
KPMG

Data Center Vietnam with bright growth prospects

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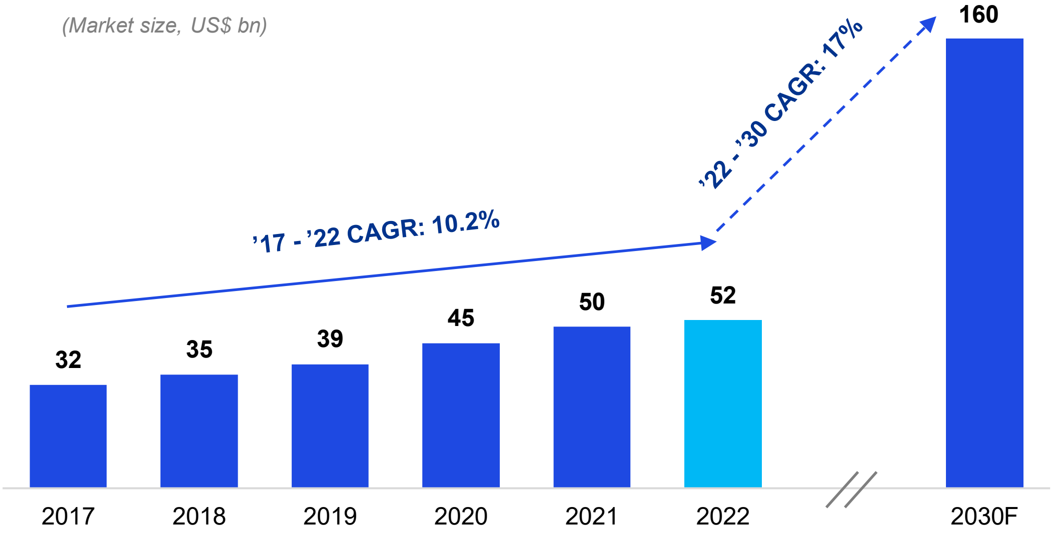
May 2023

1. Market Overview

Global colocation DC market at a glance

Market size of global colocation DC reached US$ 52bn in 2022 and expected to continue growing at 17% CAGR



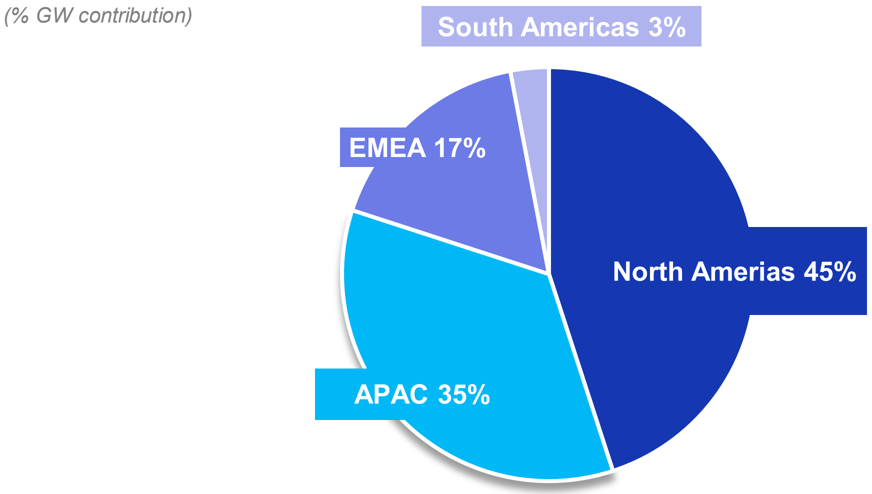
47.5 GW *Global data center's total capacity*

> 3.5 GW *Under-construction DCs in primary and emerging markets **

Sources: IMARC, 451 Research S&P 500, JLL, Cushman& Wakefield

Surpassing EMEA, APAC is emerging as the attractive destination for data center investment

Global data center capacity break down by regions



US$ 16.2bn

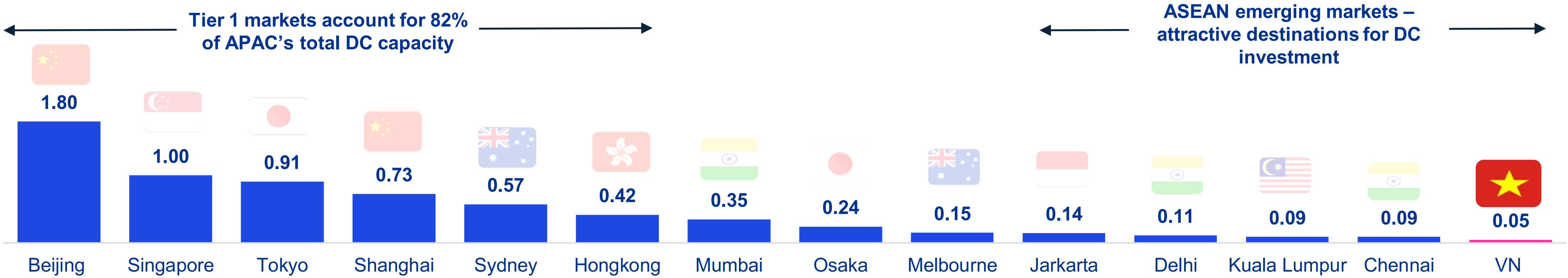
APAC's market value in 2022

Approx. **6.6 GW**

APAC's current Colocation DC capacity in 2022

Vietnam is one of top 10 emerging colocation markets

Colocation DC capacity (GW) by APAC market, 2022

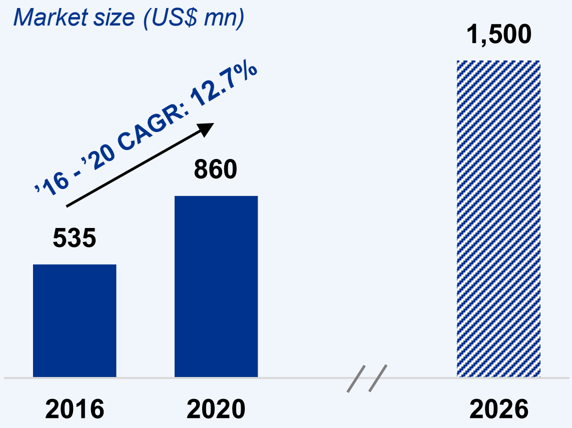


5.4 GW
Total Capacity

Yet, tier 1 markets are facing

- Shortage in mass land for development and expensive RE costs
- High construction and power costs
- Increasing regulatory frameworks in sustainability and data privacy

Vietnam is ranked 7th in 10 emerging colocation markets globally



45 MW

Data center capacity in 2022

28

 # Operating data centers in 2022

Sources: JLL, Cushman& Wakefield, Vietnam Ministry of Information and Communication, KPMG Insights

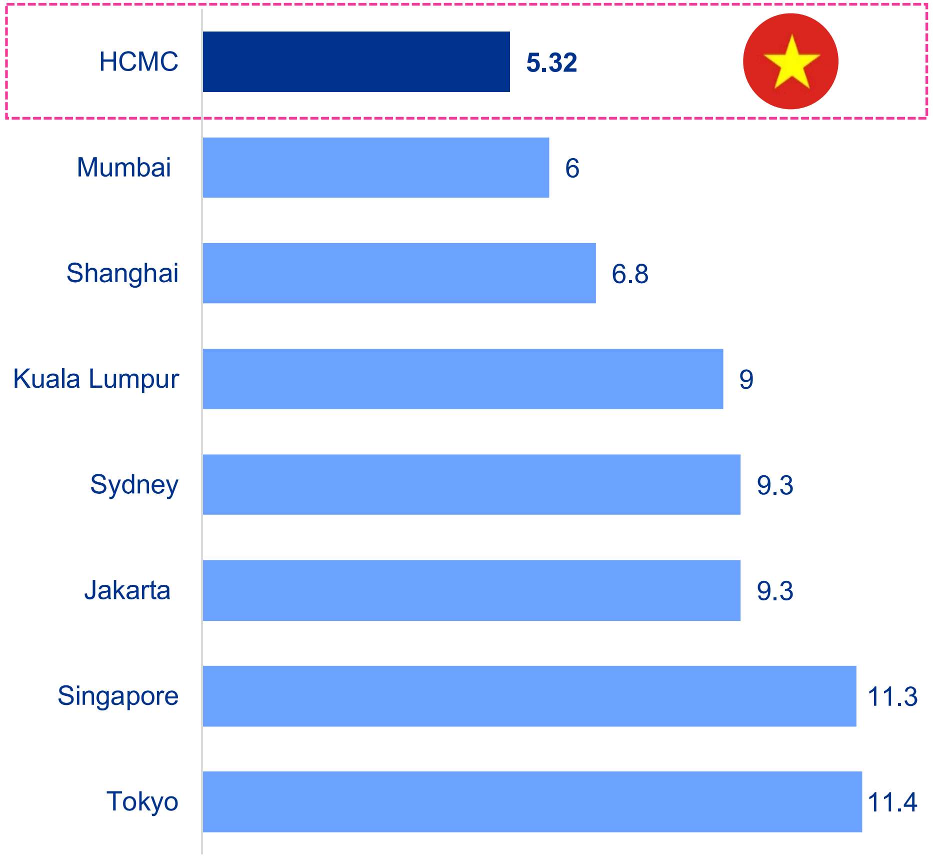
Key growth drivers for Vietnam Colocation market

- Lowest development cost in SEA and capable internet system
- Reliable power resource at SEA lowest price
- Accelerated digital transformation, digital economy and cloud computing
- Nascent market's "white space": Massive in demand while shortage in supply
- Favorable government policies

DC construction cost and internet capacity

Lowest DC construction cost per watt

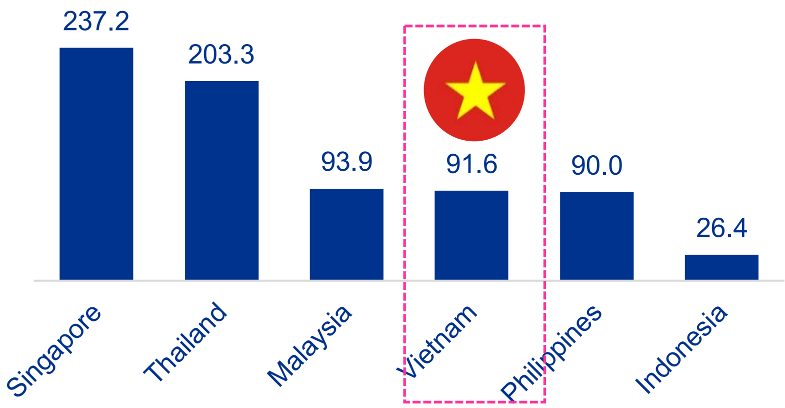
Turner & Townsend Data center cost index 2022



Internet capacity

Download fixed broadband (Mbps) – Speedtest global index, as of 2023

Vietnam is ranked 39th globally in Download fixed broadband



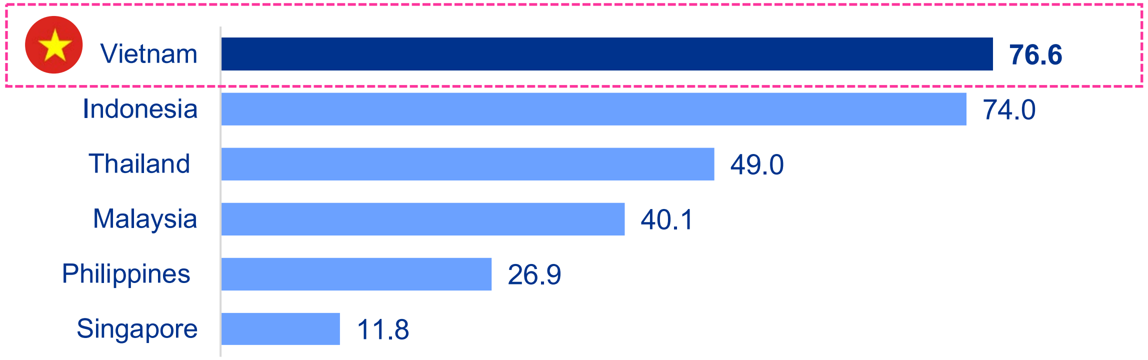
351.6 Tpbs	Total undersea cable capacity
119,400 km	Total cable length

- Currently, Vietnam operates **5 international fibre optic cables**. 2 new cable routes connecting VN to APAC region: ADC and SJC, will be put into operation in Q3 this year
- VN aim to have 16 international undersea cable routes by 2030

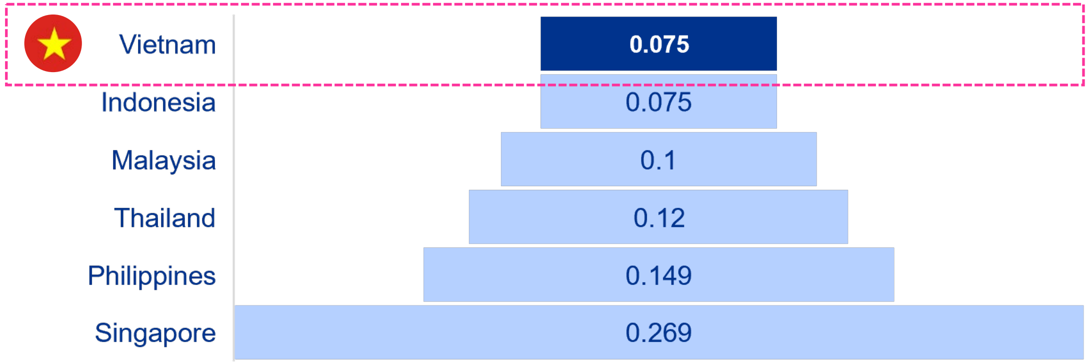
Sources:Turner & Townsend, Speedtest

The largest power generator with lowest price in SEA

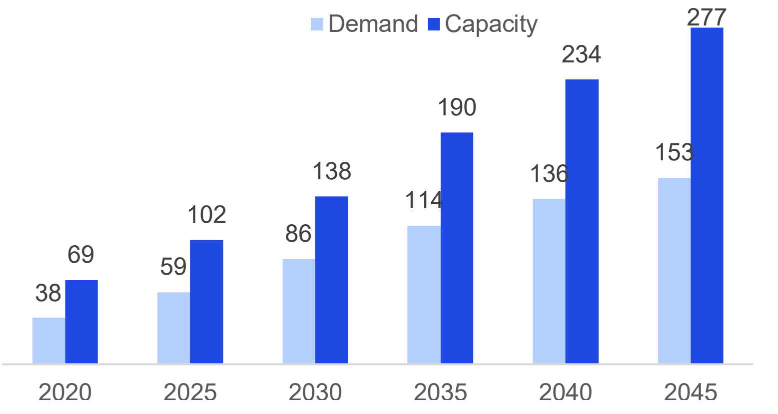
Power installed capacity in SEA (GW) , as of 2021



Business power price US$ per kWh

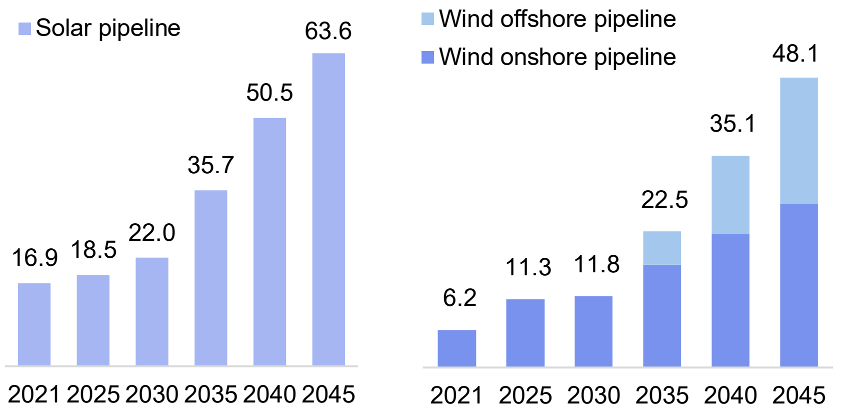


Projected energy demand and capacity (GW)



Note: The figure is subject to change upon the official release of PDP VIII.

Projected renewable energy demand and capacity (GW)*



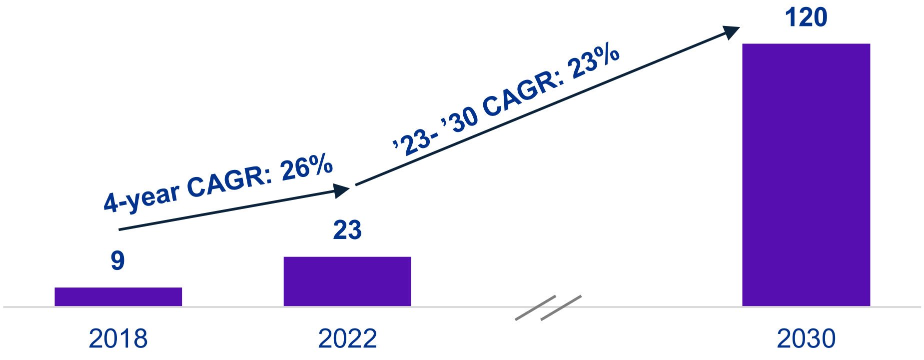
(*) Note: Data as of Nov 1st 2021
Source: Document 6742/EVN-TTĐ dated 2/11/2021 by EVN
146 PPA' s signed with EVN for a total capacity of 8171 MW

- In 2022, 23% of Vietnam's total energy is still rely on coal-fired themal power
- At COP26, Vietnam has pledged to phase out coal power as part of the commitment to achieve net-zero emissions by 2050

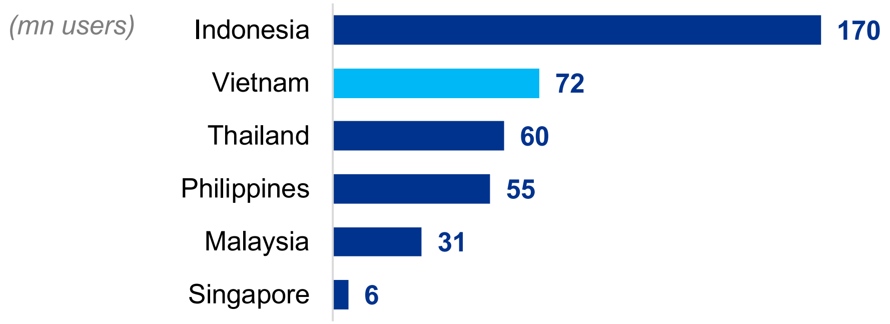
Digital economy and cloud computing

Expected to be the second largest digital economy in SEA by 2030

Digital economy, GMV (US$bn)

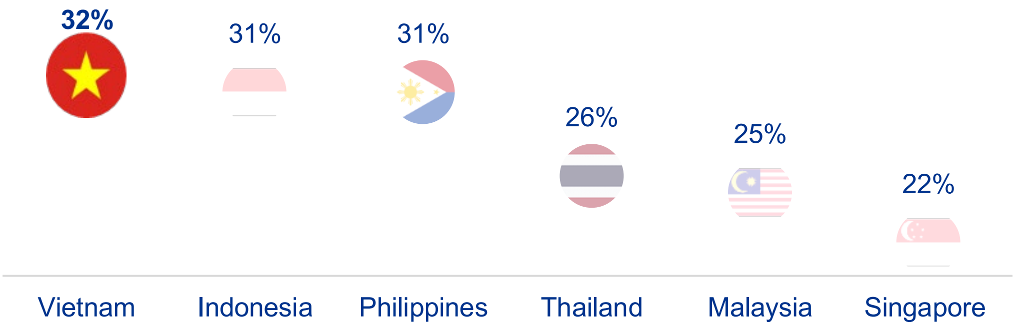


Driven by the largest internet population (2021)



Cloud computing growing at region's most rapid space

Cloud market CAGR 2018-2023



US$ 592mn Cloud market in 2022	**US$ 851mn** Cloud market by 2025

Digital transformation makes headway thanks to favorable Government policies

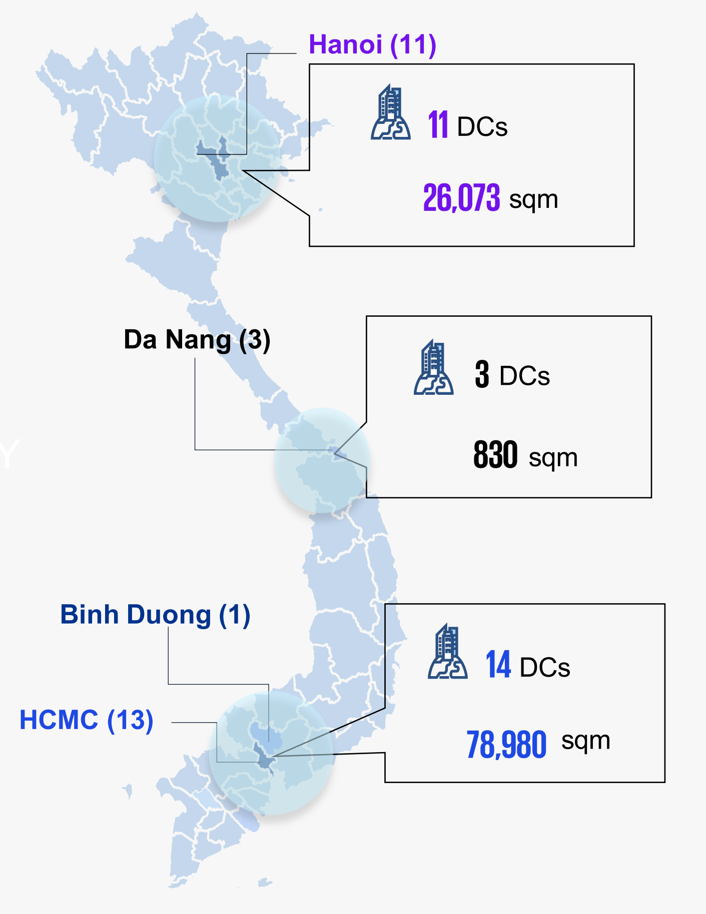
National Digital Transformation Programme by 2025 and vision towards 2030:

- Cloud-first approach for key sectors
- Digital economy will contribute 20% to the country's GDP by 2025 and 30% by 2030

Sources: Google, Temasek, Bain analysis

Vietnam market overview

Data center footprints



28 data centers with approx. **108,700 sqm total computing space** (as of April 2023)

6 data centers with **Uptime Tier 3** certification

45 MW total capacity and **270,000 total servers**

Median rack yield of 600, and **average GFA of 4000 sqm**

Source:KPMG insight

Vietnam market overview

The market is concentrated, 5 major players hold 89% of the country's total computing space

	Player	Ownership structure	Computing space	Current full racks	Market share
Major players	Viettel IDC	SOE	35,000	3,250	32%
Major players	VNPT	SOE	22,550	N/A	21%
Major players	CMC Telecom	JV between Segmenta Denmark and CMC Telecom	14,200	N/A	13%
Major players	FPT	Public	12,880	6,900	12%
Major players	VNG Cloud	Private	12,400	1,600	10%
Minor players	VNTT (A member of Becamex IDC)	UpCom	5,000	400	5%
Minor players	Hanoi telecom (Hanoi Telecom Corporation)	Private	N/A	3,000	N/A
Minor players	Telehouse	JV between FPT, KDDI and Mitsui Busan	2,073	640	3%
Minor players	GDS (Data Center in Vietnam)	JV between VNPT and NTT	600	N/A	2%
Minor players	Hanel Telecom	JV between Hanel and CSF, SITEM	650	250	1 %
Minor players	USDC Tecnology Smart Data Center	Private	300	134	0%

11 data center operators

89%

market share of VN computing space

- **Major players:** owning at least one hyperscale data center with > 10,000 sqm computing space
- **Minor players:** having total computing space <5000 sqm

Decree 13/ 2023/ND-CP on Personal Data Protection

1

Identify role in processing personal data

Assign responsibility and protocols for every processing activity to the relevant business units. Review the data processing and recording techniques e.g., whether it is transactional, real time, batch, or multi-processing

2

Identify types of personal data processed

Develop or review internal data management structures and operating rules and set up a data categorization and management system for different types of personal data.

3

Identify lawful basis for personal data processing

The burden of proving that data is processed lawfully is on the entity processing the data.

Consider if the existing practice, policies, training and system logs can demonstrate compliance. Internal rules and policies should include: rules and procedures for processing personal data; authorization for personnel to process data, rules and processes in case of personal data breaches, and remediation protocols.

A mechanism is put in place to ensure consent is capable of being printed or reproduced in writing, which can be in electronic format. Assess if the form of consent complies with the requirements of Decree 13.
If relying on other conditions to process, assess if the data subject will be notified.

4

Implement mechanism for individuals to withdraw consent

Evaluate and update current mechanisms to guarantee this right; train employees responsible for handling data subject requests and raise personal data protection awareness.

Where consent is used as a legal basis for processing personal data, to have a mechanism for individuals to withdraw their consent, which should allow for printing or re- production as needed.

The system must have the ability to notify the individual of the consequence or damage that has arisen from the withdrawal.

5

Personal data processing notification requirements

Either review and update existing or develop new privacy policies containing minimum requirements prescribed by Decree 13 to provide to the individuals as soon as possible.
Consult your legal advisors to ensure compliance.

Decree 13/ 2023/ND-CP on Personal Data Protection

6

Implement system to handle data subject requests

Assign responsibility and protocols for every processing activity to the relevant businessunits.Review the data processing and recording techniques e.g., whether it is transactional, real time, batch, or multi-processing

7

Data protection officer

Appoint a data protection officer ("DPO") or designate a department with this compliance task.

8

Data security and data breach notification/reporting

Depending on the role of the data handler, a system to detect, handle and notify the relevant authorities and affected data subjects in case of breach using the prescribed formats provided in Decree 13.

Review contracts with Data Processors to check if it contains duties and obligations in relation to data protection and security and clarify how liability will be allocated between the parties.

9

Impact assessment reports to authorities for personal data processing and crossborder transfer

Review existing, or develop, personal information protection impact and risk assessment template in the format prescribed by Decree 13. The reports will need to be stored and be made available for inspection.

Have a mechanism to ensure that these reports are produced and submitted within 60 days of commencement of processing activities or changes to the same.

10

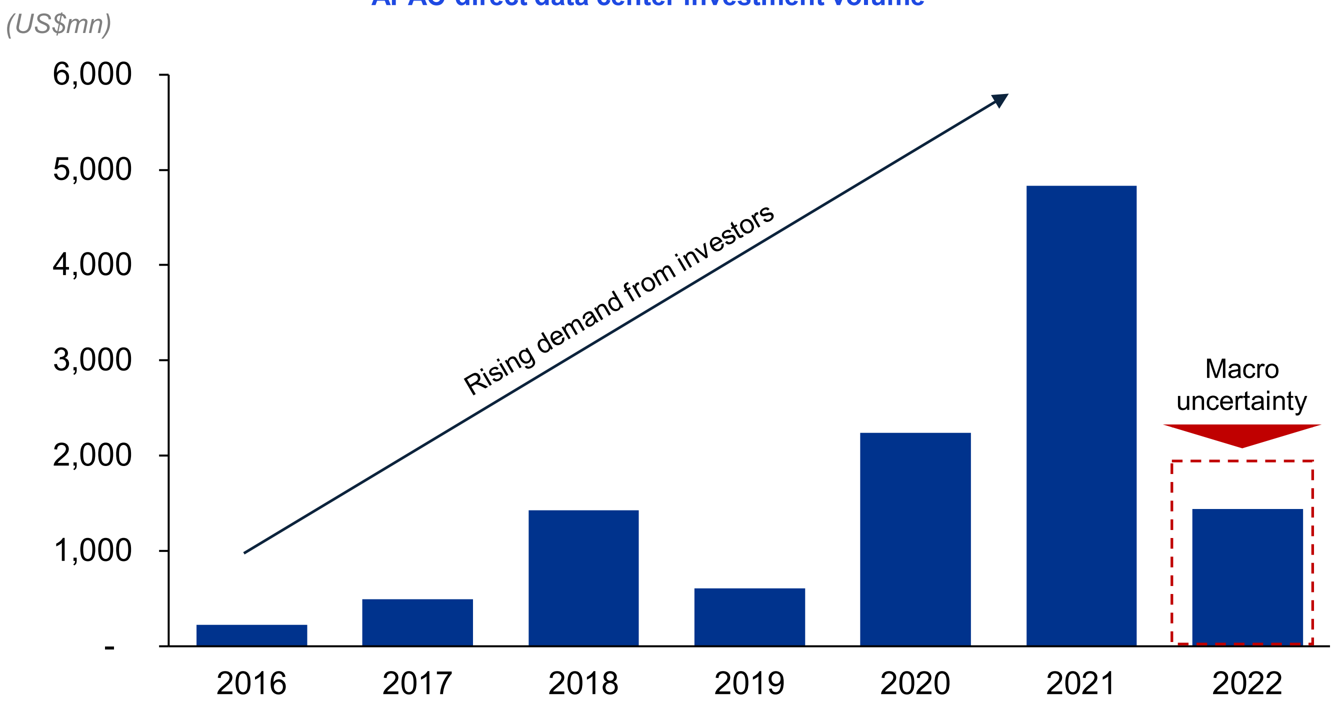
Investigations and audits

Have a mechanism and personnel tasked to handle any investigation and audit requests from the authorities.

APAC Data center investment volume poised to grow resiliently

APAC Transaction volume & fundraising activities had risen rapidly in FY16-FY21

APAC direct data center investment volume



Data center is considered as one of the most popular alternative sector for investment

Source: CBRE

Typical investor profile in the sector

01 Regional DC operators

02 Traditional real estate investors

03 Financial investors seeks to establish DC JV

04 Financial investors acquires existing local DC operating platform

Rising number of investors engaging in DC M&A across the region

Rising list of investors

Keppel Capital

基滙資本 Gaw Capital

GLP

GIC

nuveen A TIAA Company

STACK INFRASTRUCTURE

Blackstone

Warburg Pincus

Mitsui & Co.

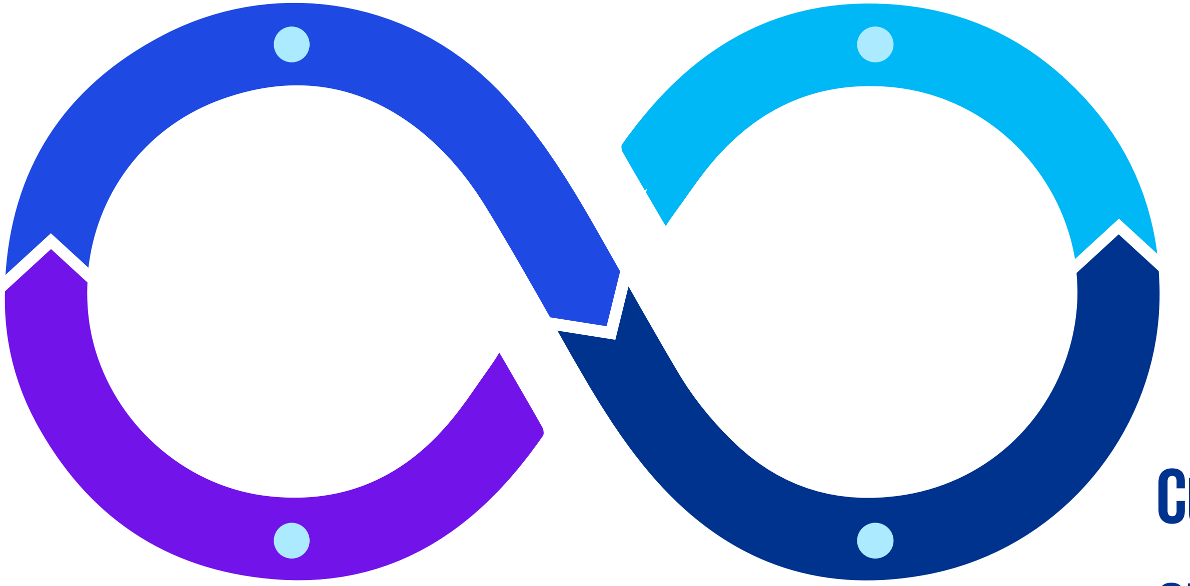
Vantage Data Centers

Notable recent transactions in APAC

Transaction Announced Date	Acquirer	Target	Deal size	% Acquired	Deal Type	Country
January 24, 2022	EtixEverywhere	Genesis data center	$10.8m	67%	Majority Stake	Thailand
February 17, 2022	Edgeconnex	GTN Data Center	Undisclosed	100%	Majority Stake	Indonesia
August 16, 2022	Saratoga	Atria DC	Undisclosed	Undisclosed	JV	Indonesia
June 15, 2021	Digital Edge	Indonet	$165m	Undisclosed	Majority Stake	Indonesia
April 6, 2022	Nuveen	Cargo Consolidation Complex	HKD 2.88bn	Undisclosed	Majority Stake	Hong Kong
June 21, 2022	Keppel DC REIT	Neo Telemidia	$210.0m	38%	JV	China
January 11, 2022	GDS	SZ11	Undisclosed	100%	Majority Stake	China
July 19, 2022	Keppel Fund II	Heying	€ 205m	Undisclosed	JV	China
April 26, 2022	SK Ecoplant	Digital Edge	$1.0bn	Undisclosed	JV	South Korea
July 14, 2021	CPP Investment	Mitsui Co Ltd	$400m	Undisclosed	JV	Japan

Source: KPMG analysis

Investment criteria for investor



Operational control

Controlling financial position

Carrier neutrality

Customer diversity and retail-focused model

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mace

Data Centres

Agenda

Introduction

What’s different?

Pre-construction

Construction

Commissioning

Handover / Operate

Introduction

Introduction MACE Vietnam

Mace is a leading global construction and consultancy company that provides a wide range of services including project management, construction management, cost consultancy, construction delivery, and more.

Our team in Vietnam blend international, regional and local experience. Clients take advantage of our UK best practice in health and safety procedures, sustainability and quality control, along with our in-depth knowledge of the Vietnamese market and regulations.

Alongside our construction management and project and programme management services, we also offer construction supervision, a legal requirement unique to Vietnam.

We bring expertise in technical construction methodologies, innovative planning and scheduling, and proven project management and construction management processes.

This has enabled us to take on projects that provide construction challenges for local contractors, such as the deep basement structure and high-rise structure of Landmark 81, the tallest tower in south-east Asia.

Introduction MACE Vietnam

Since establishing our Vietnam office in 2009, we have built strategic partnerships with established local businesses that we call upon to assist us with specific aspects of Vietnamese approval processes and building codes, if required.

The major projects we have delivered in Vietnam span the residential, hospitality, industrial, healthcare and retail sectors, but in response to demand we have been primarily involved in mixed-use developments since setting up the business.

In addition to Landmark 81, notable projects include a huge production facility for Nokia in Bac Ninh Province and Deutsches Haus, a 25-storey mixed-use development in Ho Chi Minh City.

Mace have established ourselves as a trusted partner for consultancy services in Vietnam, and we continue to play a significant role in shaping the country's skyline & built environment.

What’s different?

What's different?

- Interconnected Buildings housing rows of Equipment cabinets full of data processing equipment
  - Data Cabinet density roughly 1 per 3 m2
  - Data Halls 40 – 60 % of Building
- Reliability a key concern –
  - Decides location – away from floods- earthquake zones, highways, flight paths etc.
  - 2 measures Uptime Institute (Tiers) EIA TIA 942 (Rated)
  - Concurrently Maintainable N+1 vs Fault Tolerant 2N
- Increasing power consumption –
- Power ideally from renewable source- Hydro- Wind
- Often quoted as power density in w/m2 or W/ rack
  - Was 3kW now 8-15kW can be 50kW per rack
  - High power demand key concern
  - Power utilization efficiency PUE
  - PUE = Total power used / power used by data > 1.4

What’s different?

- High Specialized Equipment Content Generators, UPS, HV switchgear, Chillers etc.
- Long Lead Equipment (LLE) can determine schedule -14 month delivery periods
- High structural Floor loads 20KPa– good load bearing ground
- Good Telecommunications connectivity – fibre network – near sub sea cabling landing stations?
- Speed to market normally high priority – short schedule on site 12-18 months
- Pre-fabrication recommended
- Shell and core + first data hall facility to add more halls
- High Engineering cost / Low building cost
- Benchmark is USD/W or MUSD / MW – skewed if Shell & Core and initial fit out only
- Completed DC excl land before covid 8-10USD/W now 11-13USD/W depending on specification

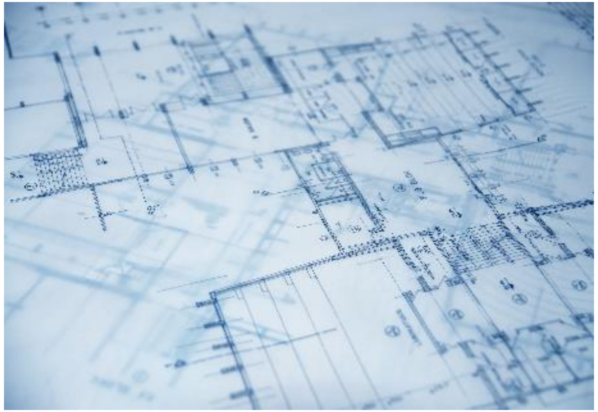
Data Centre- Pre-Construction

Pre-construction

- Document Management
- Site Selection / Due Diligence
  - Utility availability
  - Planning restrictions /Permitting Environment
  - Test Fits
  - Surveys – Topographical, Geotechnical, Underground services & Environmental Baseline
  - Schedule
  - Supply Chain
- Estimating & Budget
- Feasibility
- Go / No Go Criteria

Pre-construction

- Appoint Project Management / Design Team
- Develop Procurement Strategy
- Design management 30,60 & IFC page turns
- Environmental Management
- Permitting /Utility and AHJ Liaison
- Schedule Control
- Cost Control & Value Engineering
- Design for Safety / Manufacture
- Procurement including early LLE procurement
- Interface management
- Prefabrication
- Factory Acceptance testing



Data Centre Construction

Construction

- Management Co-ordination and Control including QC of
- **Environmental Health & Safety**
- Sub & Superstructure
- Civil Structural & Early Works
- Critical Milestone- substantially watertight
- Complex MEPF Systems
- High & Medium Voltage –
- Critical Milestone - Power on date
- Utility Connections
- Extensive Sophisticated Centralized monitoring &control
- State of the art security
- Documentation, AHJ approvals & Permits

Commissioning

Commissioning

- ASHRAE 5 stage Process
- Uses physical labels or tags to sign off each level
- Commences with Factory Testing
- Followed up with post delivery inspection
- Level 3 –hydraulic / cable tests or pre-energization
- Level 4 stand alone system test using heat loads
- Level 5 Integrated test multiple failure scenarios
- Independent Commissioning Management Team
- Involve operator at stage 4 as part of training

Level 1 Factory Acceptance Test

Level 2 Field Component Verification

Level 3 Field Inspection & Certification

Level 4 Site Acceptance testing

Level 5 Integrated Systems testing

Post handover

Post Handover

- Site Clearance
- Handover Management
- Revised Security and SOP's
- As Built BIM Model
- Operating & Maintenance manuals
- Provision of Spares
- Activating maintenance contracts bid as part of GC
- Resolution of AHJ / Permitting Comments
- Preparations for future fit-outs

Thank You & Questions