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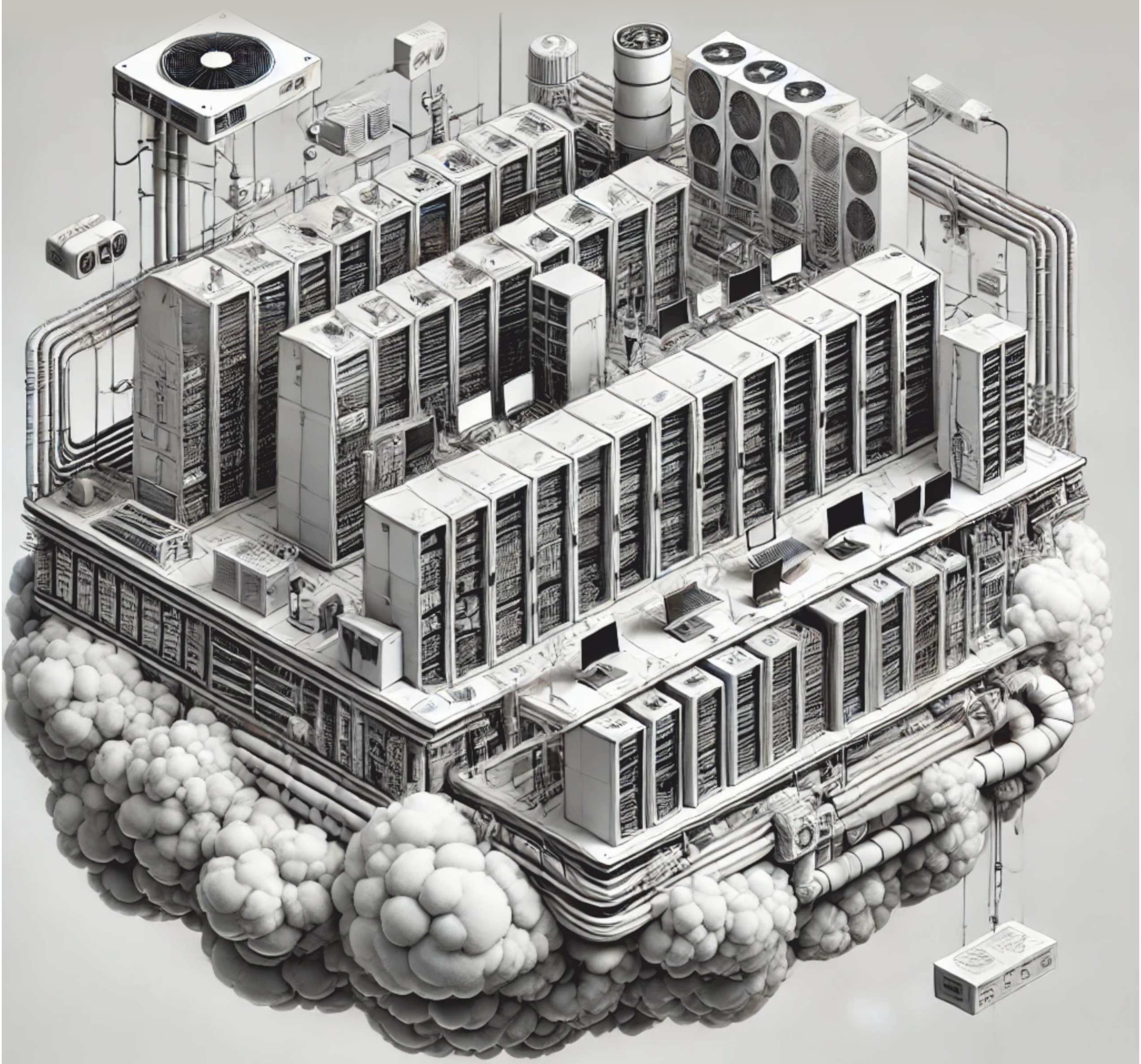
Data Centre 101: India's Cloud Moment



Data Centre Primer: 101 questions to demysitify everything investors need to know on DC

We estimate 5GW of DC capacity by 2030 entailing USD 20bn of capital outlay over the next 5 years

Anticipate slew of listings driving c.USD 10bn of fresh equity raise, at an enterprise valuation of USD 100bn

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This report is Data Centre 101, quite literally. We have, through 101 questions, tried to demystify and simplify various aspects of DC here. Importantly, we have kept investors at the centre while framing our questions. Apart from the basics of DC, we have covered commercial aspects such as unit economics, capital requirement and valuation. We have listed/profiled various players through which public market investors could play the DC story for now. That said, this report is just an initial ground work for this sunrise industry. We plan to build on this and come out with more concrete actionable ideas in subsequent works. For a foundational view, read on!

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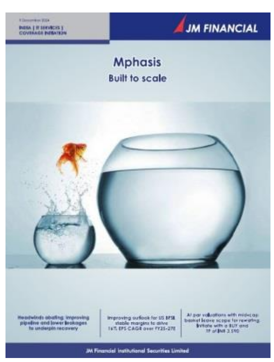

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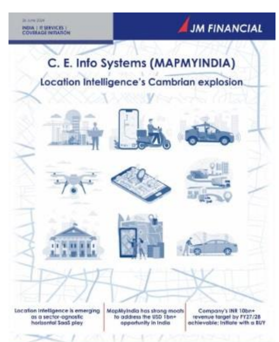
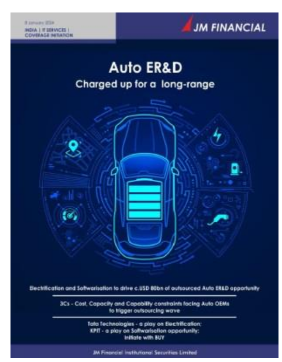


C.E. Info Systems (MapmyIndia)



Auto ER&D: Charged up for a long-range

Data Centre 101: India's Cloud Moment

Data centre (**"DC"**) demand in India is, unequivocally, rising. Factors fuelling the uptrend are both structural and cyclical. A large internet user base generating trove of data, government's data localisation push and AI are some of the structural tailwinds. Disproportionately lower share of DCs in India - India generates 20% of global data, yet has only 5.5% of global DC capacity - and slower-than-desired capacity addition in the past has steepened the demand-supply mismatch, ushering in a cyclical boom in DC capacity expansion. Our bottom-up analysis (Exhibit 24) indicates India's colo DC capacity as of 2024 stands at 1.35GW, up 38% YoY. Despite this, India's DC density is 14 petabyte/MW (Exhibit 47), one of the lowest in the world. We estimate that India needs a total capacity of 5GW by 2030, just to reach 50% of China's DC density. This aligns with the current announced under-construction + planned capacity of 3.3GW by 2028. At an average capex/MW of INR 465mn (Exhibit 64), this will translate into an incremental capital outlay of c.USD 20bn over the next 5 years. Investments on cloud infrastructure (servers, etc.) could be an additional c.USD 60bn. While a majority of the cloud infrastructure spend will be done by hyperscalers, in our view, capex towards DC capacity (USD 20bn) alone could entail equity issuance of USD 10bn (assuming average D/E of global players). Still, these will merely serve India's domestic demand. India could, in fact, emerge as a preferred data hub for the entire region. Improving cross-border connectivity as more sub-sea cable landings come on stream, lower capex/MW (Exhibit 54), lesser operating cost (utilities, manpower, etc.) and its strategic location (between ME and SEA) give India an edge. Lower rack density even for AI workloads, as promised by DeepSeek, could push the scale further in India's favour, we believe.

At the global average EV/MW of c.USD 20mn (Exhibit 165), the colo DC segment alone could reach an enterprise value of USD 100bn by 2030. Currently though, the listed universe offer limited direct plays on the DC evolution in India. Apart from listing the larger proxy plays (Exhibit 137), we profile a few (unrated) who are more directly indexed to the DC demand - Anant Raj Cloud, E2E Networks, Black Box, to name a few. We anticipate more listings over the next 5 years – from upstream colo DCs to even downstream Cloud/AI players.

India's DC demand: Into the cloud

India's current colo DC capacity is 1,350MW, constituting 5.5% of global capacity. Rising data consumption/generation, favourable policy, data localisation push and a thriving start-up ecosystem are factors driving DC demand. We estimate that India needs 5GW of colo DC capacity by 2030 to reach half of China's DC density (petabyte/MW). Leading DC players such as NTT, Nxtra, Sify, etc. have already announced planned + under-construction capacity addition of c.2GW by 2028. Total announced new capacity, including 3GW by Reliance alone, exceeds 5GW, making our 2030 estimate achievable. This could sustain even beyond 2030 if India were to capture global DC demand. Enabling factors are falling in place.

DC unit economics: High margins + strong cash flow visibility

DC is a highly profitable business. We estimate, based on announced capex and our checks, that DC requires capex of c.INR 465mn/MW. There are two revenue models: a) Rental (dominant model) - where DC player leases out capacity to end-client who manages its own IT Infra; and b) Managed Services – maintains IT/Cloud infra as well and offers Infra-as-a-Service and charges pay-per-use – compute/storage etc. In the lease model, rentals could be INR 100mn-110mn/MW/year. Utilities cost is typically a pass-through on top of the rentals. Steady state EBITDA margin could range from 40% to 50%. Demand-supply mismatch would ensure sustained rental inflation, longer-term leases and higher occupancy, lending cash-flow visibility, in our view.

DeepSeek and IndiaAI mission: Serendipitous

DeepSeek's more efficient AI models operate with significantly lower computational power and energy consumption. These, while a threat to high-end GPU/DC, could boost demand for DCs with lower rack density (12-20KW/rack) to handle AI workloads. Media articles suggest DeepSeek has fuelled H200 chip demand. Incidentally, IndiaAI mission entails procurement of 18,000+ compute chips such as NVIDIA H200.We therefore believe that India's current DC capacity, though of lower density (6-12KW/rack), can be repurposed to handle AI loads. These will not only make India's current and upcoming DC capacity AI-ready, but also provide an impetus to the development of indigenous AI models, thus proliferating AI use-cases and, in turn, boosting DC demand.

DC investments: A USD 100bn enterprise value opportunity

Our estimate of 5GW of colo DC capacity (incremental capacity of 3.65GW) by 2030 would entail a capital outlay of USD 20bn over the next 5 years. At 1x D/E (avg. gearing ratio of globally listed DCs), this will require USD 10bn of fresh equity raise. Globally listed DC operators trade at c.USD 20mn EV/MW. That translates into an enterprise value of USD 100bn for the DC segment. Currently, there are no pure-play listed DC operators in the country. Given the capital-intensive nature of the segment, we anticipate that many of the domestic operators will list to gain access to capital. The initial investment opportunity could be concentrated in the upstream value-chain (DC operators, suppliers, renewables;Exhibit137). But we expect many tech-focussed downstream opportunities, such as E2E Networks (Not Rated), to emerge. Investors will have their hands full.

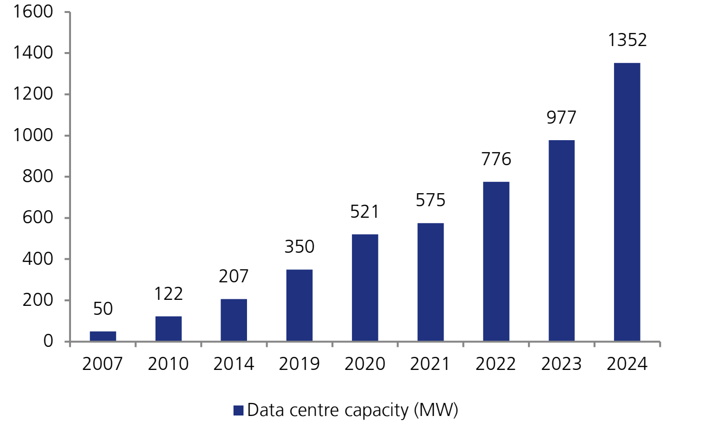
Abhishek Kumar
abhishek.kumar@jmfl.com
Tel: (91 22) 66303053

Nandan Arekal
nandan.arekal@jmfl.com
Tel: (91 22) 62241874

We acknowledge the support of **Anushree Rustagi** in the preparation of this report

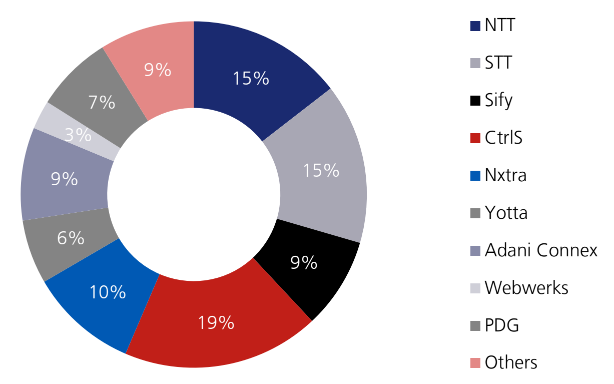
Story in Charts

Exhibit 1. India's colo DC capacity as of 2024 was 1.35GW; while this has grown at 27% CAGR over 2020-24, it still remains inadequate
Data centre installed colocation IT load (MW)



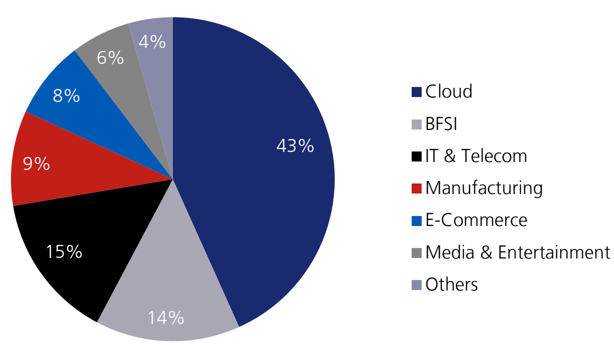
Source: Cushman & Wakefield, JM Financial

Exhibit 2. NTT, STT, Sify and CtrlS are the top players; Top 5 players account for 66% of total operational capacity
Current capacities across players as a % of total



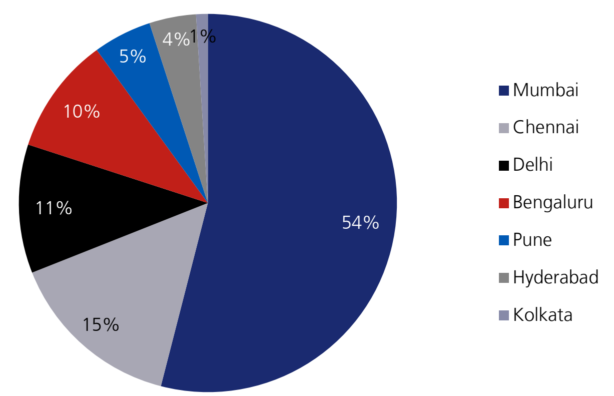
Source: Capacities according to company websites, JM Financial

Exhibit 3. Hyperscalers, BFSI and Telecom tenants occupy ~75% of colocation capacity
Tenant-wise distribution of colocation capacity (2023)



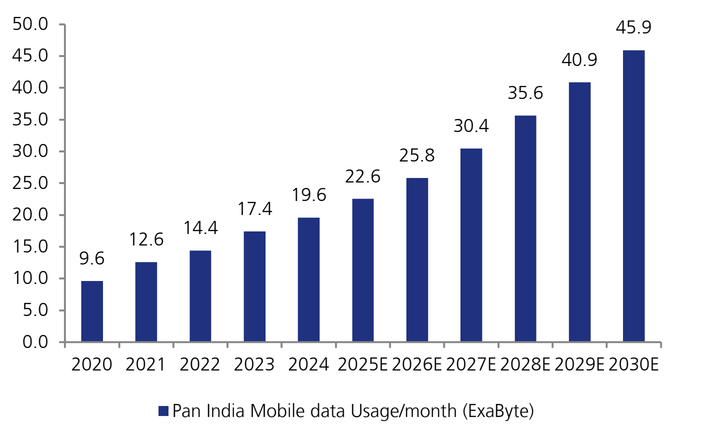
Source: Cushman & Wakefield, JM Financial

Exhibit 4. Data centre capacity concentrated in Mumbai and Chennai with cable landing stations located in these cities
Data centre capacity demand projection – 2024-2030E



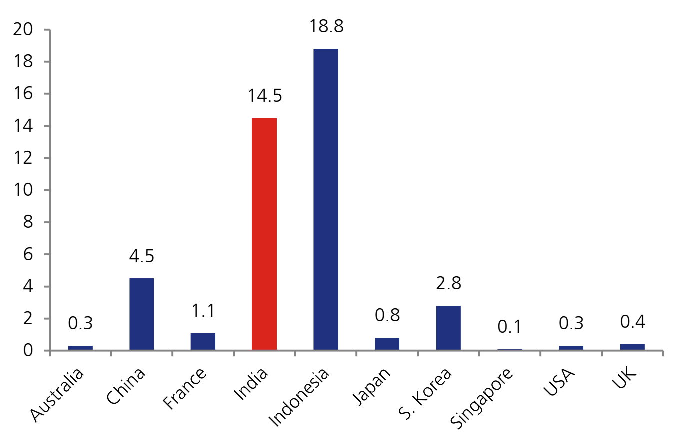
Source: Cushman & Wakefield, JM Financial

Exhibit 5. Growing data consumption - mobile data usage/month est. to grow at 15% CAGR over 2024-30E – necessitates higher capacity
Pan-India mobile data usage/month (Exabyte)



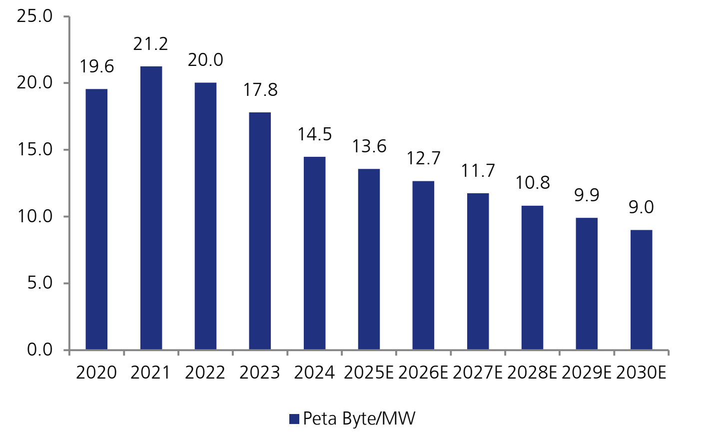
Source: India mobile broadband index, Ericsson, JM Financial

Exhibit 6. Moreover, India's current DC density is already one of the lowest in the world, implying significant under-capacity
Peta Bytes/MW-2023



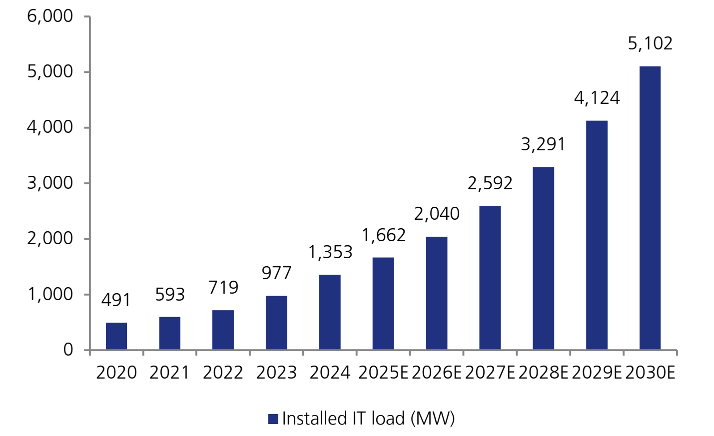
Source: Cushman & Wakefield, JM Financial

Exhibit 7. Our DC capacity forecast in based on the assumption that India's DC density approaches half of China's by 2030
India petabytes/MW – 2020-2030E



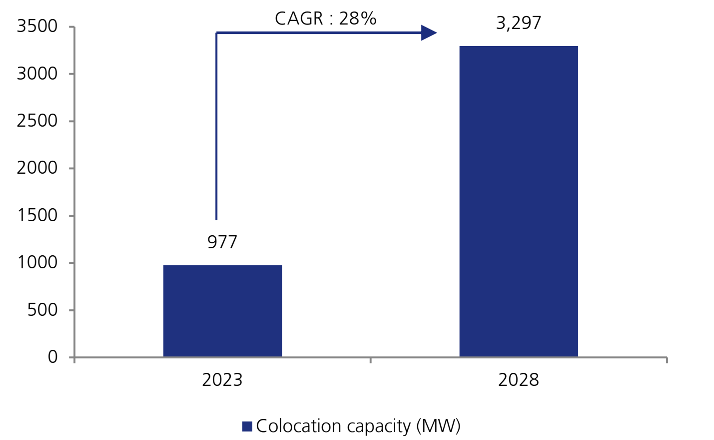
Source: JM Financial estimates

Exhibit 8. We estimate an incremental addition of 3.7GW of colo DC capacity over 2024-30, reaching an installed capacity of 5GW
Data centre capacity projection – 2024-2030E



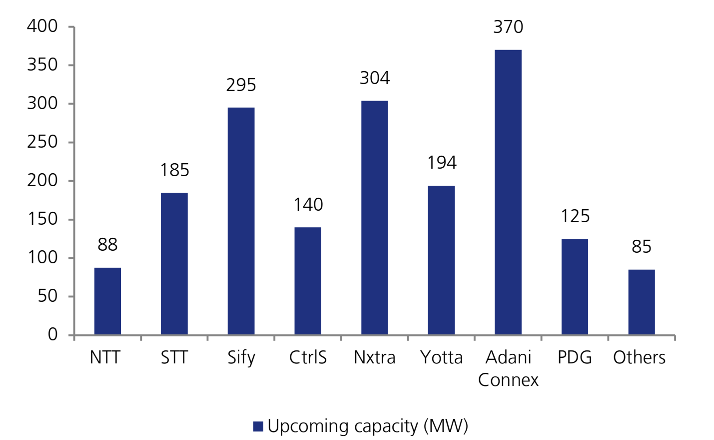
Source: JM Financial estimates

Exhibit 9. 2.Our projections are aligned with current planned and under-construction capacity addition announced by various players
India colocation capacity (MW)



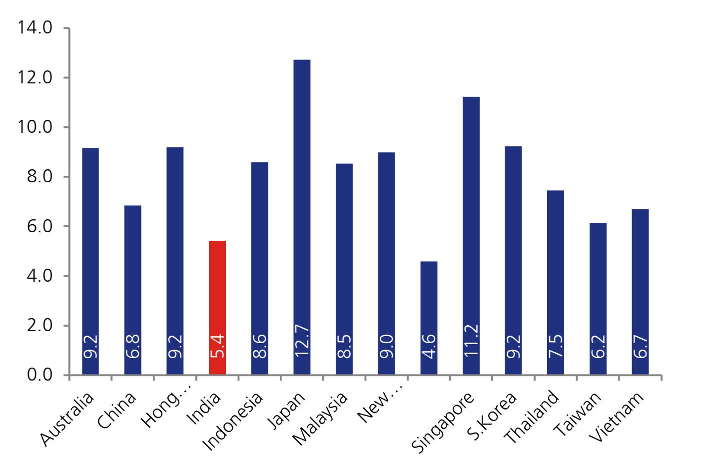
Source: Cushman & Wakefield, JM Financial

Exhibit 10. Adani Connex, Nxtra and Yotta to add c.860MW of capacity; more than 1.6GW of capacity additions planned
Upcoming capacities across colocation players



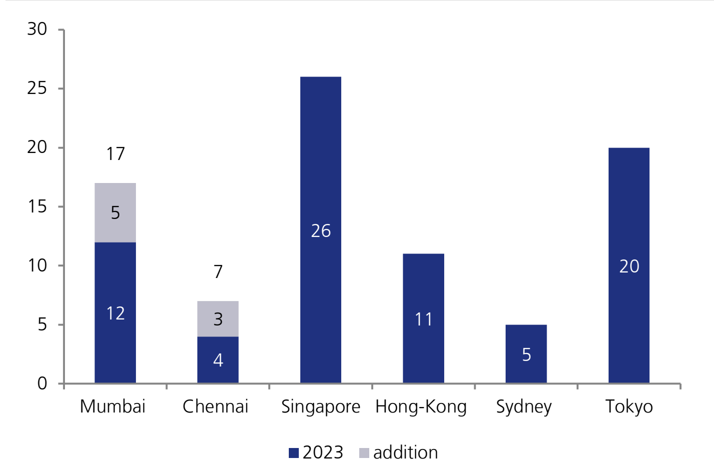
Source: Upcoming capacities according to company websites, JM Financial

Exhibit 11. Besides 5GW of DC capacity for domestic use, India could emerge as a global DC hub; lower capex/MW in India should help
Capex per MW – USD mn



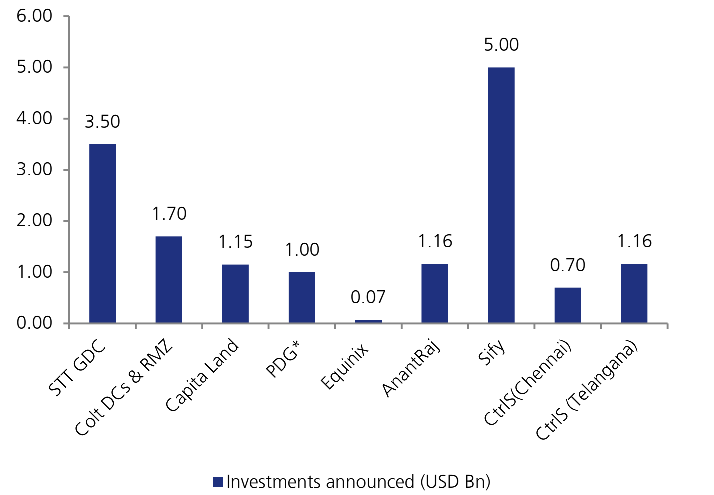
Source: Cushman & Wakefield, JM Financial

Exhibit 12. Rising sub-sea cable landings should also improve cross-border connectivity, facilitating India's rise as global data-hub
No. of subsea landing cables – Nos.



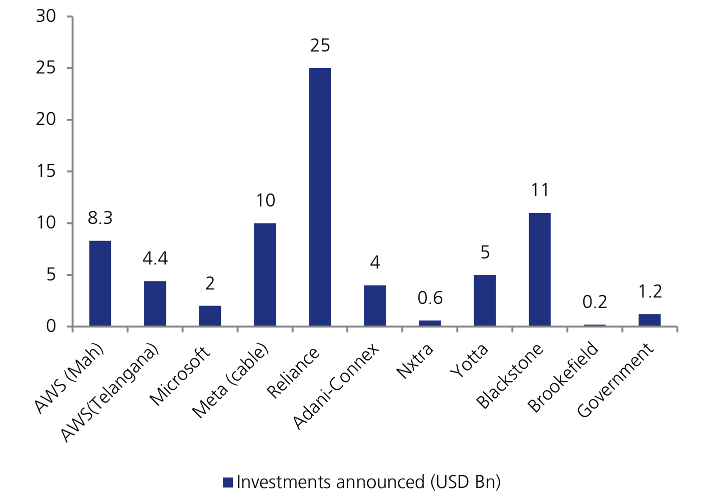
Source: Submarine networks, JM Financial

Exhibit 13. Over USD 15bn of investments announced by colocation players; STT and Sify have announced aggressive expansion plans
Investments announced towards data centre capacity – USD bn



Note: PDG – Princeton Digital Group. Source: Announcements from media sources, JM Financial

Exhibit 14. Over USD 60bn in investments announced by various investors and business houses.
Investments announced (USD bn)



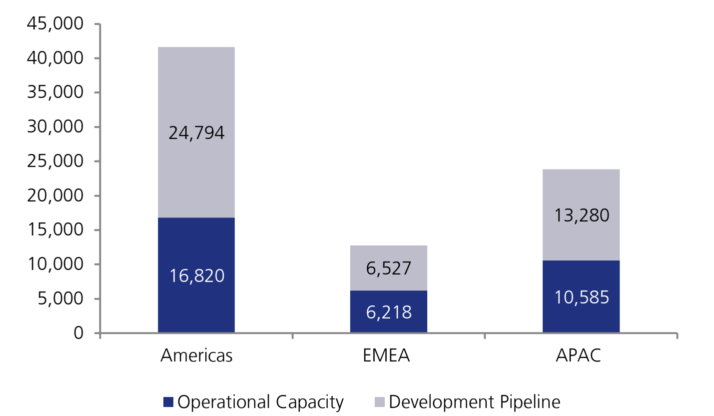
Source: Announcements from media sources, JM Financial

Exhibit 15. Enterprise value at c.USD 20 Mn per MW. USD 80 Bn of EV to be generated with projected capacity addition of c.4GW
Global Valuation comparables – EV/MW calculation

Name	Installed capacity MW	Enterprise Value (USD Mn)	EV per MW (USD Mn)
Equinix	4,285	96,264	23.1
Digital Realty	2,700	66,172	24.8
Iron Mountain	365	42,054	116.9
Next DC	170	5,158	33.2
Keppel DC REIT	650	4,747	7.4
Average			22.13
Acquisitions			
Cyrus One	984	15,000	19.8
QTS	1,050	10,000	12.4

Note: CyrusOne acquired by KKR in Mar 2022, QTS acquired by Blackstone in Aug 21, and Acquisition cost assumed to be enterprise value here. Source: Bloomberg, JM Financial

Exhibit 16. Global operational DC capacity at 33GW, upcoming capacity stood at 44GW; DC capacity high in the Americas
Operational capacity vs. Development pipeline (2024) - MW



Source: Cushman & Wakefield, JM Financial

Data Centre 101: 101 questions to demystify Data Centres

A. Fundamentals of a Data Centre

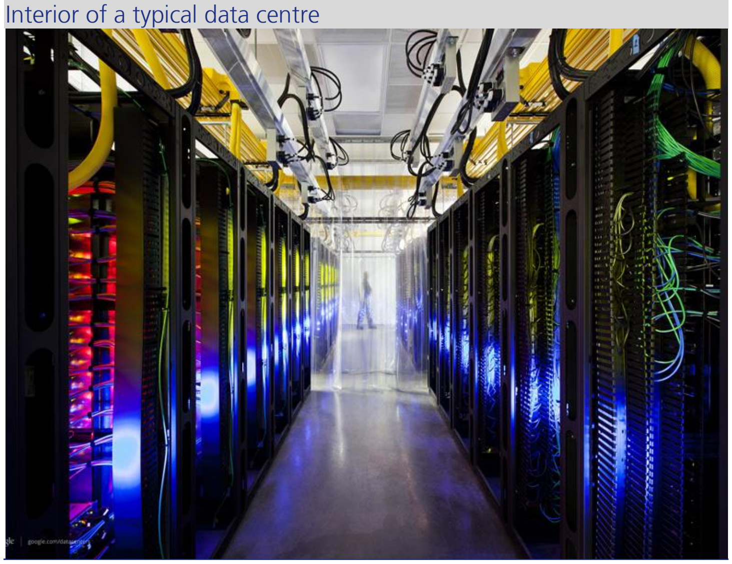
1. What is a data centre?

At its simplest, a data centre is a physical facility that organizations use to house their critical applications and data. A data centre's design is based on a network of computing and storage resources that enable the delivery of shared applications and data. The key components of a data centre design include routers, switches, firewalls, storage systems, servers, and application-delivery controllers.

Modern data centres are very different than they were just a short time ago. Infrastructure has shifted from traditional on-premises physical servers to virtual networks that support applications and workloads across pools of physical infrastructure and into a multi-cloud environment.

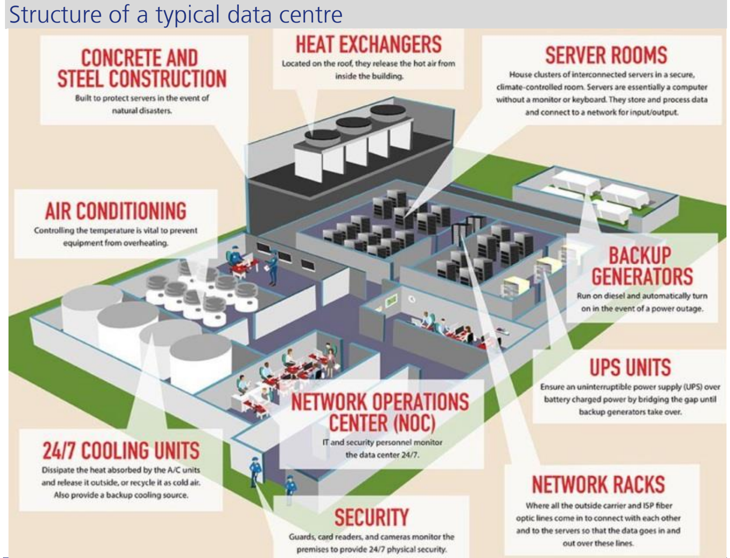
In this era, data exists and is connected across multiple data centres, the edge, and public and private clouds. The data centre must be able to communicate across these multiple sites, both on-premises and in the cloud. When applications are hosted in the cloud, they are using data centre resources from the cloud provider.

Exhibit 17. Inside a typical data centre rows of high density server racks are arranged…
Interior of a typical data centre



Source: Google, JM Financial

Exhibit 18. …in a climate-controlled environment, supported by robust power and cooling systems
Structure of a typical data centre



Source: GA Consulting, JM Financial

2. Who uses data centres?

Data centres serve as critical infrastructure to a wide range of industries, powering cloud computing, AI, financial transactions, telecommunications, e-commerce and digital content. As technology evolves, data centres will continue to support emerging applications, ensuring businesses and governments have the computational power needed to operate efficiently.

Exhibit 19. Key industries that use data centres

Industry	Usage
Cloud Service Providers	Companies such as Amazon Web Services (AWS), Microsoft Azure, and Google Cloud operate data centres to support cloud computing, AI, and global enterprise applications
Government and Public Sector Organizations	Rely on data centres for national security, citizen services and data, defence, and e-governance applications
AI and High-Performance Computing	Revolutionizing the way data centres operate with increasing demand for GPU-powered AI training clusters
BFSI	One of the largest consumers of data centre resources, as it processes high-frequency trading, digital banking, fintech applications, and regulatory compliance data
Telecommunications and ISPs	Operate data centres to support digital communication, 5G networks, and cloud-based services
Media, Entertainment, and Gaming	Heavy dependence for high-resolution video streaming, content distribution, and cloud gaming platforms. Streaming giants operate through cloud-based data centres to store and distribute vast vide libraries, while gaming companies use data centres for real time, cloud-based gaming
E-Commerce and Retail	Rely on cloud data centres to manage inventory, logistics, customer data, and personalization algorithms, rise of E-commerce has made real-time transaction processing and AI-driven recommendation engines essential
Healthcare and Life Sciences	Requires massive computational power for functions such as medical imaging, electronic health records (EHRs), and AI-driven diagnostics

Source: JLL, BCG, CBRE, JM Financial

3. Who owns and operates data centres?

Data centres are owned and operated by a diverse set of entities, including cloud service providers, real estate investors, telecom companies, hyperscale operators, colocation providers, and financial institutions. Ownership and operations depend on business models, investment strategies, and industry demands.

Exhibit 20. Types of data centre owners and the respective ownership models

Owner Type	Ownership Model
Hyperscale Cloud Providers	Owns and operates large-scale hyperscale data centres for cloud computing, AI, and global digital services.
Colocation & Wholesale Providers	Owns multi-tenant data centres, leasing space to enterprises, hyperscalers, and public sector entities.
Telecom & ISP-Owned Data Centres	Owns network-integrated data centres, often colocated with telecom infrastructure to support connectivity and 5G.
Real Estate Investment Trusts (REITs) and Institutional Investors	Invests in, acquires, and leases data centres as long-term real estate assets for high-yield returns.
Government & Public Sector	Owns government data centres for sovereign cloud, national security, and regulatory compliance.
Enterprise & On-Premise Data Centres	Owns private data centres for internal IT operations, ensuring security, compliance, and business continuity.

Source: JLL, Industry, JM Financial

4. What are the primary uses of a data centre?

Following are the primary uses of a data centre –

- Data Storage and Management: Data centres serve as secure repositories for storing, organising, and managing digital data. They house vast amounts of structured and unstructured data, ensuring quick retrieval, backup, and recovery.

  Example: Cloud storage services and enterprise databases rely on data centres to store sensitive business and consumer information.

- Computing Power and Processing: Data centres provide high-performance computing resources to process complex tasks such as AI model training, analytics, simulations, and scientific computations. The ability to scale computing power on demand is a key benefit.

  Example: AI-driven workloads, big data analytics, and machine learning applications use large-scale data centres for computation.

- Application Hosting and IT Services: Organisations host business-critical applications such as email servers, enterprise software, and customer management systems in data centres. These facilities ensure low latency, security, and uninterrupted service for IT applications.

  Example: Cloud-based applications, SaaS platforms, and e-commerce websites run on data centres to ensure 24/7 availability.

- **Security and Compliance Management:** Data centres implement cybersecurity protocols, encryption, and multi-layered access control to protect sensitive information. They also ensure regulatory compliance with data protection laws such as GDPR, HIPAA, and local data localisation policies.

  Example: Government and financial organisations rely on data centres to safeguard classified data and comply with regulatory standards.

5. How is capacity measured for a data centre?

Data centre capacity is usually gauged by its power consumption, mostly measured in megawatts (MW). This metric reflects the total electrical load the facility can support, encompassing both IT equipment and supporting infrastructure. Power consumption is one of the most critical factors in determining the capacity, scalability, and operational efficiency of these facilities.

- **Power defines data centre capacity:** Total computing capability of a data centre is directly proportional to the amount of power it consumes. Each rack of servers typically consumes 5-50kW, and a full data centre can require hundreds of megawatts of power. Instead of measuring by physical size (square footage), power availability determines how many servers and workloads a facility can support.
- **Power costs drive data centre economics:** Electricity is the largest operational expense for data centres, often comprising 30-60% of total costs. Higher MW capacity requires advanced power grid connections and backup power (generators, batteries, microgrids).
- **Scalability and expansion planning:** Power consumption-based measurement helps data centre developers plan future capacity expansions. Grid power availability is a major constraint. Power consumption also determines the cooling infrastructure needed, as more power usage generates more heat.

6. How have data centres evolved over the years?

The evolution of data centres reflects the rapid advancements in computing technology and the growing demand for data processing and storage.

Exhibit 21. Evolution of data centres over the years

Period	Data centre status
1940s-1950s: The Mainframe Era	The inception of data centres traces back to the 1940s with the development of large-scale mainframe computers. These early machines required specialized environments due to their size, power consumption, and cooling needs. For instance, the U.S. Army's ENIAC, completed in 1945 at the University of Pennsylvania, is an early example of a data centre that required dedicated space to house its massive machines.
1960s-1970s: Commercial Expansion and Standardization	The 1960s and 1970s saw businesses adopting mainframe computers, leading to the construction of dedicated facilities to house these machines. IBM, for instance, began constructing facilities to house its mainframe computers in the 1970s, introducing standardized designs to accommodate the growing demand for data processing.
1980s: Client-Server Architecture and Networking	The 1980s marked a shift towards client-server architecture, necessitating dedicated spaces for servers and networking equipment. This period laid the groundwork for modern data centres, as organizations recognized the need for centralized IT resources to manage growing computing demands.
1990s: The Internet Boom and Data Center Proliferation	The rise of the internet in the 1990s led to a surge in demand for data centres. Companies required robust infrastructure to host websites and manage online services, resulting in the rapid expansion of data centre facilities.
2000s: Virtualization and Cloud Computing	Advancements in virtualization technologies during the 2000s enabled more efficient use of physical servers, paving the way for cloud computing. This era saw data centres evolving to support scalable and flexible IT services, transforming how businesses managed their digital operations.
2010s: Hyperscale Data Centres and Edge Computing	The 2010s introduced hyperscale data centres, massive facilities designed to support extensive data processing and storage needs of tech giants. Concurrently, edge computing emerged, bringing data processing closer to end-users to reduce latency and improve performance.
2020s: AI Integration and Sustainability Focus	In the current decade, data centres are adapting to support artificial intelligence workloads, which require significant computing power. There's also a heightened emphasis on sustainability, with initiatives aimed at reducing energy consumption and environmental impact.

Source: FS, IBM, Prosource, SFGATE, JM Financial

7. What are the different types of data centres?

Following are the different types of data centres –

- **Enterprise Data Centres:** Owned and operated by individual organisations, enterprise data centres are dedicated to support internal IT operations and applications. These facilities are typically located on-premises or at a site chosen by the organisation and are managed by in-house IT staff. They offer customised solutions tailored to the organisation's specific requirements, providing greater control over infrastructure and security.
- **Colocation Data Centres:** Colocation facilities, also known as "carrier hotels", are data centres where multiple organisations rent space to house their servers and other computing hardware. The data centre owner provides the building, cooling, power, bandwidth and physical security, while the customers supply and manage their equipment. Colocation is either on a Retail basis, catering to customers with smaller power capacity needs, or on a Wholesale basis, where businesses lease entire suites or private data halls to deploy their IT infrastructure.
- **Hyperscale Data Centres:** Hyperscale facilities, also known as Cloud DCs, are massive, cloud-native facilities operated by a single company. These facilities primarily support cloud service providers and tech giants that require enormous computation, storage, and networking capabilities.
- **Edge Data Centres:** These data centres are smaller facilities located closer to end-users to reduce latency and improve speed. They process data locally before sending it to central data centres or cloud environments. Such facilities are essential for applications requiring real-time data processing, such as autonomous vehicles or IoT devices.

8. How do these types differ from each other?

Data centres are specialised facilities, and each type of data centre differs across various parameters including the types of customers they serve, size of the facilities, and lease timeline.

Exhibit 22. Distinction between the different types of data centres across clientele, size, and lease tenure

Type	Clientele	Size	Lease Tenure
Enterprise DCs	Large corporations including financial institutions, healthcare firms and government agencies, among others that require dedicated infrastructure for sensitive data and critical applications	Customized based on organization's scale and requirements	Generally owned by the organization
Retail Colocation DCs	SMBs, Startups, and enterprises seeking flexible solutions without the overhead of maintaining their own data centre	100kW - 1MW	1 - 3 years
Wholesale Colocation DCs	Large enterprises with substantial IT infrastructure needs, requiring dedicated spaces	250kW - 10MW	5 - 10 years
Hyperscale DCs	Major cloud service providers like AWS, Google Cloud, etc., and large-scale SaaS providers requiring vast infrastructure to support extensive data processing and storage needs	5 - 100MW	10 - 15 years
Edge DCs	Telecommunications companies, 5G network providers, CDNs, and organizations deploying IoT devices requiring low-latency data processing	10 - 500kW	Flexible lease terms, can be either short-term or long-term

Source: AFL, ENCOR, Flexential, Equinix, UfiSpace, Dgtl Infra, Prime Data Centers, JM Financial

9. What are the standards for data centre infrastructure?

Data centres require significant infrastructure to support the centre’s hardware and software. One of the most widely adopted standard for its design and infrastructure is ANSI/TIA-942. The ANSI/TIA-942-ready certification which ensures compliance with one of the four categories of data centre tiers.

The tiering system for data centres, established by the Uptime Institute, categorises data centres based on their infrastructure reliability, redundancy, and availability. The system consists of four tiers, ranging from Tier I (basic) to Tier IV (most advanced).

Exhibit 23. Performance and use cases across the tiers

Tier	Uptime	Infrastructure	Backup	Use Case
Tier I - Basic Site Infrastructure	99.671% (maximum of 28.8 hours of downtime per year)	Single power and cooling path, minimal redundancy	Limited, often relying on basic UPS	Small businesses, startups, or non-critical applications
Tier II - Redundant Capacity Component Site Infrastructure	99.741% (maximum of 22 hours of downtime per year)	Redundant power and cooling components	Partial redundancy, but single distribution path	Mid-sized businesses, hosting providers with moderate uptime needs
Tier III - Concurrently Maintainable Site Infrastructure	99.982% (maximum of 1.6 hours of downtime per year)	Redundant power and cooling, dual power paths (N+1 configuration)	Allows maintenance without downtime	Enterprises, cloud service providers, financial institutions
Tier IV - Fault Tolerant Site Infrastructure	99.995% (maximum of 26.3 minutes of downtime per year)	Fully redundant (2N configuration), independent power and cooling systems	Dual independent power and cooling paths	Mission-critical applications

Source: Cisco, Uptime Institute, JM Financial

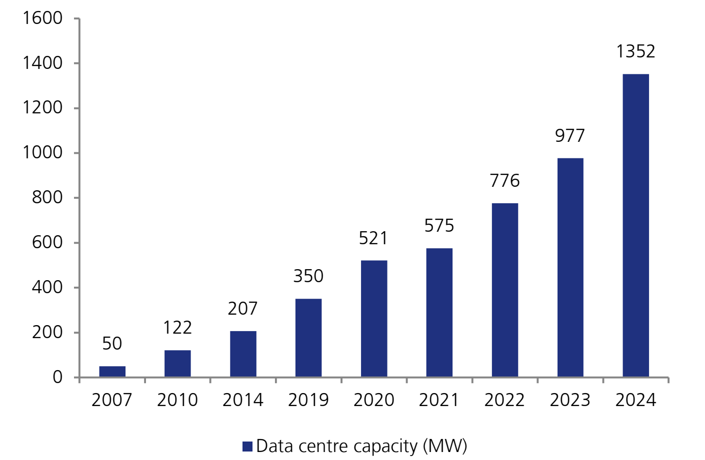
B. India's Current Installed Capacity

10. What is the installed Data centre capacity in India and where is it located?

The total installed colocation data centre capacity in India stood at 977MW in CY23. Our bottom-up analysis suggests that capacity has grown to 1,352MW in Mar'25, up 38% YoY. Capacity has grown at a CAGR of 27% since 2020 and 23% since 2014. Growth in capacity has accelerated in line with acceleration in data generation and usage.

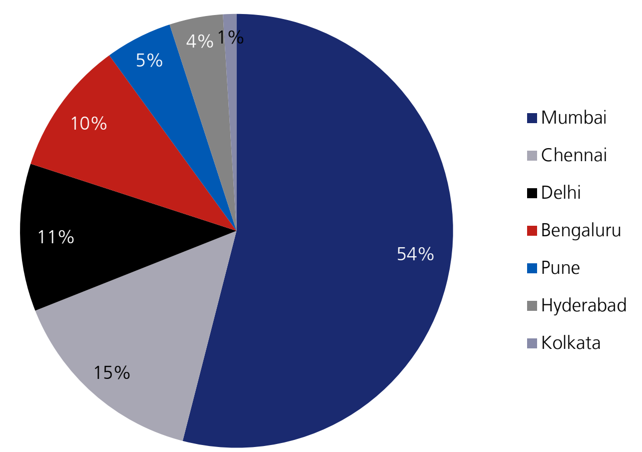
In terms of location, Mumbai has 54% of data centre capacity, followed by Chennai (18%). Availability of reliable power, cable handling stations, BFSI and Hyperscaler demand and absence of natural threats make these preferred locations for DC capacity.

Exhibit 24. Data centre capacity grew at a CAGR of 27% since 2020 and 23% since 2014 to reach 1,352GW in 2024
Data centre installed colocation IT load (MW)



Source: Cushman & Wakefield, CareEdge, JM Financial estimates

Exhibit 25. Data centre capacity of Mumbai, Chennai and Delhi accounts for 80% of installed capacity
City wise distribution of colocation capacity - %

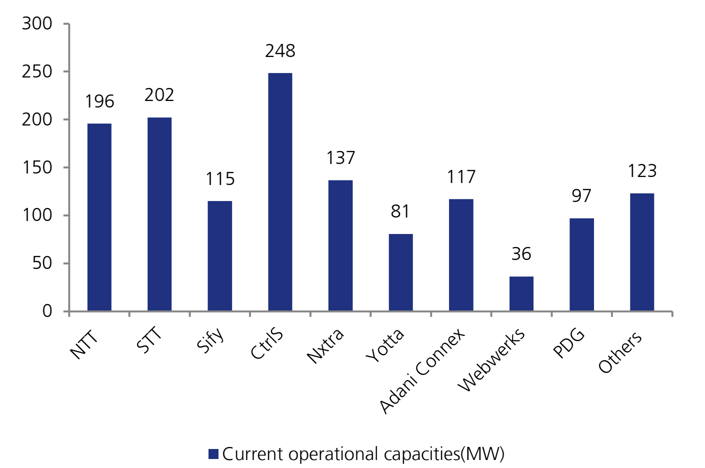


Source: Cushman & Wakefield, JM Financial

11. Who are the major data centre colocation operators in the country?

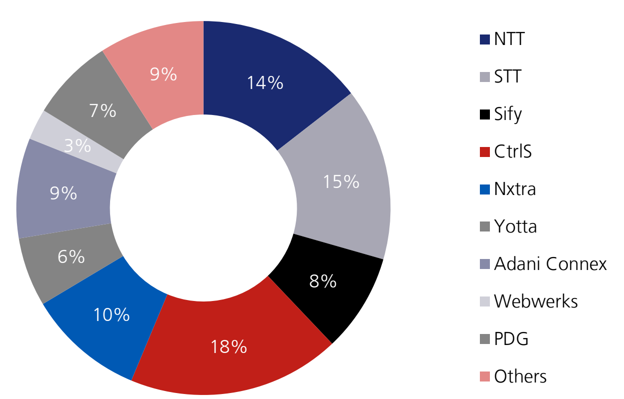
CtrlS, NTT and STT are the major colocation opertors in the country. CtrlS has its facilities primarily located in Mumbai, Chennai and Hyderabad. NTT has most of its facilities in Mumbai, and some in Bengaluru while STT is focused in Mumbai and Chennai. Sify has its facilities in Rabale (in MMR). Interestingly, Airtel's Nxtra has 50MW of edge data centre capacity spread over 120 sites.

Exhibit 26. CtrlS, NTT and STT are the largest players currently with combined capacity of more than 600MW
Current operational capacity – MW



Note: Capacities according to company websites. Source: Company, JM Financial

Exhibit 27. Top 5 players account for 66% of total operational capacity; Top 3 account for c.50%
Current capacities across players as a % of total



Note: Capacities according to company websites. Source: Company, JM Financial

12. What are the services offered by these colocation operators ?

The colocation operators in the country also offer other value-added services to their tenants. Many offer managed services offerings, some are involved in data centre design, and build-to-suit solutions where they build data centre facilities for clients. Almost all offer connectivity solutions where they provide connectivity to cloud, other data centres and to capacities within the same data centre. Data centre integration and migration services, where clients can transfer their data across IT infrastructure, is another service some operators offer.

Exhibit 28. Services offered by colocation operators

Operator	Services Offered
NTT	**Colocation:** flexible colocation options tailored to client needs
	Data centre implementation and management: comprehensive services ranging from planning and design to operation and optimization, including on-site support and 24x7 remote assistance
	Data centre connectivity: Carrier-neutral solutions providing high availability and secure interconnection with client infrastructures and ecosystems
STT	**Colocation:** Secure, scalable and flexible offerings for clients' critical infrastructure
	Connectivity: carrier neutral provider, i) cross connect: connections within Data centre, ii) Campus connect: between 2 data centres in the same campus, iii)Metro connect: connection between data centre in the same metro city, iv) Cloud connect: Secure connections to leading platforms. v) Dedicated internet access
	Support Services: Services include i) Remote hands service: Round the clock service for handling Data centre operations smoothly ii) Technical cleaning: specialized cleaning services of IT infrastructure
Sify	**Colocation:** flexible colocation solutions, accommodating deployments ranging from single cabinets to multi-megawatt.
	Build to suit solutions: They also offer built to suit data centres tailored to specific customer requirements. Additional services include physical migration of IT assets, cross-connects, 24x7 support and secure office spaces
	Data centre integration Services: Helps enterprises design, build, deploy, deliver and secure applications. Private cloud build: building cloud DC with full automation and centralized control. Data centre build: building on-prem DC for business-critical application. Data centre modernization: Standardizing, automating and enhancing security.
	Data centre integration services: DCI technology connects multiple DCs to facilitate data exchange and redundancy. Sify connects 66 DCs across India on a high speed network.
CtrlS	**Colocation:** CtrlS offers customized colocation solutions catering to various requirements from individual rack spaces to dedicated buildings.
	Managed Services: CtrlS provides remote infra management services: 24/7 monitoring and mgmt. of IT infra, comprehensive security mgmt. to protect critical assets. Backup as a service: Reliable data backup solutions to prevent data loss. Virtual desktop infra: secure and scalable virtual desktop solutions. Infra as a Service: Flexible infra solutions to meet dynamic needs.
	Connectivity: Cloud connect: seamless integration with cloud platforms, Metro connect: High speed connections between DCs in metros, Campus connect: data flow within campuses, Internet: reliable high speed internet, IX connect: Access to Internet exchange points for optimized network
Nxtra	**Colocation:** Secure, scalable and sustainable colocation services, providing businesses with necessary space and infra to power their digital operations
	Interconnections: Interconnect services enabling businesses to bridge and integrate their infra effectively
	Bespoke solutions: tailored to meet specific business requirements, custom built security measures and fit outs
	Migration: smooth transition when moving into new premises, minimizing business disruptions
Yotta	**Colocation:** provides state of the art colocation. Scalable, secure physical spaces with reliable power, cooling, fire detection and suppression. Multi-tenant colocation services are designed for high efficiency and affordability
	Cloud Services: Yotta's enterprise cloud, hosted in their tier 4 DC in Navi Mumbai, delivers cost efficient public cloud services including compute, storage, connectivity and business continuity solutions
	Managed IT services: Offers integrated Managed services encompassing DC operations, connectivity, security, cloud and IT management.
	Connectivity solutions: DCI (data centre interconnect) tech connects multiple DCs over distances using high speed connectivity
Adani Connex	**Colocation:** Colocation services offering robust facilities designed for 99.99% uptime, ensuring maximum reliability for client's critical infrastructure
	Build to suit solutions: They offer customized DC solutions tailored to specific business requirements
	Connectivity : Carrier neutral, ensures seamless connectivity with major telecom providers, facilitating efficient data flow and network integration
	Managed Services : Range of MS to support client's needs ensuring optimal performance and security of DC operations
Webwerks	**Colocation:** Web werks provides colocation services to wholesale, retail and hyperscale customers.
	Cloud computing: They offer both private and public cloud computing solutions, enabling businesses to choose the best-fit environment for their applications and workloads
	Dedicated Servers: Web werks provides dedicated server solutions, offering businesses full control and enhanced performance for their hosting needs
	Managed services: Managed services encompass apps, middleware, web hosting, DB management and more
	Back up as a Service (BaaS): Offer backup solutions to protect critical data and ensure business continuity
	Security as a Service (SecaaS): Web Werks provides comprehensive security services to safeguard digital assets
	Disaster recovery as a Service (DRaaS): DRaaS solutions help businesses recover quickly from disruptions
PDG*	**Hyperscale data centres:** PDG specializes in developing large scale hyperscale DCs designed to meet the expansive needs of cloud and AI companies.
	Colocation services: PDG offers colocation solutions that provide secure, reliable infra for businesses to house their IT infra.

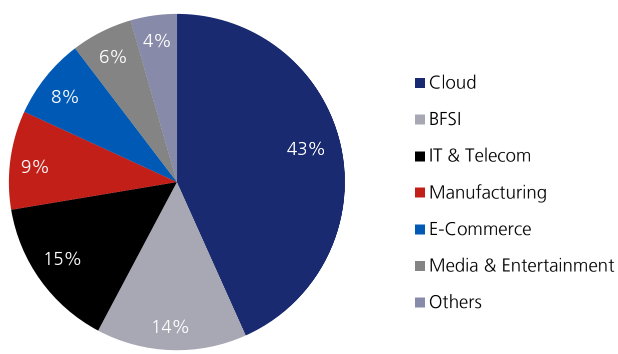
Note: *PDG – Princeton Digital Group. Source: Company, JM Financial

13. Who are the tenants of India's data centre capacity?

Cloud service providers are the major tenants of colocation capacity in India (43%). Colocation capacity allows them to scale with low upfront capex and strategically locate incremental capacity.

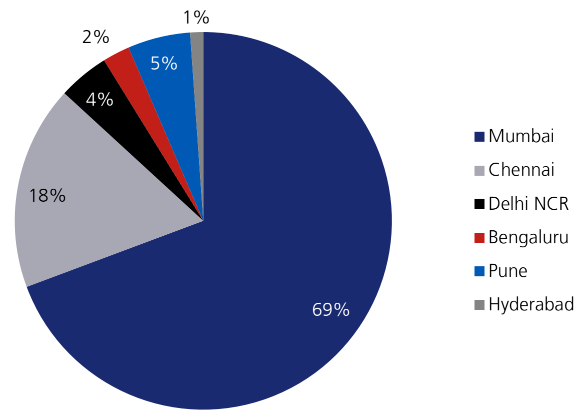
Hyperscaler occupied capacity is located in Mumbai and Chennai; together, these two cities account for more than 90% of capacity. Cable landing stations in these cities make them preferred locations for hyperscalers. Mumbai has 12 landing stations while Chennai has 4. BFSI tenants also prefer Mumbai; c.56% of BFSI occupied capacity is located in Mumbai. 37.4% of IT/Telecom capacity is located in Mumbai, while Bengaluru accounts for 24%. IT/Telecom load accounts for 35% of Bengaluru's capacity.

Exhibit 29. Hyperscalers, BFSI and Telecom tenants occupy ~75% of colocation capacity
Tenant-wise distribution of Colocation capacity (2023)



Source: Cushman & Wakefield, JM Financial

Exhibit 30. Mumbai and Chennai equipped with cable landing stations account for 90% of cloud occupied colo capacity
City wise distribution of cloud occupied colocation capacity (2023)



Source: Cushman & Wakefield, JM Financial

C. Drivers for Data Centre Demand

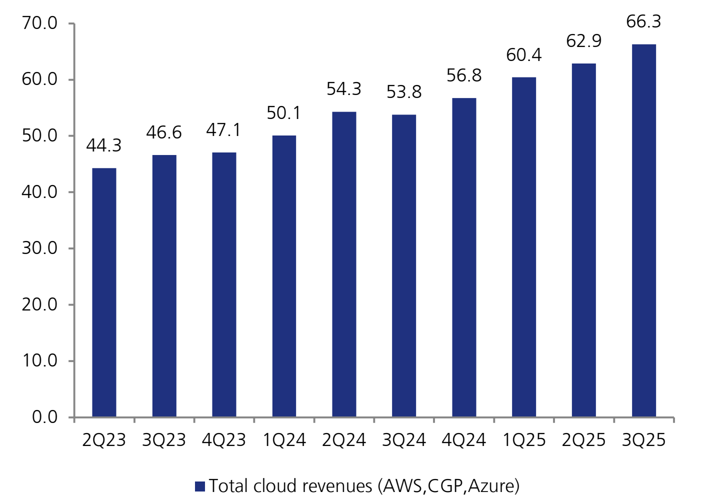
14. How is cloud adoption set to drive data centre demand?

Cloud adoption in India is acclerating rapidly, driven by a combination of enterprise digital transformation, government iniatitives, and technological innovation. Enterprises are increasingly moving beyond cost optimisation to leverage cloud for agility, innovation and data monetisation. With 5G rollout, expanding AI applications and a young, digitally adept population, cloud has become foundational to digital infrastructure. This surge is translating directly into growing need for data centres.

Hyperscalers such as Microsoft are investing heavily in capex (mostly towards cloud/AI DC infra); the LTM capex of Microsoft grew 83% YoY. Given that Microsoft's capex is based on demand signals, we can see the significant demand for cloud capacity from enterprises. Other Hyperscalers are also making massive investments in cloud/AI DC infrastructure.

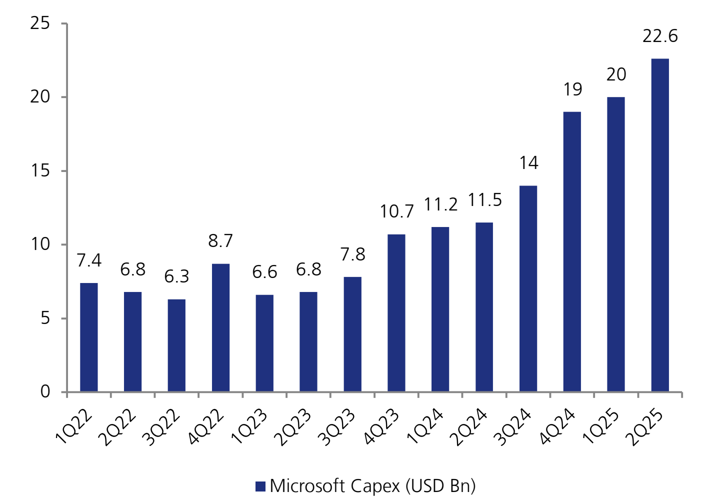
Cloud revenue also continues to grow at a healthy pace. LTM revenue for the largest players grew at 20.1% YoY, in the latest quarter. The global cloud computing market is expected to grow at a CAGR of 17% to reach USD 1.6trln. The growing cloud market is bound to drive further demand for DC capacity.

Exhibit 31. Hyperscaler LTM revenue grew 20.1% YoY in 3QFY25, double high digit growth expected in the medium term
Total cloud revenue (AWS,GCP,Azure) – USD bn



Source: Company, JM Financial

Exhibit 32. LTM capex for Microsoft grew 83% YoY bolstered by cloud/AI related capex, other players also making similar investments
Microsoft capex including capital leases (USD bn)



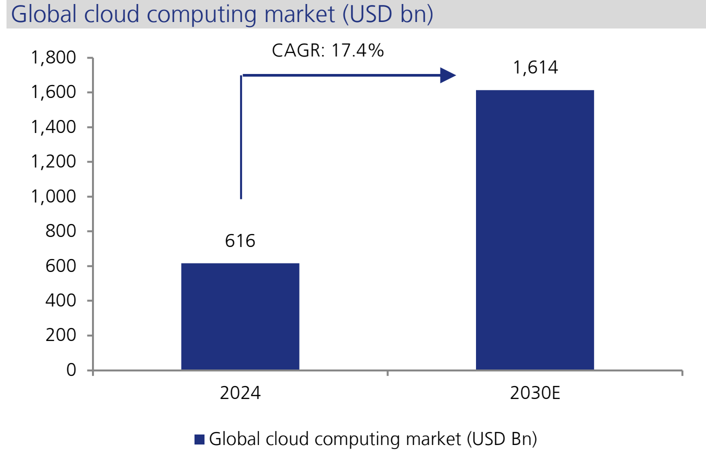
Source: Company, JM Financial

Exhibit 33. Reasons why companies are adopting cloud

Drivers for cloud adoption	% of companies surveyed
Cost saving	82.5%
AI/ML and data analytics	79%
Modernize data infrastructure	78%
Observability	67.0%
Monetization of data	63%
Developer productivity	51%
Data modernization	49%
Business growth	47%
Optimization	47.0%
Innovation and incubation	43%
Collaboration and workplace productivity	40%
App Modernization	40.0%

Source: EY Survey, JM Financial

Exhibit 34. Global cloud computing market still in high growth phase, potential for acceleration to due to GenAI
Global cloud computing market (USD bn)



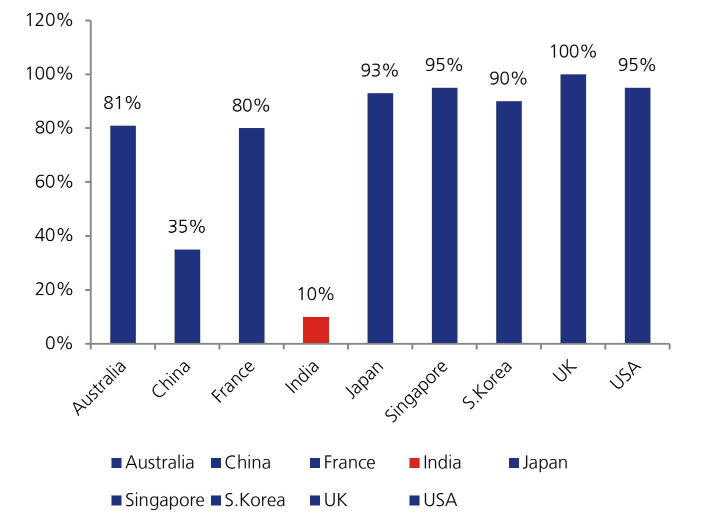
Source: Precedence research, JM Financial

15. How is 5G and 4G adoption among Indian consumers set to drive data centre demand?

India's accelerating 4G and 5G adoption is set to significantly boost data consumption, thereby driving demand for data centre capacity. India's 5G connectivity is currently at just10%- well below global peers- but is poised to rise sharply. 4G penetration is under 50% currently but is expanding rapidly. Total 4G and 5G subscribers are expected to grow at a CAGR of 10.5%, from 855mn in 2023 to 1.15bn in 2026.

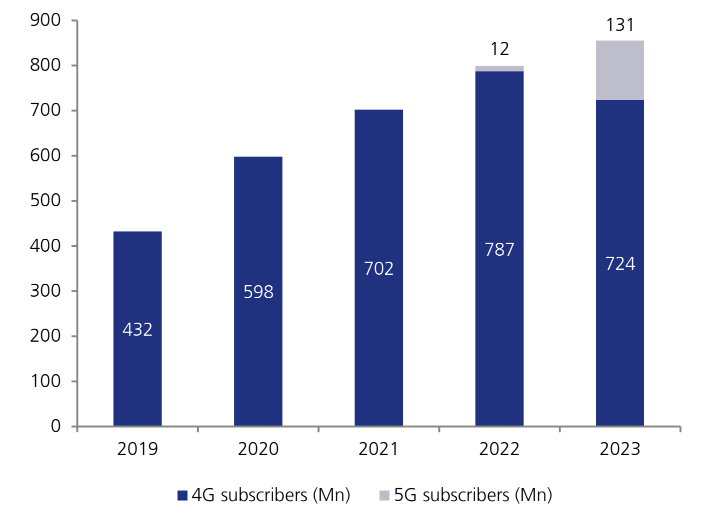
5G subscribers are set to rise from 131mn in 2023 to 575mn in 2026; this adoption is set to drive exponential growth in 5G data usage. 5G data usage is expected to grow 10x from 2023-2026. This explosive growth in mobile broadband usage will require robust digital infrastructure, fuelling large-scale investments in data centres to meet the surge in latency sensitive and high throughput applications.

Exhibit 35. 5G adoption in India is well below global average, 5G adoption is expected to rise in the future driving data usage further
5G connectivity coverage across population-%



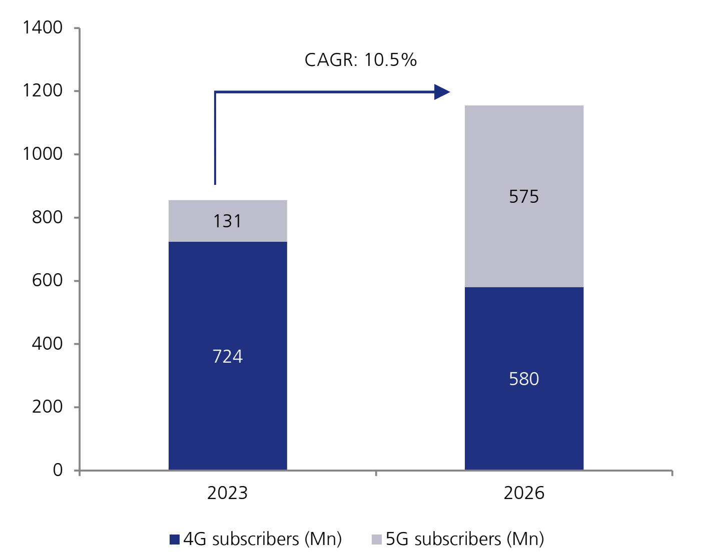
Source: Cushman & Wakefield, JM Financial

Exhibit 36. 4G penetration at c.50% currently, this is expected to expand in the future
4G and 5G subscribers (mn)



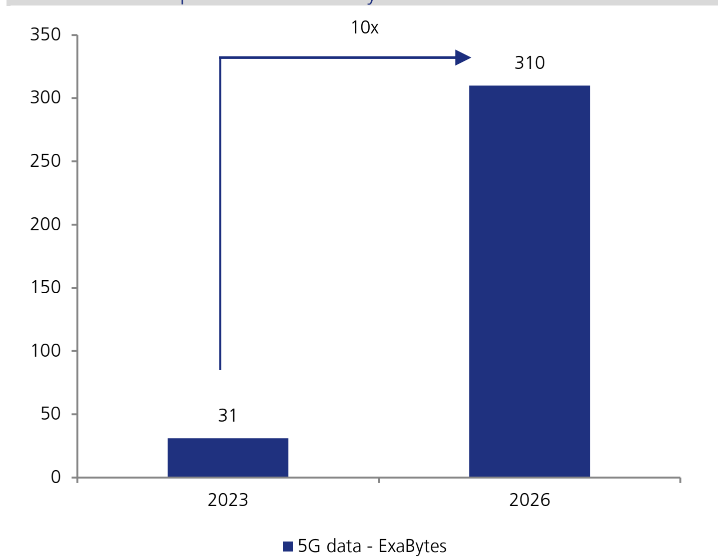
Source: Nokia, Mobile broadband index 2024, JM Financial

Exhibit 37. 4G and 5G subscribers are expected to grow at a CAGR of 10.5% to 1,155mn by 2026
4G and 5G subscribers (mn)



Source: Nokia, Mobile broadband index 2024, JM Financial

Exhibit 38. 5G data consumption is expected to rise 10x from 2023 to 2026, driving further demand for data centre capacity
5G data consumption 2026 – ExaBytes



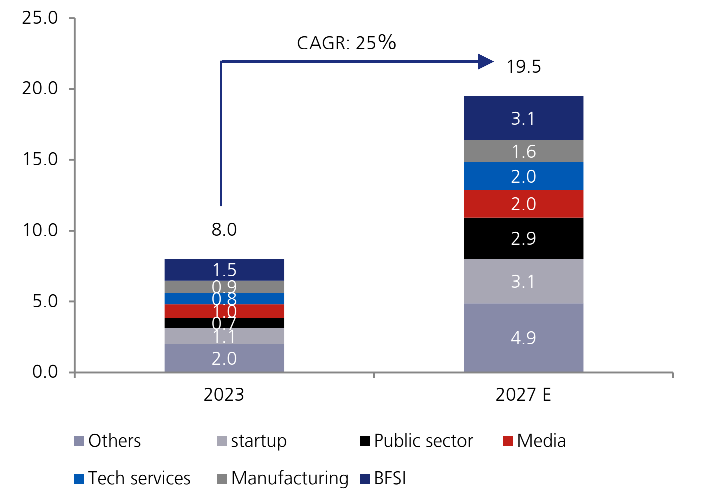
Source: Nokia, Mobile broadband index 2024, JM Financial

16. How will increased adoption of AI drive data centre demand in India?

India's accelerating AI adoption is set to be a major catalyst for data centre demand. The Indian AI market is projected to grow at 25% CAGR, reaching USD 19.5bn by 2027, with sectors like tech services and BFSI leading the charge. Globally, GenAI-based IT workload (MW) is expected to grow at 34% CAGR from 2024–2030. In India, dedicated GenAI data centre capacity in India could potentially exceed 1.1GW by 2030.

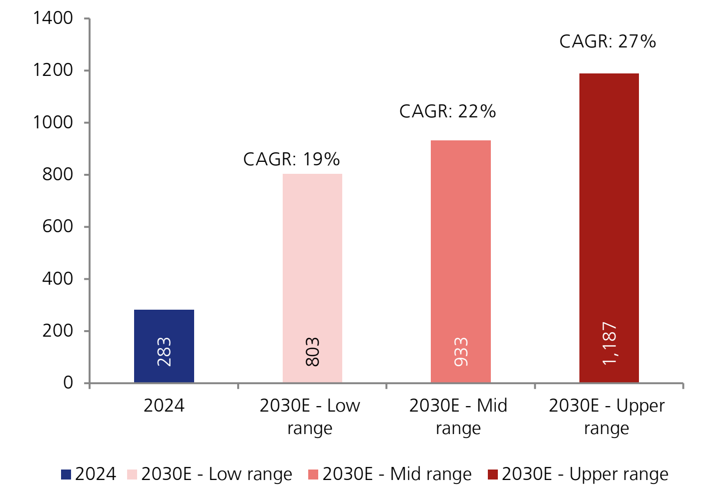
Globally, the AI market (ML, vision, GenAI) is expected to grow at 31% CAGR, reaching USD 350bn by 2027. All of this is expanding the need for hyper scale and AI-ready infrastructure. The scale and performance requirements of GenAI models are pushing enterprises and hyperscalers to invest in new data centre capacity capable of handling high-density compute, networking, and storage.

Exhibit 39. India AI market growing at a CAGR of 25% will drive massive capex investments in Data centre capacities
India AI market – USD bn



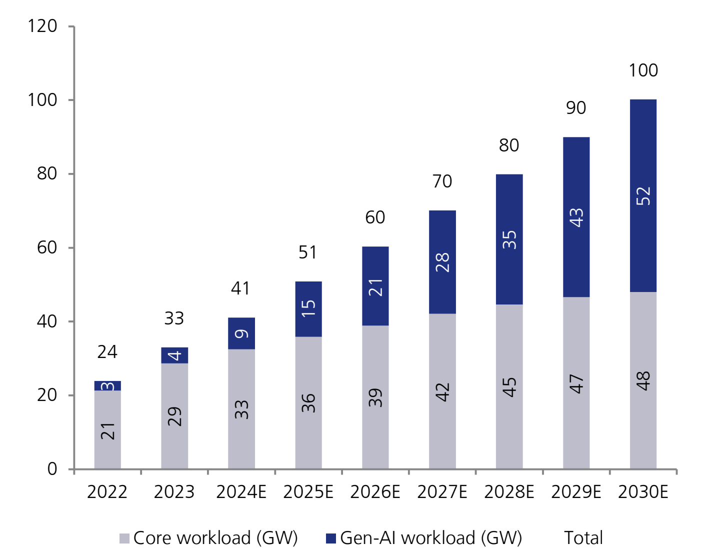
Source: JLL, JM Financial

Exhibit 40. Gen-AI workload dedicated DC capacity has potential to cross c.1.1GW by 2030, generating massive capex
India Gen-AI dedicated DC capacity (MW)



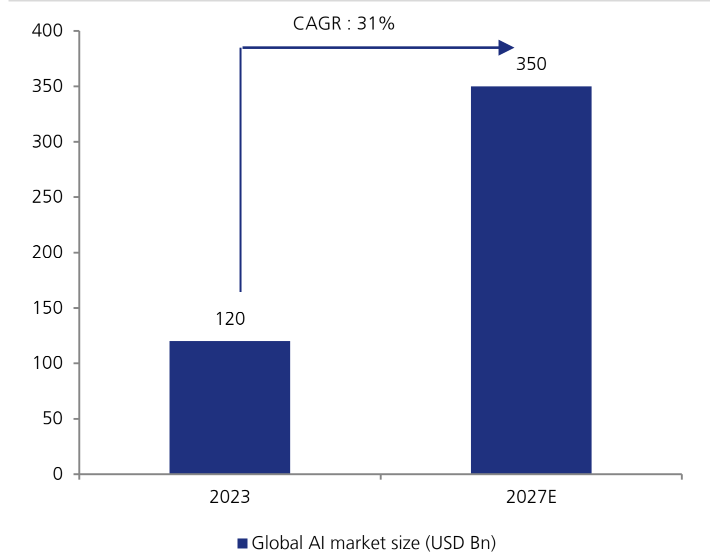
Source: McKinsey, JM Financial estimates

Exhibit 41. GenAI IT workload to grow at a CAGR of 34% during 2024-2030E, driving the need for incremental capacity
Core workload (MW) and Non-GenAI workload (MW)



Source: CBRE, DataCenterHawk, Factset, JM Financial

Exhibit 42. Global AI market size is expected to grow at a CAGR of 31%, requiring massive investments in supporting infrastructure
Global AI market size – USD bn



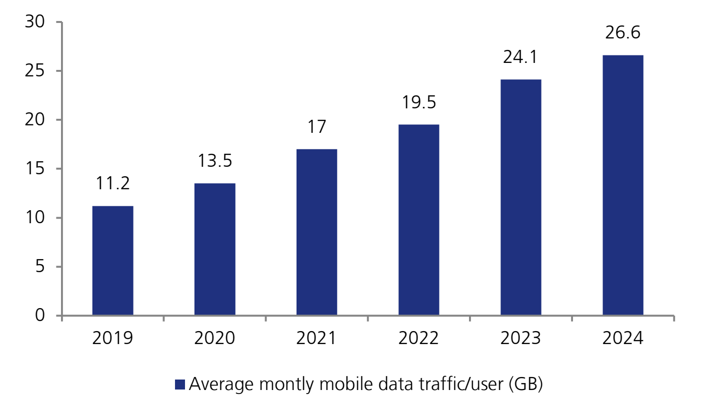
Source: JLL, JM Financial

17. What is the current and expected mobile data consumption in India and is the current data centre capacity sufficient to cater to that?

The growth in mobile traffic is being driven by multiple factors. Affordable data costs (data cost in India is one of the lowest in the world), 5G rollout, 4G adoption, the rise of video streaming, online gaming, increased enterprise adoption of cloud and AI are driving data usage. Along with this, government initiatives such as Digital India, IndiaAI mission are providing regulatory push to data usage.

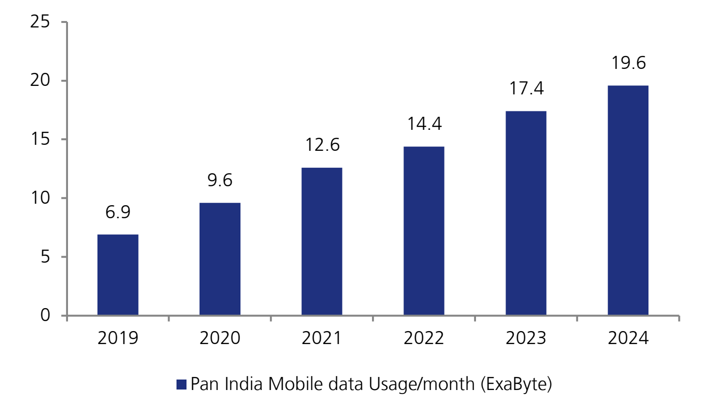
Average monthly mobile traffic/user has grown at a CAGR of 19% since 2019 to reach 26.6 GB per month in 2024. Overall data usage per month stands at 19.6 ExaBytes per month. In 2024 only 736 Mn people were users of mobile data, representing c.50% of the population. The number of mobile data users are expected to grow to reach 829 Mn people by 2030.

Exhibit 43. Average monthly mobile traffic/user has grown at a CAGR of 19% over the last 5 years to reach 26.6 GB
Average monthly mobile data traffic/user (GB)



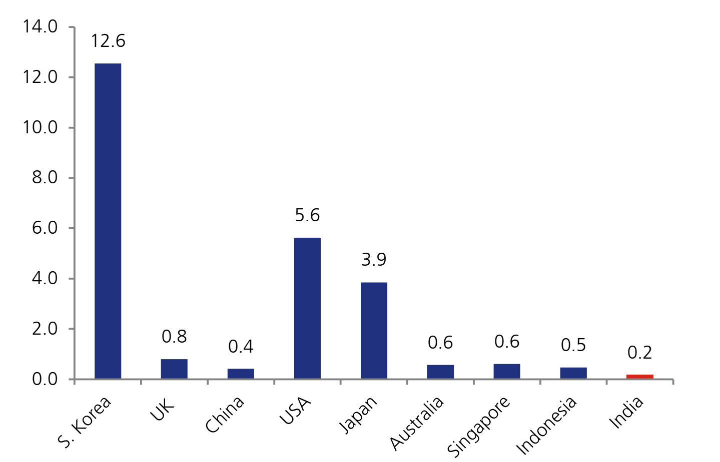
Source: Ericsson, India mobile broadband index- Nokia, JM Financial

Exhibit 44. Pan-India data usage has grown at a CAGR of 23% from 2019. We expect data usage to continue to grow
Pan-India mobile data usage/month (Exabyte)



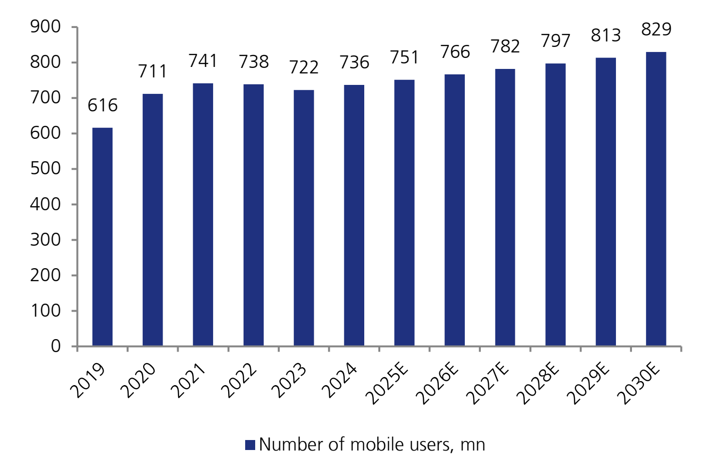
Source: Ericsson, India mobile broadband index- Nokia, JM Financial

Exhibit 45. Cost of purchasing data in India is one of the lowest relative to other countries
Average price of data across countries (USD)



Source: Cushman & Wakefield, JM Financial

Exhibit 46. The number of mobile data users to grow at a CAGR of 2% to 829mn by 2030
Number of mobile users – mn



Source: Ericsson, India mobile broadband index- Nokia, JM Financial

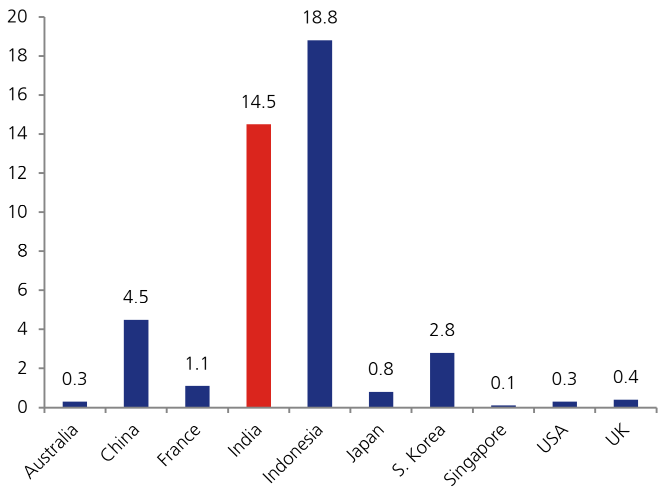
D. Projection of India's Data Centre Capacity

18. What is India's data centre density relative to the world and how is it expected to evolve?

India's data centre density is significantly lower than the global average. Currently, it stands at 14.5 PB/MW as compared to 4.5 for China and 0.3 for US. Capacity addition at a CAGR of 25% till 2030 will take India's data centre density to 9.0 PB/MW, which is still 2x that of China's current density. Thus, there is a large supply-demand mismatch currently that needs fixing. Massive investments in capacity announced by various operators and investor groups give some confidence that supply is catching up. Data centre density will however continue to trail that of the developed markets in the near term.

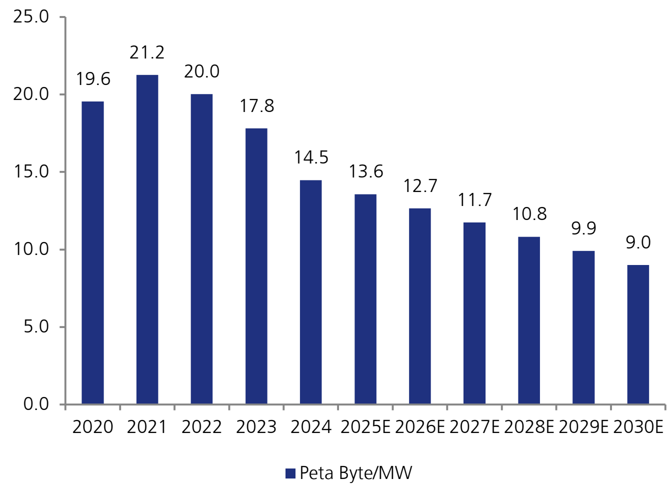
As of 2023, India had 915 internet users per MW, this is 18x/3x that of the US/China, indicating substantial under-penetration. Even after the projected capacity additions, India will still have 8x/1.7x the number of users per MW as US/China. Given the high data usage of Indians, DC capacity needs to do extensive catch-up to meet demand.

Exhibit 47. India's DC density is significantly lower when compared to global averages. It is at 14.5PB/MW currently vs. 4.5 for China
Peta Bytes/MW - 2023



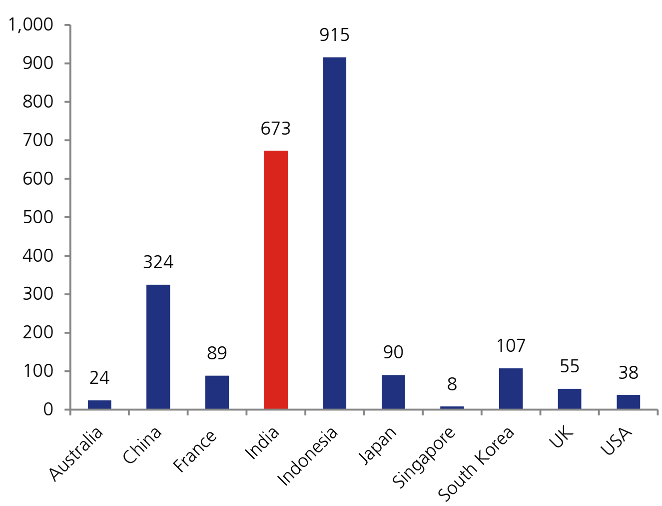
Source: Cushman & Wakefield, JM Financial

Exhibit 48. Projected capacity addition expected to take the PB/MW from 14.5 down to 9.0; at 9.0, PB/MW is 2x that of China's
Peta Bytes/MW – 2020-2030E



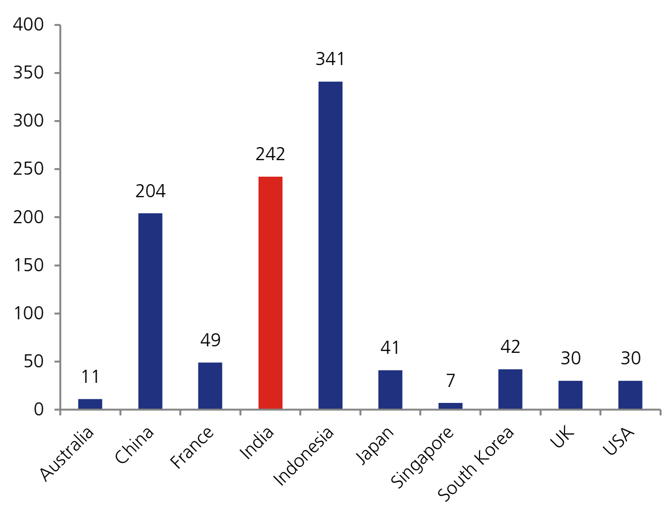
Source: Cushman & Wakefield, JM Financial estimates

Exhibit 49. The number of users per MW of data centre capacity is 18x/3x that of the US/China
Internet users per MW (2023) – 000's



Source: Cushman & Wakefield, JM Financial

Exhibit 50. Post projected capacity addition, User per MW would still remain considerably high as compared to US (8x) and China (1.7x)
Internet users per MW (2028)– 000's



Source: Cushman & Wakefield, JM Financial

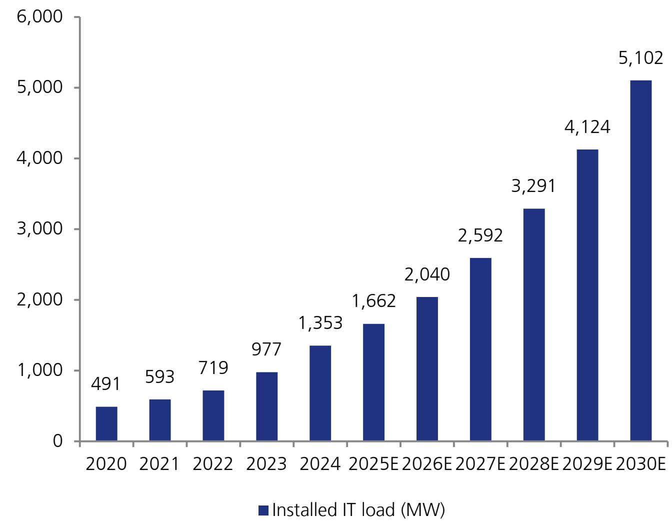
19. What could potentially be the installed data centre capacity in India by 2030?

We have used PB/MW benchmark across the world to estimate India's colo DC capacity by 2030. India's current DC density (measured in PB/MW) is at 14.5, better only to that of Indonesia. China, on the other hand, has a density of 4.5. Developed market DC density is far lower. India's rising data consumption is further going to suppress India's DC density. We have therefore assumed that India's DC density should conservatively reach 9 PB/MW, still 2x of China's (in other words half of China's current DC density).

Based on this, we expect DC capacity in India to surpass 5GW by 2030, registering a CAGR of 25% over this period. We expect steady growth in the number of mobile users and the average mobile traffic/user to raise the pan-India mobile usage to c.45 exabytes per month by 2030. Growth in data usage and increase in data centre density informs our capacity projection of 5.1GW by 2030.

Exhibit 51. We estimate India's DC capacity to grow at 25% CAGR over 2024-2030E to reach 5.1GW

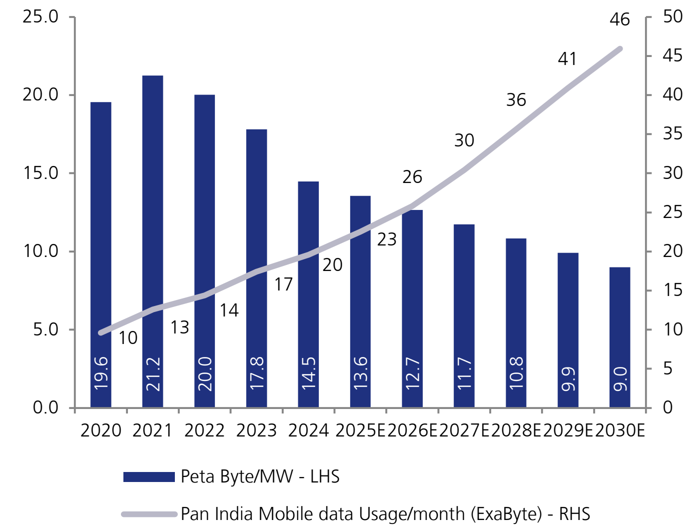
Data Centre capacity demand projection – 2024-2030E



Source: JM Financial Estimates

Exhibit 52. Our projection is based on the assumption that India's DC density will approach half of China's by 2030

Pan-India mobile data usage/month (exabyte)



Source: JM Financial Estimates

Exhibit 53. Demand projection for data centre capacity

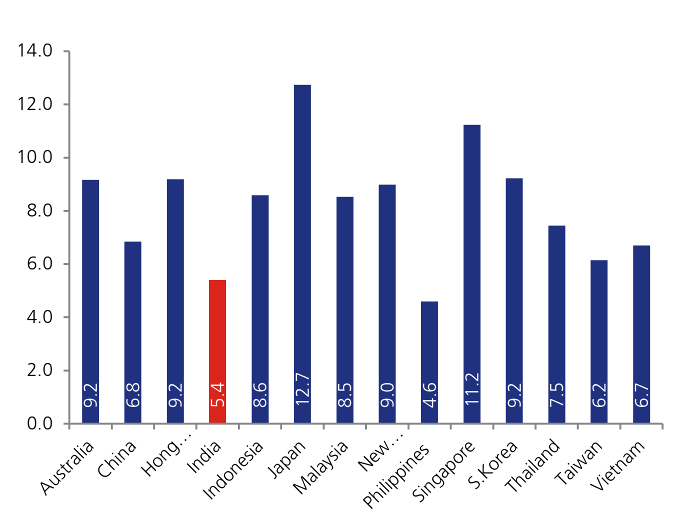
	2020	2021	2022	2023	2024	2025E	2026E	2027E	2028E	2029E	2030E
Average monthly mobile data traffic/user (GB)	13.5	17.0	19.5	24.1	26.6	30.0	33.7	38.9	44.7	50.3	55.4
Growth, YoY	20.5%	25.9%	14.7%	23.6%	10.4%	12.9%	12.2%	15.6%	14.8%	12.5%	10.1%
Number of mobile users, mn	711	741	738	722	736	751	766	782	797	813	829
Growth YoY	15%	4%	0%	-2%	2%	2%	2%	2%	2%	2%	2%
Pan India Mobile data Usage/month (ExaByte)	9.6	12.6	14.4	17.4	19.6	22.6	25.8	30.4	35.6	40.9	45.9
Growth YoY	39.1%	31.3%	14.3%	20.8%	12.6%	15.1%	14.5%	17.9%	17.1%	14.8%	12.3%
Peta Byte/MW	19.6	21.2	20.0	17.8	14.5	13.6	12.7	11.7	10.8	9.9	9.0
Installed IT load (MW)	**491**	**593**	**719**	**977**	**1,353**	**1,662**	**2,040**	**2,592**	**3,291**	**4,124**	**5,102**

Source: Cushman & Wakefield, India Mobile broadband index, Ericsson, JM Financial estimates

20. Can India become a global hub for data centre capacity?

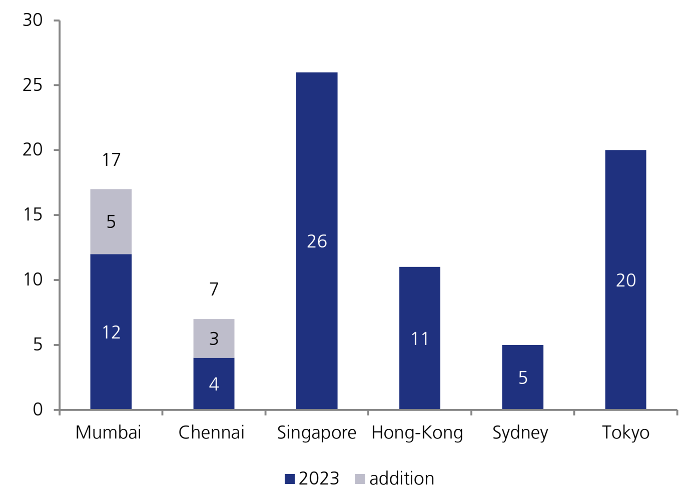
India has the potential to emerge as a preferred data centre hub for the entire SEA region. This can further drive growth in capacity beyond our 2030 projection. India's cross-border connectivity is increasing; it is adding 8 more subsea cable landing stations (5 in Mumbai and 3 in Chennai), and the total will rival that of established hubs such as Singapore (26 cable landing stations). Capex per MW in India is one of the lowest in the world at USD 5.4mn, vs. 6.8 in China. Operating costs also will be lower with competitive industrial power costs and availability of low-cost technical talent. India also has ample power generation capacity and is rapidly adding capacity as well. Power generation capacity is set to increase from 453GW in 2024 to 815GW. India also has one of the largest renewable power generation capacities; India generates 203GW (45% of total) of renewable energy currently and is set to increase this to 500GW (61% of total) by 2030. This supports the growing demand for sustainable and green power for responsible data centre operators and hyperscalers. High cross-border connectivity, low capex and operating costs and ample renewable power make a compelling argument for India to become a global/regional data centre hub.

Exhibit 54. India is an attractive location for DC capacity, capex per MW is one of the lowest in the world
Capex per MW – USD mn



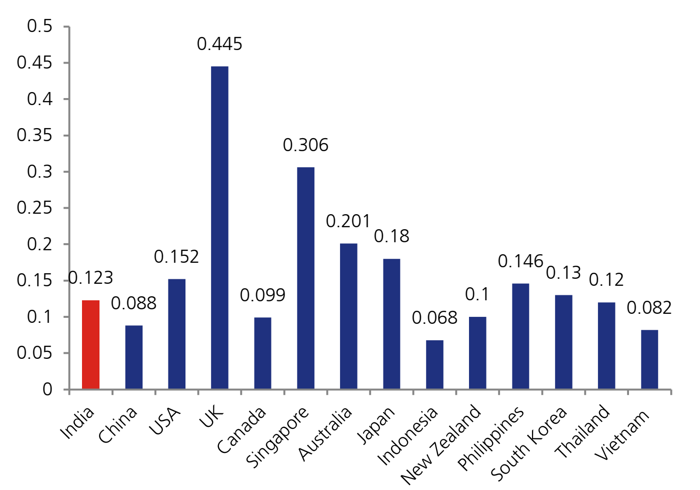
Source: Cushman & Wakefield, JM Financial estimates

Exhibit 55. Mumbai and Chennai combined will have 24 subsea landing cables by 2030, rivalling that of Tokyo/Singapore
No. of subsea landing cables – Nos



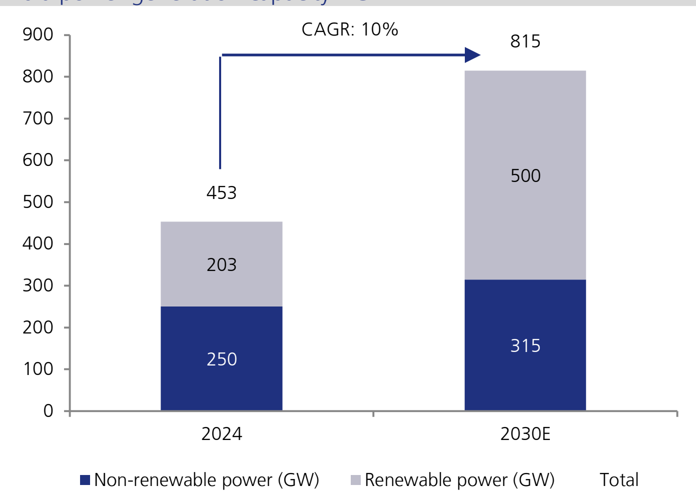
Source: Submarine networks, JM Financial

Exhibit 56. India's Industrial power cost per KWH is competitive globally, cheaper than developed countries
Industrial power cost per kWH – USD



Source: Electricity boards and Agencies, , JM Financial

Exhibit 57. India's power capacity is expected to double by 2030 and more than 60% of power generation to be from renewable sources
India power generation capacity - GW



Source: Central electricity Authority , JM Financial

21. What is the capex investment required to build the projected capacity?

The projected data centre capacity will require massive investments in capex. At INR 465mn (refer Q no. 25) of capex per MW, and growth in capex per MW in line with inflation, we estimate that over the next 6 years, Indian data centre colocation industry will see investments of INR 2,055bn/USD 24bn. This figure can trend higher with higher increase in costs or with higher initial capex estimate. Our capex estimate is for a generic colocation facility; the capex can be higher for more complex and GPU-based facilities.

Exhibit 58. Estimation of capex over 2025-30E

	2024	2025E	2026E	2027E	2028E	2029E	2030E
Installed IT load (MW)	1,353	1,662	2,040	2,592	3,291	4,124	5,102
Growth YoY		23%	23%	27%	27%	25%	24%
Incremental Capacity (MW)		309	378	552	699	833	978
Growth YoY			22%	46%	27%	20%	17%
Capex per MW	**465**	484	503	523	544	566	588
Capex (INR Bn)	175	150	190	289	380	471	575
Total (INR Bn)							**2,055**
Total (USD Bn)							**23.6**

Source: JM Financial estimates

Exhibit 59. Sensitivity analysis. X-axis: Cost per MW (2024)- INR Bn . Y-Axis: cost increase -%

	300	350	465	500	550	600
2%	14.0	16.4	21.8	23.4	25.7	28.1
3%	14.6	17.1	22.7	24.4	26.8	29.3
4%	15.2	17.8	**23.6**	25.4	27.9	30.5
5%	15.9	18.5	24.6	26.5	29.1	31.8
6%	16.5	19.3	25.6	27.6	30.3	33.1
7%	17.2	20.1	26.7	28.7	31.6	34.4

Source: JM Financial estimates

22. What is the revenue potential from projected colocation capacity?

The average monthly recurring revenue in Mumbai ranges from INR 9.75K (sub-250KW) to INR 6.9K (>5MW) per KW; larger capacity tenants are given favourable rates. Prices in other data centre hub cities are lower as compared to Mumbai. We have taken a simple average of the prices here as we do not have visibility into the average capacity rented by tenants. We estimate the blended average MRR at INR 7.7K per KW. Without assuming any MRR increase the yearly revenue works out to be INR 585bn/ USD 6.8bn. The market size for colocation players is therefore huge. Given that this is a fast-growing market and given the demand drivers, the data centre market is an attractive market for investment.

Exhibit 60. Revenue potential of upcoming capacity

Monthly Recurring Revenue (MRR)-INR per KW	Mumbai	Chennai	Pune	Hyderabad	Delhi-NCR	Bengaluru	Kolkata	Blended
Sub 250 kw	9,750	8,625	7,688	8,625	8,625	8,250	9,000	**8,652**
250kw-1MW	8,438	8,250	7,238	7,800	7,800	7,988	7,875	**7,913**
1-5 MW	7,313	7,500	6,750	7,050	7,050	7,500		**7,194**
5 Mw plus	6,938	6,563	6,188	6,750	6,750	6,638		**6,638**
Average	**8,109**	**7,734**	**6,966**	**7,556**	**7,556**	**7,594**	**8,438**	**7,708**
Current (2024) Revenue potential	**Mumbai**	**Chennai**	**Pune**	**Hyderabad**	**Delhi-NCR**	**Bengaluru**	**Kolkata**	**Total**
Current capacity (EST)	730	203	68	54	149	135	14	**1,352**
Revenue potential monthly (INR Mn)	5,920	1,569	471	409	1,124	1,027	114	**10,421**
Revenue potential yearly (INR Mn)	71,046	18,822	5,651	4,904	13,485	12,320	1,369	**127,597**
Revenue potential yearly (USD Mn)	**826**	**219**	**66**	**57**	**157**	**143**	**16**	**1,484**
2030E Revenue potential	**Mumbai**	**Chennai**	**Pune**	**Hyderabad**	**Delhi-NCR**	**Bengaluru**	**Kolkata**	**Total**
2030E Capacity	2,648	729	183	599	561	295	87	**5,102**
Average MRR - 2030 E	9,866	9,410	8,475	9,193	9,193	9,239	10,266	
Revenue potential monthly (INR Mn)	26,122	6,864	1,554	5,507	5,160	2,724	892	**48,823**
Revenue potential yearly (INR Mn)	313,465	82,371	18,642	66,087	61,919	32,686	10,708	**585,879**
Revenue potential yearly (USD Mn)	**3,645**	**958**	**217**	**768**	**720**	**380**	**125**	**6,813**

Source: JLL, Cushman & Wakefield, JM Financial estimates

23. What is the target D/E ratio used to finance capex in data centre capacity?

An analysis of the global listed players in the data centre colocation industry indicates that D/E ratios range from as low as 0.37 to as high as 1.91. The average D/E is 0.91. We believe a gearing of 1.0 is a fair assumption given the high initial capex, and fixed nature of the assets. Debt financing should be easy to obtain given the cash flows and the recurring nature of revenue.

Exhibit 61. D/E ratio for publicly traded colocation data centre companies

Name	Equity (LC Mn)	Debt (LC Mn)	D/E
Equinix Inc	13,527	17,486	1.29
Digital Realty	21,340	16,712	0.78
Iron Mountain	-304	13,718	NA
Next DC	3,567	1,375	0.39
Keppel DC REIT	3,426	1,715	0.50
Digital Core REIT	1,279	548	0.43
GDS Holding	3,094	5,897	1.91
Meeza	725	271	0.37
VNET	6,514	10,645	1.63
Average			**0.91**

Source: Company, JM Financial

24. What is the amount of equity that needs to be raised to finance the required data centre capex?

The massive investments required to meet demand for data centre capacity implies that a substantial amount of equity has to be raised either through the public markets or through private sources of capital. At our capex assumption of INR 465mn and assuming inflation-linked growth in capex costs, we estimate capex of INR 2,055bn. At a D/E of 1.0, this works out to INR 1,027.5bn/USD 11.95bn of equity to be raised. If operators choose to employ more debt financing, then the equity raise could reduce to USD c.8bn levels.

Exhibit 62. More than USD 10bn of equity needs to be raised to finance the required data centre capex

	2024	2025E	2026E	2027E	2028E	2029E	2030E
Installed IT Load, MW	1,353	1,662	2,040	2,592	3,291	4,124	5,102
Incremental capacity (MW)		309	378	552	699	833	978
Capex per MW	465	484	503	523	544	566	588
Capex (INR Bn)		150	190	289	380	471	575
Capex (USD bn)		1.74	2.21	3.36	4.42	5.48	6.69
D/E Ratio		1.0	1.0	1.0	1.0	1.0	1.0
Equity (USD Bn)		0.87	1.10	1.68	2.21	2.74	3.35
Debt (USD Bn)		0.87	1.10	1.68	2.21	2.74	3.35
Total Equity to be raised (USD Bn)							**11.95**
Total Debt to be raised (USD Bn)							**11.95**

Source: JM Financial estimates

Exhibit 63. Sensitivity analysis, X-axis: Capex per MW, Y-axis: D/E ratio

	300	350	465	500	550	600
0.05	14.7	17.1	22.8	24.5	26.9	29.4
0.75	8.8	10.3	13.7	14.7	16.2	17.6
1.00	7.7	9.0	12.0	12.8	14.1	15.4
1.25	6.9	8.0	10.6	11.4	12.6	13.7
1.50	6.2	7.2	9.6	10.3	11.3	12.3
2.00	5.1	6.0	8.0	8.6	9.4	10.3

Source: JM Financial estimates

E. Unit Economics

25. What is the average capex per MW of colocation capacity in India?

We estimate that the average capex per MW in India is INR 465mn/ USD 5.4mn. This works out to roughly INR 24.2k of capex per sqft. This estimate is derived from various investment announcements made by colocation players, PE investors and business houses. Capex per MW ranges from INR 333mn for Anant Raj at the lower end, to INR 592mn announced by Colt and RMZ at the higher end.

Exhibit 64. Average capex per MW calculation; announced investment vs. capacity to be built

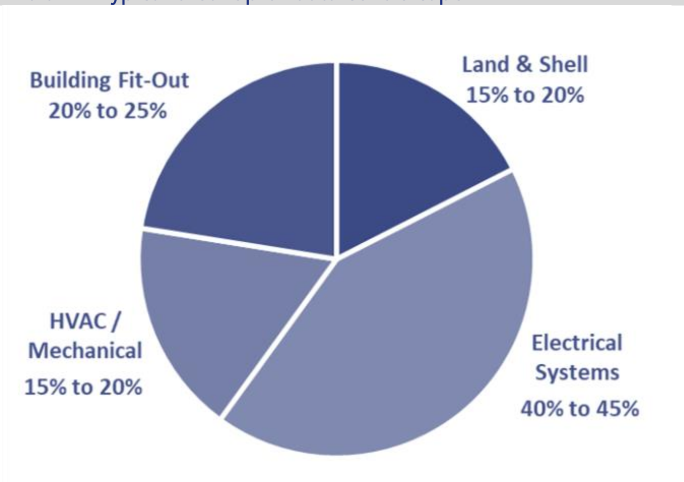
Source	Investment (INR Mn)	Capacity being built (MW)	INR Mn per MW	USD MN per MW	Capex per Sqft estimate (1000's)
Anant Raj	100,000	300	333	3.9	18.5
STT GDC	35,000	100	350	4.1	19.4
STT GDC	304,500	550	554	6.4	30.8
Colt and RMZ	147,900	250	592	6.9	32.9
Capitaland	100,050	244	410	4.8	22.8
PDG	87,000	230	378	4.4	21.0
Reliance	2,175,000	3,000	725	8.4	40.3
Adani Connex	348,000	1,000	348	4.0	19.3
Yotta	450,000	900	500	5.8	27.8
Blackstone	200,000	500	400	4.7	22.2
ICRA estimates	525,000	1,000	525	6.1	29.2
Average			**465**	**5.4**	**24.2**

Note: Announcements made by companies through media sources. Source: Company, JM Financial

26. What is the breakup of colocation capex outlay?

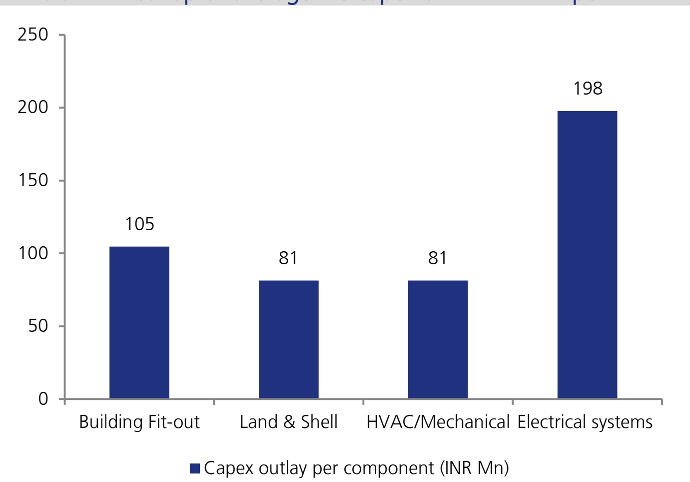
The capex outlay for data centre capacity is substantial and the breakup of this outlay can indicate the potential order book for capital goods companies. For 1MW, electrical systems will see an outlay of INR 198mn, for 3.7GW of incremental capacity; this implies INR 732bn of capex. Building and fit out players might see incremental order book of c.390bn from data centre capacity.

Exhibit 65. Typical breakup of data centre capex



Source: Dgtlinfra, JM Financial

Exhibit 66. Breakup of average DC capex of INR 465mn per MW



Source: Dgtlinfra, JM Financial

27. What is the incremental spend for Cloud/IT Infra spend per MW?

To set up operational cloud capacity, IT infrastructure is the incremental capex that needs to be done over and above the colocation infrastructure. We estimate that an average server costs INR 300K, and has an average power rating of 330W. A rack can fit 42 such servers, therefore the power load for a rack works out to 13.9KW. Based on this, we estimate the cost of servers to be INR 915mn for 1MW IT load. The overall cost for greefield cloud capacity of 1MW works out to INR 1,380mn.

Exhibit 67. Average capex per MW of cloud capacity

Servers	Form Factor	Price - lower end INR(000's)	Price - Higher end INR(000's)	Average INR(000's)	Wattage (W)
Dell PowerEdge R250	1U	150	250	200	250
HPE ProLiant DL20 Gen10	1U	180	280	230	240
Lenovo ThinkSystem SR250 V2	1U	250	350	300	260
Supermicro SYS-5019C-MR	1U	140	220	180	220
Lenovo ThinkSystem SR645	1U	520	680	600	680
Average		**248**	**356**	**302**	**330**
KW per rack (42U)					**13.9**
Cost of servers per rack (INR Mn)					**12.7**
Cost of servers per MW (INR Mn)					**915**
Cost of developing colocation per MW (INR MN)					**465**
Total cost of 1 MW of cloud capacity (INR Mn)					**1,380**

Source: Company, JM Financial

28. What are the various business model of a DC?

Exhibit 68. Various business models of a Data Centre

Business Model	Revenue Stream	Examples
Colocation Model (Retail & Wholesale Leasing)	Charging businesses for rack space, power consumption, and cooling.	Global: Equinix, Digital Realty
	Pricing varies based on server rack size (e.g., per rack, per cabinet, per cage) and power usage (kW per rack).	India: Sifi, STT
Cloud Services Model	Pay-as-you-go or subscription-based pricing for virtual machines (VMs), storage, and network resources.	AWS, Azure, GP
	Charges for data egress, API calls, and premium services (e.g., AI processing, advanced security).	India: E2E Networks, Yotta
Managed Services Model	Offering IT management, security, disaster recovery, and backup services as a subscription or contract	Globa: IBM Cloud, Rackspace
	Businesses outsource infrastructure management instead of handling it in-house	India: Anant Raj Cloud, Yotta
Wholesale Leasing Model	Leasing large portions of data center space or entire buildings to single enterprise customers or cloud providers	Bulk data center leasing by hyperscalers such as AWS, Azure, GCP
	Long-term contracts (often 5+ years) provide stable revenue.	
Interconnection Services	Charging fees for cross-connects, internet exchanges (IX), and private network links between businesses and cloud providers.	Global: Equinix

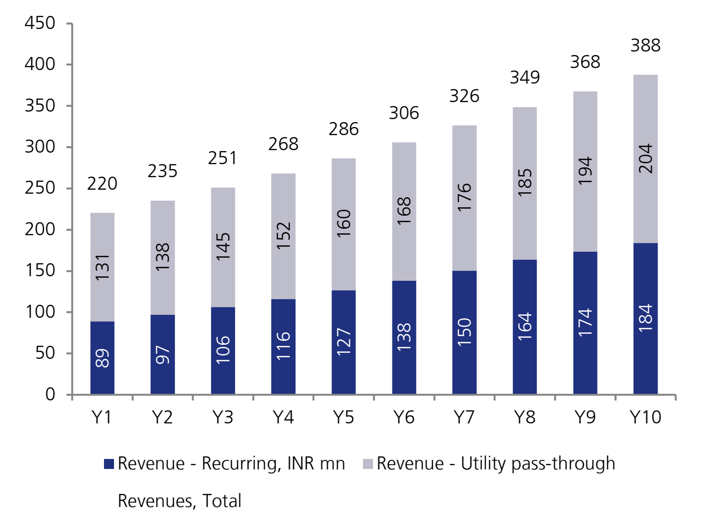
Source: Industry, JM Financial

29. What is the estimated revenues for 1MW colocation capacity ?

We estimate that the typical incremental capacity coming up in 2025 will have monthly recurring revenue of INR 9.5K per KW. We estimate the total revenue from 1 MW capacity in Y1 to be INR 220mn; this is expected to grow at a CAGR of 6.5% to INR 388mn in Y10. The recurring revenue will likely grow faster than the utility pass-through revenue. Utility costs associated with particular IT infrastructure installed by tenants are passed through to them. We estimate 6% growth in recurring revenue and c.5% growth in pass-through revenue.

Exhibit 69. Revenue potential of INR 220mn in Y1; expected to grow at a CAGR of 6.5% over 10 years to INR 388mn

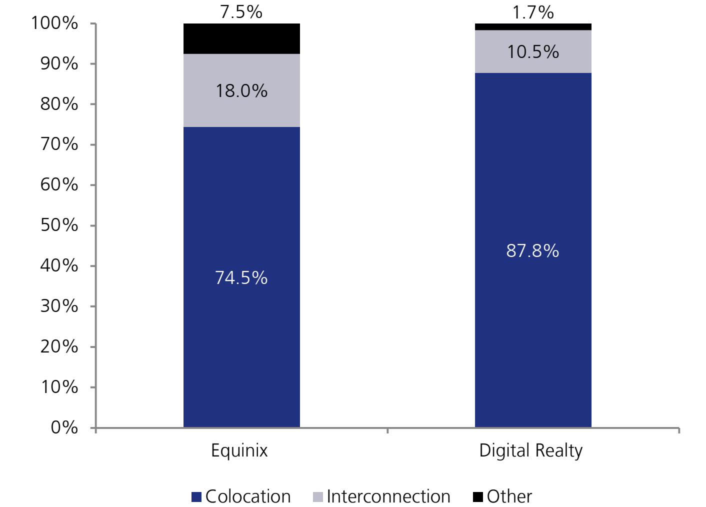
Estimated revenue for 1 MW colocation capacity – INR mn



Source: JM Financial estimates

Exhibit 70. Colocation operators derive 75%+ of their revenues from colocation and Utility pass through, 11-18% from interconnection

Breakup of global Colocation operator revenues – FY24



Source: Company, JM Financial

30. What are the key operational cost for a Data Centre?

Exhibit 71. Following are the key cost line items to run a DC operations

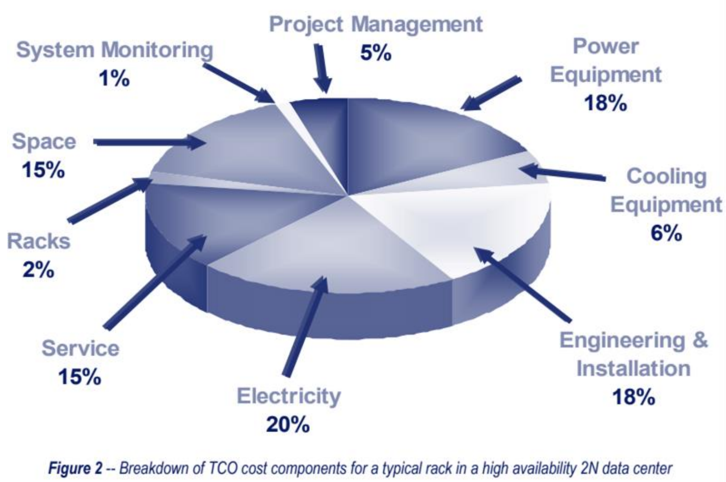
Cost Items	Description
Power and Cooling	**Electricity costs** (for servers, cooling, UPS, and lighting).
	Cooling systems (chillers, liquid cooling, airflow management).
	Backup power (fuel for generators, battery replacements).
	Energy efficiency initiatives (renewable energy, carbon credits).
Network & Bandwidth	Internet Service Provider (ISP) costs.
	Cross-connect fees for colocation customers.
	Dedicated fiber optic connectivity and peering costs
Maintenance & Repairs	Routine maintenance for **hardware, HVAC, UPS, and generators**.
	Spare parts for IT and power equipment.
	Hardware lifecycle replacement costs (servers, storage).
Security & Compliance	**Physical security** (guards, cameras, access control).
	Cybersecurity (DDoS protection, threat monitoring, patching).
	Audits & regulatory compliance (data sovereignty, GDPR).
Workforce & Staffing	Salaries for **network engineers, IT support, facility managers, security personnel**.
	Training and certification costs for staff.
Cloud & Software Costs (For cloud services model)	SaaS tools for monitoring, automation, and management.
	Licensing fees for proprietary software (Microsoft, VMware).
Additional Cost Factors	**Disaster Recovery & Backup**: Investment in secondary sites for redundancy.
	Scaling & Upgrades: Cost of expanding storage and compute resources.

Source: Industry, JM Financial

31. What is the breakdown of the total cost of ownership of a typical rack over its lifetime?

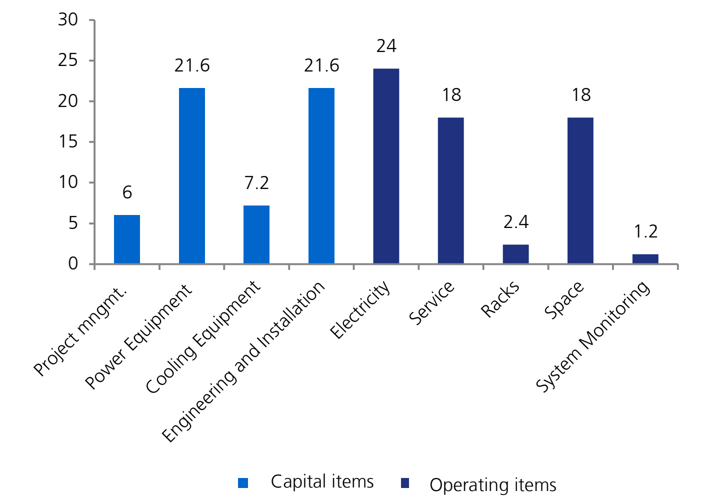
The total cost of ownership of a 1MW capacity can be broken down into 9 components as shown below. Capital items such as equipment, installation, etc. constitute c.50% of overall costs, and operating items constitutes the remaining 50%. APC estimates the lifetime costs of a typical rack to be USD 120K. The number of racks for 1 MW could range from 67 to 100. This implies TCO of USD 8mn-12mn per MW.

Exhibit 72. Breakdown of the total cost of ownership (lifetime) of a rack; 50% is capital expense and 50% is operating expense
Breakdown of lifetime TCO - %



Source: APC, JM Financial

Exhibit 73. The TCO (lifetime) of a typical rack is USD 120K per rack; typically there are 67-100 racks per MW
Breakdown of TCO (USD 120K) across expenses – USD 000's

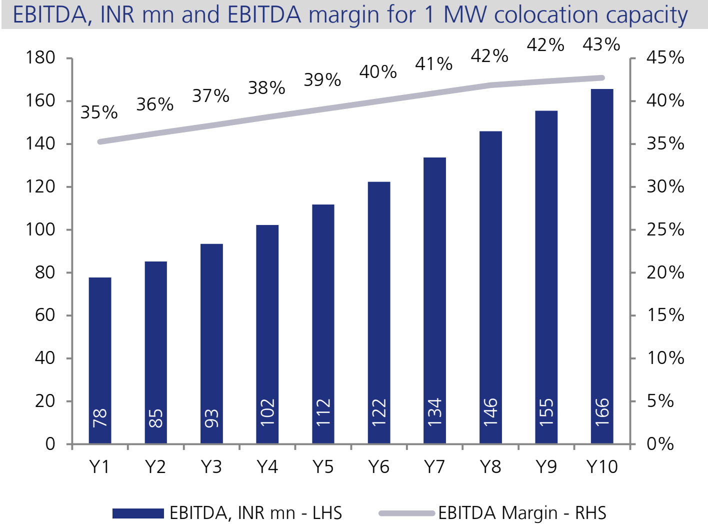


Source: APC, JM Financial

32. What could be the estimated margins and depreciation rates for 1MW colocation capacity?

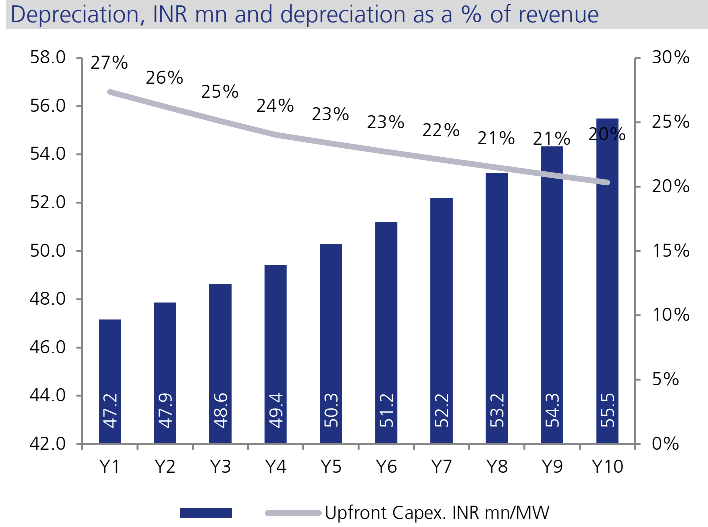
EBITDA margin for 1MW colocation capacity is estimated at c.35% in Y1. With operating leverage and growth in MRR, this will trend upwards to reach 43%. Depreciation is estimated at 10% of capex and therefore we estimate that the asset will be fully depreciated in 10 years. As a % of revenue, in Y1 depreciation will be high at 27%, and will trend downward with increase in revenue, to reach 20% in Y10.

Exhibit 74. EBITDA margin estimated to trend upwards from 35% in Y1 to 43% in Y10, with growth in ARR and drop in costs
EBITDA, INR mn and EBITDA margin for 1 MW colocation capacity



Source: JM Financial estimates

Exhibit 75. Depreciation at 10% of capex; as a % of revenue it is expected to trend downwards from 27% to 20%
Depreciation, INR mn and depreciation as a % of revenue



Source: JM Financial estimates

33. How does our margin projections compare with the actual margin profile of DC players?

We have analysed the income statements and operating margins of three colocation operators – Equinix, Digital Realty and Sify Infinit Spaces. EBITDA margin for Equinix was 37.7%-39.2% over FY22-24, for Digital Realty it was 42.1%-47.7% and for Sify Infinit Spaces it was 40.4%-43.1%. Depreciation ranged from 20.3%(Sify) to 33.6% (Digital Realty) in FY24.

Exhibit 76. Abridged income statement of colocation providers

Income statement	FY22	As a % of Revenue	FY23	As a % of Revenue	FY24	As a % of Revenue
Equinix - USD Mn						
Revenue from operations	**7263**	**100.0%**	**8188**	**100.0%**	**8748**	**100.0%**
Cost of revenues	3751	51.6%	4228	51.6%	4467	51.1%
Sales and Marketing	787	10.8%	855	10.4%	891	10.2%
General and administrative	1499	20.6%	1654	20.2%	1766	20.2%
Total operating costs	6037	83.1%	6737	82.3%	7124	81.4%
EBIT	**1226**	**16.9%**	**1451**	**17.7%**	**1624**	**18.6%**
Depreciation and Amortization	1532	21.1%	1637	20.0%	1801	20.6%
EBITDA	**2758**	**38.0%**	**3088**	**37.7%**	**3425**	**39.2%**
Digital Realty - USD Mn						
Revenue from operations	**4,691**	**100.0%**	**5,477**	**100.0%**	**5,555**	**100.0%**
Rental property operating and maintenance	1,826	38.9%	2,382	43.5%	2,318	41.7%
Property taxes and insurance	192	4.1%	216	4.0%	201	3.6%
General and administrative	422	9.0%	449	8.2%	480	8.6%
Other	12	0.3%	8	0.1%	27	0.5%
Provision for impairment	3	0.1%	118	2.2%	191	3.4%
EBITDA	**2,236**	**47.7%**	**2,304**	**42.1%**	**2,338**	**42.1%**
Depreciation and Amortization	1,578	33.6%	1,695	30.9%	1,772	31.9%
EBIT	**658**	**14.0%**	**609**	**11.1%**	**566**	**10.2%**
Sify Infinit spaces - INR Mn						
Revenue from operations	**7582**	**100.0%**	**10213.4**	**100.0%**	**11141.7**	**100.0%**
Cost of services rendered	3025	39.9%	4645	45.5%	4773.7	42.8%
Employee benefit expenses	275	3.6%	319	3.1%	408.6	3.7%
Other expenses	1017	13.4%	1124	11.0%	1368	12.3%
EBITDA	**3266**	**43.1%**	**4126**	**40.4%**	**4591.4**	**41.2%**
Depreciation and Amortization	1537	20.3%	2083	20.4%	2548.5	22.9%
EBIT	**1729**	**22.8%**	**2043**	**20.0%**	**2042.9**	**18.3%**

Source: Company, JM Financial

34. What is the actual depreciation schedule of colocation data centre companies?

We have analysed the property, plant and equipment of 3 colocation operators- Equinix, Digital Realty and Sify Infinit Spaces. Equinix has gross block of USD 30,723mn for an estimated capacity of c.4,285MW. This implies a gross block per MW of USD 7.16mn. The gross block per MW for Digital Realty and Sify is USD 10.2mn and 2.7mn respectively. Sify depreciates its PPE at c.10% per year, while Equinix and Digital Realty have depreciation rates around 6%.

Exhibit 77. Depreciation schedule for colocation players

Equinix - USD Mn	FY 24 - Gross block	As a % of total	FY 23 - Gross block	As a % of total	Estimated useful lives
Core Systems	12,890	42.0%	12,604	43.2%	3-40 years
Buildings	9,475	30.8%	8,970	30.7%	12-60 years
Construction in progress	2,204	7.2%	1,918	6.6%	12-40 years
Internal use software	2,149	7.0%	1,936	6.6%	3-5 years
Leashold improvements	1,980	6.4%	2,045	7.0%	12-40 years
Land	1,652	5.4%	1,407	4.8%	NM
Personal property	373	1.2%	320	1.1%	NM
Total Gross block	**30,723**	**100.0%**	**29,200**	**100.0%**	
Accumulated depreciation	11,474		10,601		
Depreciation	1,801		1,637		
Dep. As a % of gross block	**5.9%**		**5.6%**		
Average life of PPE	**17.1**		**17.8**		
Average age of PPE	**6.4**		**6.5**		

Digital Realty - USD Mn	FY 24 - Gross block	As a % of total	FY 23 - Gross block	As a % of total	Estimated useful lives
Land	1,108	4.0%	1,087	4.0%	NM
Buildings and improvements	25,567	92.8%	25,389	93.0%	5-39 years
Tenant improvements	884	3.2%	830	3.0%	Terms of lease
Total gross block	**27,559**	**100.0%**	**27,306**	**100.0%**	
Accumulated depreciation	8,641		7,824		
Depreciation	1,772		1,695		
Dep. As a % of gross block	**6.4%**		**6.2%**		
Average life of PPE	**15.6**		**16.1**		
Average age of PPE	**4.9**		**4.6**		

Sify Infinit spaces – INR Mn	FY 24 - Gross block	As a % of total	FY 23 - Gross block	As a % of total	Estimated useful lives
Buildings	4,484	19.3%	2,627	14.0%	30
Plant and Equipment	10,366	44.6%	9,432	50.2%	10
Furniture and Fittings	42	0.2%	40	0.2%	10
Office equipment	2,064	8.9%	1,808	9.6%	5
Vehicle	3	0.0%	0	0.0%	8
Leashold improvements	6,272	27.0%	4,885	26.0%	6
Total Gross block	**23,232**	**100.0%**	**18,791**	**100.0%**	
Accumulated depreciation	10,660		8,431		
Depreciation	2,229		1,849		
Dep. As a % of gross block	**9.6%**		**9.8%**		
Average life of PPE	**10.4**		**10.2**		
Average age of PPE	**4.8**		**4.6**		

Source: Company, JM Financial

35. What is the average electricity cost for a DC of 1MW IT Load?

Exhibit 78. Electricity cost for a DC of 1MW IT Load capacity

Power Cost Calculation	Value
Electricity Charge/KwH, INR	10
Number of hours/Month	730
Electricity Charge/KW/Month, INR	7,300
Electricity Charge/MW/Month, INR mn	7.3
IT Load of DC, MW	1.0
PUE	1.5
Electricity Requirement, MW	1.5
Electricity Charge/MW of IT Load/Year, INR mn	131

Source: JM Financial estimates

36. How would a data centre P&L look like over 10 year period?

Exhibit 79. P&L for 1 MW colocation capacity in India

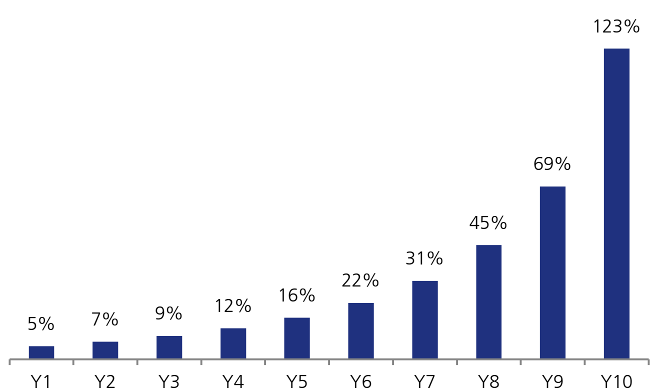
	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9	Y10
Revenues										
Capacity, KW	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
MRR/KW/Month, INR	9,500	10,070	10,674	11,315	11,994	12,713	13,476	14,284	15,142	16,050
Rental Growth, YoY		6%	6%	6%	6%	6%	6%	6%	6%	6%
Utilisation	78%	80.5%	83.0%	85.5%	88.0%	90.5%	93.0%	95.5%	95.5%	95.5%
Revenue - Recurring, INR mn	89	97	106	116	127	138	150	164	174	184
Revenue - Utility pass-through	131	138	145	152	160	168	176	185	194	204
- % Change, YoY		5%	5%	5%	5%	5%	5%	5%	5%	5%
Revenues, Total	**220**	**235**	**251**	**268**	**286**	**306**	**326**	**349**	**368**	**388**
Operating Expense										
Operating Expense, ex-power cost	18	19	20	21	23	24	26	27	28	29
% of recurring revenues	20.0%	19.5%	19.0%	18.5%	18.0%	17.5%	17.0%	16.5%	16.0%	15.5%
Utilities cost	125	131	138	145	152	159	167	176	184	194
% of utilities revenue	95.0%	95.0%	95.0%	95.0%	95.0%	95.0%	95.0%	95.0%	95.0%	95.0%
Total operatng cost	143	150	158	166	175	183	193	203	212	222
EBITDA, INR mn	78	85	93	102	112	122	134	146	155	166
EBITDA Margin	35.3%	36.2%	37.2%	38.1%	39.1%	40.0%	40.9%	41.9%	42.3%	42.7%
Depreciation	47.2	47.9	48.6	49.4	50.3	51.2	52.2	53.2	54.3	55.5
% of revenues	21.4%	20.3%	19.4%	18.4%	17.6%	16.7%	16.0%	15.3%	14.8%	14.3%
EBIT	30.5	37.3	44.7	52.8	61.6	71.1	81.4	92.7	101.1	110.1
EBIT Margin	14%	16%	18%	20%	21%	23%	25%	27%	28%	28%
NOPAT	22.9	28.0	33.6	39.6	46.2	53.3	61.1	69.5	75.9	82.6
Tax Rate	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%

Source: JM Financial estimates

37. What would be the steady state return ratio of a 1MW DC?

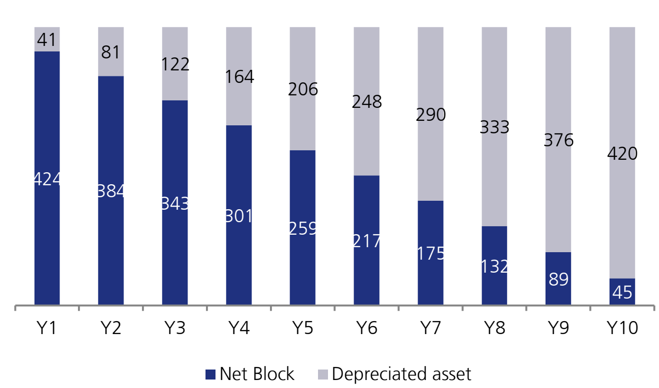
The initial ROCE for a DC will be low due to upfront capex and lower occupancy initially. However, as the gross block depreciates and utilisation improves to steady-state (95%), ROCE improves substantially.

Exhibit 80. ROCE evolution over 10 years in a 1MW IT load DC



Source: JM Financial

Exhibit 81. Lower net block as depreciation kicks in



Source: JM Financial

38. What is the timeline of construction for data centre capacity?

The timeline of construction for data centre capacity ranges from 27 months on the lower end to 42 months on the upper end. Steps in setting up capacity involves site selection and planning, construction and commissioning and testing. Time taken for tenants to occupy can be estimated at 3-36 months.

Exhibit 82. Representative timeline for construction of data centre capacity

	Lower	Upper
Site selection and planning	**6**	**12**
-Site selection		
-Design and engineering		
-Permitting and approvals		
Construction	**18**	**24**
-Site preparation		
-Building, shell and core		
-Mechanical, electrical and plumbing (MEP) systems		
Commissioning and testing	**3**	**6**
-System Integration		
-Testing		
-Certification		
Total	**27**	**42**
Occupancy Timeline (70%)	**3**	**36**
Hyperscale anchored facility	3	12
Wholesale colocation	6	24
Retail colocation	12	36

Source: AvisenLegal, JM Financial

F. Regulations

Regulations, incentives and government AI initiatives driving and supporting data centre capacity

39. What are the major regulations and policy interventions by the government in the data centre ecosystem?

The major regulations and policy interventions in the data centre ecosystem include The draft data centre policy-2020, The IndiaAI mission, The Digital personal data protection act-2023 and Data localisation directives by RBI, Department of Consumer Affairs and Department of Telecommunications.

Draft Data centre policy – 2020: This policy intends to make India a global data centre hub, promote investment in the sector, propel digital economy growth, enable provisioning of trusted hosting infrastructure to fulfil the growing demand of the country and facilitate state of the art service delivery to citizens.

The IndiaAI mission – This is a strategic initiative by the government to establish a robust and inclusive AI ecosystem. It includes procurement and creating avaialbility of GPU infrastructure, encouraging model development, allowing access to high quality datasets, enabling application development, encouraging skill development and providing access to financing for startups in the AI ecosystem.

The Digital Personal Data Protection Act (DPDP) – 2023: The DPDP Act aims to balance an individual's right to data protection with the need for lawful processing for legitimate purposes. It applies to digital personal data processed within India and data processed outside india; it relates to offering goods or services to Indian individuals. It instructs that the data fiduciary should provide clear notice regarding collection, processing and purpose of processing and must protect the data. It gives the data principles (users) the right to access, correction and erasure and gives the right to greivance redressal and to withdraw consent. The Act however does not implement any blanket restriction on transfer of data outside India.

Data localisation directives by RBI, Dept. of Consumer Affairs:

The RBI directives instruct how payment-related information, and personal banking information of individuals is processed and where it can be stored and processed. This directive applies to all payment system providers, and all banks. It applies to data that contain end-to-end transaction details and info pertaining to payments, settlement that is gathered/transmitted/processed as part of payment. According to the directive, the entire payment data should be stored in systems located in India, the processing of the transaction however can be done abroad.

The Dept. of Consumer Affairs has provided guidelines for consumer protection in e-commerce. It has instructed that personally identifiable information of customers is protected, and that such data collection and storage and use comply with provisions of the Information Technology (Amendment) Act, 2008.

The Telecommunications Act 2023:

According to the Act, the government can enforce data localisation measures by requiring network operators to store and process such data within India, it can declare certain telecom networks or parts as critical telecom infra and prescribe localisation requirements for data stored or processed within these networks. The government has authority to mandate storage of sensitive telecom data within india in the interest of national security and telecom providers must ensure proper storage and verification of subscriber identity within India.

40. What is the Draft Data Centre Policy 2020?

The Draft Data Centre Policy's vision is to make India a global data centre hub, promote investment in the sector, propel digital economy growth, enable provisioning of trusted hosting infrastructure to fulfil the growing demand of the country and facilitate state-of-the-art service delivery to citizens. It also intends to ensure sustainable and trusted DC capacity in the country, strenghten India's position as a favourable country for DC and encourage domestic and foreign investments, promote R&D for manufacturing and development of DC-related products, IT products and non-IT products.

Some of the measures introduced in the policy are enabling ease of doing business, promoting the sector through fiscal and non-fiscal incentives, promoting startups, MSMEs and Indian IT companies, facilitating access to power and promoting data security.

The government is set to revise the draft policy to meet current industry demands, MeitY is considerng new incentives within the policy for advanced AI and ML data centres and plans to grant infrastrucutre status.

Exhibit 83. Measures implemented under the Draft Data Centre Policy, 2020

Measures	Description
Ease of doing business	-Provide "infrastructure status" for the DC sector, bringing benefits of long term credit from domestic and international lenders at easier terms.
	-Simplify clearances. Single window clearance in time bound manner
	-Publish list of clearances required, with defined timelines for the same
	-States shall be encouraged to demarcate specific zones for setting up DC parks with necessary infra
	-Promote pre-provisioned Data Centre parks, to enable 'plug and play' model for Data Centre providers, by provisioning access to : Land parcel, Power availability at low rates, High capacity network back-haul, pre-approved clearances/approvals
	-Formulate Data centre incentivisation scheme
Favourable ecosystem for operation of DC	-Availability of uninterrupted, clean and cost-effective electricity for Data Centres
	-Facilitate provisioning of quality power for uninterrupted supply, facilitate DC parks to set up own generation capacity, enable direct procurement from power generation companies, encourage renewable energy
	-MeiTy and DOT to facilitate robust and cost effective connectivity backhaul.
	-Data Centres to be declared as an Essential Service under "The Essential Services Maintenance Act, 1968 (ESMA)
	-Continuous functioning of Data Centres is critical for continued delivery of services and to maintain the normalcy of day to day activities
	-Data Centre buildings require different norms as compared to other office/ commercial buildings and therefore, there is a need for creation of a separate category code for Data Centres in the National Building Code of India (NBC 2016).
Setting of DC economic zones	-Government of India also proposes to set-up at least four (4) Data Centre Economic Zones (DCEZ) in the country, as a Central Sector Scheme - DCEZ Scheme. These DCEZs would be concentrated and specialized Data Zones, with the most conducive non-IT and IT infrastructure, connectivity, power and regulatory environment.
	-The proposed Data Centre Economic Zones would create an eco-system of Hyperscale Data Centres, Cloud Service Providers, IT companies, R&D units and other allied industries.
Promote indigenous technology development, research and capacity building	-Promote R&D in DC ecosystem, promote tech firms to produce innovative products and services for DC ecosystem
	-Promote adoption of established global standards
	-Capacity building and HR development
Mechanism for policy governance	An Inter-Ministerial Empowered Committee (IMEC) to be set up under the Chairmanship of Secretary, MeitY, with participation from various Central Ministries and State Governments. It shall be the key decision-making body to facilitate the implementation of various measures as defined under this policy framework, enabling ease of doing business in the sector.

Source: Ministry of Electronics and Information Technology, JM Financial

41. What is the IndiaAI mission?

The Union government approved the IndiaAI mission on 7th Mar'24. This is a strategic imitative to establish a robust and inclusive AI ecosystem. The IndiaAI Mission aims to build a comprehensive ecosystem that fosters AI innovation by democratising computing access, enhancing data quality, developing indigenous AI capabilities, attracting top AI talent, enabling industry collaboration, and providing startup risk capital. The Union Cabinet has approved a budget outlay of INR 103,720mn to procure 18,000+ GPUs (Intel Gaudi2, AMD MI300X, NVIDIA H100, H200, A100 and AWS tranium). Eligible users can access this AI compute capacity at 40% reduced cost under the mission.

The GPUs to be procured are designed for large scale and deep learning, training and inference tasks. The compute performance of these GPUs ranges from 312 TFLOPs/s (A100) to 1307 TFLOPs/s (AMD MI300X). The power consumption for each GPU ranges from 400W to 750W per accelerator. A single data centre rack can fit a maximum of 32 GPUs per rack. Therefore, the power consumption per rack ranges from 12.8KW to 24 KW.

Exhibit 84. 7- Pillars of the IndiaAI mission

Pillar	Description
IndiaAI compute capacity	Under the IndiaAI Compute Pillar, the Mission is developing a scalable AI computing ecosystem to support India's growing AI startup and research community. This initiative includes the establishment of a state-of-the-art AI compute infrastructure featuring 18,000+ GPUs, built through public-private partnerships. The Union Minister of Electronics & IT, Railways, and I&B has announced that eligible users can access AI compute at up to 40% reduced cost under the IndiaAI Mission, which has a budgetary outlay of ₹10,372 Cr. The GPUs selected for procurement are Intel Gaudi 2, AMD MI300X, NVIDAI H100, H200, A100 and AWS Tranium.
IndiaAI Innovation Centre	The Innovation Centre will undertake the development and deployment of foundational models, with a specific focus on indigenous Large Multimodal Models and domain-specific foundational models. It will include models with high resource requirements that cater to applications across priority sectors such as governance, healthcare, agriculture, sustainability, manufacturing etc.
IndiaAI Datasets platform	The IndiaAI Datasets Platform aims to revolutionize access to non-personal data, empowering Indian startups and researchers to drive AI breakthroughs. It will streamline access to high-quality AI-ready datasets by building a unified platform for seamless data discoverability, access, and use.
IndiaAI Application development initiative	The IndiaAI Application Development Initiative aims to support the development, scaling, and promotion of impactful AI solutions that address real-world challenges. The initiative will source problem statements from Central Ministries, State Departments, and institutions in critical sectors and invite AI researchers, innovators and startups to build, develop and deploy solutions that address the identified challenges.
IndiaAI Future skills	The India Future Skills pillar aims to enhance India's AI workforce readiness by mitigating barriers to entry in AI programs and advancing the AI talent pipeline. The pillar will increase AI courses in undergraduate, postgraduate, and Ph.D. programs. Further, it aims to foster inclusive access to AI education by establishing Data and AI Labs in Tier 2 and Tier 3 cities across India to impart foundational level courses.
IndiaAI startup Financing	The pillar aims to foster entrepreneurial growth in AI. With the spirit to enhance India's AI competitiveness, the pillar will support and accelerate deep-tech AI startups and provide them streamlined access to funding to enable futuristic AI Projects.
Safe and trusted AI	The Safe & Trusted AI pillar aims to design and develop adequate guardrails to advance the responsible development, deployment, and adoption of AI. The pillar will enable the implementation of responsible AI projects that promote the development of indigenous tools and frameworks, self-assessment checklists for innovators, and other guidelines and governance frameworks that advance the adoption of responsible AI principles throughout the AI lifecycle.

Source: Indiaai.gov, JM financial

42. What are the state level incentives provided by state governments to promote data centre capacities?

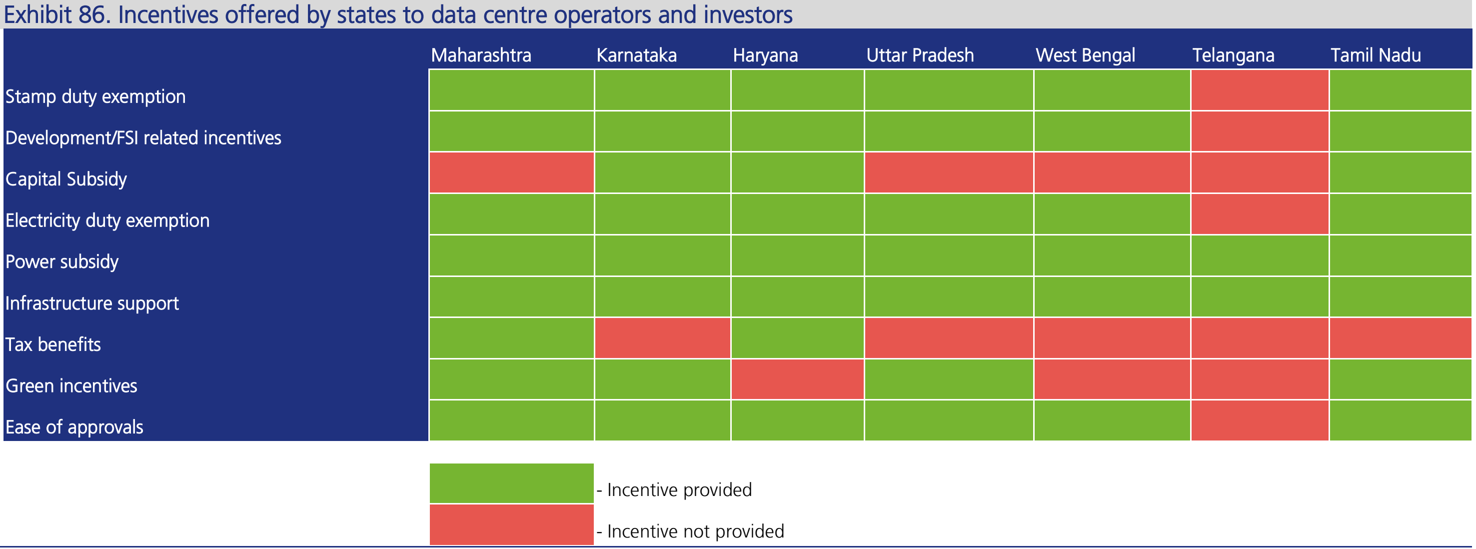
Several Indian states have implemented targeted policies and incentives to attract data centre investments, creating a competitive landscape for capacity development. States like Tamil Nadu and Telangana offer comprehensive benefits, including capital subsidies, power tariff reimbursements, and renewable energy mandates (e.g., Tamil Nadu requires at least 30% power from green sources). Uttar Pradesh and Karnataka provide land and stamp duty exemptions, with UP also offering dual power grid access and transmission cost subsidies. Haryana has declared data centres as essential services and energy-intensive infrastructure, facilitating fast-track approvals. As shown in the incentive matrix, most states provide benefits like electricity duty exemption, power subsidies, and ease of approvals, although support for green incentives and infrastructure varies. These state-led initiatives significantly enhance the viability and attractiveness of setting up data centres across India.

Exhibit 85. Details of state level policies to promote data centre operators and investors

State	Policy Details
Haryana	State GST, stamp duty, electricity duty exempted
	Data centre to be declared as a separate infrastructure industry and energy-intensive industry
	Data centres to be declared as an essential service under ESMA
	Right of Way to be accorded under State Communication and Connectivity Infrastructure Policy
Karnataka	Land conversion fee, stamp duty, electricity duty exemption, concessional power tariff and green power tariff reimbursement
	Special package of incentives for projects of strategic importance
Tamil Nadu	Power incentives to Data centre investment above INR 5000 Bn and at least 30% energy consumption through renewable sources
	Conditional concession in stamp duty and land fee
	10% of remuneration of local employees to be reimbursed
	Training subsidy to be provided
Telangana	50% rebate on Building fees and concession on land fee
	Preference to start up/ SMEs for data centre services
	25% reimbursement on internet charges capped at INR 250,000 per year for first three years of operation
	Concessional fuel price for backup power sources
	Exempt from purview of statutory power cuts
Uttar Pradesh	Capital subsidy of 7% up to INR 100 Mn
	Interest subsidy of 60% on annual interest for seven years subject to maximum INR 500 Mn per park
	Land subsidy 25% in Madhyanchal and Paschimanchal; and @50% on prevailing sector rates in Bundelkhand, and Poorvanchal up to INR 750 Mn to parks and units
	Stamp duty exemption of 100% on the first transaction and 50% on the second transaction to both parks and units
	Electricity duty Exemption of 100% for 10 years to units
	Dual Power Grid power supply to first three DC parks established in the state. Energy department to bear the cost of the second grid.
	Transmission and wheeling charges exemption for 25 years of 50% on intrastate sale of power; 100% for intrastate transmission system
	For 5 years import of energy from outside UP to both parks and units

Source: EY, JM Financial

Exhibit 86. Incentives offered by states to data centre operators and investors



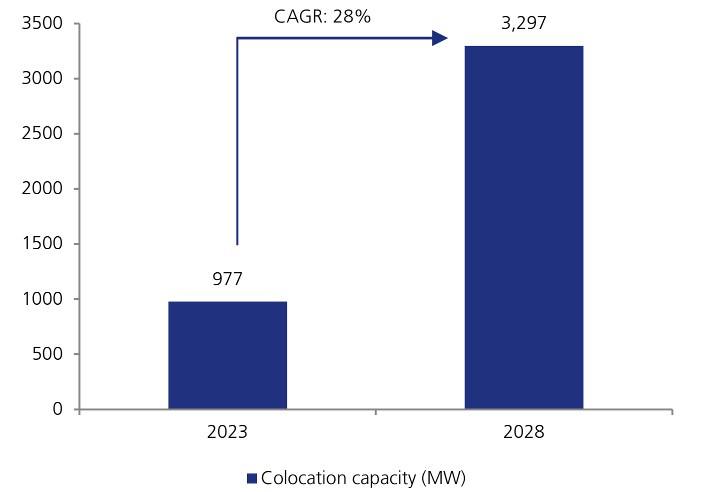
Source: CBRE, JM Financial

G. Investments in India's Data Centre Capacity

43. What is the upcoming and planned data centre capacity in India by 2028?

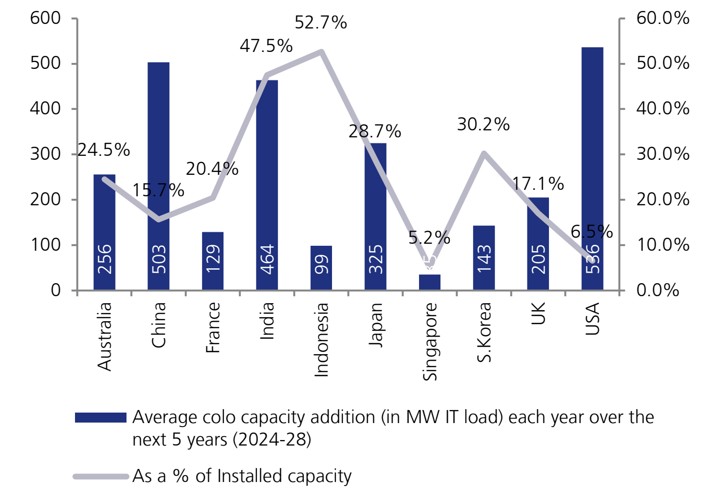
A lot of capacity is currently coming up and or is in the planning phase. Colocation data centre capacity in India is set to grow at a CAGR of 28% to 3.3GW by 2028, in line with our data usage-based projections. India will see one of the highest capacity additions relative to current operational capacity globally. During 2024-2028, India will add 464MW (50%) of 2023 capacity (977MW) annually. Our estimates of current capacity (Mar'25) stand at 1,352MW, indicating that c.400MW of capacity has been added since 2023.

Exhibit 87. 2.32GW of additional capacity to go live by 2028, growing at a CAGR of 28% between 2023-2028
India Colocation capacity (MW)



Source: Cushman & Wakefield Research, JM Financial

Exhibit 88. India to add c.50% of present capacity, every year for the next 5 years
Avg. colo capacity addition (24-28), As a % of Installed capacity (23)

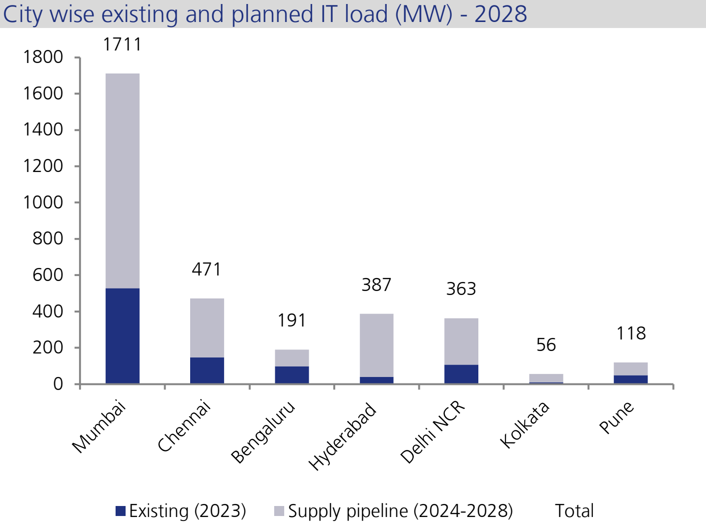


Source: Cushman & Wakefield Research, JM Financial

44. Where is this planned capacity coming up?

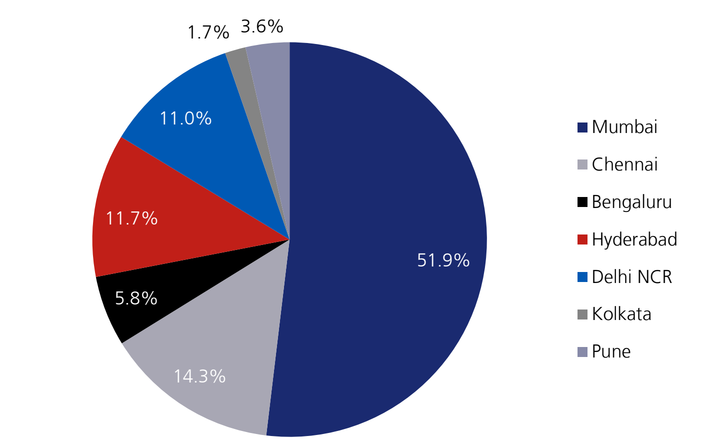
A major portion of the capacity being added is in Mumbai, Mumbai will be adding 1.2GW of capacity during this period. Hyderabad is also set to become a major data centre market in India. AWS is investing USD 4.4bn in the region to set up their data centres and has designated Telangana as a strategic region. Chennai continues to add capacity at a healthy rate; it is set to add 334MW in capacity over this period.

Exhibit 89. Planned capacity for most cities more than 100% of existing capacity
City wise existing and planned IT load (MW) - 2028



Source: Cushman & Wakefield, JM Financial

Exhibit 90. Mumbai to remain a major portion of data centre capacity in India, Hyderabad to see massive capacity addition
City wise distribution of capacity – 2028 E

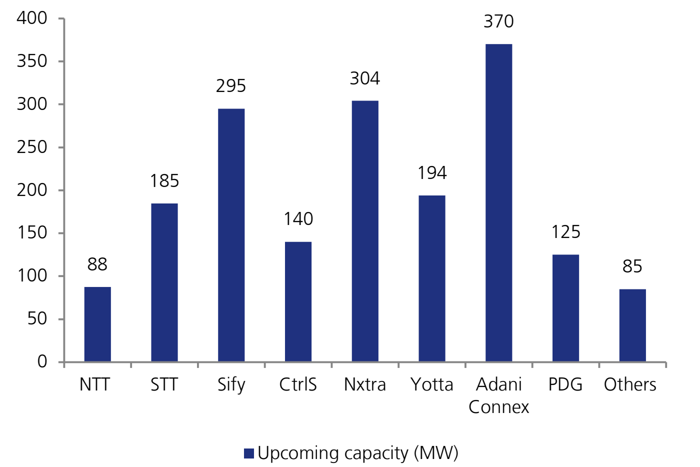


Source: Cushman & Wakefield, JM Financial

45. What is the overall capacity additions planned by colocation players?

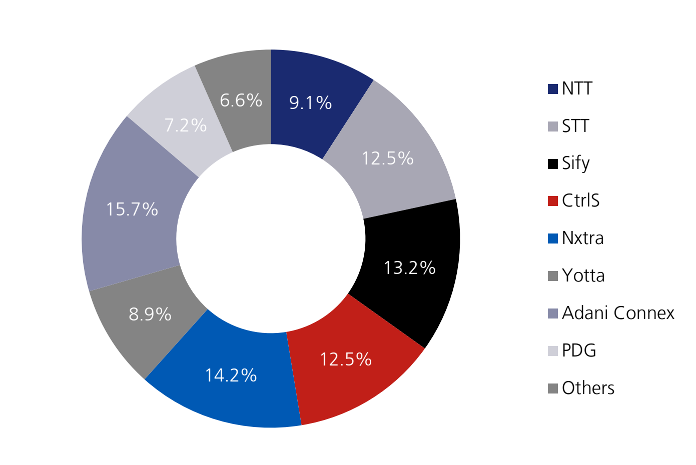
Colocation players such as Adani Connex, Nxtra, Sify and CtrlS have planned massive capacity additions. These announced additions have varying timelines and compleiton schedules. Adani Connex is adding almost 370MW of capacity. The new capacity is coming up in Mumbai, Hyderabad, Vizag and Pune. Nxtra is adding more than 300MW of capacity as well; it is adding 100 MW+ in Pune. Sify is adding or planning addition of c.295MW, it has room for expansion of 377MW in Navi Mumbai and 250MW in its Hyderabad campus. CtrlS is planning 140MW capacity addition in Mumbai. Overall, colcoation players have planned addition of 1.6GW of capacity. We can safely expect that colocation operators will not fall behind the curve in providing supply to meet the prevalent robust demand.

Exhibit 91. Adani Connex, Nxtra and Yotta to add c.860MW of capacity. More than 1.6GW of capacity to be added
Upcoming capacities across colocation players



Source: Upcoming capacities according to company websites., JM Financial

Exhibit 92. Nxtra, Adani Connex and ctrlS to be the largest players with combined capacity of 1.3GW
Total capacities including upcoming - %

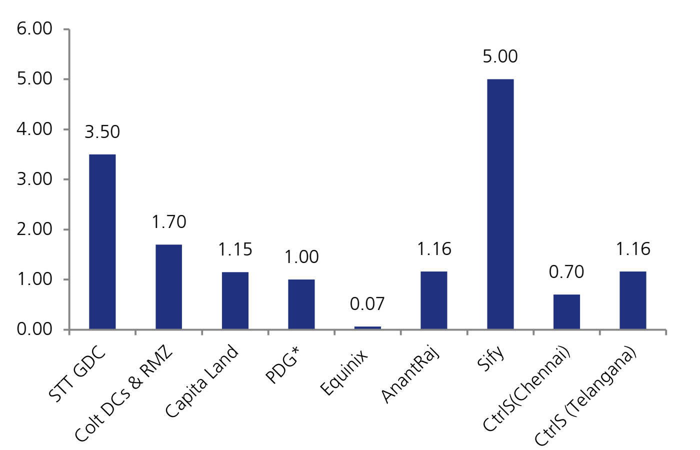


Source: Upcoming capacities acc. To company websites, JM Financial

46. What is the quantum of investment announced by colocation players?

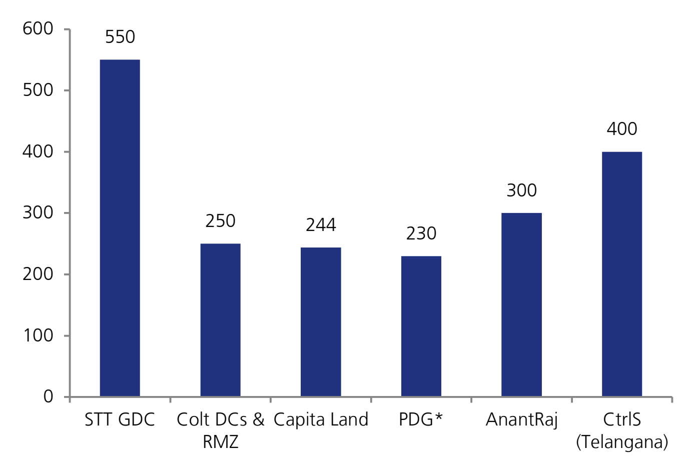
Colocation operators combined have announced investments of c.USD 15bn in data centre capacity. This translates to roughly c.2.8GW of capacity addition (at USD 5.4mn per MW). These announced investments have varied timelines and of course could undergo revisions; nevertheless the quantum of investments announced is substantial despite this. More than 6 colocation operators have announced plans to invest USD 1bn+ in capacity. STT, Sify, Colt and Anant Raj lead the pack in announced investments.

Exhibit 93. Over USD 15bn of investments announced by colocation players; STT and Sify have aggressive expansion plans
Investments announced towards Data centre capacity-USD bn



Note: PDG – Princeton Digital Group Source: Company, JM Financial

Exhibit 94. Over 2GW of capacities explicitly announced to be added by global and Indian colocation players
Announced capacities additions by Colocation players in India (MW)



Note: PDG – Princeton Digital Group. Source: Company, JM Financial

Exhibit 95. Investments announced by colocation players

Company	Description	Date of announcement
STT GDC	Plans to invest INR 3500 cr for 100 MW capacity in Telangana	21-Jan-25
STT GDC	STT GDC to invest USD 3.5 bn to build 550 MW capacity in India over the next 5-6 years	Sep 6 2024
COLT DCS and RMZ joint venture	RMZ, an alternative asset owner and Colt data centres announced a joint venture to invest USD 1.7 Bn to build 250 MW of capacity. The investments will be in Navi Mumbai and Chennai and an additional third site (TBD)	19-Nov-24
Capitaland	Singapore-based CapitaLand Investment (CLI) will be investing around $1.15 billion in setting up data centres in India to reach a capacity of 244 MW over three-four years, which is part of its larger plan to double its overall investments in India by 2028	Sept 4 2024
princeton digital group	PDG to invest ~1 Bn to build 230 MW of capacity in India. Investments to be made in Mumbai and Chennai	Sept 19 2024
Equinix	Equinix to invest USD 65 mn in Chennai to open its first IBX (international business exchange) data centre in India	June 25 2024
Anantraj	Plans to set up 300 MW capacity with INR 10,000 cr of investments over the next 4-5 years. Capacity to be built in Haryana	26-Mar-24
Sify	Sify plans to invest USD 5 Bn in India over a period of 5 years, the company will be using these funds to build smaller AI inferencing facilities in 20 tier II cities	20-Jan-25
Ctrl S	CtrlS plans to invest INR 6000 cr in Chennai to expand its DCs over the next 2-5 years	Feb 26 2025
CtrlS	CtrlS plans to build capacity of 400 MW AI data centre in Telangana with an investment of INR 10,000 cr	Jan 22 2025

Source: Company, JM Financial

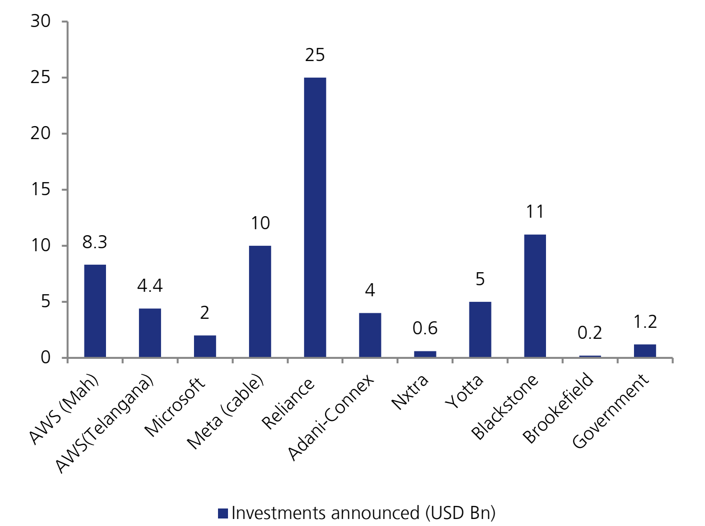
47. What are the investments in capacity announced by other pools of capital?

Many other pools of capital are mulling investments in data centre capacity. Hyperscalers, business houses and private equity investors have announced investments in DC capacity. The government is also investing USD 1bn+ in GPUs. The combined investments across these capital pools are at USD 60bn.

Reliance in Jan'25 announced investment of USD 20bn-30bn to set up c.3GW of capacity. This will be one of the largest investments in tech infrastructure. Reliance is also a partner to Meta, which is installing a subsea cable of 500 TBps capacity with a capital outlay of USD 10bn.

Exhibit 96. Over USD 60bn in investments announced by various investors and business houses

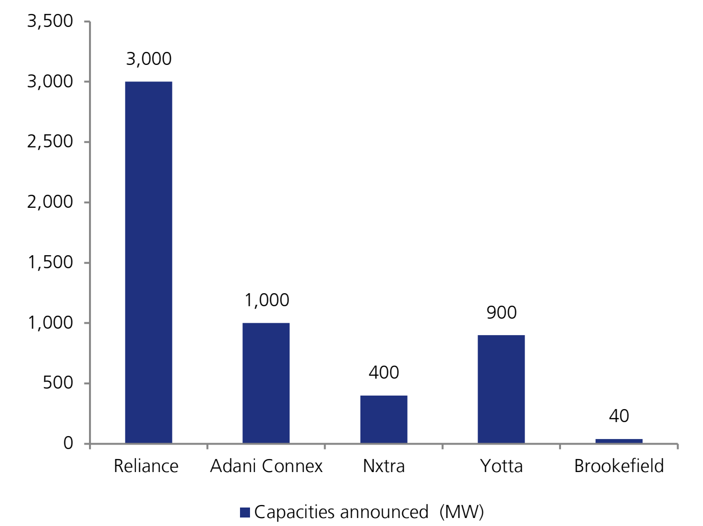
Investments announced (USD bn)



Source: Company, JM Financial

Exhibit 97. Over 5.3GW of capacities explicitly announced by investors and business houses

Announced capacity additions (MW)



Source: Company, JM Financial

Exhibit 98. Investments announced in data centre capacity by hyperscalers, Indian business houses, PE and government

Company	Description	Date of announcement
Hyperscalers		
AWS	AWS to invest USD 8.3 bn in Maharashtra for expansion of DC capacity by 2030	Jan 23 2025
AWS	AWS to invest 4.4Bn USD by 2030 for DC capacity in Telangana, already invested USD 1 bn	Jan 23 2025
Microsoft	Microsoft to invest USD 2 bn in DC capacity in India	Jan 7 2025
Meta	Meta plans to build 500 tbps, subsea cable requiring USD 10 bn in investments, the cable will either be connected to Gujarat or Chennai in collaboration with Reliance (Meta's partner)	Dec 4 2024
Indian Business houses		
Reliance industries	Reliance Industries, led by Mukesh Ambani, is planning to build the world's largest AI-driven data centre in Jamnagar, India. This facility will have an enormous capacity of three gigawatts, designed to support the growing demand for artificial intelligence (AI) services. The project is expected to cost between $20 billion and $30 billion, making it one of the largest investments in India's tech infrastructure. Once completed, it will far exceed the current largest data centre, Microsoft's 600-megawatt site in Virginia	Jan 24 2025
AdaniConnex	The 50:50 JV between Adani enterprises and Edge Connex, plans to invest USD 4 bn to set up 1 GW capacity by 2030.	April 18 2024
Nxtra	Nxtra plans to invest INR 5000 cr, over the next 3 years to set up a total capacity of 400 MW	Nov 6 2024
Yotta /(hiranandani)	Yotta Infrastructure, part of the Hiranandani group, plans to have an 800-1000 MW (megawatt) data centre capacity in India and overseas by 2030.The average capital investment in data centre projects is around INR 50 crore per MW.	Dec-22
Private Equity		
Blackstone	Blackstone Group, the world's largest alternative asset manager, is set to invest up to $11 billion in Maharashtra over the next three to five years.	Jan 24 2025
Blackstone	Blackstone Group, the world's largest alternative asset manager, and its development partner Panchshil Realty are planning to develop India's single largest hyperscale data centre with 500 MW capacity in Navi Mumbai with an investment of over INR 20,000 crore	Feb 24 2025
Brookefield	Brookefield, RIL and Digital realty set up a 3 way joint venture to develop data centres. 100 Mw campus in Chennai is under development and the JV plans to set up a 40 MW DC in Mumbai	Dec 12 2023
Government		
Govt.	investment of USD 1.2 Bn to develop AI compute infrastructure of atleast 10,000 GPUs aimed at empowering AI startups and significantly expand compute infra in the country	

Source: Company, JM Financial

H. Global Capacity

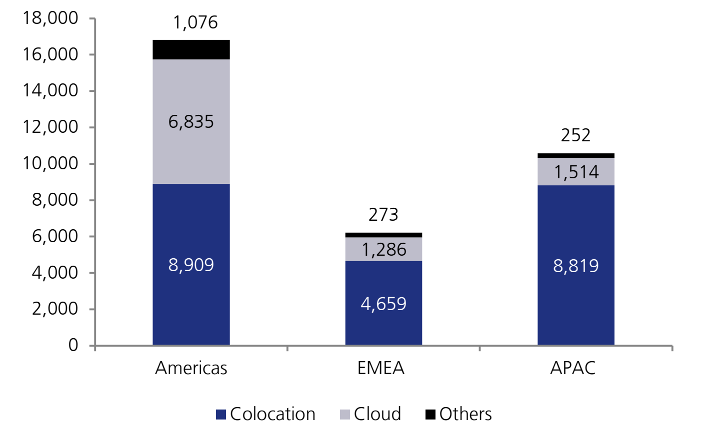
48. What is the installed data centre capacity in the world?

Global data centre capacity stands at c.33.6GW (2024), Colocation players account for a major share of this capacity at 22.4GW (67%), cloud owned capacity stands at 9.6GW (29%), and others comprising of telecom and edge operators have capacity of 1.6GW (5%).

71% of cloud owned capacity is in the Americas. Proximity to customers, tax exemptions, low energy costs, low latency internet exchanges and well developed digital infrastructure makes the US an attractive location for hyperscalers.

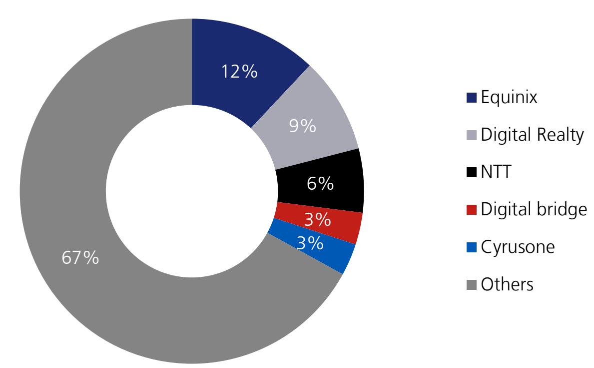
Equinix, Digital Realty, NTT, Digital Bridge and Cyrus-one are the largest colocation players in the world. The top 5 players combined account for 33% of colo revenue.

Exhibit 99. 71% of Cloud owned capacity is located in the Americas, lower presence in other regions
Operational capacity split based on region and type (2024)- MW



Source: Cushman & Wakefield, JM Financial

Exhibit 100. Top 5 global players account for 33% of global colo revenue; Equinix largest player with 12% revenue market share
Revenue market share of top colocation players (2023)

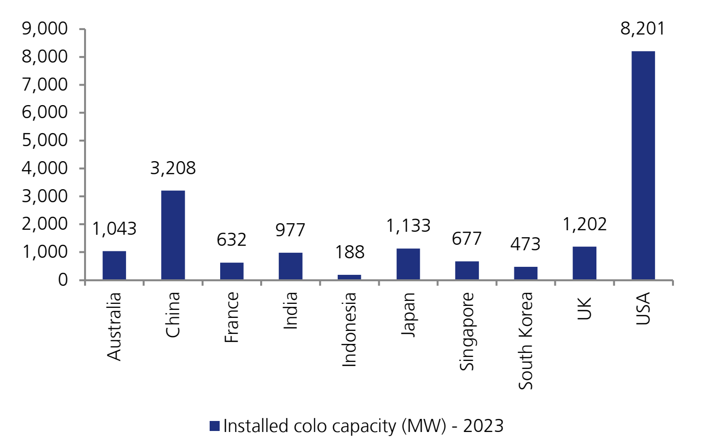


Source: NTT, JM Financial

49. Where is the installed capacity in the world located?

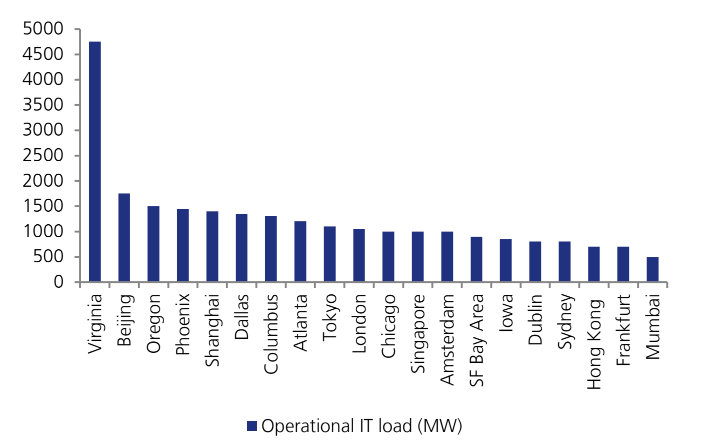
The US accounts for 37% (c.8.2 GW) of colocation capacity. Virginia in the US is the largest data centre hub in the world; it has c.4.5GW of capacity. Virginia hosts an important internet exchange point, has one of the densest fibre optic networks, provides tax breaks and has access to attractively priced and renewable power. This makes Virginia attractive to large scale players. APAC accounts for 31% of total global capacity. Beijing, Shanghai and Tokyo are important markets in APAC.

Exhibit 101. USA accounts for 37% of total installed colocation capacity of the world, China accounts for 18%
Installed colocation DC capacity (2023) - MW



Source: Cushman & Wakefield, JM Financial

Exhibit 102. Virginia is the largest data centre hub in the world with capacity of c.4.5GW, Beijing and Shanghai are top APAC markets
Region-wise operational IT load (2024) – Top 20 cities (globally)



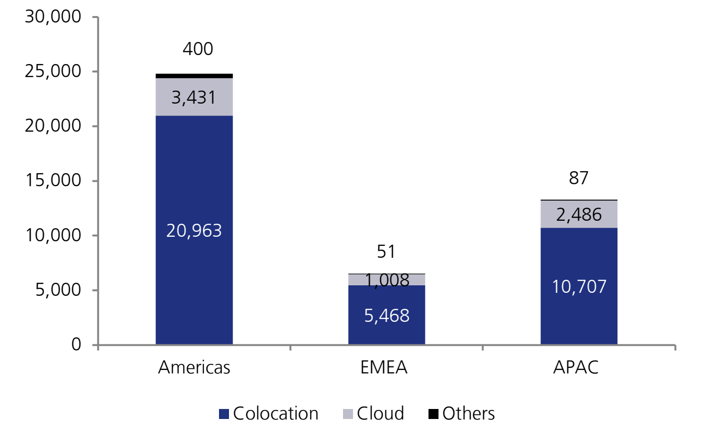
Source: Cushman & Wakefield, JM Financial

50. What is the upcoming data centre capacity in the world and where is it located?

The total data centre capacity in the development pipeline (under construction and plans filed) stood at 44.6GW in 2024. Upon completion, this will take the capacity to c.78GW globally.

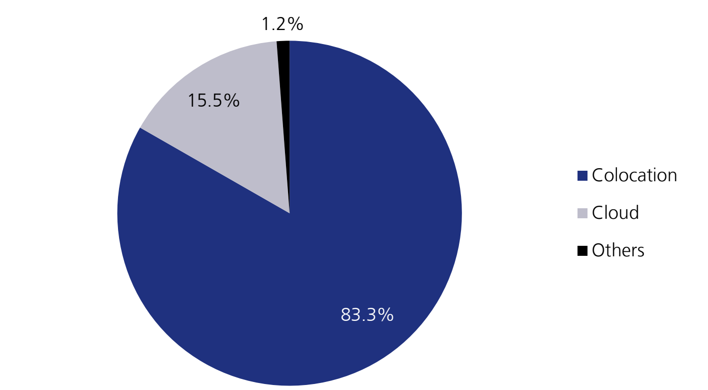
A large portion of the upcoming capacity is colocation capacity (83.3%), Colocation offers flexibility and capital efficiency for enterprises and hyperscalers, thus driving demand. It is also attracting large investments from PE, REITs and other capital pools.

Exhibit 103. 56% of new capacity coming up in the Americas; Europe set to lose share, APAC accounts for 30% of new capacity
Development pipeline across regions (2024) – MW



Source: Cushman & Wakefield, JM Financial

Exhibit 104. Colocation accounts for most of the new planned capacity, seeing large investments
Upcoming pipeline share b/n colocation, cloud and others - %



Source: Cushman & Wakefield, JM Financial

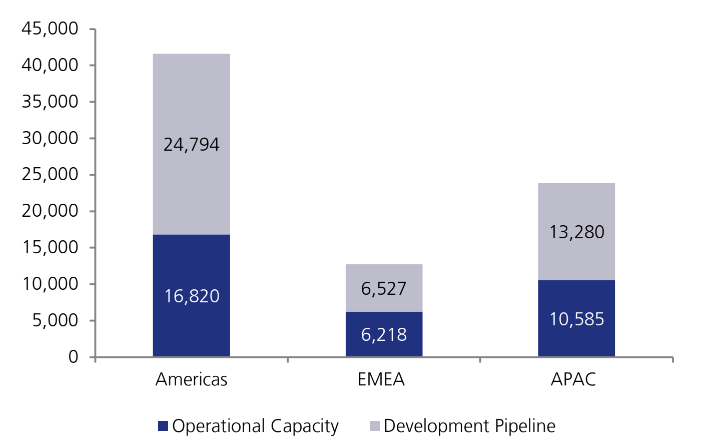
51. Where will the new upcoming capacity be located?

Americas' share in capacity is set to increase from 50% currently to 53%. EMEA is set to lose share. Virginia will see doubling of capacity, with over 4.5GW in the pipeline within which almost 1.5GW is under construction.

Cloud capacity is shifting outside Americas; c.2.5GW capacity is planned in APAC vs. the current operational load of 1.5GW. Americas share in cloud owned capacity is set to decline from 71% to 61%.

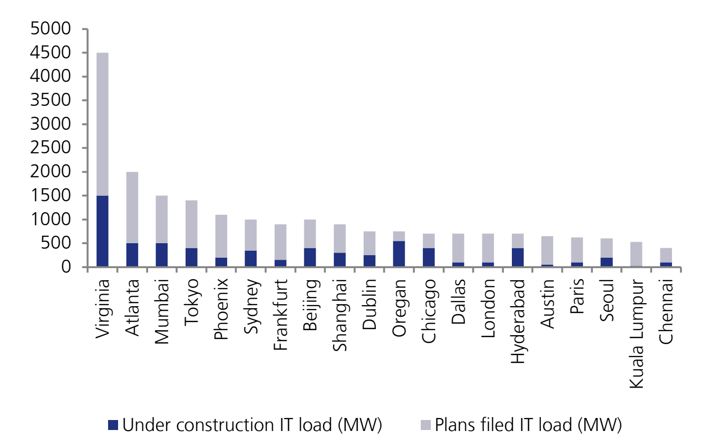
Mumbai has almost 1 GW of capacity in the pipeline; upon completion, Mumbai will feature among the top 5 data centre markets in the world. 700MW of capacity is coming up in Hyderabad (AWS is investing USD 4.4bn); the city is set to feature in the top 20 data centre markets globally.

Exhibit 105. In Americas, 1.5x of current capacity in development pipeline. 1.25x for APAC
Operational capacity vs. Development pipeline (2024) – MW



Source: Cushman & Wakefield, JM Financial

Exhibit 106. Virginia to add 4.5GW of incremental capacity; Mumbai to feature among top 5 and Hyderabad in top 20
City wise, data centre development pipeline (MW)



Source: Cushman & Wakefield, JM Financial

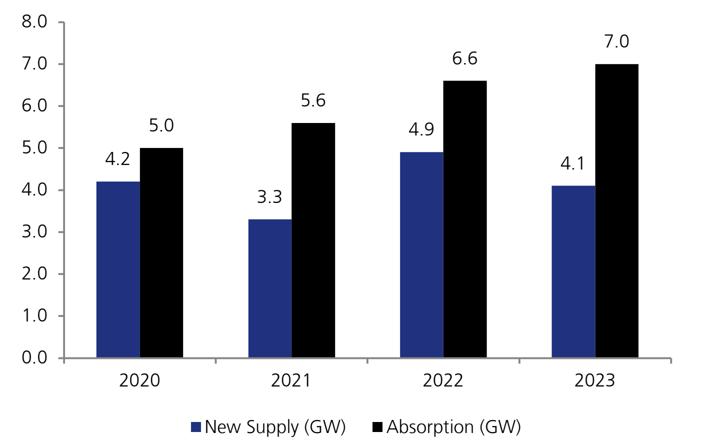
I. Global Data Centre Trends

52. What are the trends in absorption and vacancy rates across the world?

Absorption Rates: Global data centre absorption has surged significantly, with a 40% increase over the last 3 years, notably outpacing new supply by more than 50%. In the US, Virginia alone represented approximately half of the net absorption among the top four markets, highlighting its dominant market position. Europe followed closely, led by Frankfurt and other FLAP cities (Frankfurt, London, Amsterdam, and Paris), signalling robust and sustained demand across major global markets.

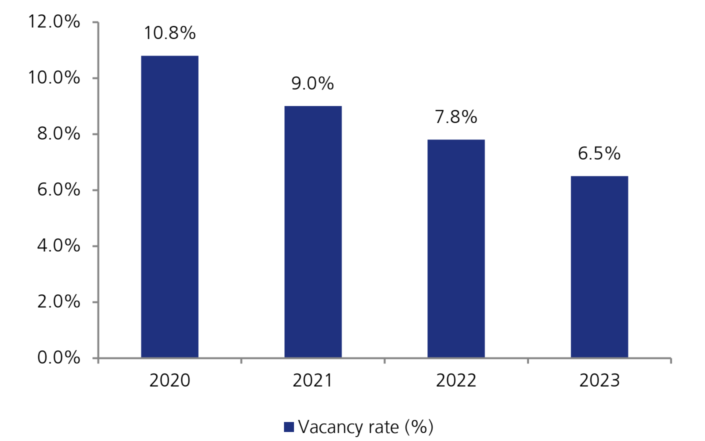
Vacancy Rates: Globally, vacancy rates have seen a marked decline, dropping from over 10% in 2020 to just 6.5% in 2023. The US experiences particularly acute shortages, exemplified by Virginia's historically low vacancy rate of merely 0.9%. Europe maintains slightly higher vacancy rates at 10.6%, but even there, prime locations like Frankfurt have become increasingly tight, demonstrating widespread pressure on available capacity.

Exhibit 107. Absorption has outpaced supply over the past 4 years
Global DC new Supply (GW) and absorption (GW) – 2020-2023



Source: Data center Hawk, Digital Realty, JM Financial

Exhibit 108. Vacancy rates have trended lower over the past 4 years
Global DC vacancy rate, % - 2020-2023

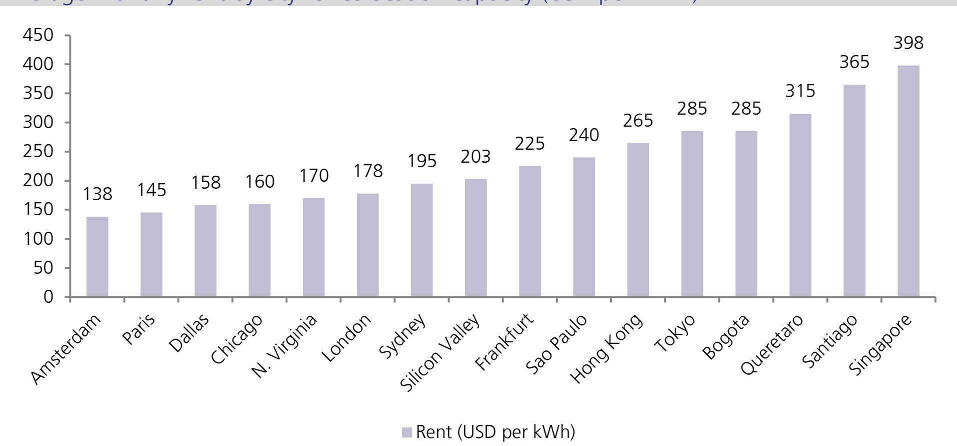


Source: Data center Hawk, Digital Realty, JM Financial

53. What are current rental rates in colo data centres across the world?

Rental Rates: Rental rates for data centres have entered a period of sustained upward momentum, primarily driven by robust demand outpacing constrained supply and persistent inflation. After relative stability pre-pandemic, rents are now forecasted to continue increasing at high single-digit rates. Europe currently exhibits slightly lower nominal rental rates compared to the US, reflecting variations in local electricity costs, but overall rental trends indicate an upward trajectory across global markets.

Exhibit 109. Rents highest in space constrained cities, Indian rates below global average
Average monthly rent by city for colocation capacity (USD per KWH)



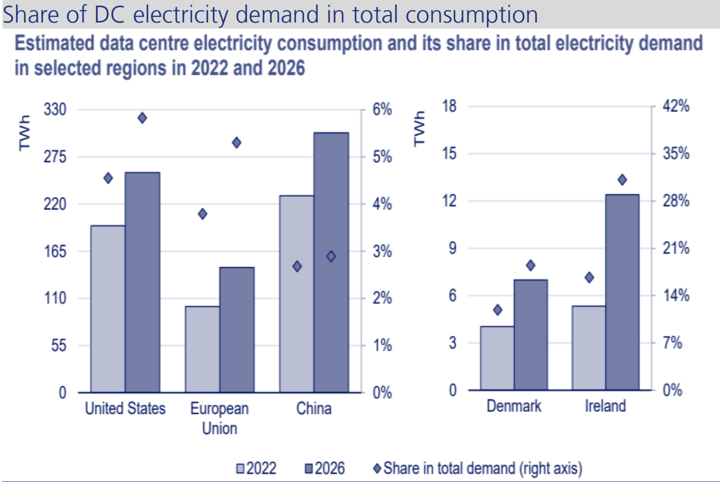
Source: Data centre Hawk, Digital Realty, JM Financial

54. What are the trends in power and cooling requirements?

Energy Requirements: Data centres currently consume about 2% of global electricity, a figure expected to rise significantly with increasing digitalisation and AI workloads. By 2026, global data centre electricity consumption could exceed 1,000TWh, highlighting a growing need for reliable, competitively-priced, low-carbon energy. In the US, consumption is expected to rise from 200TWh in 2022 to 260TWh in 2026. Operators face dual challenges of managing rising electricity demand while navigating energy sourcing constraints, pushing them to explore alternative solutions such as renewable power agreements and small modular nuclear reactors (SMRs).

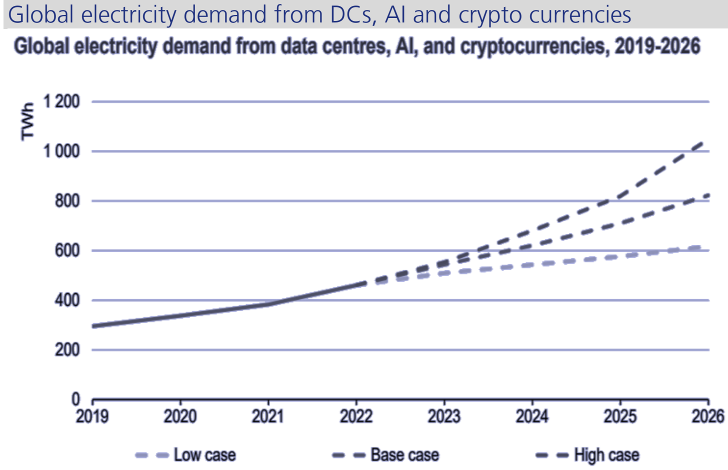
Cooling Requirements: Cooling typically represents 30-40% of a data centre's total energy consumption, driving continuous innovation to improve efficiency. Traditional mechanical cooling methods (such as air- or water-cooled chillers) are energy-intensive and water-consuming. Emerging solutions, such as direct-to-chip liquid cooling and immersion cooling, offer significantly better thermal efficiency and lower environmental footprints, thus, becoming critical as power densities exceed 100 kW per rack in advanced AI-focused facilities.

Exhibit 110. Share of electricity consumption is set to increase going forward requiring fresh power generation capacity
Share of DC electricity demand in total consumption



Source: IEA, JM Financial

Exhibit 111. Electricity demand from data centres, AI and crypto currencies could grow exponentially
Global electricity demand from DCs, AI and crypto currencies

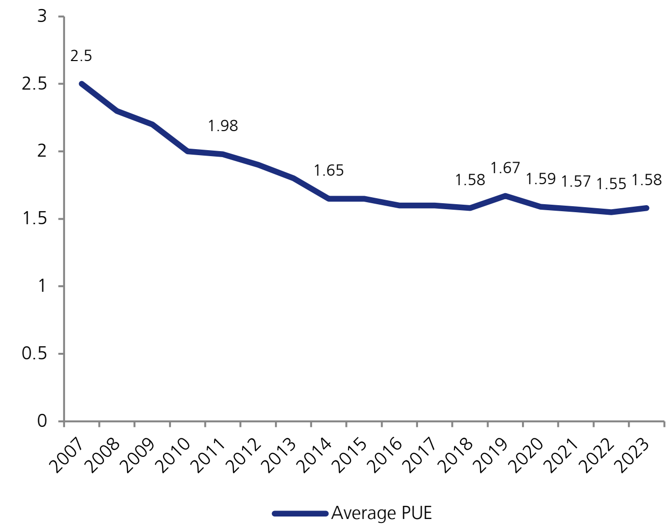


Source: IEA, JM Financial

55. What are the trends in Power Usage Effectiveness (PUE)?

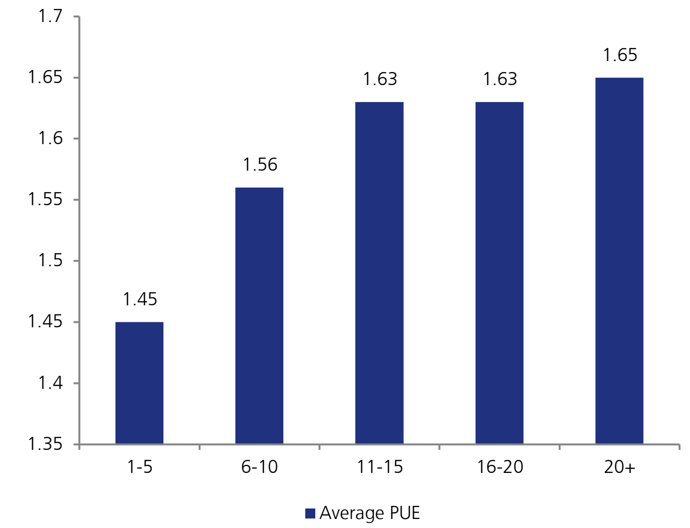
Ideal PUE values typically range closer to 1.0, meaning nearly all consumed energy powers the IT equipment rather than cooling or power distribution losses. Historically, data centres had higher PUE values, generally ranging from 1.8 to above 2.0, indicating that more than 80-100% additional energy was required for cooling and non-IT infrastructure. Traditional enterprise or older DCs frequently reported PUE above 1.8 due to less efficient infrastructure design and older cooling techniques. In recent years, driven by efficiency mandates and sustainability initiatives, average PUE values have significantly improved. Current industry averages globally range around 1.5 to 1.6; however, leading-edge hyperscale DCs often report PUE values close to 1.1 to 1.3, showcasing substantial efficiency improvements.

Exhibit 112. Average PUE has been trending lower, driving down costs and increasing cooling efficiency
Average PUE – (among survey respondents)



Source: Uptime institute global survey of IT and Data Centre managers 2023, JM Financial

Exhibit 113. Older facilities are less efficient in power usage; facilities older than 10 years have PUE factor of greater than 1.5
Average PUE by age of facility (among those surveyed)



Source: Uptime institute global survey of IT and Data Centre managers 2023, JM Financial

56. What are the emerging technology trends and sustainability initiatives in data centres?

Technology trends in data centres underline the data centre industry's evolution towards more powerful, efficient, sustainable, and intelligent infrastructure, increasingly driven by AI workloads, sustainability mandates, and the rapid digitisation of global business and consumer activities.

Technology trends

Advanced Cooling Technologies: Data centres are shifting to advanced cooling methods like direct-to-chip liquid cooling, immersion cooling, and modular, prefabricated systems due to rising power densities (often exceeding 100 kW per rack), driven by AI and HPC workloads.

HPC and AI-driven Infrastructure: AI and HPC applications, such as generative AI models, are significantly reshaping data centre infrastructure, requiring specialised GPUs, AI accelerators (e.g., TPUs), and ultra-fast interconnect technologies like NVIDIA's NVLink or InfiniBand, prompting growth in hyperscale facilities.

Edge Computing: Growth in latency-sensitive applications like IoT, 5G, AR/VR, and autonomous vehicles is leading to increased adoption of edge computing solutions, including micro data centres, prefabricated modular units, and hybrid edge cloud platforms.

Energy Efficiency and Smart Management Solutions: Data centres increasingly employ AI-driven software for real-time energy optimisation, advanced power management technologies, and innovative heat reuse systems, driving improved operational efficiency and lower Power Usage Effectiveness (PUE).

Data Sovereignty and Cloud Infrastructure Trends: Data residency regulations and privacy concerns encourage investment in sovereign cloud infrastructure, while hybrid and multi-cloud strategies drive demand for versatile data centre architectures supporting public and private clouds seamlessly.

Advanced IT Hardware and Semiconductor Trends: Customised chipsets (e.g., Google's TPUs, Amazon's Graviton processors) tailored to data centre-specific workloads, along with high-speed interconnect technologies such as PCIe Gen 5/6 and Compute Express Link (CXL), are significantly enhancing data throughput and efficiency.

Automation, Robotics, and Remote DC Management: Facilities increasingly adopt robotics, digital twin technology, and AI-driven predictive analytics to manage hardware remotely, optimise operations, enhance reliability, and improve uptime with minimal human intervention.

Emerging Storage and Memory Technologies: The growing adoption of high-speed NVMe flash storage and Storage-Class Memory (SCM) technologies, like Intel's Optane DC Persistent Memory, are significantly enhancing data storage performance, latency, and accessibility within data centres.

Sustainability initiatives

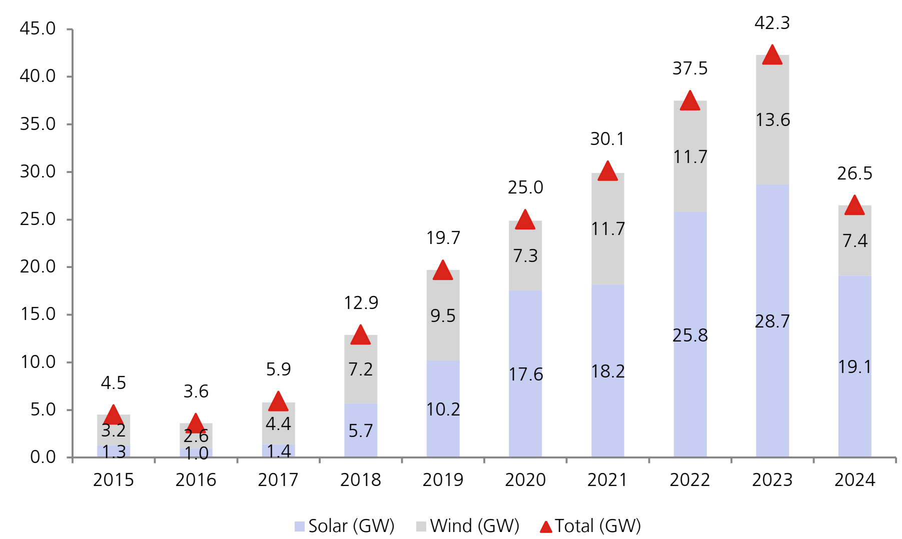
Use of renewable energy: Leading global operators have upto 75% of their power coming from green energy sources. Indian data centres currently use less than 5% green power, but this is expected to rise to 20-25% by 2028. Companies like NTT have also committed to achieving net-zero emissions by 2040 through renewable energy adoption and green innovations.

Energy efficient technologies: Increasing use of liquid cooling for high density AI workloads is improving energy efficiency by reducing reliance on traditional air conditioning. Rightsizing infrastructure can cut TCO by60%, significantly improving energy efficiency and reducing waste.

Government and policy support: The Centre's Digital India and state-level policies include green incentives such as power subsidies and electricity duty exemptions, and there is a concerted such for green energy usage. By 2030, 60% of India's power generation will be from renewable sources; the government is pushing adoption of green energy by making it abundantly available.

Sustainability metrics and goals: Data centre operators increasingly rely on renewable energy sources, using long-term power purchase agreements (PPAs) with solar and wind providers, on-site renewable energy generation, and micro grids to ensure carbon-neutral or low-carbon operations. Emerging trends include capturing waste heat for reuse in district heating or industrial processes, promoting circular economy practices, and enhancing overall resource efficiency. Operators like NTT and others are aligning with science-based targets initiative and aiming for net zero goals.

Exhibit 114. Solar and Wind PPA have grown at a rapid pace, PPAs have grown at 24% CAGR over 2017-2024
Annual global corporate PPA volumes, by power source (GW)



Source: Bloomberg, JM Financial

57. What is edge computing and why is it important?

Edge computing refers to processing of data closer to the location where it is generated- at the "edge" of the network- rather than in centralised cloud data centres. It includes Device edge (on-device processing), Premise Edge (On-site processing), Access edge (near access points, e,g., telecom tower), Metro edge (regional data centres).

Features: Edge DCs are much smaller than centralised data centres and serve local populations; they are designed to be modular and scalable in response to evolving needs. Edge data centres are also considerably more energy efficient due to their small size and localised operations. The power density of edge DCs are also lower. For example, Nxtra has edge DC power density of just c.2 KW per rack.

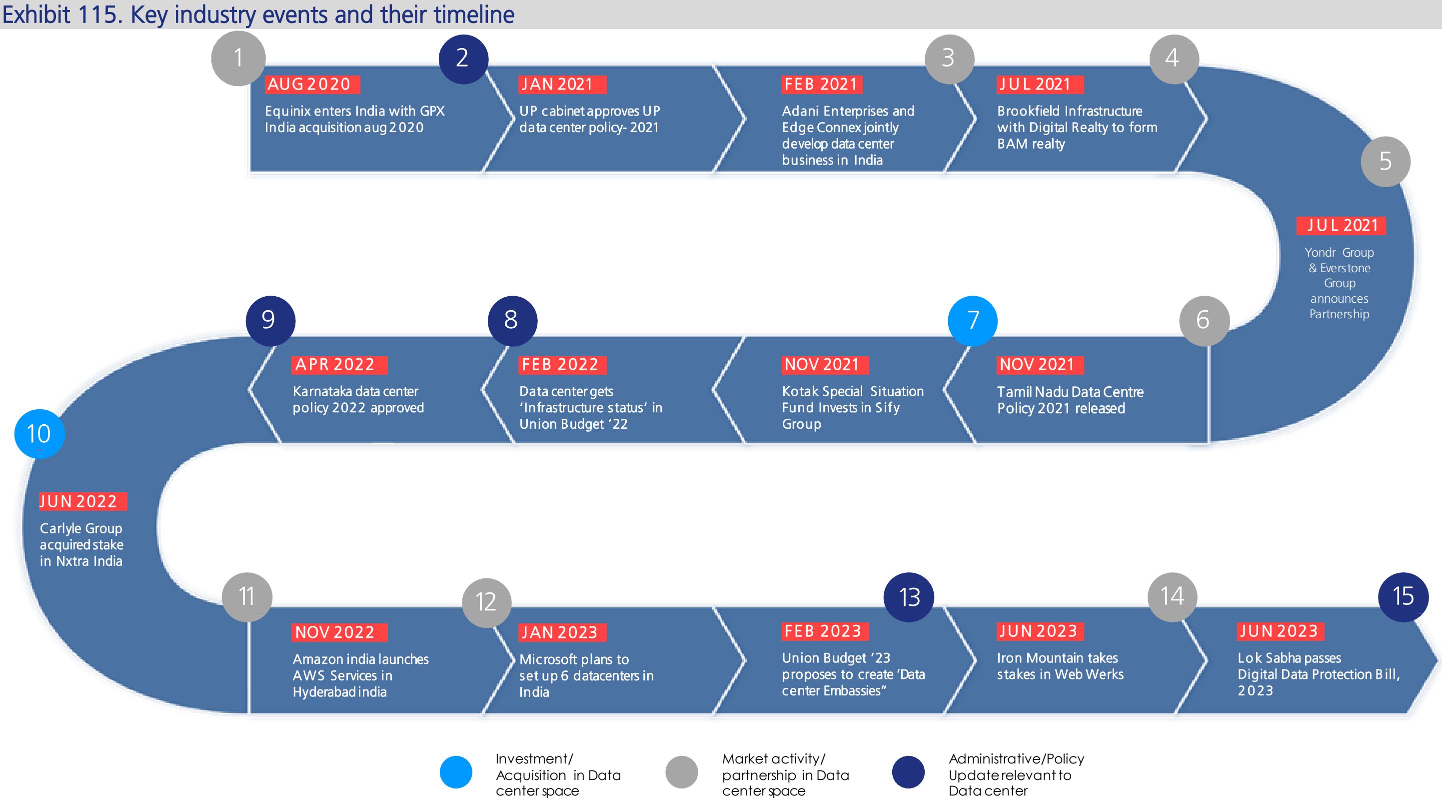
Edge's advantage: Edge computing is critical because it reduces latency, which is important for applications like autonomous vehicles, algorithmic trading or remote surgery. It lowers bandwidth usage by minimising data sent to central servers. It increases reliability where network access is inconsistent, and it improves data security and privacy by keeping sensitive data locally.

Edge in India: Edge computing in India is evolving and rising rapidly. A lot of edge data centre capacity is coming up in tier II and III cities. Edge computing in India is becoming important in India due to rising data traffic, AI, IoT adoption and 5G deployment.

Edge players: Many data centre players are coming up with new edge data centres. A few of them are i) - Nxtra – Nxtra has 50 MW of installed edge DC capacity with 26,000 racks, across 120+ sites. These sites are spread across the country. Nxtra has listed 14 sites in the East, 23 sites in North, 18 sites in South and 11 sites in West as locations where it has edge capacity. These are mostly Tier-II and Tier-III cities. ii)- Techno electric and engineering – TEECL has announced plans to build 102 edge data centres across the country; the company will be developing these in phases, and the first phase will involve construction of 20 edge DC sites.

58. What are the key industry events and their timeline?

Exhibit 115. Key industry events and their timeline



Source: Cushman & Wakefield, JM Financial

59. What are the factors that influence location of data centre in a particular city and why is it important to locate data centre capacity close to end-users?

Following are the factors influencing site selection of a data centre in a particular city -

Exhibit 116. Factors influencing location of data centre capacity

Drivers	Description
Connectivity and latency	Proximity to cable landing stations is a major driver. Cities like Mumbai and Chennai are preferred for their dense submarine cable infrastructure, which ensures low-latency, high speed global data transmission.
Power availability and quality	Data centres are energy-intensive. Reliable and uninterrupted power supply is critical. Cities/states offering power surplus, high capacity substations (like 220 KvA or 400 KVA lines) and green energy sourcing are preferred
Regulatory and policy support	Incentives at the state level, such as capital subsidies, tax breaks, and stamp duty exemptions, attract investment. In India states like Maharashtra, Tamil Nadu and Telangana have well-developed data centre policies
Climate and cooling requirements	Cooler climates are preferable due to lower cooling costs, but this is often balanced with connectivity and power factors
Real estate cost and availability	Availability of industrial-grade land and real estate suited for high density server loads is critical. Tier-I cities dominate for now, but Tier-II cities are emerging as viable alternatives with lower land costs and improving infrastructure
Talent availability	Cities with skilled workforce in IT/ITES and cloud engineering are preferred for operations and maintenance for DCs
Demand clusters	Locations with high enterprise, fintech, OTT and hyperscaler presence see more DCs due to client proximity needs
Low latency requirements	Edge computing and latency -sensitive applications (eg. Gaming, video streaming, AR/VR, autonomous vehicles, algorithmic trading etc.) require data centres closer to the end user
Content delivery and streaming	Content delivery networks (CDNs) often rely on edge data centres in metro areas to store and deliver cached content quickly. Being closer ensures faster loading times and reduced backbone congestion
AI inference workloads	AI training is done in centralized, power dense data centres. But, Inference, benefits from being closer to users for real time response needs
Data localisation and regulatory compliance	In industries like banking, healthcare and public services, local storage is not just a performance issue but a regulatory mandate, often requiring data to remain within a particular state or geography
5G and IoT Applications	5G and IoT is fuelling the rise of edge data centres in smaller cities to handle real time processing close to where the data is generated and consumed

Source: Cushman & Wakefield, BCG, EY, JLL, ICRA, JM Financial

J. Working and Performance Measures

60. What are the essential components of data centre infrastructure?

A data centre's infrastructure is a complex system designed to provide uninterrupted computing, storage, and security. Key components of the infrastructure can be classified into four categories: Compute, Storage, Network, and Support systems.

Exhibit 117. Key components of the data centre infrastructure

Area	Key Components	Description
Computing Infrastructure	Servers (Rack, Blade, AI-optimized GPUs)	Handles data processing, AI workloads, and enterprise applications with high-performance servers.
Storage Infrastructure	File Storage, Block Storage, Solid-State Drives, Hard Disk Drives	Stores and retrieves vast amounts of structured and unstructured data efficiently.
Networking Infrastructure	Routers, Switches, Fiber-Optic Cables, Cloud Interconnects	Ensures high-speed, low-latency data transmission for cloud computing, AI, and enterprise connectivity.
Support Infrastructure	Power (UPS, Generators, Renewable Energy), Cooling Systems, Security (Surveillance, Access Control)	Maintains uptime and reliability with redundant power, cooling, and security measures.

Source: Natixis, Industry, JM Financial

61. What are the key hardware components required for data centre functioning?

A data centre's performance and efficiency rely heavily on specialised hardware components that ensure high availability, reliability, and scalability.

- Rack Servers: Horizontal servers stacked in cabinets, used in enterprise and colocation data centres.
- File Storage (NAS - Network Attached Storage): Used for shared file access across multiple servers.
- Block Storage (SAN - Storage Area Network): High-speed storage solution for enterprise applications.
- Routers & Switches: Manage internal data traffic and external internet connections.
- Fibre-Optic Cables: Provide high-bandwidth connectivity for cloud services and enterprise workloads.
- Cloud Interconnects: Enable direct, high-speed connections to AWS, Azure, and Google Cloud.
- Cooling Systems: Prevents overheating and ensures optimal operating conditions for data centre hardware.
- Surveillance Systems: Monitors facility access and potential security breaches.

62. What are the key software components required for data centre functioning?

A data centre's software stack is critical for managing infrastructure, optimising performance, ensuring security, and enabling virtualisation. Data centres rely on a robust software ecosystem to manage infrastructure, optimise networking, ensure security, and monitor performance.

Data Centre Managements Software:

- Data centre Infrastructure Management (DCIM): Provides real-time monitoring of power, cooling, and space utilisation.
- Baseboard Management Controller (BMC): Monitors hardware health, power usage, and remote access control.
- IT Asset Management (ITAM): Keeps track of server locations, resource allocation, and software licensing.

Virtualization and Cloud Management:

- Hypervisors (VMware vSphere, Microsoft Hyper-V, KVM, Xen): Allow multiple virtual machines (VMs) to run on a single physical server.
- Container Orchestration (Kubernetes, Docker Swarm): Manages containerised applications for cloud-native computing.
- Software-Defined data centre (SDDC) Platforms: Automate and integrate compute, storage, and network functions via software.

Networking and Traffic Optimisation Software:

- Software-Defined Networking (SDN): Centralised control of network traffic for better performance and security.
- Load Balancers (NGINX, F5, Citrix ADC): Distribute traffic to prevent bottlenecks and enhance redundancy.
- WAN Optimisation Software: Enhances wide-area network performance for hybrid cloud operations.

Security and Compliance Software:

- Firewall & Intrusion Detection (Palo Alto Networks, Cisco Firepower): Blocks malicious traffic and detects unauthorised access attempts.
- Zero Trust Security (ZTNA): Requires authentication for every device and user before granting network access.
- Regulatory Compliance Software: Ensures GDPR, HIPAA, ISO 27001 compliance for data protection.

Virtualisation and Cloud Management:

- Application Performance Monitoring (APM): Identifies slowdowns and latency issues in cloud and enterprise applications.
- AI-Based Predictive Maintenance: Uses machine learning to detect hardware failures before they occur.
- Data Centre Energy Management: Monitors and optimises power usage, cooling efficiency, and carbon footprint.

63. What type of power systems required for a data centre?

Data centres are critical infrastructures that require robust and reliable power systems to ensure continuous operation and safeguard data integrity.

Exhibit 118. Key power system requirement for a data centre

Type	Components	Description
Power Supply Infrastructure	Utility Grid Connection	Data centres typically rely on the municipal electric grid as their main power source, necessitating a stable and high-capacity connection to meet substantial energy demands.
	Dual Power Feeds	Many data centres employ dual grid connections to ensure redundancy and prevent single points of failure.
Power Distribution Infrastructure	Transformers	These devices adjust the voltage from the utility supply to levels suitable for data centre equipment, ensuring compatibility and safety.
	Switchgear	Comprising circuit breakers and switches, switchgear manages the distribution of electrical power within the facility, providing control and protection.
	Power Distribution Units (PDUs)	PDUs distribute electrical power to servers, networking hardware, and other equipment, ensuring organized and efficient power management.
Uninterruptible Power Supply (UPS) Systems	Battery Backup	UPS systems provide immediate, short-term power during outages or fluctuations, preventing disruptions and allowing for safe shutdowns or generator start-up.
Backup Power Generators	Diesel Generators	Commonly used to provide extended power during outages, ensuring continuous operation until the primary power is restored.
	Natural Gas Generators	An alternative to diesel, offering cleaner emissions and potentially more reliable fuel supply.
Renewable Energy Integration	On-Site Solar and Wind Power	Implementing renewable energy sources on-site reduces dependence on the grid and lowers carbon footprints.
	Energy Storage Systems	Combining renewable sources with energy storage, such as batteries or kinetic systems, ensures a stable and continuous power supply even when renewable generation is variable.

Source: TRG, Reuters, Testguy, JM Financial

64. How is efficiency of a data centre measured?

The efficiency of a data centre is measured using several key metrics that evaluate energy consumption, resource utilisation, and environmental impact. These metrics help data centre operators optimize operations, reduce costs, and improve sustainability.

- **Power Usage Effectiveness (PUE):** This metric is used to measure how efficiently a data centre utilises power. A PUE value close to 1.0 indicates higher efficiency, meaning most of the power is used for computing rather than cooling, lighting, or other overheads. However, PUE does not measure IT efficiency, meaning an energy-efficient facility can still have underutilised computing resources.
- **Data Centre Infrastructure Efficiency (DCiE):** This metric is the inverse of PUE, measuring the percentage of power used by IT equipment compared to total facility consumption. A higher DCiE percentage signifies better energy utilisation. It is used alongside PUE to track efficiency gains over time.
- **Water Usage Effectiveness (WUE):** This metric measures how much water is consumed for cooling per unit of IT energy used. Since AI workloads and high-density computing have increased water consumption significantly, this is an essential metric to gauge efficiency of water consumption.
- **Carbon Usage Effectiveness (CUE):** This metric quantifies the carbon footprint of a data centre’s energy consumption. A low CUE indicates greener energy sources, such as renewables or nuclear power. Regulatory bodies in the EU and US are enforcing carbon tracking for data centres to ensure sustainability.
- **Energy Reuse Effectiveness (ERE):** This metric measures how much waste heat generated by data centres is repurposed instead of being wasted. Heat reuse is becoming a negotiation tool for governments approving new data centres.
- **Compute Efficiency Metrics:** Beyond facility efficiency, measuring IT hardware performance is equally important. This is measured through metrics like Performance per Watt (evaluates computing power per unit of energy used) and Server Utilisation Rate (track how much of the installed compute power is actively used).

Exhibit 119. Formula for data centre efficiency metrics

Metric	Formula
PUE	Total Facility Energy Consumption / IT Equipment Energy Consumption
DCiE	IT Equipment Energy Consumption / Total Facility Energy Consumption
WUE	Annual Water Usage (Litres) / Total IT Energy Consumption (kWh)
CUE	Total Carbon Emissions (kgCO_2e) / Total IT Energy Consumption (kWh)
ERE	(Total Energy Consumed - Reused Energy) / IT Energy Consumption

Source: Natixis, Nlyte, JM Financial

65. What is the most commonly used efficiency measure, and why?

Power Usage Effectiveness (PUE) is the most widely used metric to measure how efficiently a data centre utilises power. It remains the most commonly used efficiency metric because of its simplicity, regulatory adoption, financial relevance, and benchmarking capabilities. It provides a clear, industry-wide standard for measuring and improving energy efficiency in data centres.

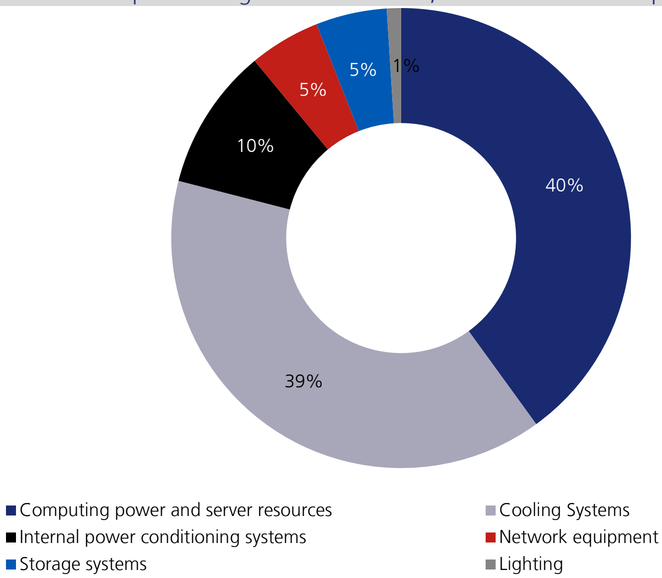
- **Simplicity and Ease of Calculation:** It provides a straightforward and easily measurable method for assessing data centre energy efficiency. A lower PUE value (closer to 1.0) indicates that a higher proportion of energy is used for IT operations, making the data centre more efficient. Since it only requires measuring total facility power usage and IT equipment power consumption, it is easy to track and compare across different facilities.
- **Correlation with Cost Savings and Investment Decisions:** PUE is a key metric for cost-saving strategies in data centres since energy costs account for a significant portion of operational expenses. A drop from PUE 2.0 to PUE 1.3 can reduce energy costs by over 35%, making efficiency improvements a priority for data centre operators. Hyperscale cloud providers like AWS, Google, and Microsoft use PUE as a performance metric to optimise energy usage, reduce OpEx, and enhance overall profit margins. Additionally, investors and real estate firms assessing data centre infrastructure investments prioritise PUE as an indicator of long-term cost efficiency, making it a valuable tool for capital allocation decisions.
- **Industry Standard and Regulatory Adoption:** PUE has been widely adopted as the industry benchmark for energy efficiency by organisations such as Uptime Institute and The Green Grid. Many governments and regulatory bodies have incorporated PUE into mandatory reporting frameworks. For instance, Germany's Energy Efficiency Act requires new data centres to achieve a PUE of 1.2 by 2026 and existing ones to reach a PUE of 1.3 by 2030. Similarly, the EU Energy Efficiency Directive and Singapore's Digital Infrastructure Act mandate PUE reporting to track and enforce sustainability targets.

66. What is the typical distribution of power usage across key components in a data centre?

In a data centre, computing power and cooling systems are the primary energy consumers, accounting for 40% and 38-40% of total power usage, respectively. Servers drive processing workloads, AI computations, and enterprise applications, while cooling systems—such as CRAC units, liquid cooling, and AI-driven optimisations—regulate temperature to prevent overheating. Internal power conditioning systems, including UPS and PDUs, consume 8-10% of power to ensure stable energy distribution, while networking and communication equipment like routers and switches use 5%, supporting seamless data transmission. Storage infrastructure (5%) demands power for HDDs, SSDs, and cloud storage systems, whereas lighting and other facilities collectively account for 1-2%.

With increasing AI and high-performance computing workloads, data centre operators are adopting renewable energy sources, advanced cooling solutions, and intelligent power management systems to improve efficiency. Liquid cooling, immersion cooling, and predictive analytics are being integrated to reduce cooling-related power consumption, while solar, wind, and energy-efficient battery storage help offset carbon footprints. By optimising power distribution, enhancing IT hardware efficiency, and implementing green technologies, data centres are evolving towards lower PUE and greater sustainability.

Exhibit 120. Computing power and cooling systems are the primary energy consumers in a data centre, accounting for c.80% of the total power usage typically
Distribution of total power usage in a data centre, across different components



Source: Deloitte, JM Financial

67. What type of data centres have a lower PUE and why?

Hyperscale data centres have the lowest PUE among all data centre types, with values typically between 1.08 and 1.22, as reported by industry leaders like Google, Microsoft, and Alibaba. These facilities achieve superior efficiency through custom-designed infrastructure, advanced cooling technologies, and optimized energy distribution. Their economies of scale enable massive IT workloads with minimal overhead energy consumption, while innovations like liquid cooling, AI-driven energy management, and renewable energy adoption further enhance efficiency.

Newer data centres also exhibit lower PUE values compared to older facilities. Facilities less than 5 years old typically operate at a PUE of ~1.2, while legacy data centres (10+ years old) often exceed 1.6 due to inefficient cooling, outdated power distribution, and higher energy losses. Geographic location plays a role as well—data centres in colder regions (Nordic countries) leverage free air cooling, significantly reducing cooling energy demands and improving PUE.

In contrast, retail and wholesale colocation data centres tend to have higher PUE values, often above 1.35, because they lack the full-stack energy optimisations of hyperscalers. These facilities serve multiple tenants with diverse IT workloads, leading to inconsistent power usage and cooling inefficiencies. Additionally, colocation operators do not always control tenant hardware choices, limiting their ability to implement holistic energy-saving strategies. Consequently, while hyperscalers aggressively push for lower PUE values, colocation providers must balance efficiency with flexibility and multi-tenant demands.

68. What are the cooling and environmental controls required in a data centre?

Following are the key environmental and cooling controls required in a data centre –

- Temperature Control: Temperature management is crucial for data centres to prevent overheating, ensure equipment longevity, and optimise energy efficiency. According to ASHRAE guidelines, data centres should maintain a temperature range of 18-27°C to ensure optimal hardware performance. Various cooling systems help regulate temperature, including Computer Room Air Conditioners (CRACs) and Computer Room Air Handlers (CRAHs), which circulate cooled air within the facility. Hot and cold aisle containment is another widely used technique that directs airflow efficiently, reducing energy consumption by up to 40%. Liquid cooling methods, such as direct-to-chip cooling and immersion cooling, are increasingly being deployed for AI and high-performance computing (HPC) workloads, as they offer superior heat dissipation and reduce reliance on traditional air cooling.

- Humidity Control: Maintaining proper humidity levels is essential to prevent electrostatic discharge (ESD) and hardware corrosion. Data centres typically operate within a relative humidity range of 45-55% to minimise these risks. Excessive humidity can lead to condensation, potentially damaging sensitive IT equipment, whereas low humidity can result in static electricity build-up, which increases the risk of hardware failures. To manage humidity, precision air conditioning systems (PACs) and humidifiers/dehumidifiers are integrated into data centre cooling infrastructure. Additionally, desiccant-based dehumidification systems and moisture control sensors are commonly used to ensure stable environmental conditions.
- Quality and Sustainability Controls: Beyond temperature and humidity, several other environmental controls are critical for maintaining energy efficiency and sustainability in data centres. Air quality control systems are implemented to filter dust and airborne contaminants, reducing the risk of hardware malfunctions. AI-driven climate control systems optimise PUE and dynamically adjust cooling settings, resulting in up to 30% energy savings. Additionally, heat reuse and energy recovery systems are gaining traction, allowing excess heat generated by data centres to be repurposed for district heating, office spaces, or industrial applications . Renewable energy-powered cooling solutions, such as free air cooling and evaporative cooling, are also being integrated to enhance sustainability in modern data centre operations.

69. What are the sustainability considerations of a data centre?

Data centres are among the most energy-intensive infrastructures, with sustainability becoming a critical focus due to rising concerns about energy consumption, carbon emissions, and resource utilisation. As AI, cloud computing, and high-performance computing (HPC) workloads expand, data centre operators are adopting green technologies, renewable energy, and efficiency measures to minimise their environmental footprint.

- Renewable Energy Adoption: Electricity sourcing is a major sustainability challenge for data centres. To reduce dependence on fossil fuels, operators are investing in solar, wind, and hydroelectric power, with companies like Google, AWS, and Microsoft committing to 100% renewable energy usage. In some regions, PPAs with renewable energy providers are being used to ensure a steady supply of green electricity.
- Energy Efficiency and Power Usage Optimisation: PUE remains the gold standard for measuring data centre efficiency, with modern hyperscale facilities targeting a PUE below 1.2. New-generation AI-powered cooling systems, liquid cooling, and immersion cooling are being deployed to reduce cooling power demand, which typically accounts for 38-40% of total energy consumption. Additionally, high-voltage DC power distribution and energy-efficient processors are improving IT power efficiency while minimising conversion losses.
- Water Usage and Cooling Innovations: Water-intensive cooling systems present another sustainability concern, with WUE emerging as a key metric. AI-driven cooling, evaporative cooling, and heat reuse systems are being deployed to reduce water consumption. Hyperscale providers are also exploring air-cooled and liquid-cooled technologies to limit environmental impact.
- Waste Heat Reuse and Carbon Emissions Reduction: Innovative waste heat reuse programmes are gaining traction, where excess heat from data centres is redirected for district heating, agricultural use, or industrial applications. European regions, including Denmark and Sweden, have integrated data centre heat recycling into municipal infrastructure. At the same time, operators are focusing on CUE to measure and mitigate emissions from non-renewable power sources.

70. What are the key safety concerns and mitigation mechanisms of working in a data centre?

Working in a data centre involves navigating a range of safety concerns due to the nature of the infrastructure and operations. One of the primary risks stems from high-voltage electrical systems, which power servers, storage, and networking equipment. These systems pose threats of electrocution and arc flashes, especially during maintenance or power switching operations. Additionally, the dense concentration of electronic equipment increases the likelihood of fire hazards, exacerbated by complex cabling and constant power draw. Overheating is another concern, as thermal buildup can damage equipment and create physically hazardous conditions for personnel.

Beyond electrical and thermal risks, data centre environments also present physical safety challenges. Workers often operate in confined spaces with raised floors, heavy equipment, and tightly packed racks, increasing the chances of slips, trips, and ergonomic injuries. Environmental hazards such as battery leaks, refrigerant exposure, or diesel spills from backup systems also pose health and safety risks. Coupled with the pressure of maintaining continuous uptime and the mental strain of shift work, these factors make data centres uniquely demanding from a safety standpoint.

Exhibit 121. Key risks in a data centre and their respective mitigation processes

Risk Type	Mitigation Mechanisms
Electrical Hazards	Strict lockout/tagout procedures before any maintenance
	Use of insulated tools and PPE (personal protective equipment) and routine electrical safety audits
	Redundant power systems to prevent overloads or short circuits
Fire Risks	VESDA (Very Early Smoke Detection Apparatus) for early warning
	Fire-rated cable management and containment systems
	Regular fire drills and training
Overheating and Thermal Risks	Real-time thermal monitoring
	Redundant HVAC systems and cooling zones
	Clear SOPs for working in high-temperature environments
Physical Injuries and Ergonomic Issues	Use of server lifts and trolleys
	Cable management to reduce trip hazards
	Ergonomically designed workspaces

Source: Odata, TechTarget, Databank, JM Financial

K. Key Technological Aspects

71. What is Vacancy Rate? What are its implications?

The vacancy rate in a data centre refers to the percentage of available, unleased capacity at a given time. This metric is crucial for understanding market demand and supply trends, and investment viability. A lower vacancy rate suggests strong demand and limited available space, while a higher vacancy rate may indicate excess supply or slow leasing activity.

Vacancy Rate (%) = {Total Available Capacity (MW or Sq Ft)/Total Data Centre Capacity (MW or Sq Ft)}*100

Following are the implications of vacancy rates –

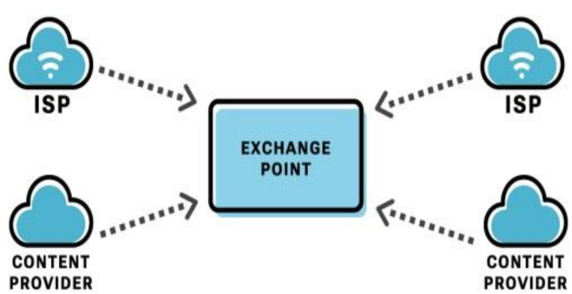
- Low vacancy (<5%): High demand, potential for higher rent pricing. Limited availability may force companies to pre-lease capacity years in advance.
- Moderate vacancy (5 - 15%): Balanced market conditions. Enough supply for growth without oversaturation risks.
- High Vacancy (>15%): Risk of oversupply, leading to lower rental yields. Tenants may have more negotiation power on lease terms.

72. What is an IXP?

An Internet Exchange Point (IXP) is a physical infrastructure where multiple networks—including Internet Service Providers (ISPs), content delivery networks (CDNs), cloud providers, and enterprises—interconnect to exchange internet traffic directly instead of routing it through third-party transit providers. By facilitating direct peering, IXPs help reduce latency, lower bandwidth costs, and improve network reliability.

Instead of data traveling through long, inefficient routes via multiple network providers, IXPs create a central location where participating networks exchange traffic more efficiently. For example, if ISP A and ISP B are connected to the same IXP, traffic between their customers flows directly, avoiding delays and reducing transit fees. This makes IXPs critical for enhancing internet performance and scalability.

Exhibit 122. Working of a typical IXP



Source: Guam IX, JM Financial

Exhibit 123. Key benefits of traffic movement through IXP

Benefits	Description
Lower Latency	Reduces the number of hops between networks, improving speed for streaming, gaming, and cloud services.
Cost Efficiency	Direct traffic exchange eliminates the need for costly upstream transit providers.
Improved Network Redundancy	Enhances reliability by providing alternative routing paths, reducing congestion and downtime.
Scalability	Supports high-bandwidth applications like AI, edge computing, and global content delivery.

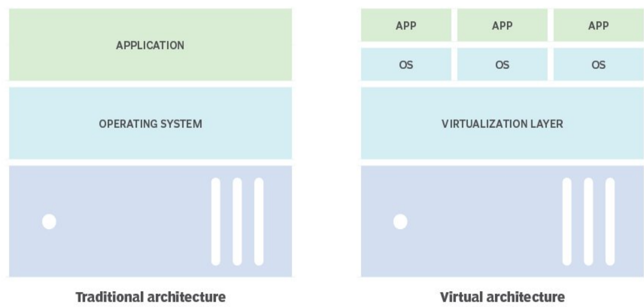
Source: Vaultas, MDC, JM Financial

73. What is Virtualisation?

Virtualization is a technology that allows multiple virtual instances of computing resources—such as servers, storage, and networks—to run on a single physical machine. It enables better resource utilisation, scalability, and flexibility by abstracting hardware and creating software-defined environments. A virtual machine (VM) is a virtual representation, or emulation, of a physical computer. It is often referred to as a guest while the physical machine it runs on is referred to as the host. Virtualisation makes it possible to create multiple virtual machines, each with their own operating system (OS) and applications, on a single physical machine.

A VM cannot interact directly with a physical computer. Instead, it needs a lightweight software layer called a hypervisor to coordinate between it and the underlying physical hardware. The hypervisor allocates physical computing resources — such as processors, memory, and storage — to each VM. It keeps each VM separate from others so they don't interfere with each other.

Exhibit 124. Difference between Traditional and Virtual architecture



Source: TechTarget, JM Financial

Exhibit 125. Key components that use virtualisation technology

Type	Description
Server Virtualization	Divides a single physical server into multiple virtual machines (VMs), each running its own operating system and applications.
Storage Virtualization	Combines multiple physical storage devices into a single, unified storage pool, improving efficiency and scalability.
Network Virtualization	Creates virtual network instances, allowing software-based management of firewalls, routers, and switches without relying on physical hardware.
Desktop Virtualization	Enables users to access virtual desktops remotely, improving security and centralizing IT management.
Application Virtualization	Allows applications to run in isolated environments, ensuring compatibility across different devices and operating systems.

Source: Global Knowledge, JM Financial

74. What is Distributed Computing?

Distributed computing is a computing model where multiple interconnected machines (nodes) work together to execute tasks, process data, and share resources. Instead of relying on a single powerful system, distributed computing breaks down workloads and distributes them across multiple computers, enabling parallel processing, higher scalability, and fault tolerance. This architecture is essential for cloud computing, AI, big data analytics, and high-performance computing (HPC), where large datasets and computationally intensive tasks need to be processed efficiently.

In data centres, distributed computing enables load balancing, redundancy, and seamless scalability by dynamically allocating resources across multiple servers and locations. Cloud providers like AWS, Google Cloud, and Microsoft Azure use distributed computing to ensure high availability and minimal downtime. Applications such as block-chain networks, global content delivery, and real-time data processing rely on distributed systems to enhance performance, optimise resource utilisation, and improve resilience against hardware failures.

75. What is Redundancy? Why is it important?

Redundancy in a data centre refers to the duplication of critical components and systems to ensure continuous operation in case of failures. This applies to power supplies, cooling systems, networking, and storage infrastructure, reducing the risk of downtime and enhancing system reliability. Redundancy is crucial because hardware failures, power outages, or unexpected events can disrupt operations, leading to data loss, financial damage, and service interruptions. Redundancy configurations are denoted using 'N', where 'N' represents the minimum requirement for a fully functional system without any redundancy.

Ensuring high availability and business continuity is a primary reason data centres invest in redundancy. Large-scale cloud providers, financial institutions, and enterprise IT environments require near-zero downtime, making failover mechanisms and backup infrastructure essential. Implementing redundancy also improves disaster recovery capabilities, allowing data centres to switch to backup systems automatically, ensuring smooth operations during failures. Higher redundancy levels, such as 2N and 2N+1, are used in mission-critical data centres, such as financial services, government systems, and hyperscale cloud providers, where 100% uptime is mandatory.

Exhibit 126. Commonly used redundancy configurations and what they mean

Configuration	Description	Failure Response
N	The system has only the required number of components needed to function, with no backups.	If a failure occurs, downtime is inevitable.
N+1	Provides one additional backup component beyond what is required (e.g., one extra power supply in a system with five).	If one component fails, operations continue without disruption.
2N	A fully duplicated system, meaning two independent sets of critical infrastructure (e.g., dual UPS systems, dual cooling systems)	Seamless failover in case of failure.
2N+1	A fully duplicated system with an additional backup component.	Highest level of fault tolerance.

Source: CoreSite, JM Financial

76. What is Rack Density?

Rack density refers to the amount of power consumed by IT equipment housed within a single data centre rack, typically measured in kilowatts per rack (kW/rack). It is a crucial factor in determining the efficiency and scalability of a data centre, impacting power distribution, cooling infrastructure, and overall operational costs. As computing demands grow, businesses are shifting towards higher rack densities to maximise processing power within a limited footprint, reducing real estate requirements while improving performance. Higher densities allow data centres to host more servers, storage, and networking hardware in the same space, but they also introduce challenges related to heat dissipation and energy management.

Rack density is measured by assessing the cumulative power draw of all equipment within a standard 42U or 48U data centre rack. The total power consumed by servers, storage devices, and networking equipment is summed up, typically monitored through PDUs and DCIM software. Low-density racks generally consume around 3-5kW, while medium-density setups range between 6-10kW. High-density racks, especially in AI-driven or HPC environments, can exceed 20kW per rack. Monitoring rack density is critical for optimising power supply and cooling efficiency while ensuring uptime and reliability.

Historically, data centres operated at low to medium densities, with 3-5kW per rack being the norm for traditional enterprise workloads. However, modern cloud computing, hyperscale, and HPC environments are pushing densities higher, with 10-20kW per rack becoming increasingly common. Cutting-edge deployments, particularly in AI, deep learning, and block chain processing, are exceeding 30-50kW per rack, necessitating advanced cooling technologies such as liquid cooling or immersion cooling to manage excessive heat. The shift towards higher rack densities reflects the industry’s move toward energy-efficient, compact, and high-performance data centres capable of supporting future computing demands.

77. What are the different data centre cooling technologies?

Efficient cooling is critical for maintaining optimal performance and preventing equipment failure in data centres. As rack densities increase, cooling technologies have evolved to handle rising heat loads.

Following are the primary Air-based cooling methods:

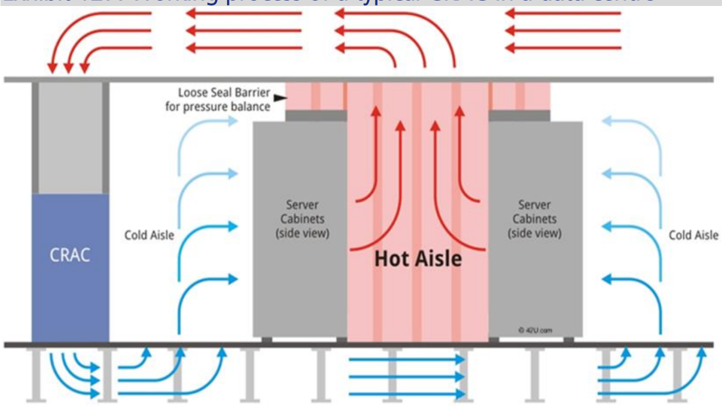
- Computer Room Air Conditioners (CRAC) and Computer Room Air Handlers (CRAH): These are traditional cooling methods where air is cooled and circulated within the data centre using raised floors or ducted systems.
- Cold Aisle/Hot Aisle Containment: By physically separating cold intake air from hot exhaust air, containment systems improve cooling efficiency and reduce energy consumption.
- Direct Expansion (DX) Cooling: Uses refrigerants in CRAC units for cooling smaller data centres with lower densities.

Following are the primary Liquid-based cooling methods:

- Chilled Water Cooling: Chilled water is circulated through cooling coils in CRAH units, offering better efficiency than traditional air cooling, especially in high-density data centres.

- Rear Door Heat Exchangers (RDHx): A liquid-cooled heat exchanger mounted at the back of a rack absorbs and removes heat before it enters the data centre environment.
- Direct-to-Chip Cooling: Coolant is delivered directly to the processors and other heat-generating components through microchannels, significantly improving cooling efficiency.
- Immersion Cooling: IT equipment is fully submerged in a non-conductive dielectric liquid, which absorbs heat efficiently and eliminates the need for air-based cooling entirely.

Exhibit 127. Working process of a typical CRAC in a data centre



Source: LearnCAx, JM Financial

Exhibit 128. Depiction of liquid cooling in data centres

Source: Hypertec, JM Financial

78. What are the key success factors for the functioning of a data centre?

A data centre's success is determined by several critical factors that ensure reliability, efficiency, and operational excellence. As data-driven applications grow in complexity, factors such as operational continuity, low latency, and a stable power supply become essential in maintaining high-performance standards.

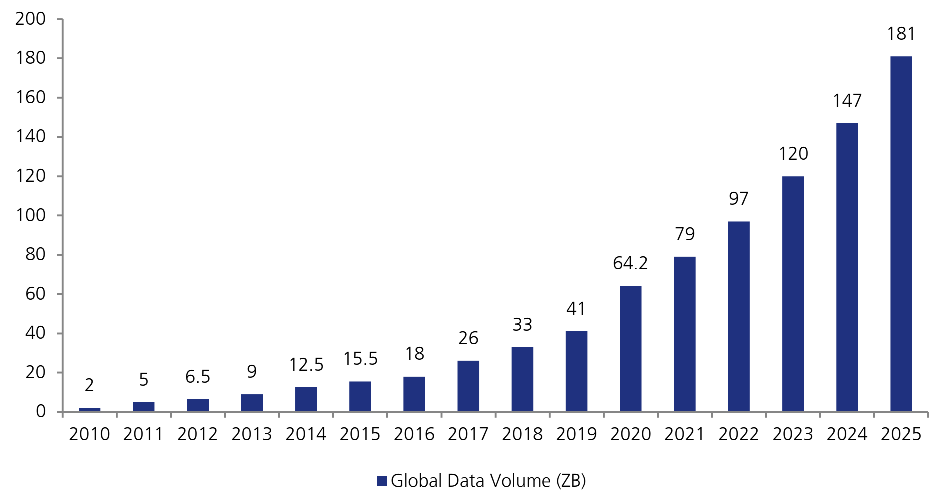
- Operational Continuity: Operational continuity is fundamental to minimising downtime and ensuring uninterrupted service availability. Data centres employ redundancy strategies to prevent failures from disrupting operations. The Uptime Institute's tier classification system rates data centres from Tier I to Tier IV, where Tier IV facilities offer the highest resilience, ensuring dual power sources, backup cooling, and multiple redundancies . Advanced data centres also implement disaster recovery and failover mechanisms, allowing workloads to transition seamlessly across geographically distributed sites during system failures.
- Low Latency and High-Speed Connectivity: Low latency is crucial for real-time applications, including cloud computing, high-frequency trading, and AI model training. Data centres achieve low latency by maintaining proximity to Internet Exchange Points (IXPs), submarine cables, and fibre-optic networks. Hyperscale and edge data centres are emerging in strategic locations to process data closer to end users, reducing delays for applications like autonomous vehicles and 5G-powered services.
- Reliable Power Supply and High Rack Density: A stable and uninterrupted power supply is one of the most crucial factors for a data centre's success. High-density data centres require 10kW to over 100kW per rack to support advanced computing workloads, particularly for AI, machine learning, and cloud services. Modern facilities integrate energy-efficient power management, including UPS systems, PDUs, and renewable energy sources, to improve sustainability and uptime.
- Efficient Cooling and Thermal Management: Cooling systems account for a significant portion of total energy consumption, making efficient thermal management critical. Data centres deploy hot/cold aisle containment, liquid cooling, and AI-driven cooling optimization to reduce energy waste and maintain optimal temperatures.
- Security, Compliance, and Risk Management: Physical and cybersecurity protections are essential for safeguarding mission-critical data. Data centres incorporate biometric access controls, 24/7 surveillance, and multi-layered firewalls to prevent breaches.

79. How does growth in global data volumes impact data centres globally?

The rapid acceleration of global data generation has profound implications for data centre. In 2020, approximately 64.2ZB of data were created, and projections estimate this figure will surge to over 180ZB by 2025. This exponential growth necessitates significant expansion and adaptation within data centre infrastructures to effectively manage, store, and process these vast data volumes. Given that traditional data centres typically have capacities ranging from 10MW to 30 MW, accommodating such data growth would require a substantial increase in both the number and scale of data centres.

Consequently, the data centre industry is experiencing unprecedented growth. For instance, in Europe, data centre capacity is projected to increase by 43% in 2025 compared to 2024, driven by the expansion of AI and cloud computing activities. Similarly, in the US, the rapid development of energy-intensive data centres is pushing electricity consumption to new heights, with projections indicating that their demand will triple within 3 years, consuming 12% of the country's power supply. This surge underscores the critical need for strategic planning in data centre construction, energy sourcing, and infrastructure development to sustainably support the escalating data demands.

Exhibit 129. Global data volumes have grown at a CAGR of 23% over 2020-2024, and is expected to reach 181 ZB in 2025
Global data volumes (ZB)



Source: IDC, JM Financial

80. What are the emerging technologies improving data centre efficiency and capacity?

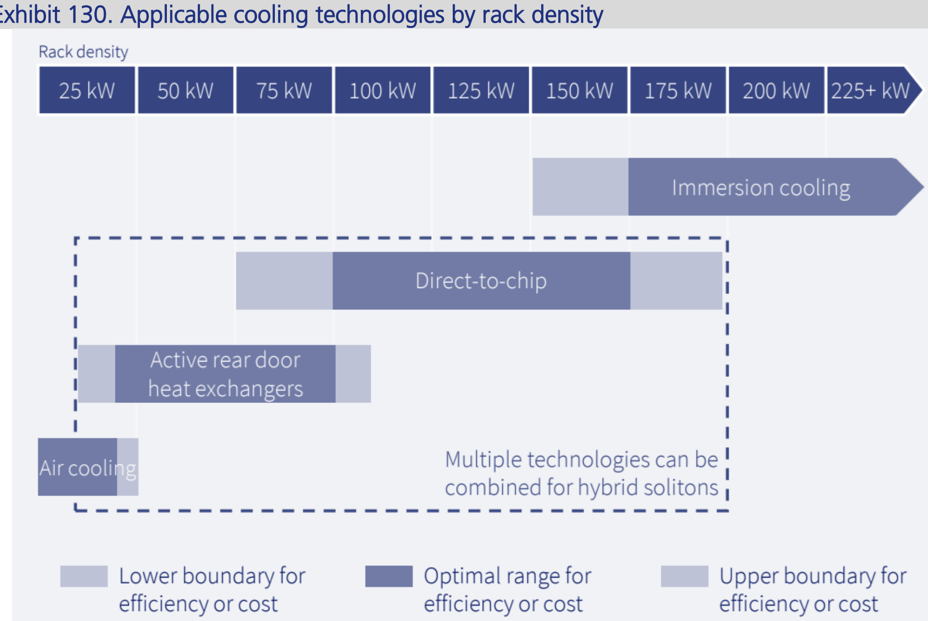
As data volumes grow exponentially, data centres must evolve to handle increased computational and storage demands while improving efficiency and sustainability. Emerging technologies are driving advancements in power management, cooling, networking, AI-driven optimisation, and next-generation computing.

- Power Efficiency Enhancements: Traditional data centres suffer significant energy losses due to multiple AC-DC conversions. The adoption of high-voltage direct current (HVDC) power distribution reduces conversion inefficiencies, allowing for direct power delivery to IT equipment with minimal loss. Additionally, silicon carbide-based inverters in UPS systems improve power efficiency by reducing switching losses and heat generation. Machine learning-powered intelligent energy management systems are also being implemented to optimise real-time power allocation, reducing over-provisioning and ensuring energy is used only when needed, thereby improving overall PUE.
- Advanced Cooling Technologies: As server rack densities rise from 3-5kW per rack to 30-50kW per rack, traditional air-based cooling methods become inadequate. Liquid cooling solutions, including direct-to-chip cooling and immersion cooling, circulate dielectric fluids or water-based solutions directly over heat-generating components, significantly

improving thermal efficiency and reducing cooling energy costs. Microfluidic cooling, which uses microscopic liquid channels to dissipate heat at the chip level, is emerging as a crucial solution for AI and HPC workloads.

- Storage and Networking Innovations: To handle increasing data demands efficiently, data centres are transitioning from hard disk drives (HDDs) to solid-state drives (SSDs), which offer lower latency, higher energy efficiency, and reduced heat generation. The shift to NVMe (Non-Volatile Memory Express) storage allows for faster data retrieval, crucial for AI and big data applications. Meanwhile, photonic interconnects, which use optical instead of copper-based connections, significantly improve data transfer speeds and energy efficiency. Additionally, the deployment of edge data centres, which process data closer to the source rather than relying on centralised cloud facilities, reduces network congestion, enhances latency-sensitive applications, and optimises bandwidth usage.
- AI-Driven Optimisation: AI-powered workload orchestration is revolutionising how data centres manage their computing resources by dynamically allocating workloads based on real-time demand. This prevents servers from running idle, significantly improving energy efficiency. Predictive maintenance algorithms leverage AI to analyse system performance and detect potential failures before they occur, minimising downtime and reducing maintenance costs.

Exhibit 130. Applicable cooling technologies by rack density



Note: Ranges are approximations. Source: JLL, JM Financial

81. What are the different models of cloud computing?

Cloud computing encompasses various models tailored to different organisational needs, primarily categorised by deployment methods and service offerings.

Exhibit 131. Different deployment models in cloud computing

Type	Description
Public Cloud	Services are delivered over the public internet and shared across multiple organizations, offering scalability and cost-effectiveness.
Private Cloud	Dedicated infrastructure for a single organization, providing enhanced security and control, either on-premises or hosted by a third-party provider.
Hybrid Cloud	Combines public and private clouds, allowing data and applications to move between them, offering flexibility and optimization of existing infrastructure, security, and compliance.

Source: Microsoft, LogicMonitor, JM Financial

Exhibit 132. Different service models in cloud computing

Type	Description
Infrastructure as a Service (IaaS)	Provides virtualized computing resources over the internet, allowing organizations to rent servers, storage, and networking, thereby eliminating the need for physical hardware.
Platform as a Service (PaaS)	Offers hardware and software tools over the internet, typically for application development, enabling developers to build, test, and deploy applications without managing underlying infrastructure.
Software as a Service (SaaS)	Delivers software applications over the internet on a subscription basis, allowing users to access software without installation or maintenance responsibilities.
Function as a Service (FaaS)	A serverless computing model where developers can execute code in response to events without managing server infrastructure, allowing for scalable and event-driven computing.

Source: Brainhub, Google, JM Financial

82. What are the drivers of cloud adoption?

Organisations are increasingly adopting cloud computing to enhance operational efficiency, drive innovation, and maintain competitiveness. Key drivers influencing this shift include:

- Cost Efficiency: Cloud computing reduces the need for significant upfront investments in hardware and infrastructure by offering a pay-as-you-go model. This shift from capex to opex allows businesses to allocate resources more effectively and scale services based on demand, leading to overall cost savings.
- Scalability and Flexibility: The cloud enables rapid scaling of IT resources to accommodate fluctuating workloads, providing businesses with the agility to respond to market changes and growth opportunities without the delays associated with traditional infrastructure expansion.
- Enhanced Security: Cloud providers invest heavily in advanced security measures, offering robust protection against cyber threats. This allows organisations to leverage high-level security protocols and compliance certifications, often surpassing what they can implement internally.
- Business Agility: By utilising cloud services, companies can accelerate product development and deployment cycles, fostering innovation and allowing for quicker adaptation to market demands. This agility is crucial for maintaining a competitive edge in today's fast-paced business environment.
- Remote Accessibility and Collaboration: Cloud computing supports remote work by providing employees with access to applications and data from any location with internet connectivity. This enhances collaboration across geographically dispersed teams and ensures business continuity, a benefit that has become increasingly important in recent years.

83. Why does AI need Data centre?

AI requires data centres to provide the substantial computational power, storage, and specialized infrastructure essential for processing complex algorithms and managing vast datasets.

- High Computational Demands: AI workloads, especially model training, demand HPC infrastructure equipped with GPUs, TPUs, and AI accelerators. For instance, training models like ChatGPT requires tens of thousands of GPUs, consuming vast amounts of processing power.
- Scalability and Flexibility: AI applications require dynamic scaling of resources for training, inference, and real-time processing. Hyperscale data centres provide the flexibility to allocate GPU and CPU resources based on demand, preventing idle computing power and optimising costs. The applications often experience variable workloads, requiring infrastructure that can scale resources up or down based on demand.
- Low Latency and High-Speed Connectivity: For real-time AI applications, such as autonomous vehicles and telemedicine, minimal latency is crucial. Hyperscale and edge data centres enable faster data processing and real-time decision-making, reducing delays that could be critical in AI applications.
- Enhanced Power and Cooling Capabilities: AI workloads consume significantly more energy than traditional computing, with power consumption per rack increasing ~10x compared to standard enterprise workloads. Data centres are designed with advanced power and cooling systems to manage these demands effectively.
- Data Storage and Management: AI models require extensive datasets for training, validation, and inference. Generative AI and deep learning algorithms process petabytes of structured and unstructured data, requiring high-speed NVMe storage and object-based storage solutions. Data centres offer robust storage solutions and efficient data management systems, ensuring secure and organised data handling essential for effective AI operations.

84. At what all points does a typical application require a data centre?

A modern application, whether a cloud-based service, an AI model, or enterprise software, interacts with a data centre at multiple stages of its lifecycle. Data centres provide the backbone infrastructure for computing, storage, and networking throughout the application's development, deployment, and continuous operation.

- **Development & Testing Stage:** During the development phase, software engineers write, test, and iterate on their code using cloud-based development environments hosted in data centres. Many rely on PaaS offerings from hyperscale cloud providers such as AWS, Azure, and Google Cloud, which provide pre-configured environments with scalable compute, storage, and networking resources. Continuous Integration/Continuous Deployment (CI/CD) pipelines run automated tests within data centres, using virtual machines, containers, or Kubernetes clusters to simulate real-world usage. AI models in this phase consume high-performance GPU or TPU clusters for initial training runs.
- **Training and Optimisation (For AI/ML Applications):** If the application involves AI or ML, it undergoes a training phase, where models process vast datasets using high-density computing infrastructure. This stage requires GPUs, TPUs, and high-speed NVMe storage, typically hosted in hyperscale AI data centres. AI-specific data centres leverage liquid cooling and advanced power management to handle the computational load, ensuring efficient processing and minimal latency.
- **Deployment and Hosting:** Once development and testing are complete, the application is deployed on cloud-based or dedicated data centre servers. This can be done using IaaS or colocation services, where the application is hosted on virtual machines, bare-metal servers, or containerised platforms like Kubernetes. At this stage, data centres provide load balancing, redundancy, and failover systems to ensure high availability.
- **Live Operations and User Requests:** Once the application is live, data centres handle real-time user requests, data processing, and network traffic. This involves compute resources - servers process application logic, user authentication, and real-time interactions, database and storage, network and content delivery, and security and compliance
- **Scaling and Optimisation:** As user traffic grows, applications leverage data centre infrastructure to dynamically scale resources. AI-based auto-scaling algorithms monitor load conditions and allocate additional compute, storage, or networking resources when needed. Edge data centres are deployed closer to users to reduce latency, especially for IoT, real-time analytics, and video streaming applications.
- **Maintenance, Updates, and Compliance:** Throughout its lifecycle, an application requires periodic updates, security patches, and compliance audits. Data centre infrastructure supports automated software updates, backup and disaster recovery (DR), and regulatory compliance (such as GDPR, HIPAA, or India's data localisation laws). AI models may require continuous retraining, leveraging hyperscale AI compute resources for periodic improvements.

L. Impact of DeepSeek

85. What is DeepSeek?

DeepSeek, a prominent Chinese Artificial Intelligence startup, has rapidly ascended in the AI landscape by developing advanced LLMs. It is sponsored by High-Flyer, a China based hedge fund. High-Flyer was co-founded by Liang Wenfeng, an AI enthusiast. In 2016, DeepSeek released its first series of models – DeepSeek LLM in Nov'23. On 25th Dec'24, it released DeepSeek V3, an open-source LLM with 671bn parameters (against LLaMa3.1's 405bn). However, its architecture (Mixture-of-Experts) means it only activates 37bn parameters/token, against all 405bn for LLaMa3.1. On 20th Jan'25, DeepSeek released DeepSeek-R1-Zero and DeepSeek-R1 models. These are reasoning models, similar to OpenAI's o1, and use chain-of-though (COT) reasoning process which perform better on reasoning tasks, e.g., mathematics, coding, and scientific reasoning.

86. What chips have been primarily utilised to train DeepSeek models?

DeepSeek's flagship model, DeepSeek-V3, was trained using 2,048 NVIDIA H800 GPUs, accumulating around 2.79 mn GPU-hours. The H800 GPUs, though less advanced than the H100 series, were effectively leveraged by DeepSeek to achieve high-performance outcomes. DeepSeek initially utilised NVIDIA's A100 GPUs extensively for training its early LLMs, benefiting from their robust computational power and scalability. DeepSeek's Fire-Flyer 2 computing cluster was equipped with ~5,000 NVIDIA A100 GPUs arranged across 625 nodes, each node featuring eight GPUs interconnected via high-speed networks, enabling efficient parallel training. This strategic GPU selection allowed DeepSeek to rapidly prototype, iterate, and scale its foundational AI models, setting a performance benchmark that was later optimised further with newer hardware like the H800 GPU.

In 2023, NVIDIA released the H800 GPU, similar to H100 but tailored for the Chinese market to comply with US export controls. But in Oct'23, the US government banned the export of H800s to China. Given this ban, alternative chips and strategies could include Biren BR100, Huawei Ascend 910, and Moore Threads GPUs. Moreover, Liand Wenfeng, the co-founder of DeepSeek, has mentioned that the company owns a cluster of 10,000 NVIDIA A100 GPUs, a less powerful AI chip.

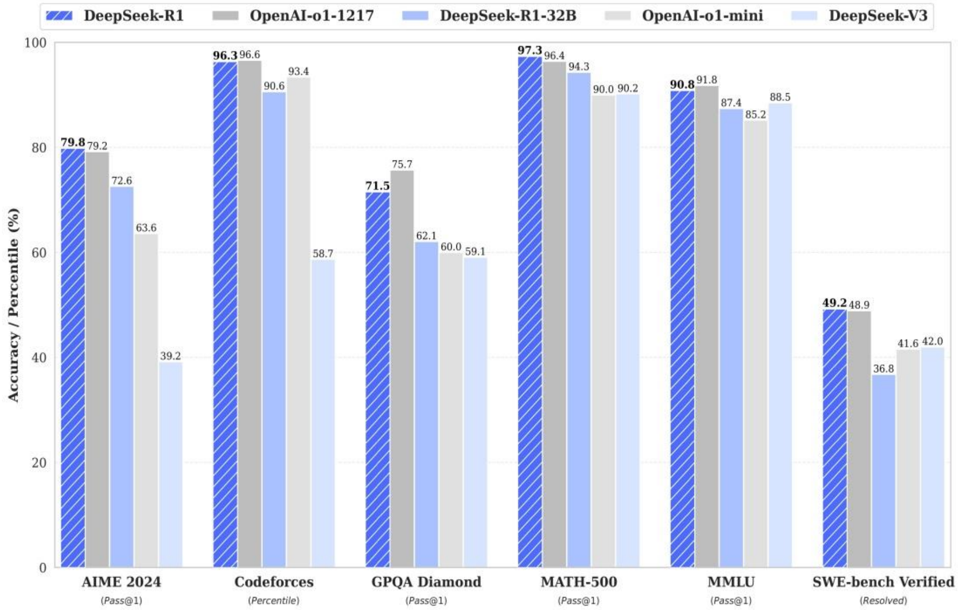
87. How are DeepSeek models different from their peers?

DeepSeek-V3 is based on Mixture-of-Experts (MOE) architecture. MOE is a machine learning framework which activates only specific "experts" or sub-models to process the input, thus making it a computationally efficient model. Moreover, DeepSeek uses a variety of optimisation techniques – auxiliary-loss-free-strategy, multi-token prediction training, supervised fine tuning (SFT) and reinforced learning – to further improve the efficiency of its model. As a result, it was able to fully train V3 LLM in 2.778mn H800 GPU hours (not the latest NVIDIA chip). At c.USD 2/hour rental cost, it translates into USD 5.6mn of training cost. This is significantly lower than the cost to develop models such as OpenAI's GPT-4 and GPT-o1 (est. at USD 100 Mn+ each).

DeepSeek's reasoning model R1 scores better than most reasoning models on standard assessments (maths, coding etc.) and is comparable to OpenAI's latest o1 model (Exhibit 1). While DeepSeek has not revealed the training cost, going by its API pricing, it is likely a substantial improvement over others. DeepSeek's pricing for the R1 model (USD 2.19 per 1M tokens) is significantly lower than OpenAI's o1 model (USD 75 per 1M tokens).

Exhibit 133. DeepSeek-R1 performs better than or comparable to both OpenAI's o1 (latest) model and the V3 model on which it is trained.

Comparison of AI models on math and reasoning tasks (published on Github)



Source: Github, DeepSeek, JM Financial

Exhibit 134. DeepSeek's pricing is extremely competitive given its performance; R1 is priced at USD 2.19 as compared to USD 75 for o1 with similar performance

Pricing comparison of AI models

OpenAI	Model	Context length	Input cost (per 1M token) - USD	Output cost (per 1M token)	Total cost (per 1M token)
Open AI	GPT-4	8k	30.00	60.00	90.00
	GPT-4o	128k	2.50	10.00	12.50
	GPT-3.5 Trubo	16k	0.50	1.50	2.00
	o1	128k	15.00	60.00	75.00
	o1 Mini	128k	3.00	12.00	15.00
DeepSeek	DeepSeek R1	128k	0.55	2.19	2.74
	DeepSeek V3	128k	0.14	0.28	0.42
Anthropic	Claude 3.5 Pro	200k	3.00	15.00	18.00
	Claude 3.5 Lite	200k	0.80	4.00	4.80
Google	Gemini 1.5 Pro	128k	1.25	5.00	6.25
	Gemini 1.5 Lite	128k	0.08	0.30	0.38
Meta	LLaMA 3.1 (70B)	128k	0.23	0.40	0.63
	LLaMA 3.1 (405B)	128k	1.79	1.79	3.58
Amazon	Nova Pro	300k	0.80	3.20	4.00
	Nova Lite	300k	0.06	0.24	0.30
	Nova Micro	128k	0.04	0.14	0.18
Cohere	Command R	128k	0.50	1.50	2.00
	Command Lite	4k	10.00	20.00	30.00
Mistral AI	Mistral 8x7B	32k	0.50	0.50	1.00
	Mistral Nemo	128k	0.15	0.15	0.30

Source: Company, JM Financial

88. How is DeepSeek's rise impacting H200 demand?

The emergence of DeepSeek's advanced AI models has led to a notable surge in demand for NVIDIA's H200 chips. Cloud service providers are reporting that DeepSeek's open-source models, particularly the V3 and R1 releases, require substantial computational power for full-scale inference, prompting enterprises to secure H200 capacity in advance.

This increased demand for H200 chips underscores the broader impact of DeepSeek's innovations on the AI hardware market. Despite initial market reactions suggesting a potential decline in GPU demand due to DeepSeek's model efficiency, the reality reflects a growing need for high-performance hardware to support these sophisticated AI applications. DeepSeek's models have not only stimulated immediate GPU sales but are also compelling cloud service providers to expand their AI infrastructure proactively. As companies increasingly adopt DeepSeek's open-source models, the necessity for high-performance GPUs intensifies.

89. What is the rack density typically required to process AI chips like NVIDIA's H100 and H200?

Integrating NVIDIA's H100 and H200 GPUs into data centres necessitates careful planning due to their substantial power and cooling requirements, which directly influence rack density configurations.

- NVIDIA H100 GPU Rack Density Considerations: Each DGX H100 system consumes ~10.2 kW, NVIDIA recommends deploying 4 DGX H100 systems per rack, resulting in a total power draw of ~40.8 kW per rack. Alternative configurations of two systems and one system per rack will result in a power draw of ~20.4 kW and ~10.2 kW respectively per rack. These configurations should be tailored to align with the data centre's available power and cooling capacities.
- NVIDIA H200 GPU Rack Density Considerations: Each H200 GPU has a Thermal Design Power (TDP) of 700W. HGX H200 4-GPU server has a 2.8 kW total power requirement while the 8-GPU server has a 5.6 kW total power requirement. Assuming five servers per rack, the power draw would be ~14 kW per rack for the 4-GPU server and ~28 kW for the 8-GPU server.

Considering the above configurations, NVIDIA's H100 and H200 chips would typically have a total power draw of 10-30kW per rack.

90. What is the typical rack density of India's data centres?

In India, the typical rack power density in data centres has traditionally ranged from 6kW to 12kW per rack. This standard has been influenced by factors such as infrastructure capabilities, cooling technologies, and the nature of workloads predominantly handled within these facilities. Many Indian data centres have historically operated with rack populated to about one-third capacity, with the remaining space filled with blanking panels to manage cooling and airflow effectively.

However, the landscape is evolving due to increasing adoption of high-performance computing tasks, including AI and data analytics. While traditional facilities may struggle to support densities exceeding 12 kW per rack, modern data centres are being designed to accommodate higher densities, sometimes reaching up to 20 kW per rack or more, especially in hyperscale environments. For instance, RackBank's upcoming AI-optimised data centre in Indore, Madhya Pradesh, offers flexible rack density options ranging from 50kW to 150 kW per rack, designed for scalability and accommodating Nvidia's upcoming GPU architecture.

91. Progress of DeepSeek: A headwind or a tailwind for India?

DeepSeek has trained competitive AI models using fewer GPUs - ~2,000 GPUs compared to ChatGPT's ~25,000 GPUs. This resource-efficient approach has demonstrated that strategic algorithmic innovations and optimised architectures can achieve world-class results without the need for excessive hardware resources. India's current data centre landscape, traditionally characterised by lower rack densities (approximately 6–12 kW per rack), can leverage similar software-driven efficiencies to bridge infrastructure gaps. Following are the aspects that demonstrate how DeepSeek acts as a tailwind for India's AI infrastructure.

- Government Initiatives and GPU Procurement: Recognising the strategic importance of AI, the Indian government has launched the IndiaAI Mission, a USD 1.25bn initiative aimed at fostering AI startups and infrastructure development. To support these initiatives, India has procured ~18,000 GPUs, including NVIDIA's H100 and H200 chips, surpassing its initial target. This substantial acquisition underscores India's commitment to building the computational infrastructure necessary for AI training and deployment.
- India well-positioned to leverage Gen AI efficiencies: The integration of high-performance GPUs necessitates enhancements in data centre infrastructure, particularly concerning rack density and cooling solutions. However, DeepSeek's models operate with significantly lower power and energy consumption. While such efficiencies may challenge high-density infrastructure, they open opportunities for data centres having lower rack densities (~12-20kW per rack). This aligns well with India's current infrastructure, where rack densities are typically around 6–12kW per rack, enabling Indian data centres to effectively support the next wave of Gen AI with minimal upgrades.
- Catalyst for Domestic AI Innovation: DeepSeek's success has underscored the feasibility of developing powerful AI models with limited resources, inspiring Indian startups to pursue similar endeavours. Companies like Sarvam AI and Krutrim AI are at the forefront of this movement. Sarvam AI focuses on creating AI models tailored for Indian languages, aiming to make AI accessible across India's diverse linguistic landscape. Its platform has been trained on 2bn parameters, emphasising vernacular languages to cater to the Indian customer base. Similarly, Krutrim AI is developing LLMs that capture India's cultural and linguistic diversity.

M. Players in the Data Centre Ecosystem

92. What are the areas of building a data centre ecosystem?

Each area in the building of a data centre plays a crucial role in its lifecycle, from design and construction, to operation and scalability. Together, they form an intricate ecosystem that powers cloud computing, enterprise IT, digital platforms, and now, AI workloads.

Exhibit 135. Key Areas for the build-out of a data centre ecosystem

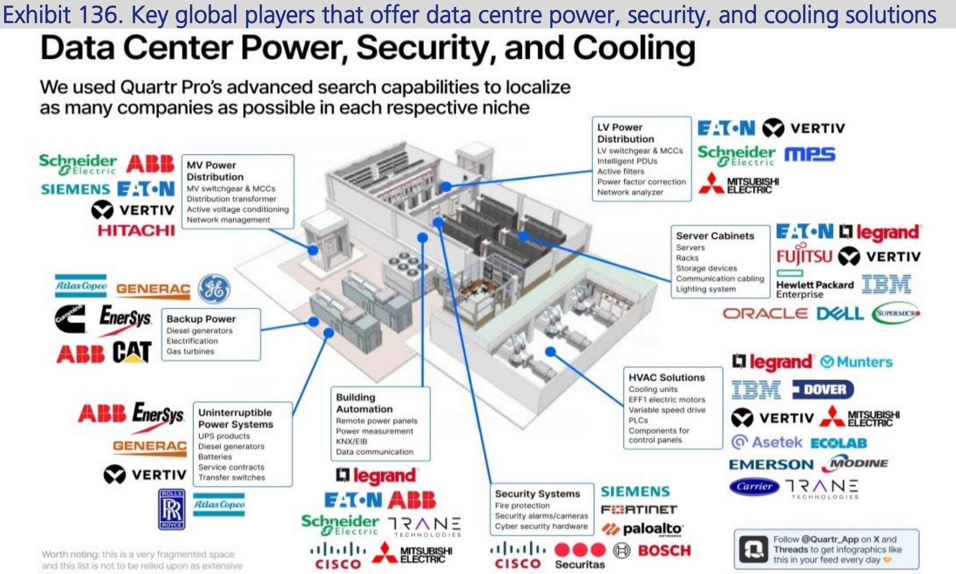
Area	Description
Servers	Computing units that host applications, process data, and run services in a data centre.
System Integrators	Firms that design, implement, and manage end-to-end data centre infrastructure using hardware, software, and networks.
Storage Systems	Infrastructure for storing, retrieving, and protecting data including SAN, NAS, and object storage solutions.
Networking Equipment	Routers, switches, firewalls, and related devices for data transfer and connectivity inside and outside the data centre.
Internet Service Provider (ISP)	Companies providing internet backhaul, leased lines, and cloud connectivity for external access to data centres.
Cabling	Physical layer infrastructure including copper and fibre optic cables for connecting data centre components.
Racks and Enclosures	Frameworks used to house servers and networking gear, facilitating organization, airflow, and cable management.
Power Supply Systems	Equipment such as transformers, UPS, and battery systems that ensure uninterrupted power to data centre infrastructure.
Environmental Control and Cooling Systems	Solutions for maintaining optimal temperature and humidity, such as CRAC units, in-row cooling, and chillers.
Floor Tiles and Floor Electrical Panels	Raised flooring systems and power panels used for cable routing and power distribution in data centres.
Security and Cybersecurity	Physical and digital systems to protect against unauthorized access and cyber threats, including firewalls and surveillance.
Full Stack and DCIM	End-to-end software and tools for managing data centre infrastructure including monitoring, automation, and optimization.
Data Centre Space and Real Estate	The physical land and buildings used to host data centre infrastructure, including hyperscale and colocation facilities.
EPC Providers and Build-out	Companies responsible for engineering, procurement, and construction of data centres including civil and MEP work.

Source: Industry, JM Financial

93. What are the key global players that operate in power, security, and cooling solutions?

Global data centres rely on a specialised ecosystem of companies that deliver robust power, security, and cooling solutions. Leaders like ABB, Schneider Electric, Eaton, Siemens, and Vertiv provide critical infrastructure for power distribution, uninterruptible power supply (UPS), and electrical automation. Companies such as Generac, CAT, and EnerSys ensure backup power reliability through generators and energy storage systems. For environmental control, Trane Technologies, Carrier, Munters, and Emerson offer advanced HVAC and cooling technologies to maintain optimal operating conditions. Meanwhile, security—both physical and cyber—is safeguarded by firms like Cisco, Fortinet, Palo Alto Networks, and Bosch. Together, these players form the backbone of operational resilience and efficiency in modern data centres.

Exhibit 136. Key global players that offer data centre power, security, and cooling solutions



Source: Quartr Pro, JM Financial

94. What are the key listed Indian players that operate across the data centre value chain?

Following are the major publicly listed Indian players that provide their services at various points during the build-out journey and operations of a data centre.

Exhibit 137. Key Indian listed players providing services for data centre operations

Companies	Industry	Brief Description	Position in the data centre Value Chain	Market Cap (INR Cr)
Bharti Airtel Ltd	Telecommunications	A leading global telecommunications company offering mobile, broadband, and digital TV services across multiple countries.	Bharti Airtel has expanded into digital infrastructure and data centres through its subsidiary, Nxtra Data, positioning itself as an internet service provider and a provider of data centre space and real estate, as well as power supply and cooling systems.	10,22,701
Power Grid Corporation of India Ltd	Power Transmission and Distribution	India's central power transmission company responsible for planning, coordination, and operation of interstate power transmission systems.	Plays a crucial role in the power supply systems and backbone transmission infrastructure essential for data centres.	2,64,463
Siemens Ltd	Industrial Automation and Engineering	A diversified engineering company providing automation, electrification, and digitalization solutions across industries.	Contributes to power supply systems, environmental control, and automation within data centres.	1,85,822
Adani Green Energy Ltd	Renewable Energy	A renewable energy company focused on building, owning, and operating solar and wind energy projects in India.	Develops large-scale solar and wind projects, providing green power supply systems and renewable energy sources for data centres.	1,52,788
ABB India Ltd	Industrial Equipment and Automation	Part of the global ABB Group, offering robotics, automation, and electrification solutions for utility and industrial sectors.	Provides data centre infrastructure solutions, impacting power supply systems, floor electrical panels, automation, and environmental control.	1,16,808
CG Power and Industrial Solutions Ltd	Electrical Equipment	Manufactures electrical equipment including transformers, switchgear, and other power solutions.	Supports power supply systems and electrical panels crucial for data centres.	99,109
Tata Communications Ltd	Telecommunications	A global provider of communication and technology solutions, including network, cloud, and security services.	Offers network, cloud, and security services, including data centre hosting, positioning itself as an internet service provider and a provider of data centre space, security, and full-stack solutions.	45,754
Blue Star Ltd	HVAC (Heating, Ventilation, Air Conditioning) and Refrigeration	Engaged in the manufacturing and contracting of air conditioning, commercial refrigeration, and water purifiers.	Provides environmental control and cooling systems essential for data centres.	45,643
APL Apollo Tubes Ltd	Steel - Structural and Tubes	India's leading manufacturer of structural steel tubes and pipes used in construction and infrastructure.	Contributes to racks, enclosures, and structural components for data centres.	42,001
GE Vernova TandD India Ltd	Power Transmission and Distribution	Provides solutions in the field of power transmission and distribution, including substations and grid automation.	Ensures efficient power delivery, supporting power supply systems and electrical transmission equipment for data centres.	40,677
KEI Industries Ltd	Cables and Electrical Equipment	A manufacturer of a wide range of wires and cables including power, control, and instrumentation cables.	Provides cabling solutions for power transmission and networking infrastructure in data centres.	27,426
Apar Industries Ltd	Conductors, Cables and Specialty Oils	Produces conductors, cables, specialty oils, and polymers for the power and telecom sectors.	Supports cabling, power systems, and cooling fluids for transformers in data centres	23,739
Amara Raja Energy and Mobility Ltd	Batteries and Energy Storage	One of India's leading industrial and automotive battery manufacturers, also involved in energy storage.	Supplies energy storage solutions, including backup energy storage for data centres.	19,538
Redington	IT Distribution and Services	An IT supply chain solutions provider distributing hardware, software, and mobility products across multiple regions.	Deals in servers, storage, and cloud infrastructure equipment, acting as a system integrator within the data centre ecosystem.	19,337
Anant Raj Ltd	Real Estate and Infrastructure	Engaged in real estate development with a focus on residential, commercial, and hospitality projects.	Provides data centre space and real estate, as well as EPC services for data centre build-outs.	18,276
Triveni Turbine Ltd	Industrial Steam Turbines	Designs and manufactures industrial steam turbines for power and process industries in India and abroad.	Offers backup and captive power solutions for data centres.	17,992
Schneider Electric Infrastructure Ltd	Electrical Infrastructure and Energy Management	Provides products and services for power distribution and automation, primarily in medium voltage segments.	Electric supports power supply systems, environmental control, and data centre infrastructure management (DCIM).	15,767
Jupiter Wagons Ltd	Rail Equipment and Heavy Engineering	Manufactures railway wagons, components, and other transportation engineering products.	Manufactures containers specifically designed for data centres and battery energy storage systems (BESS)	14,857
Techno Electric and Engineering Company Ltd	EPC and Power Infrastructure	Provides EPC services in power infrastructure including generation, transmission, and distribution projects.	Contributes to EPC services and power systems integration within the data centre industry.	11,743
Railtel Corporation of India Ltd	Telecommunications and Network Infrastructure	A government-owned telecom company offering broadband and VPN services using railway fibre infrastructure.	Railtel is developing edge data centres, positioning itself as an internet service provider and a provider of data centre space and network infrastructure.	10,045
Netweb Technologies India Ltd	High-Performance Computing and IT Hardware	A domestic technology company offering high-performance computing systems and IT hardware solutions.	Acts as a system integrator and full-stack provider within the data centre ecosystem.	8,854

Source: Company, BSE, JM Financial; Note: Market Cap values as of 24 March, 2024

N. Players Profiles

95. Anant Raj Cloud – Anant Raj's Data Centre Business

Exhibit 138. Anant Raj has recently forayed into data centres…
Brief overview, data centre business

Overview	In 2023, Anant Raj forayed into the data centre sector with a vision to invest INR 100bn (~USD 1.2bn) over the next few years to develop a 307MW data centre footprint.
Capacity Plan	They plan to develop Tier III and IV data centres with up to 157MW IT Load with modifications to the existing IT Park Buildings in Haryana, remaining 150MW is to be developed through greenfield projects across the three locations.
Future - Cloud Services	The company recently launched their cloud platform "Ashok Cloud", on 0.5MW IT load in the current capacity, and plan to allocate ~14MW of the total capacity to cloud by FY26.

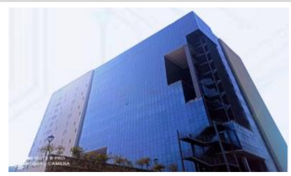
Source: Company, JM Financial

Exhibit 139. …and plans to scale up services from colocation to cloud
Service expansion plan

Past	Present	Future
Co-location Services	Cloud Services - IaaS (In association with Orange Business)	PaaS and Saas
	Co-location Services	AI enabled Solutions
		Cloud Services - IaaS (In association with Orange Business)
		Co-location Services

Source: Company, JM Financial

Exhibit 140. Anant Raj aims to retrofit three commercial projects (in Manesar, Rai, and Panchkula) into data centres with a total capacity c.300MW over the next 5-6 years

Facilities	 IT Park, Manesar, Haryana	 IT Park, Panchkula, Haryana	 IT SEZ RAI, Sonepat, Haryana
Total Area (Acres)	10	9.23	25
Operational Capacity (MW)	6	0	0
Under Development Capacity (MW)	15	7	0
Potential Capacity	Brownfield - 50MW	Brownfield - 7MW	Brownfield - 100MW
	Greenfield - 0MW	Greenfield - 50MW	Greenfield - 100MW
Total Potential Capacity (MW)	50	57	200

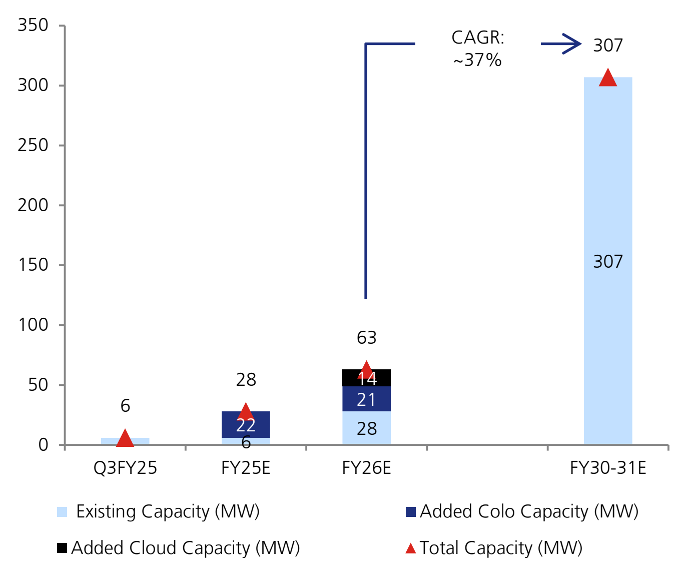
Source: Company, JM Financial

Exhibit 141. Anant Raj Cloud has partnered with Orange Business to drive its cloud and data centre expansion…
Key aspects of partnership with Orange Business

Overview	In Dec 24, Anant Raj Cloud has teamed up with Orange Business to expand its offerings. Anant Raj Cloud launched their sovereign-cloud platform 'Ashok Cloud' with an objective to provide cloud services alongside its data centre business to enterprises and public sector undertakings in India.
Current Status	Orange Business has designed, built, and is now operating multiple services for Anant Raj Cloud's platform, including setting up a data centre and cloud infrastructure. The deployment phase is completed, and Anant Raj has already started onboarding its customers. Initial 1st Phase capacity already operational at Manesar, Haryana.
Future Plan	In the future, Anant Raj Cloud plans to introduce additional services to support the growth of its customers businesses more effectively.

Source: Company, JM Financial

Exhibit 142. …and plans to allocate c.25% of the total capacity for cloud in FY26
Capacity expansion plan (MW)



Source: Company, JM Financial

96. Sify Infinit Spaces – Sify's Data Centre Business

Exhibit 143. Sify has 24 years of experience in data centres…
Brief overview and history

Overview	Sify Infinit spaces is a wholly owned subsidiary of Sify Technologies that provides data centre and digital infrastructure services across major Indian cities. With over 24 years of experience, the company is one of the largest Indian companies in the data centre space.
History	In 2000, Sify Technologies started offering data management solutions by investing in data centres at Mumbai. Since then, they have transformed from a "data storage player" to a "digital transformation specialist".
Capabilities	The company had 120+ MW IT Power as of Dec 24, and plans to add 350+ MW capacity by 2025.
	They currently have 12 live facilities, and 2 are upcoming
Strong customer relations	3 out of 4 Hyperscalers
	India's top 5 banks
	600+ customers across all major industries

Source: Company, JM Financial

Exhibit 144. …providing a wide range of services and solutions
Key service offerings

Service	Description
Colocation Services	This enables customers to bring in their own rack-mountable servers and house them in shared racks, or hire complete racks and 'secure cages' at the hosting facility
Managed Hosting Services	This includes storage, backup and restoration, performance monitoring and reporting, hardware and software procurement, and network configuration
Value-Added Services	This includes rack space, caged enclosures with access control system, dedicated CCTV cameras, cross-connect services, rack cabling - power and network, dedicated seating space, asset migration, remote hands support, private connectivity to national and international internet exchanges and multiple public cloud environments, and static transfer switch

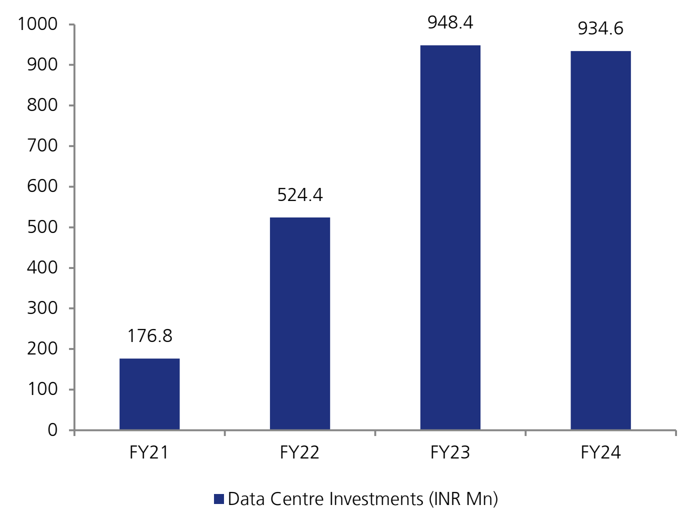
Source: Company, JM Financial

Exhibit 145. The company has 12 pan-India data centres across 6 cities

City	Noida		Kolkata	Mumbai			Hyderabad		Bengaluru		Chennai	
Facility	Noida 01	Noida 02	Salt Lake City	Vashi	Airoli	Rabale	Financial District	FAB City	Electronic City	Aerospace Park	Tidel Park	Siruseri
Operational Capacity (MW)	10.8	43+	2.2	0.9	5.4	29.2 and 43+	14.4	0.0	7.6	0.0	3.6	43+
In Development Capacity (MW)	0.0	0.0	0.0	0.0	0.0	4x40+	0.0	0.0	0.0	20+	0.0	0.0
Planning (MW)	0.0	2x43+	0.0	0.0	0.0	3x40+	0.0	52-78	0.0	20+	0.0	2x43+

Source: Company, JM Financial

Exhibit 146. It has invested significantly in the business…
Data centre investments (INR mn)



Source: Company, JM Financial

Exhibit 147. …and is backed by strong financials
Key financial metrics (INR mn)

INR Mn	FY22	FY23	FY24
Revenue from Operations	7,582	10,213	11,142
Revenue Growth		34.7%	9.1%
EBITDA	3,266	4,126	4,591
EBITDA Margin	43.1%	40.4%	41.2%
PAT	858	835	570
PAT Margin	11.3%	8.2%	5.1%
EPS (INR)	1.7	1.65	1.13
Net Debt	7,801	11,646	13,086
Net Debt-to-Equity	1.2	1.1	0.7
ROE	12.8%	8.0%	3.0%
ROCE	11.1%	8.4%	5.8%

Source: Company, JM Financial

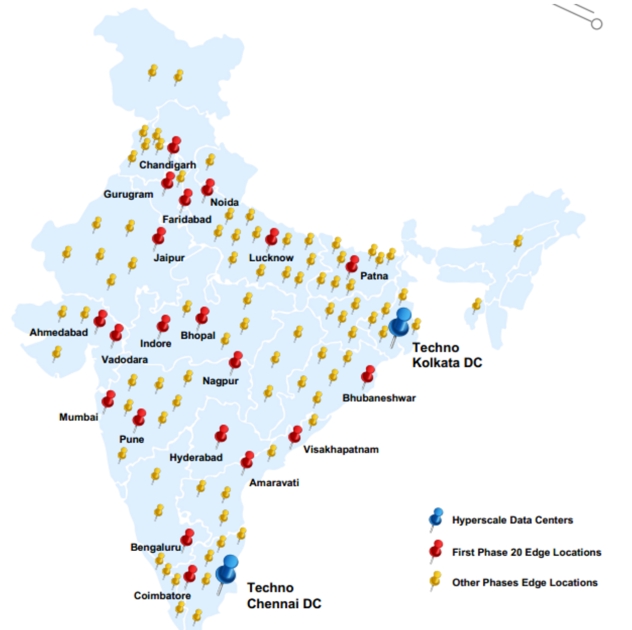
97. Techno Electric & Engineering – Data Centre Business

Exhibit 148. Techno plans to invest USD 1bn in data centres…
Brief overview and vision

Overview	In 2021, Techno Electric & Engineering forayed into the data centre domain with a vision to develop 100+ Edge data centres across India, building on their extensive experience and expertise in electrical, mechanical, civil and structural engineering. The company plans to establish data centres with a USD 1bn investment by FY30.
Infrastructure	Supply, install and commission both Non-IT and IT infrastructure for the Edge data centres – modular infrastructure solution to be deployed.
Business Model	Sale of offered data centre solutions and manage the business operation, along with revenue sharing with RailTel
Vision	Hyperscale facilities of Chennai (commissioning soon) and Kolkata (commissioning in 2027) data centres, are set to act as the Central Data Centre hub for all the Edge locations. Edge Data Centres will be developed in phases, with 20 edge data centres planned for each phase.

Source: Company, JM Financial

Exhibit 149. …to establish 100+ Edge data centres in India by FY30
Snapshot of 102 cities of Techno's edge data centres (future plan)



Source: Company, JM Financial

Exhibit 150. Blueprint of Techno's edge data centres

Phase	Description
Model	Develop, Finance, Maintain, Operate, and Transfer the largest deployment of distributed DCs as RailTel business associate
Nationwide Deployment	Development of distributed DCs in 102 across India by FY30
Long Term Operation	A 20-year lease period extendable by five years
Phased Rollout	Implementation will occur in phases. Annually, 20 distributed DCs will be developed. First 20 to be commissioned by 2025
Diverse Location Strategy	DCs will be strategically positioned with good connectivity
Customizable & Scalable Solutions	Distributed DCs are designed to be Modular infrastructure, accommodating future technological advancements

Source: Company, JM Financial

Exhibit 151. Techno's end-to-end solutions for data centres

Key Solution Areas
Land Acquisition and Site Assessment
Renewable Energy
Design and Engineering
Civil and Structural Works
Procurement of Long Lead Equipment
MEP Works
Commissioning
Statutory Approvals
Marketing and Sales
Operations and Maintenance

Source: Company, JM Financial

Exhibit 152. Techno's Hyperscale data centres are coming up in Chennai and Kolkata…
Capabilities of Chennai and Kolkata hyperscale DCs

Parameter	Chennai DC	Kolkata DC
Capacity	36 MW	20 MW
Current Construction Status	Work in Progress – All civil work completed, MEP work currently underway	In Construction Phase – Site in possession, topographic survey done, master layout developed and pre-construction work has started
Area	~5 Acres	~4 Acres

Notes: (1) Data as of 31 Dec, 2024; (2) Chennai DC area ~20,000 sqm which is ~5 Acres. Source: Company, JM Financial

Exhibit 153. …along with edge data centres in Mumbai, Gurugram and 12 more sites
Techno's near-term roadmap

Location	Timeline
Gurugram	Work started in Gurugram and will be commissioned in Feb 25
Chennai	Hyperscale data centre 36 MW capacity is going live in Mar 25
Mumbai	Work will begin in Mar 25 and will be completed by the end of Jul 25
12 Locations	Followed by 12 high-potential sites across India, marking the first phase of this ambitious nationwide initiative, targeting a vast network of 102 cities across India

Notes: (1) Data as of 31 Dec, 2024. Source: Company, JM Financial

98. E2E Networks

Exhibit 154. Founded in 2009, E2E Networks provides cloud infrastructure for AI, ML, and HPCs
Brief overview and history

Overview	E2E Networks is an Indian cloud computing company providing cloud infrastructure for AI, ML, and high-performance computing. Initially offering Linux cloud services, the company expanded into AI/Ml infrastructure, Cloud GPUs, and managed Kubernetes.
History	E2E Networks was founded in 2009 in New Delhi, India, with a focus on providing cost-effective cloud computing solutions. From 2011-2014, it raised seed fund from Blume Ventures and others. In 2018, it became a publicly listed company on NSE. Over the years, it has grown to serve 15,000+ clients globally.
Future - Strategic Priorities	1. Scale up accelerated computing GPU Capacity
	2. Increase customer base diversity
	3. Support Multi-cloud deployment models including on-prem Sovereign cloud platforms
	4. Major new cloud & GPU region near Chennai

Source: Company, JM Financial

Exhibit 155. E2E Networks' offerings include Cloud GPUs, AI/ML Platforms, Storage, and Kubernetes Services
Key products and services

Product/Service	Description
Cloud GPUs	High-performance GPU instances, including NVIDIA H200, H100, A100, L40S, and L4, tailored for AI/ML workloads.
TIR: AI/ML Platform	An advanced platform built on Jupyter Notebook, facilitating the development and deployment of machine learning applications.
Linux Cloud	Scalable Linux-based cloud servers optimized for various workloads, offering features like Quick Service Recovery, Snapshots, and faster IOPS.
Windows Cloud	Reliable Windows Server instances suitable for applications requiring a Windows environment.
Storage Cloud	Secure and cost-effective storage solutions with capabilities like scheduled snapshots and automated backups.
E2E Object Storage (EOS)	SSD-based, S3-compatible object storage service designed for demanding workloads like machine learning and deep learning.
Database as a Service (DBaaS)	Fully managed relational database service that simplifies setup, operation, and scaling in the cloud.
E2E Kubernetes Service (EKS)	Managed Kubernetes service enabling quick deployment and management of Kubernetes clusters.
E2E CDN Service	Fast content delivery network that securely delivers data and static content globally with low latency.
CPU Intensive Computing C3 Series	Compute nodes designed for CPU-intensive workloads, offering features like Quick Service Recovery and faster IOPS.

Source: Company, JM Financial

Exhibit 156. It supports leading startups and established AI/ML players in their growth journey…
Key clients

Source: Company, JM Financial

Exhibit 157. …and has shown significant topline growth coupled with strong margins and robust returns
Key financials (INR mn)

INR Mn	FY22	FY23	FY24
Revenue from Operations	519	662	945
Revenue Growth		27.6%	42.7%
EBITDA	229	331	479
EBITDA Margin	44.2%	49.9%	50.8%
PAT	65	99	219
PAT Margin	12.4%	15.0%	23.1%
EPS (INR)	4.44	6.77	14.7
Net Debt	-59	-212	941
Net Debt-to-Equity	-0.2	-0.4	1.3
ROE	16.8%	20.1%	30.9%
ROCE	12.5%	23.8%	16.3%

Source: Company, JM Financial

99. Black Box

Exhibit 158. Black Box is a digital infrastructure integrator…
Brief overview and history

Overview	Black Box is a global digital infrastructure integrator delivering network and system integration services and solutions, support services, and technology products to businesses in the United States, Europe, India, Asia Pacific, the Middle East, and Latin America
Offerings	The company has service offerings in network integration, digital connectivity infrastructure, data center build-out, modern workplace, and cybersecurity for businesses across various industries including financial services, technology, healthcare, retail, public services, manufacturing, and other sectors.
History	Black Box Limited, originally founded in 1976 in the US, began as a provider of connectivity solutions, including communication and infrastructure products for businesses. Over the decades, it evolved into a global IT solutions provider. In 2019, Black Box was acquired by AGC Networks, the technology solutions arm of Essar Group, marking its integration into a larger global platform.

Source: Company, JM Financial

Exhibit 159. …with a strong global presence
Global snapshot of presence and capabilities

Source: Company, JM Financial

Exhibit 160. Comprehensive offerings across areas…
Global snapshot of presence and capabilities

Solution Area	Offerings
Connectivity Infrastructure	Fiber Connectivity: High-speed, reliable data transmission solutions.
	IoT, Physical Security & Surveillance: Integrated systems for monitoring and security.
	Passive Infrastructure & Structured Cabling: Foundational networks
Data Centre	DC Infrastructure: Design and deployment of scalable facilities.
	Networking & Connectivity: Implementation of firewalls, load balancing, Wi-Fi networks, and distributed antenna systems (DAS)
	DC Support Services: Maintenance and optimization services.
Enterprise Networking	LAN: High-performance internal networking solutions.
	WAN: Secure and reliable connectivity across multiple locations
	Cloud Networks: Integration with cloud services.
	Wireless & Private LTE Networks: Advanced wireless solutions for enhanced mobility.
Modern Workplace	Enables digital transformation that enhances collaboration, productivity and customer engagement. From unified communications and AV integration to contact center optimization, they create connected work environments.
Cybersecurity	End-to-end services, including managed extended detection and response, infrastructure protection, and Governance, Risk, and Compliance advisory across IT ecosystems

Source: Company, JM Financial

Exhibit 161. …leading to marquee clients across sectors
Top clients across sectors

Sector	Key Clientele
Technology	6 of the top 10 Tech Companies in the US
Healthcare	8 of the 'Fortune 500' Healthcare Companies
Manufacturing	6 of the 'Fortune 500' Petroleum Refining Companies
Utilities	4 of the top 15 Utility Companies in the US
Broadcasting	2 of the top 5 Broadcasters Globally
Retail	7 of the top 30 Retailers in the US
Pharmaceuticals	7 of the 'Fortune 500' Pharmaceutical Companies
Banking	6 of the 'Fortune 500' Banks

Source: Company, JM Financial

Exhibit 162. Case study – building global Hyperscale data centres

Particular	Description
Client	One of the largest data centre holders around the world.
Challenge	Construction of multiple hyperscale data centres globally, having complex requirements and aggressive go-live deadlines while maintaining data centres that carry massive traffic throughout the world.
Solution	Black Box has a global strategy and methodology of standardizing and ensuring repeatable, predictable outcomes. Recruit, train, and retain cultivated talent for long-term projects and resource reallocation.

Source: Company, JM Financial

Exhibit 163. Key financial metrics (INR mn)

INR Mn	FY22	FY23	FY24
Revenue from Operations	53,702	62,876	62,816
Revenue Growth		17.1%	-0.1%
EBITDA	2,518	2,266	3,928
EBITDA Margin	4.7%	3.6%	6.3%
PAT	727	237	1,377
PAT Margin	1.4%	0.4%	2.2%
EPS (INR)	4.38	1.41	8.18
Net Debt	-372	1,424	1,747
Net Debt-to-Equity	-0.1	0.5	0.4
ROE	27.9%	8.0%	28.6%
ROCE	20.8%	12.4%	22.8%

Source: Company, JM Financial

O. Valuation

100. What are the multiples at which colocation data centre players trade globally?

In our valuation comparison, we have included large USD-based REITs such as Equinix, Digital Realty, and Iron Mountain, along with Singapore-based REITs such as Keppel DC and Digital Core. We have also included ADRs of Chinese companies (GDS, VNET), a Qatari company (Meeza) and an Australian REIT (Keppel DC REIT).

Exhibit 164. Colocation data centre valuation comparison

Name	Local Currency (LC)	CMP (LC)	Mcap ($m)	EV ($m)	P/E			EV/EBITDA		
					FY25E	FY26E	FY27E	FY25E	FY26E	FY27E
Equinix Inc	USD	831.1	80,887	96,264	62.3x	53.2x	46.x	21.7x	19.6x	17.8x
Digital Realty	USD	149.4	51,278	66,172	105.4x	89.6x	69.3x	21.x	18.7x	16.6x
Iron Mountain	USD	87.0	25,564	42,054	42.5x	37.1x	33.x	15.9x	14.5x	13.6x
Next DC	AUD	12.0	4,858	5,158	NA	NA	NA	38.1x	35.x	27.6x
Keppel DC REIT	SGD	2.2	3,688	4,747	21.7x	19.4x	19.2x	21.5x	19.9x	18.6x
Digital Core REIT	SGD	0.5	695	1,435	13.7x	13.4x	15.7x	19.8x	18.2x	16.7x
GDS Holding	USD	27.4	5,321	10,500	NA	1325.8x	400.1x	13.9x	12.2x	10.8x
Meeza	QAR	3.0	528	526	27.x	19.8x	15.6x	12.4x	9.3x	7.4x
VNET	USD	8.9	2,376	4,726	139.1x	142.4x	41.3x	10.8x	8.3x	6.5x
Average					**45.4x**	**38.7x**	**33.1x**	**19.5x**	**17.3x**	**15.1x**

Source: Bloomberg, JM Financial

101. What is the EV per MW multiple for colocation data centre players globally?

Equinix is the largest colocation operator in the world with an estimated installed capacity of more than 4.2GW. The EV/MW for Equinix is USD 23 Mn. Digital Realty, the second largest colocation operator, trades at an EV/MW of USD 25 Mn.

Colocation data centre space has seen a lot of acquisitions from private equity companies; QTS was acquired by Blackstone in 2021 at USD 10bn and it had a capacity of 1GW+ during the time of acquisition. Assuming a Net Debt/Equity (Market Cap) of 1.0, we can approximate an EV/MW of USD 19.04 Mn at the time of acquisition.

Cyrus One was acquired by KKR in Mar'22 for USD 15bn; assuming a Net Debt/Equity (Market Cap) of 1.0, we can approximate an EV/MW of USD 30.5 Mn at the time of acquisition.

Exhibit 165. EV/MW calculation for public DC companies and acquired companies

Name	Installed capacity MW*	Market cap (USD Mn)	Market Cap per MW (USD Mn)	Enterprise Value (USD Mn)	EV per MW (USD Mn)
Equinix	4,285	83,438	19.47	98,815	23.06
Digital Realty	2,700	52,120	19.30	67,013	24.82
Iron Mountain	365	26,187	71.75	42,677	116.92
Next DC	170	5,337	31.40	5,646	33.21
Keppel DC REIT	650	3,725	5.73	4,816	7.41
Average			**18.98**		**22.13**
Acquisitions					
Cyrus One	984	15,000	15.24	15,000	30.48
QTS	1,050	10,000	9.52	10,000	19.04

Note: Installed capacity estimated, EV/MW for acquisitions assume Net Debt/Equity (Market Cap) of 1.0. Average does not include Iron Mountain, Iron mountain is involved in other business activities apart from colocation. Source: Bloomberg, JM Financial

APPENDIX I

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Corporate Identity Number: U67100MH2017PLC296081
Member of BSE Ltd. and National Stock Exchange of India Ltd.
SEBI Registration Nos.: Stock Broker - INZ000163434, Research Analyst - INH000000610
Registered Office: 7th Floor, Cnergy, Appasaheb Marathe Marg, Prabhadevi, Mumbai 400 025, India.
Board: +91 22 6630 3030 | Fax: +91 22 6630 3488 | Email: jmfinancial.research@jmfl.com | www.jmfl.com
Compliance Officer: Mr. Sahil Salastekar | Tel: +91 22 6224 1073 | Email: sahil.salastekar@jmfl.com
Grievance officer: Mr. Sahil Salastekar | Tel: +91 22 6224 1073 | Email: instcompliance@jmfl.com

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Rating	Meaning
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