annual free cooling duration is extended to more than 98%;
3. AI helps to realize intelligent operation and maintenance, and know its own operation conditions timely, quickly and comprehensively. By establishing a deep learning model of data center, AI monitors the operation data in real time, continuously optimizes the system and gives maintenance strategies, bringing intelligent power supply and cooling, and ensuring the data center runs in a green and energy-saving manner with low energy consumption and high performance;

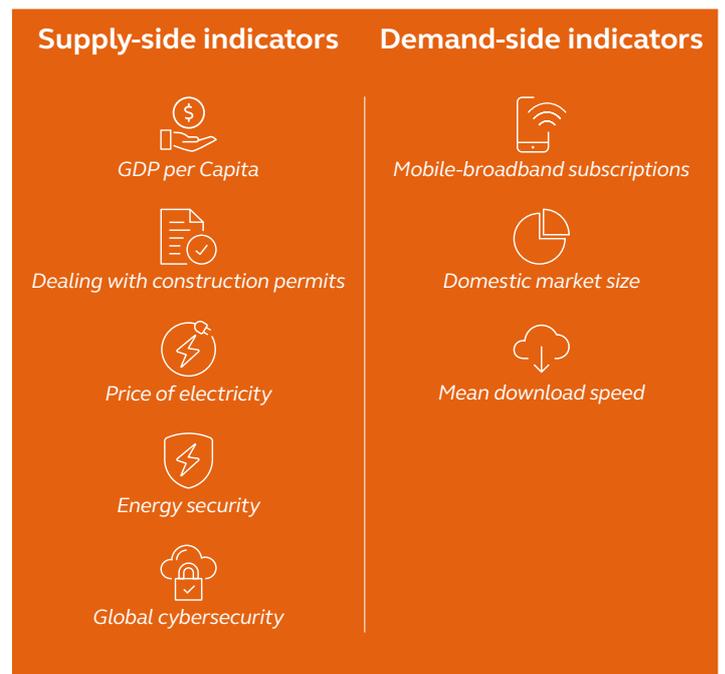
Asia Data Center Location Index 2021



(For the Index full version, please refer to the Global Report - The Arcadis Data Center Location Index 2021)

At Arcadis, we leverage our global capabilities and deep knowledge of local markets to help our clients optimize location decisions against operating costs, resilience, environmental impact, government incentives or any of the wide range of issues that a client might choose. We support data center operators with the extensive stakeholder engagement efforts associated with gaining the community buy-in that is often needed to build a large structure of any type, especially ones that use so much energy.

The Arcadis Data Center Location Index provides an indicative ranking of suitability for data center investment, based on the aggregation of eight data sets for 50 markets across the Americas, Asia Pacific, Europe, and the Middle East. These markets are ranked based on their performance across five supply-side and three demand-side criteria.



Factors Influencing City Rankings

Finding the best location for a new data center is a critical part of how companies can maximize the performance of their investment in a new facility.

There are multiple factors to analyze when deciding where to place a new data center. Companies should consider both the supply and demand-side forces at play in the relevant markets. At a high level, this means that in each market under consideration, the company must develop a comprehensive understanding of the support in place for building and operating data centers, as well as the demand for services underpinned by data. This is no simple task.

We developed the Arcadis Data Center Location Index for companies that are considering where in the world they should build their next data center. The Index can serve to validate or call into question initial discussions about the optimal location for a new facility. We examined 50 national markets, a mix of established and emerging economies, and ranked them based on their performance across eight key criteria, that include both supply and demand-side factors.



The Arcadis Data Center Construction Roadmap

At a macro level, data center operators travel through five steps on the road, from deciding to build a new data center to reaping the benefits of that investment. At each step, Arcadis offers services and solutions for clients that maximize the performance of their investment. We partner with clients throughout the entire journey and help them avoid the pitfalls of hidden costs, delays in acquiring permits or construction, and by designing and delivering sustainability and resilience features that will protect their investment over the longer-term.



STEP 1

Location

The first step is deciding where to place the proposed new data center. This is where companies need to understand countries' markets as well as regional differences within countries in terms of the availability and reliability of electricity, the status and availability of fiber optic networks, the regulatory and permitting regime, and many other factors. Ultimately, this includes the consideration of individual sites, where the data center can be constructed.

Savvy due diligence conducted at this stage is essential in terms of making informed decisions that can maximize return on investment across the entire journey.



STEP 2

Planning

Once a data center operator has decided where to place the new facility, they enter the planning phase. At this point they must decide how, and on what time schedule, they will design the new facility, secure all of the necessary permits and permissions, engage with a multitude of suppliers and service providers, have the facility built and outfitted and begin operating the data center. During this stage, companies will have to decide on the basic parameters of the new data center: roughly how large it should be, based on the desired use and other business objectives. It is important to note that this stage is also critical in terms of designing the long-term sustainability and resilience of the new data center. This is where companies can make decisions that can reduce the embodied carbon of the new building and outfit the asset with sustainability features that can greatly reduce the amount of embedded carbon as well as energy that will be used over the life of the facility.

It is critically important data center operators maintain highly competent due diligence efforts throughout this phase to help avoid unforeseen costs or delays in the ensuing steps. This is also the stage at which project, cost management and long-lead item procurement efforts work together in unison.



STEP 3

Permitting

Every jurisdiction in the world has its own unique regulatory regime, which dictates myriad aspects of the design, construction, and operation of any type of building, including data centers. During the permitting phase, data center operators settle on the detailed design of the proposed facility. Based on that design, companies then have to secure all of the necessary permits and other permissions needed to actually build the data center and switch it on.

Sustainable and resilient design of the building(s) can significantly enhance the value of the asset(s) and greatly reduce negative impacts on the environment and the communities near a site. Good design, project management and cost management expertise can help companies better navigate their way through this phase.



STEP 4

Construction and delivery

The construction and delivery of the new facilities is undoubtedly the most critical step of this process. Deficiencies in due diligence or the earlier stages of project and cost management, all too often, become evident during the build. Add to that the fact that construction cost overruns and delays in delivery are not just frequent, in some places, they are the norm. Whether it's 1 or 2% more expensive than planned or 10 to 20%, every unexpected cost or delay in this stage decreases return on investment in the facility. In other words, the difference between a successful project to build a new data center and a really successful one, is how well the operator can pull off the build and get things up and running as quickly and smoothly as possible, through clarity, strong management, and cooperation throughout the supply chain.

This is where data center operators can reap the full benefits of skillful project and cost management services.



STEP 5

Operations

After the facilities have been built, the networking and storage equipment is installed, it's connected to the fiber optic network, and the new data center is brought online. Operators will need to ensure energy supply and maintain back-up generators as a last resort. They will also run and service the cooling systems and arrange for the upkeep and maintenance of the building.

Sustainability and resilience features (designed into the plan earlier on and delivered during the build phase) can generate tremendous savings over the long-term. They allow data center operators to reduce or supplement energy consumption from the grid or harden the building against shocks like storms and flooding.

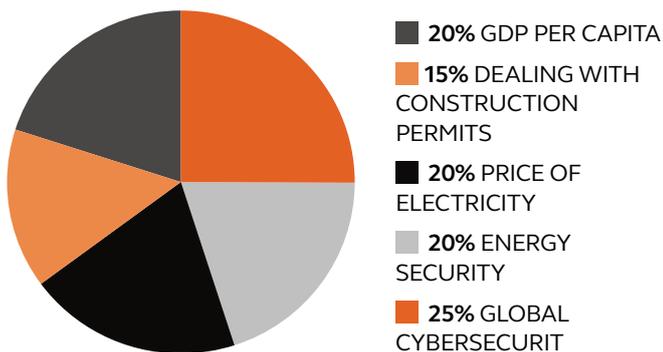
Smart analytics solutions can help operators optimize their maintenance schedules to prevent breakdowns and diminished asset performance from delays in discovering faulty equipment or infrastructure.

Methodology

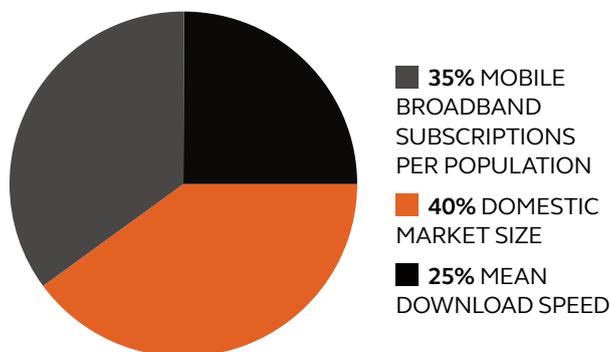
The index ranks 50 of the world's key established and emerging markets based on their performance across eight criteria: GDP per capita, dealing with construction permits, price of electricity, energy security, cybersecurity, domestic market size, the number of mobile broadband subscriptions and mean download speed. The final index value is a sum of weighted scores which have been collated from publicly available sources. Scores for each of the eight metrics are normalized on a scale of 0 to 100 using World Bank methodology. This ensures that the very large differences in scale and performance highlighted by our data are reflected in the overall assessment. All markets are ranked on a scale of 0 to 100 in a way that ensures that distance between two markets in the underlying data is scaled proportionally and remains consistent across all 50 markets.

Using the above-mentioned criteria, we have created one ranking for the supply criteria and one for the demand criteria and then combined those with equal weighting (50/50).

Within the supply side, we have used the following weighting:



Within the demand side, we have used the following weighting:



Criteria description and source of data

GDP per capita

Indicator used to analyze the prosperity of a country and its economic growth. It is a useful unit to make cross-country comparisons of average living standards and economic wellbeing.

Source: World Bank

Ease of obtaining construction permits

The procedures, time, and costs to build, including obtaining necessary licenses and permits, completing required notifications and inspections, and obtaining utility connections.

Source: World Bank

Price of electricity

The average price of electricity for warehouse use in each country is measured in US cents per kilowatt-hour.

Source: World Bank

Energy security

The energy trilemma score scores countries on their ability to provide sustainable energy through three dimensions: energy security, energy equity (accessibility and affordability), environmental sustainability.

Source: World Energy Council

Cybersecurity

Measures the commitment of countries to cybersecurity at a global level.

Source: The International Telecommunication Union

Domestic market size

Sum of gross domestic product plus value of imports of goods and services, minus value of exports of goods and services.

Source: The World Economic Forum Global Competitive Index

Mobile-broadband subscriptions

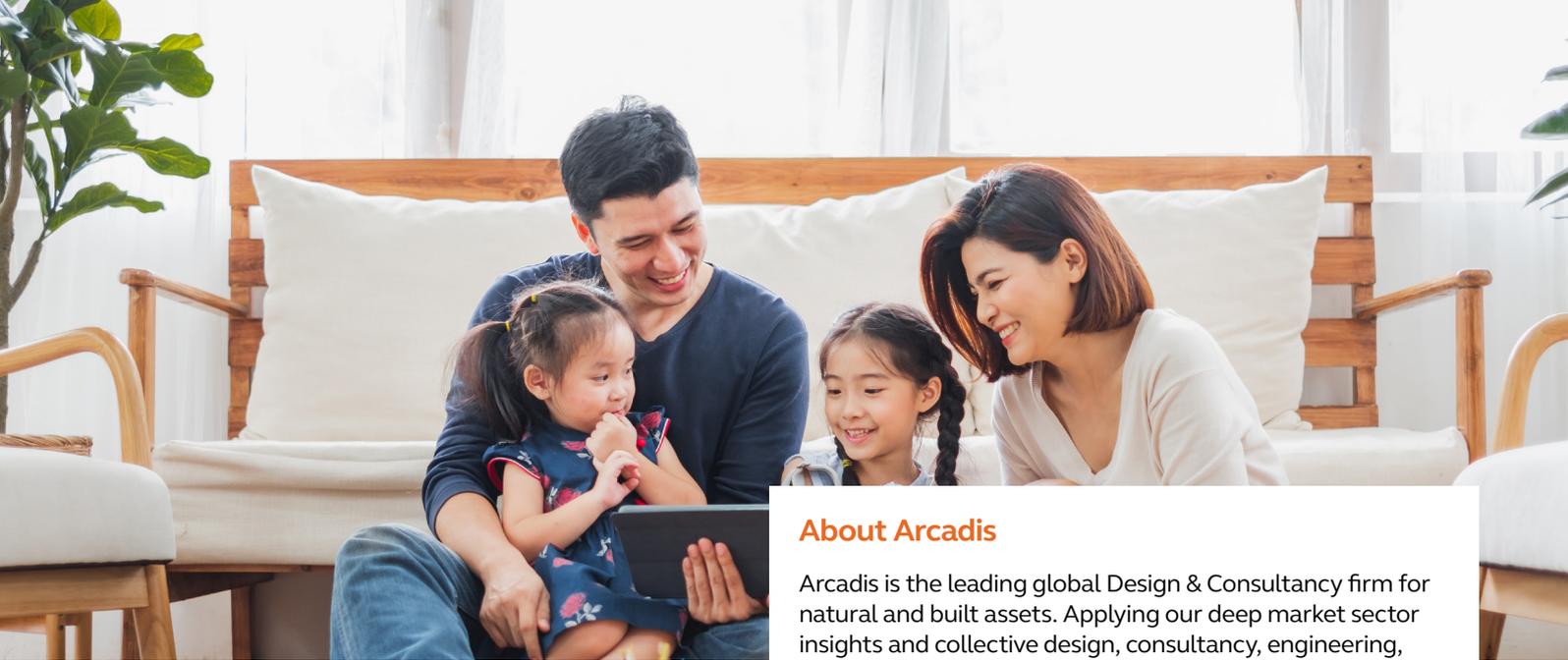
Number of active mobile-broadband subscriptions per 100 population in leading online markets.

Source: The World Economic Forum Global Competitiveness Report

Mean download speed

Mean download speed is based on the download speed of at least 50% of customers at peak time.

Source: cable.co.uk



About Arcadis

Arcadis is the leading global Design & Consultancy firm for natural and built assets. Applying our deep market sector insights and collective design, consultancy, engineering, project and management services we work in partnership with our clients to deliver exceptional and sustainable outcomes throughout the lifecycle of their natural and built assets. We are 27,000 people, active in over 70 countries that generate €3.3 billion in revenues. We support UN-Habitat with knowledge and expertise to improve the quality of life in rapidly growing cities around the world.

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