



RESEARCH REPORT



Data Center Market Analysis and Outlook

“Between Present and Future”



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Data Center Industry Overview

INTRODUCTION

Executive Summary

A data center is a centralized location where computing and networking equipment is concentrated to collect, store, process, distribute, or allow access to large amounts of data. Since the rise of IT technologies and data analytics, the importance of data in both of public and private sectors has increased dramatically, resulting in the unprecedented need for data storage, backup, recovery, management, networking, and security. The entire data sector has been growing rapidly over the past five years due to consistently rising demand globally from organizations covering private enterprises, start-ups, investment institutions, public organizations, and governments.

Robust organic growth is expected in the industry over the next five years despite negative factors like dropping rental rates, decreasing server sizes, escalating industry competition, as well as influence on capital from the COVID-19 pandemic. Upside factors such as consistently growing data traffic, trend of transition from in-house to outsourced data practices, implementation of new connectivity technologies, as well as immense growth in the demand for cloud will all function as critical growth drivers for the global data center industry. According to industry research and MCG analysis, the global data center market is expected to growth at a CAGR of 10~15% for the period between 2020 and 2025, with a potentially decelerating momentum.

The past five years from 2015 to 2020 has seen acquisition activities at an aggregated value of US\$90 million. As the industry continue to grow, escalated competition and consolidation activities will be seen in the next five year from 2020 to 2025 as industry leaders, back with capital from investors of both public and private sectors, will speed up the race of acquiring smaller facilities to expand their global networks and grab market share. During this process, abundant investment opportunities are expected to arise across local markets in the North America, Europe, and the Asia Pacific.

Report Roadmap

This study aims to take a detailed look at the data center development industry to identify industry trends, dynamics, and outlook. The discussion starts with the background and history of the industry development and will be focused on two specific types of outsourced data center business models – the traditional retail colocation model, and the more recent wholesale model.

Surrounding the above described two models, we included a discussion on customers and suppliers, followed by a detailed analysis of the competitive landscape both between and within the two data center business models. Additionally, industry trends including technology advancement and integration, evolving user requirements, global capital focuses, etc. will be explained and supported by current events and facts.

To include the influences of the ongoing COVID-19 crisis, a section of the report is dedicated to exploring how the global pandemic has reshaped supply and demand in the data center industry. This is followed by an outlook for the industry in the following 5 years, covering recovery from the pandemic, as well as growth drivers going forward.

The report is concluded with a closer look at the local data center markets in both the North America region and globally. Key characteristics of each local market are identified to better depict regional opportunities and risks.

Due to the tech-related nature of the industry, some industry-specific terms and definitions will help better understand this report. Please refer to the Appendix for definitions and explanations on these industry-specific terms.

BACKGROUND

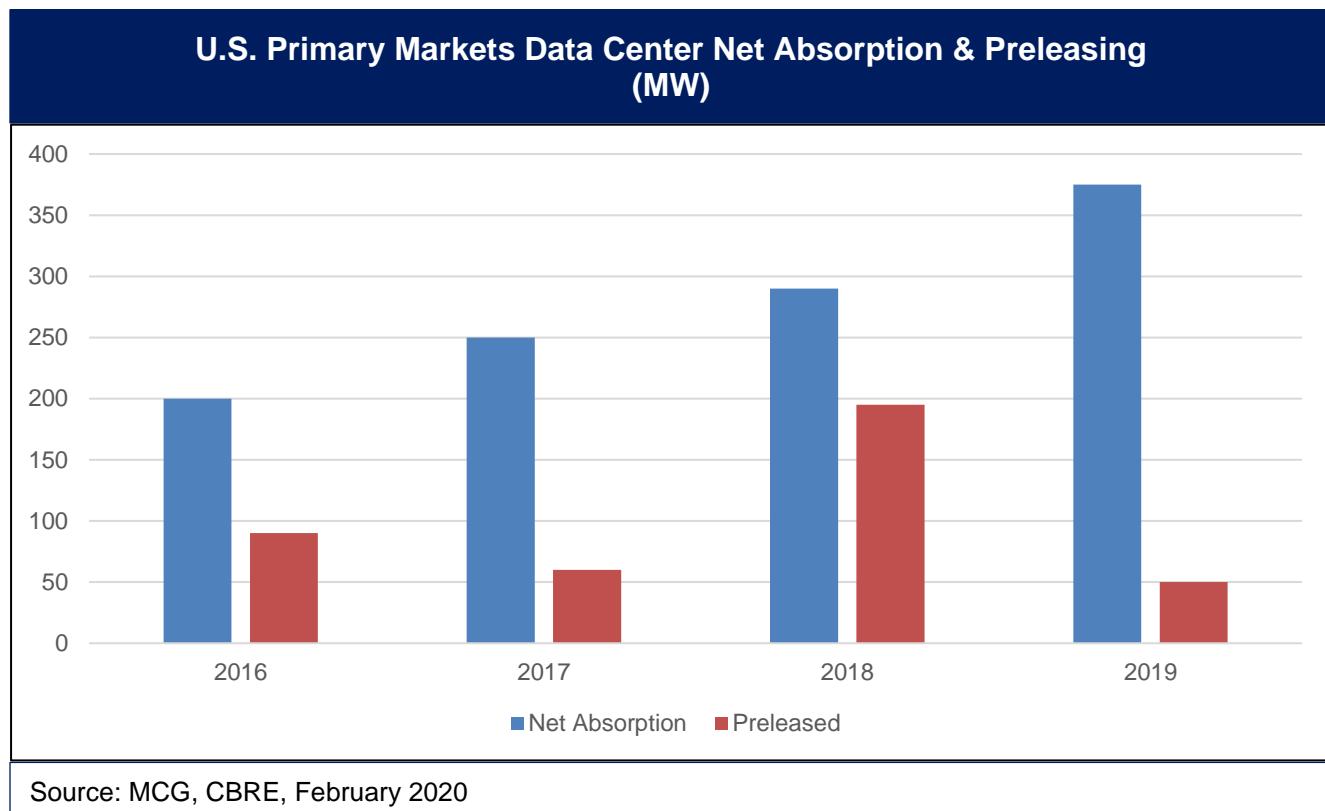
Since the outbreak of COVID-19, people's reliance on the internet has surged to a record new high. All types of physical gatherings are put on halt as people start to work from home and isolate themselves. The only way for them to connect is through the internet and different communication apps like Zoom and Google Hangout. Moreover, due to the lack of physical accessibility, companies are producing and storing more digital information than pre-COVID-19. As a result, it is expected that an increase in the purchase of data centers, especially the ones using cloud technology, will be seen in 2020 and beyond.

Even before the COVID-19 outbreak, the global data storage industry has seen healthy and steady growth in the past few years. According to Technavio's recent research report published in April 2020, the global data center market is expected to grow at a CAGR of 17% during the period between 2020 and 2023. A similar projected CAGR of 14.6% is made by Markets and Markets for the period before 2022. In North America, the U.S. takes over 92% of the market. The primary U.S. wholesale data center markets, including Atlanta, Chicago, Dallas/Ft. Worth, New York Tri-State, Northern Virginia, Phoenix, and Silicon Valley recorded a combined 206.1 MW of net absorption in H2 2019, up by 20.9% from 170.5 MW in H1 2019. Overall wholesale data center inventory increased by 468.7 MW across primary markets in 2019, up 22% year-over-year. Net absorption across all primary markets reached an all-time high of 376.6 MW in 2019.

The expansion of cloud service providers in 2019 resulted in new data center deliveries. While "cloud first" initiatives remain top of mind for end-users, demand for colocation and on-premise space remains strong. Meanwhile, on a global scale, new inventory in secondary markets is slowly climbing, although absorption in these markets has temporarily slowed down due to new deliveries in primary markets. Companies using data centers appear to favor primary over secondary markets due to lower pricing, the abundance of connectivity, and the availability of new builds. Secondary and tertiary markets close to large population hubs had the most activity and are expected to see additional growth with expanding edge deployments.

Globally, the expected space under construction in the Asia Pacific at 74 million square feet will continue to outpace North America, which is expected to grow to 69 million square feet in operational space. However, total UPS power in North America at 9,600 MW will continue to be slightly greater than the 9,100 MW in APAC. In the meantime, major European markets saw record-high net absorption in 2019 but also an increase in overall vacancy rates.

Besides, although the Latin American and African markets are currently relatively small compared to their APAC and North American counterparts, they have shown a promising outlook into the near future. According to Arizton's recent research report, the data center market in Latin America is expected to grow at a CAGR of around 6% during the period 2019–2025 and reach annual revenues of over US\$ 6 billion. Google also announced in November 2019 that it will build another data center in Uruguay in addition to the previously built one in Chile. Meanwhile, the Africa data center market is expected to grow at a CAGR of over 13% during the period 2020–2024.



Currently, North America owns 38.8% of all data centers globally, while Europe as a whole account for 31.3% of the global market. The emerging markets including APAC, Africa, and Latin America take the rest 29.9% of the market.

INDUSTRY DYNAMICS

Data Center Provisions

In general, data centers are either in-house or outsourced when being built. In-house data centers are designed, constructed and fully operated by organization's internal IT branch and are usually associated with higher security levels, as well as higher costs and human resource needs. The outsourcing options has seen increasing popularity among corporations in the recent years due to its cost-effectiveness, as well as high quality and adaptability of hardware and software services. Discussions of this report will focus on the outsourced data center segment.

In-House

This has been the traditional approach for corporations to develop data management and storage practices. The in-house approach entails corporate ownership of data center facilities and the internal management of technology services. This option may still be preferred by some large organizations with specific requirements such as a high degree of control over IT assets and corporate facilities, such as banks and military organizations. The provision of services is limited by the capacity constraints of the data center facilities and the capability of the in-house resources to meet the changing business demand. Besides, maintaining a sufficient level of power and cooling is often a significant challenge for businesses running their in-house data centers. Unless the facility is purpose-built, the organization may be reliant on mains power and office air-conditioning; both of which create a higher-risk operating environment. Most organizations with internal data centers managed in this manner are expected to have access to a range of external third-party providers who can provide similar services at competitive cost and service levels.

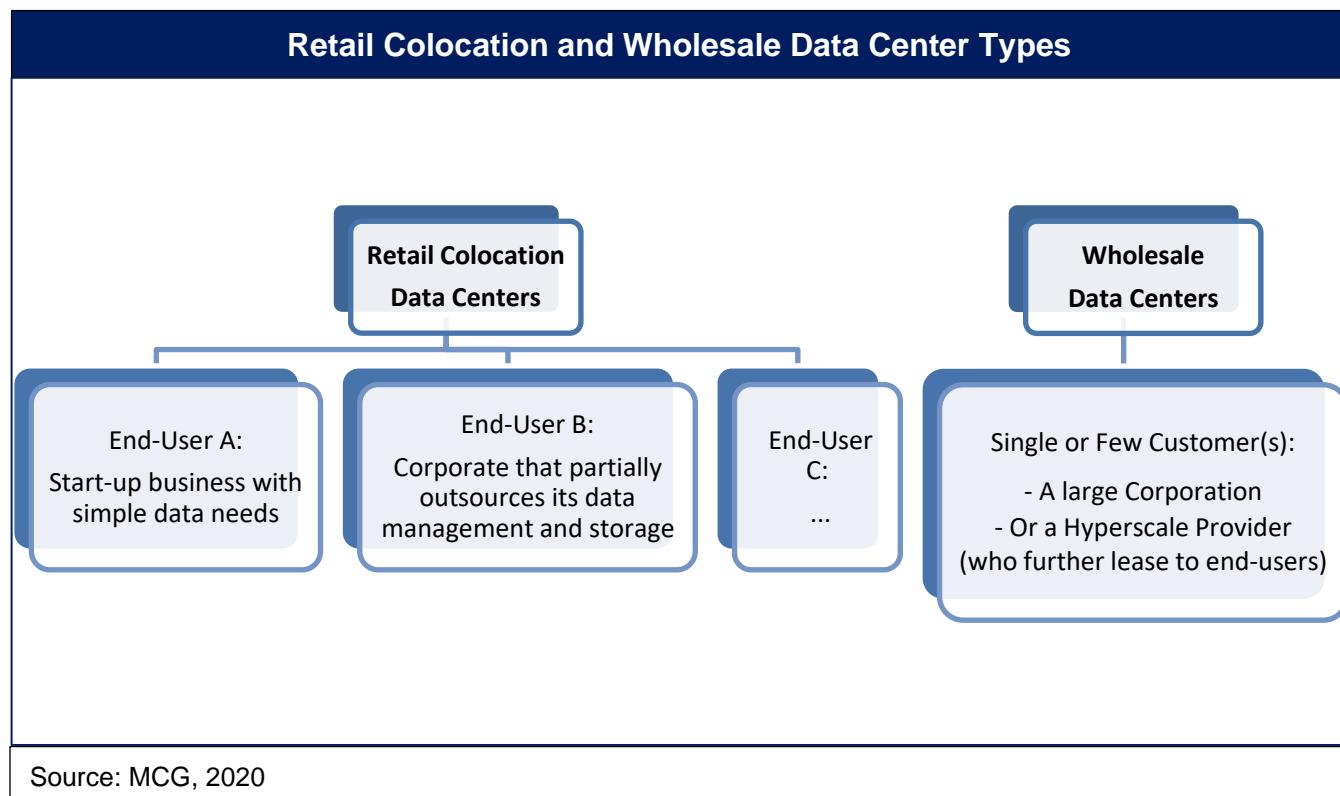
Outsourcing

This option entails the leasing of data center space from a specialized data center provider. Depending on the data center business mode of either Wholesale or Retail Colocation, users are provided with either an entire data center, or space and power within a shared or "co-located" facility. The data center provider may also provide equipment, connectivity, and value-added services under the Retail Colocation business mode. In either mode, the leasing provides greater cost transparency through predictable rental or service charges that are based on an agreed set of service levels. The ability to more accurately forecast future operational costs helps to improve budgeting accuracy on IT and thus is preferable to a lot of organizations. Besides, outsourcing functions can help to avoid the need to quickly recruit and train additional specialist staff to meet an unforeseen increase or change in business demand.

A combination of the in-house and outsourcing options is also seen in recent corporate practices due to the complex needs of the end-users, and the fact that lots of corporations are in a transitional stage with their IT management and storage strategy. For example, a corporation may have its own in-house data facilities for highly confidential information and outsource other data management needs through third-party data center providers.

Data Center Types and Target Customer Base

Two major types of data centers exist in the current markets – Retail Colocation Data Centers rent out small spaces (usually counted by racks or cages) and associated services directly to hundreds or even thousands of end-users; Wholesale Data Centers often lease to only one client that is either a large corporation with its own IT team and equipment, or a Hypescale Provider that operates the space and power and further lease to end-users.



Retail Colocation Data Centers

Retail Colocation data centers consist of one data center owner selling space, power, and cooling to multiple enterprises and customers in a specific location. Interconnection is a large driver for businesses. Retail colocation data centers offer interconnection to Software as a Service (“SaaS”) such as Salesforce, or Platform as a service (“PaaS”) like Azure. This enables businesses to scale and grow with minimum complexity at a low cost. Retail colocation data centers can also offer technical guidance for companies that do not know what data infrastructure is required for them to deliver business, or do not want the hassle to develop internal data infrastructures. Other retail colocation facilities have a slightly different model where chosen integrators provide the technical design, guidance, and specification for migrating customers. Depending on the size of the network requirement, end-users can rent 1 Cabinet to 100 Cabinets, in some cases a quarter or half of a cabinet is also available. A retail colocation data center can house hundreds if not thousands of individual customers and is ideal for smaller businesses such as start-ups due to its cost-effectiveness and strong technical support.

Wholesale Data Centers

A Wholesale Data Center refers to a relatively large data facility where the provider leases the fully built Power Shell to one single customer, or lease large spaces (rooms or suites) to a few customers. This type of Power Shells comes with professional power supplies, cooling systems, as well as other infrastructures, but do not include equipment, connectivity, or value-added services. Thus, the wholesale data center business mode is more like a traditional commercial real estate business rather than an IT service business. Customers for wholesale data centers are usually large corporations with complicated data needs and internal IT operations teams, or a Hyperscale Provider who operates the space and further leases to end-users.

Very often, large enterprises choose to lease wholesale data centers instead of building their own data center. A migration from retail colocation to wholesale data centers is also seen as corporations rapidly scales up, leading to increased data demands. While there is no industry or market standard for what power and associated space capacity constitutes a wholesale data center, most power commitments range from 1 to more than 10 MW depending on the data center design and end-user demand. This wholesales mode is ideal for customers with high data demand, want a tight control or have stringent industry regulatory standards over data, or need a great deal of customization.

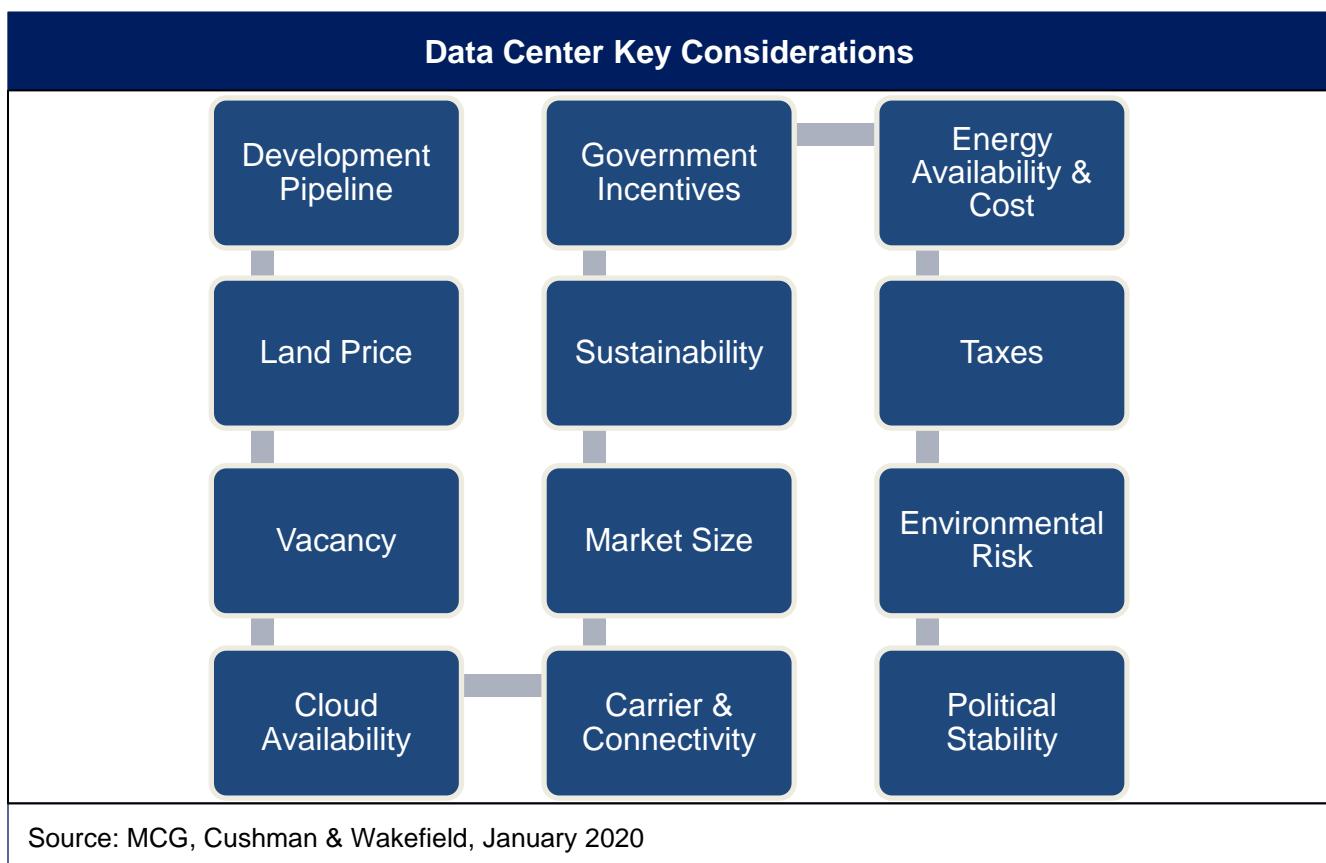
Retail Colocation vs. Wholesale Data Centers Comparison

As discussed in the previous definitions, the most distinct difference between retail colocation and wholesale data centers is the different types of customer they serve. This major differentiation in customer base results in distinctive characteristics in the size, services, and leasing terms of retail colocation vs. wholesale data centers. The following table summarizes a few most important features in our comparison:

Retail Colocation vs. Wholesale Data Centers		
	Retail Colocation	Wholesale
Customer Base	Start-ups; small to medium businesses; companies that partially outsource data needs	Large corporations who need customized data infrastructure; Hyperscale Providers
<i>Deployment Size</i>	Small, usually below 250 kW	Large, usually above 500 kW
<i>Carrier Requirement</i>	High density required	Medium density required
Business Mode	Develop and lease small spaces and technical support directly to thousands of end-users	Develop and lease large bulks of space (or entire facility) to very few customers or a single client
<i>Power Billing Mode</i>	Flat rate on a per circuit basis	Metered
<i>Technical Support</i>	Many options available	Not available
<i>Service Duration</i>	1 to 5-year lease terms	5 to 10-year lease terms
Source: MCG, DFT, 2020		

KEY CONSIDERATIONS

The speed with which the industry is shifting makes the creation of a data center strategy a complex and daunting task. Enterprises must determine whether to stay with their on-premises facility, outsource to a data center provider, move workloads entirely to the cloud or pursue a hybrid strategy. Developers and operators require a parcel with robust fiber and access to power and water while themselves having a thorough grasp of the permitting process. Investors must be able to assess the long-term potential of a data center to hold its value and how easily it can be upgraded. All involved require access to capital and a clear understanding of objectives. Therefore, several factors need to be taken into consideration when choosing the most suitable market for data centers. Listed below are 12 factors that data center investors and owners should take into consideration when valuing markets and transactions. It is also worth noticing that depending on the types of business mode (retail colocation vs. wholesale), certain factors are of higher or lesser importance.



Development Pipeline

A strong development pipeline is an indicator of many positives for a data center market. It demonstrates that permits are obtainable, land is available, that a utility has promised power, and that the prospect of financing the project exists. Perhaps even more important than all these factors, it indicates that tenants have expressed some degree of interest in the facility. A large

local ecosystem leads to positive network effects, thanks to the strong expertise available and partnership opportunities in construction and financing.

While the positive factors of a strong pipeline largely outweigh the negative, competition does tend to breed further competition and the basic laws of supply and demand apply. When several suppliers crowd into a single market at once, downward pressure squeezes pricing, particularly in the negotiations with end-users (in the case of a retail colocation) and large service providers (in the case of a wholesale data center).

The largest pipelines under active development that currently exist (140 MW+) are in traditional powerhouse markets, with good connectivity and a positive reputation among potential tenants. These include Singapore, Northern Virginia, London, Dublin, and Silicon Valley. Each of these markets has its own challenges: Singapore is extremely land constrained, Northern Virginia has fierce pricing competition, London has political risk as Brexit plays out, Dublin is power constrained and Silicon Valley has some elements of many of these issues excepting power. While the small- and mid-size markets with more affordable land have grown considerably by their own standard, they have yet to develop the inertia of the establishment.

Land Price

As the desire for larger, denser, and more scalable data center campuses grows, land availability is becoming an increasing issue for data center developers and investors. A proper site for a successful data center development includes many considerations discussed in this report, including access to fiber, proximity to a substation, a strong and affordable power grid, and available incentives. There are more prosaic real estate concerns too, as in sites certain markets are often available in sizes under three hectares (Hong Kong, Singapore) or are just emerging as data center locations (Salt Lake City, Las Vegas, Portland). Smaller sites often lead to more expensive builds, with multiple levels and higher density being required both for efficiency and to meet customer size requirements.

As in the case in other real estate categories, demand for land is affected by other factors besides physical scarcity. Ease of permitting, zoning or use restrictions, population density, and vendor ecosystem all factor into land acquisition, along with proximity to availability zones of major cloud services providers.

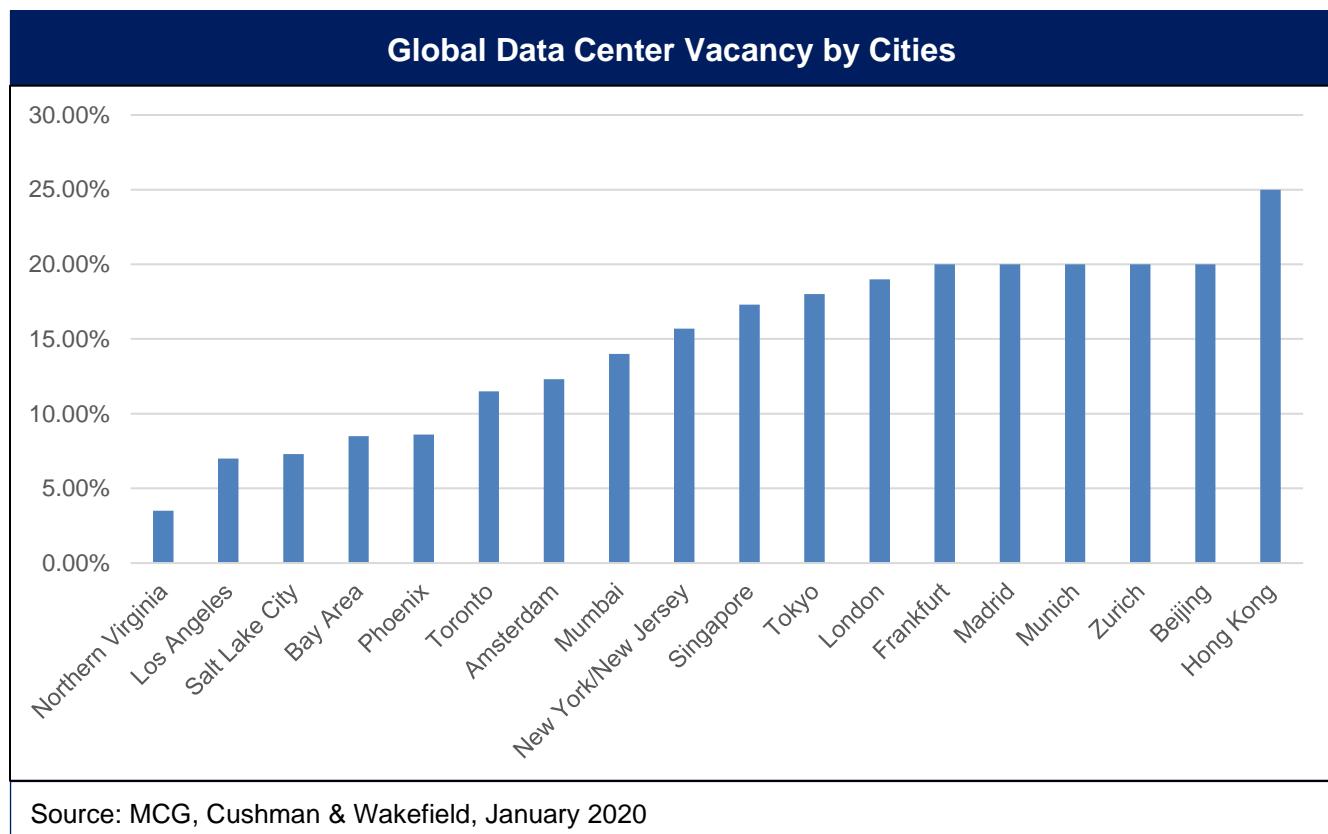
For the markets reviewed, those with the lowest cost of land are in secondary data center markets with low density or geographic restrictions, primarily in the United States. While it may not be surprising that Atlanta, Columbus or Denver have affordable pricing, land in top U.S. data center markets such as Phoenix, Dallas, and Northern Virginia remains half the price of Canadian markets and a tiny fraction of deeply constrained markets in Western Europe or Asia. Large sites in these markets can thus expect to trade at premium pricing, as new providers enter, and others expand.

Vacancy

When considering real estate market conditions, data center markets with low vacancy often indicates strong demand. Low vacancy causes prices to rise, leading to further development and opportunities for new market entrants. With the advent of cloud computing and other resource-heavy applications, average deployment size for the largest clients continues to rise. Five years ago, a five-megawatt expansion was considered exceptionally large, whereas today 50 MW would be considered notable.

Data center operators in markets favored by the big cloud platforms have recently discovered they can often lease a good portion of their facility to a large tenant (for example, eight megawatts of a ten- megawatt building), but then must find several smaller users for the remaining space. This leads to some stickiness with the remaining vacancy, with a headline vacancy figure that does not always reflect market conditions.

Northern Virginia remains the tightest data center market worldwide, with total vacancy below four percent. While this is an expected scenario, this is followed by several markets through the Western half of North America, including Vancouver, Los Angeles, Salt Lake City, Silicon Valley, and Phoenix, all with sub-10 percent vacancy. Development costs and constraints in Los Angeles and Silicon Valley remain formidable, though if these can be overcome it would indicate that latent demand still exists. Amsterdam is the tightest European market (particularly with all development temporarily halted), and developing Mumbai has the lowest vacancy throughout Asia.



Cloud Availability – mostly applies to the Retail Colocation Mode

Cloud computing has pushed the full capabilities of the data center and online applications into the hands of small- and medium-sized companies that were previously unable to afford such beneficial technology. Enterprises no longer must maintain their own data center if it is not cost effective or efficient to do so, eliminating the constant upgrade and migration costs.

Three major cloud platforms - Amazon Web Services, Microsoft Azure, and Google Cloud - have continued a relentless expansion in recent years, with an ever-increasing number of availability zones. They have driven the creation and adoption of hyperscale technology, with massive, dense and infinitely scalable data centers acting as the home for this high-level purpose. Amazon, Microsoft and Google have spent billions of dollars developing their own campuses, with millions of square feet of buildings constructed and hundreds of megawatts of power utilized.

The result of this explosion is a new industry standard for a large data center take-up, with 20-50 MW leases becoming more commonplace. This has also led to the development of another nuanced ecosystem, with cloud on-ramps at colocation campuses providing fastest access to major cloud platforms.

Today's modern technologies including the Internet of Things ("IoT"), self-driving cars and 5G connectivity will only thrive across large networks. All related applications also need somewhere to live, most likely on one of the three main platforms.

For this report, markets that were in availability zones of all three platforms received the highest scores. Though several traditionally large data center markets fall in these zones (Northern Virginia, Silicon Valley, Hong Kong, Tokyo, Amsterdam, Frankfurt), several secondary markets now have access and can provide regional competition (Zurich, Sao Paulo, Portland, Seattle). This category will have increasing weight in future as the importance of cloud computing continues to grow.

Carrier & Connectivity – mostly applies to the Retail Colocation Mode

If data centers are the brain of the modern economy, fiber networks serve as the nervous system that allow it to move and thrive. Billions of dollars are invested each year in constructing and maintaining these high-speed networks, with telecommunications companies, infrastructure funds and private equity firms fighting for market share. While a data center requires access to just one network to function, the greater the number of networks means the more the facility can prosper. Faster, denser fiber generally allows for the lowest latency and better overall network reliability, particularly when functioning with major cloud services.

Fiber networks can be short-haul and cross a metropolitan area, or longer haul to move data across the country or even past borders. Areas with the highest number of networks are found in densely populated regions of the United States with established data center markets, including Silicon Valley, Dallas and Northern Virginia. These areas form the original backbones of technical and telecom research in the country, and the historical advantage continues today.

Aside from connectivity speed, it is of high priority for most of retail colocation end-users that the data center facility they choose offers plenty of carrier options or is carrier neutral. A single-carrier facility typically only offers little, if any, choice in terms of connectivity and it puts customers in the uncomfortable situation of being locked into a specific vendor. Whereas a carrier neutral facility decreases the user's risk of getting sudden pricing change, ensures more stable uptime for the end-user, and a higher flexibility to switch to more suitable services as the business scales up.

Market Size

A large data center market not only indicates a historical predisposition to develop in that area, it often facilitates further development thanks to local market awareness and an established network of partners. The historically dense fiber throughout Northern Virginia — largely due to a strong military and R&D presence — gave birth to today's largest global data center market. Financial hubs such as London, New York, Hong Kong, and Tokyo have strong data center connectivity to process these transactions; and Silicon Valley, the technology capital of the world, still boasts a large local market. Networks beget more networks, and with the difficulty of migration it is often far easier to simply expand in place.

The “campus” model that is currently in vogue assists in this current market expansion, with developers and operators acquiring large parcels that will accommodate multiple phases or adding smaller parcels surrounding the current property as demand requires. Continued expansion of certain key markets has caused considerable pressure on infrastructure. In fact, Amsterdam has banned construction of data centers for the rest of 2019 and several other large European markets are heavily power-constrained until further power grid expansion can be completed.

Beijing and Shanghai have continued their expansion throughout China, now placing among the global leaders for market capacity. In North America, Toronto and Montreal are gaining traction for the diverse array of occupiers and low cost of power respectively, and Phoenix has attracted attention recently as operators continue to enter with plans to build large hubs.

Sustainability

While climate change threatens the planet and all inhabitants with increased temperatures and corresponding increase in sea levels, the data center industry has a peculiar responsibility to consider. All people rely on a data center for their daily information and workload, yet the largest data centers utilize more power each year than small cities. Sustainability has thus become a critical factor in data center design and location.

Pressure for sustainability not only comes from environmental groups and investors, but through the large cloud service providers and biggest data center tenants. Google plans to have zero emissions by 2030, Amazon plans to be carbon-neutral by 2040, and many cities throughout the world are planning the same by 2050, particularly throughout Europe. These companies and local governments are exploring multiple options to achieve this goal, including solar power, hydroelectricity, wind energy, and the reuse of biomass to provide cleaner, renewable power.

From a data center perspective, locating in markets with sustainable power has another benefit covered elsewhere in this report: it can be cheaper from a user perspective. Montreal has led the way on this for some time, with local utility Hydro Quebec marketing the low-cost hydroelectric power as a reason for locating data centers in the province. Sydney has recently stepped up, with all power coming from renewable sources within the year. Markets in the Northwest United States and Canada such as Seattle, Portland and Vancouver also have considerable sustainable power in place.

Government Incentives

To attract data center investment, many areas at the national, state/provincial or local level offer a varying package of incentives in the form of tax relief. This can mean a reduced sales tax on the purchase of equipment, lower or exempted property taxes, or even reduced power taxes for meeting objectives. Most of these incentives require a minimum financial investment, along with multiple permanent employees hired at an above-average wage. While in many countries incentives are determined on a case-by-case basis, certain markets have chosen specifically defined plans.

The United States is leading the way in incentives, with 25 of 50 states now offering their own packages. Nevada and Arizona have proven most aggressive, with exemptions starting at US\$25 and US\$50 million for Las Vegas and Phoenix, respectively. Other long-standing top tier markets are also buoyed by incentives, including Northern Virginia and Dallas, and Chicago looks to benefit from a new package launched by the State of Illinois in 2019 for invested amounts of US\$250 million and 20 permanent hires.

An intriguing new incentive came online in 2019 for data center development in Paris, with the French government offering an electricity tax cut that halves the price of electricity for large projects. Operators would be required to adhere to strict environmental standards, though these may also prove cost effective.

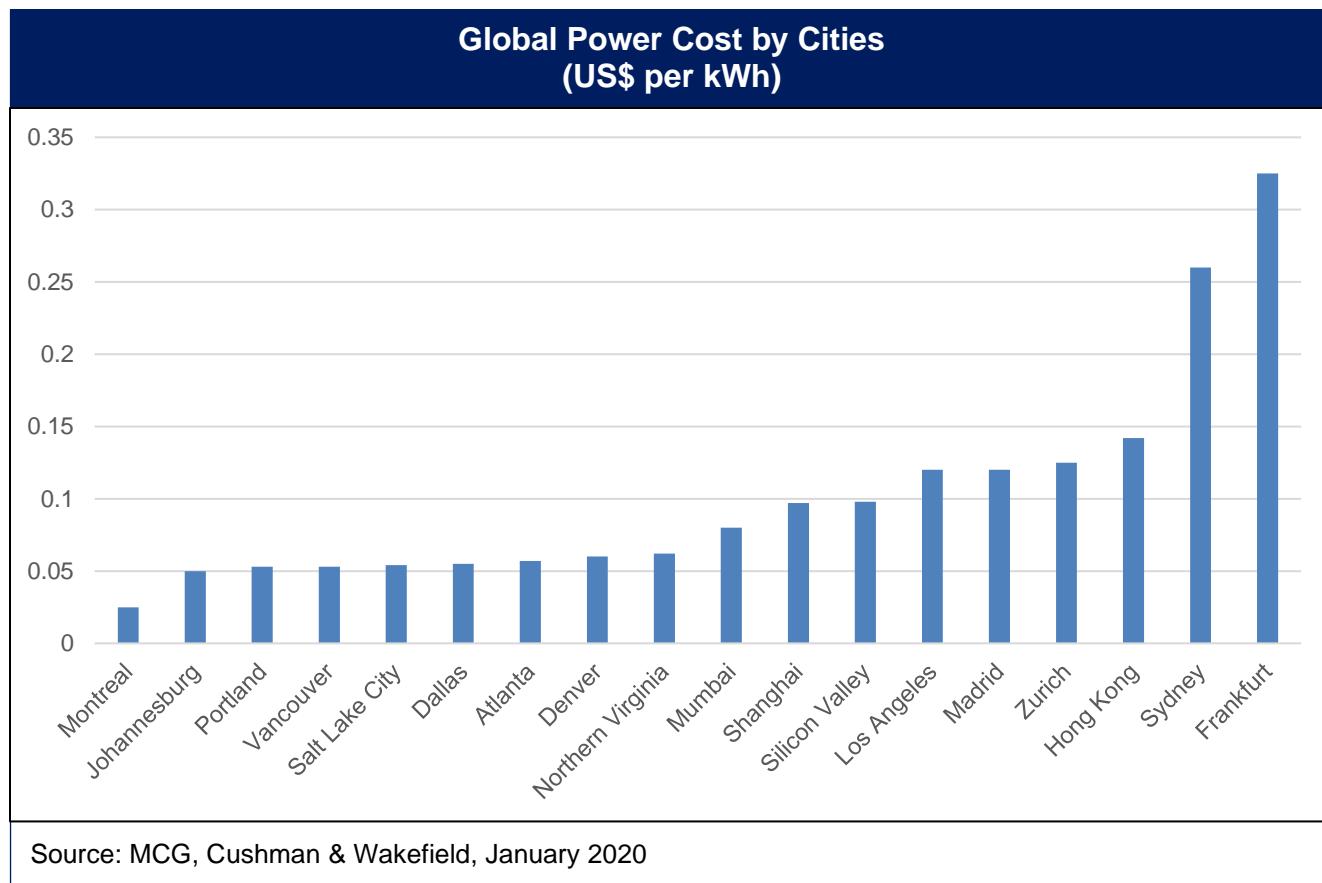
Energy Availability & Cost

Building a data center to run today's resource-heavy applications requires considerable capital during construction, particularly if attempting to offset this by aiming for a low power usage effectiveness ("PUE"). A variety of techniques can be used to achieve a low PUE, but it is also key to consider availability of both power and water resources when determining the location of the data center facility. For example, locating in a cooler climate can offset the burden on the cooling system and further reduce water usage.

Market power costs are derived from a variety of factors. Renewable power lowers the cost, particularly where hydropower is common, with this source having the lowest lifetime cost of energy. Taxes play a part, as power is taxed differently across areas depending on amount used and type of utilization. Maintaining a power grid is complex (particularly in areas with multiple types of power generated) and local utilities' decision to structure as a for-profit or non-profit entity leads to differing levels of responsiveness to the data center industry. Certain utilities have

worked to attract data center development, with Hydro Quebec, Silicon Valley Power, Tennessee Valley Authority, Dominion Energy notably willing to assist in the planning process.

A survey of power costs shows that those markets that can generate hydropower consistently appear among the low-cost leaders. Montreal leads the way at three U.S. cents/kWh. Several other markets in the Western and Southern U.S. including Salt Lake City, Dallas and Atlanta also have heavy industrial use pricing below six cents/kWh. Johannesburg in South Africa has the most affordable power of markets reviewed outside North America, albeit with an occasionally inconsistent supply.



Taxes

For data center projects in areas that do not offer government-related incentive packages, sales taxes or value-added taxes come into play when acquiring equipment and materials. A sales tax is a payment to the government for any good or service sold, while a value-added tax is paid by the end user of the value chain. With costs for large data center builds pushing into nine and ten figures over multiple phases, a market with lower tax rates can save millions of dollars over the life of a facility.

Two markets studied, Portland and Hong Kong, have neither of these taxes, thus providing an incentive as compelling as any exemptions given. Hong Kong has long been a pro-business, global center of commerce, and Portland's home state of Oregon taxes income and property instead.

Several other U.S. markets have sales tax rates from four to six percent, including Northern Virginia, Boston, Seattle and Northern New Jersey. Singapore's goods and services tax will remain at a low seven percent for at least another two years. On the opposite end of the scale, most large European markets have rates triple that of the lowest tax regimes, with rates hovering close to 20 percent.

Environmental Risks

Mission critical means that even when facing daunting natural disasters that down other business verticals, networks must stay functional, data must keep moving, and disaster recovery must be available if all else fails. In addition to the usual site selection criteria of fiber and power, thought must be spared to a data center's defenses in the face of catastrophe to avoid reliance on short-term backup systems.

Flood risk is viewed through a dual lens: the risk of a 100-year flood (a 1% or greater chance of severe flooding each year) and the risk of a 500-year flood (a 0.2% chance of severe flooding). Flooding can easily destroy any building, with data centers particularly vulnerable due to the expense of server and systems replacement thereafter and payouts due to loss of business. A review of supply shows several markets that have constructed all colocation data centers outside of major flood plains, including Dublin, Madrid, Vancouver, Johannesburg, Sydney, and Columbus.

Earthquakes can impact entire cities and destabilize whole countries, making clean-up and reconstruction efforts frustrating and expensive. Many large data center markets are in coastal zones with large populations, formed by ever-shifting tectonic plates and providing a source of risk for those located nearby. Lowest severe earthquake risk is shared by several markets in Western Europe (Dublin, Madrid, Paris, Amsterdam), the Central U.S. (Dallas), and Hong Kong.

Tornadoes and hurricanes can bring 250-kilometer-per-hour wind and mass destruction. Additional implications for data centers include the downing of electrical grids and the corresponding reliance on generators and backup systems. Areas entirely free of this risk include all markets in Western Europe, the Western U.S. and Singapore.

Political Stability

Business works best in a stable, highly functional environment and the same holds true for the data center industry. As data centers are considered mission critical to keep applications, networks, and thus entire companies operating at their highest efficiency, the greater political situation of the data center location factors into any decision making.

SUPPLIERS

Supply Insights

Globally, the supply of data centers has increased steadily in the past few years. The United States is still the largest data center market in the world, in which Northern Virginia is the largest data center market in the US. In Northern Virginia, supply increased by 340.2 MW in 2019, bringing its overall inventory to 1,200.4 MW—the largest data center market in the world, followed by Dallas (321.4 MW), Silicon Valley (290.0 MW) and Chicago (270.0 MW). The enormous growth of inventory across data center markets reflects the magnitude of leasing from cloud-service providers. In select markets, these hyperscalers account for 80% to 90% of demand.

Silicon Valley, with a historically low vacancy rate of around 7% for the past few years, had 36.5 MW of absorption in 2019, dropping its vacancy rate to 6%. The New York Tri-State market had 15.2 MW of capacity under construction, a significant increase from 2018. Unlike other years, preleasing activity dropped significantly in proportion to net absorption. Preleasing was partly driven by a shortened speed-to-market timeframe and a decrease in build-to-suit requirements. With an abundance of new supply, end users had a wide variety of space choices, resulting in relatively low rates of preleasing.

In Europe, the four largest markets (Frankfurt, London, Amsterdam, and Paris) had a combined market size of 1,670MW in 2019, having increased by 319MW in the year, representative of 24%. This means that as much new capacity has been developed in the past three years as in the 11 years before that.

Nearly half of the new capacity in 2019, 153MW, was brought on in Q4 2019 alone, with nearly 100MW of that in London. The largest scheme was NTT's LON1 facility in Dagenham, whilst Ark, CyrusOne and VIRTUS also brought on further new facilities over 15MW each.

This level of new capacity in the key markets shows that the developers are confident demand from large enterprises and hyperscale providers will remain extremely active over the next three years.

The hyperscale providers now require much larger individual facilities of 15-20MW each. This is driving the sharp increase in market size. To illustrate the point, the aggregate size of the five largest facilities to come online in the FLAP markets during 2019, would make them the fifth largest colocation market in Europe today.

Asia Pacific on the other hand still has even more data centers under construction than North America, following the surging demand brought by the increase in internet users and social media users. According to Research and Markets, it is estimated that the region's data center construction market will grow from US\$ 10 billion in 2018 to US\$23 billion by 2027, representing a compound annual growth rate of 10.2%.

Much of the new development will go to Asia Pacific's primary or tier 1 data center markets: Singapore, Hong Kong, Sydney and Tokyo. Singapore, as the region's largest data center market, offered 359.8 MW of total capacity during Q1 2019 and has an additional 177.2 MW of new supply on the way by 2021. The market has seen the likes of Facebook committing to building a US\$1 billion data center in Singapore in 2018, its first in Asia. Google also announced plans for a third data facility worth US\$350 million in the city in 2018. Supply is on the rise in the other main markets too. Tokyo will almost double its current capacity of 225MW between 2019 and 2021, while Sydney will develop a further 97.4MW during that period.

Latin American and African market are also showing good supply dynamics. Google announced in November 2019 that it would build another data center in Uruguay, to add to the one it already has in Chile. Amazon Web Services also announced that it would build a data center in Argentina. Meanwhile for Africa, capital is pouring into digital infrastructure in Africa in anticipation of a population boom on the continent. London-based investment house Actis announced in March 2020 that it had acquired Nigeria-based Rack Center and aim to build it as a continent-wide network of data centers.

Traditional Data Center Landlords

While the global data center markets are huge, there are still a few major suppliers that take a larger amount of the market. Listed below are some of the most noticeable ones.

Digital Realty

Digital Realty is an American wholesale conglomerate services company and a data center provider with over 140 locations across the globe. They currently hold US\$ 9.9 billion in capital. Digital Realty recently (successfully) acquired Telx, a small data center unit with strong connections in the United States. Digital Realty built the global standard for technical real estate, developing a unique capability to acquire, manage, and scale data center campuses. They are currently building a unique ecosystem of open solutions that power customer growth through exceptional service on a foundation of unrivaled data center expertise. Digital Realty provides the combination of a data center ecosystem business with a colocation services provider in a seamless, interconnected global network.

Recently, Digital Realty reported Q1 2020 revenues of US\$823 million, a 5% increase from the previous quarter and a 1% increase from the same quarter last year. The company delivered a Q1 2020 net income of US\$229 million, and a net income available to common stockholders of US\$203 million.

In the first quarter, Digital Realty signed total bookings expected to generate US\$75 million of annualized GAAP rental revenue, including a US\$9 million contribution from interconnection. The figures do not include any contribution from the combination with Interxion, which was completed on March 12, 2020.

Equinix

Equinix is an American organization that holds US\$ 15.4 billion in capital. Equinix currently operates about 210 data centers in 55 metros worldwide. Equinix is the global business exchange company where market leaders reliably connect and optimize delivery of dynamic content and applications.

Equinix is greatly expanding its presence in Canada, going from footprint in only one metro north of the US border to eight. The Redwood City, California-based colocation giant has agreed to pay US\$750 million to take 13 data centers off the hands of BCE, the massive telecommunications and media conglomerate, corporate parent of Bell MTS and Bell Canada.

NTT Communication

NTT Global Data Centers was created through the consolidation of 28 IT brands owned by NTT Communications, including data center providers RagingWire, e-shelter, Gyron, Netmagic, NTT Nexcenter and Digital Port Asia. The combined company operates more than 160 data centers spanning more than 20 countries, making it the third-largest global data center company, trailing only Equinix and Digital Realty. NTT executives said the consolidation highlights the full scope of the company's infrastructure to the global data center industry and provides customers with a more seamless global experience.

The new NTT Global Data Centers plans to spend US\$7 billion on building new data centers, adding capacity across multiple global markets. As part of that investment, the Americas division – previously known as RagingWire Data Centers – has acquired land in Hillsboro, Oregon and the Phoenix market. The expansion provides NTT with data center campuses in seven markets across the United States, including production campuses in Northern Virginia, Dallas and Sacramento, and projects under development in Chicago, Santa Clara, Hillsboro and Phoenix.

The new Global Data Centers division, under the leadership of Matsuo, consists of four regions that cover Americas, APAC, EMEA and India. In APAC, the platform locations include Tokyo, Osaka, Hong Kong, Singapore, Cyberjaya, Bangkok and Jakarta. In EMEA, locations include London, Amsterdam, Frankfurt, Berlin, Munich, Vienna, Zurich, Madrid, and Johannesburg. In India, NTT Ltd. has significant data center operations in Mumbai, Bangalore, Noida, and Chennai.

CoreSite

CoreSite owns 23 data centers, totaling over 4.6 million square feet, in eight strategic markets across the U.S. Our network-rich, cloud-enabled data center campuses are tethered by high count dark fiber, enabling scalable growth within, and access between markets. The CoreSite Open Cloud Exchange and our nationwide SDN solution enables interconnection to multiple markets. With inter-site connectivity, you can connect your geographically diverse deployments or improve your multi-region cloud architecture.

CoreSite Realty Corporation reported operating revenues of US\$147.4 million for Q1 2020, an increase of 6.1% year over year, largely as a result of the company's data center expansion and ground-up development projects. Meanwhile, CoreSite achieved new and expansion sales of US\$12.0 million of annualized GAAP rent for the quarter, driven by expansions from existing customers, according to the company.

CoreSite also delivered strong new and expansion sales in the first quarter, including ongoing growth in core retail colocation with sales of US\$8.4 million, about three-quarters of which came from deployments of 1,000 to 5,000 square feet, and US\$3.6 million in scale leasing. The sales included the highest core retail colocation sales in three and a half years.

The company revealed it is on track to complete its data center construction projects, assuming local jurisdictions are able to be timely with inspections and permits working under COVID-19 conditions.

Entry of Large IT Companies

Besides the traditional suppliers of data centers, a lot of large IT companies are actively developing in-house data centers to meet internal needs, or even developing cloud provider capacity to serve external end-users. In either case this would increase the industry competition as in-house developments take away demand from the market, and development of provider capacity increases market supply.

Google

Google Data Centers are the large data center facilities Google uses to provide their services, which combine large amounts of digital storage (mainly hard drives and solid-state drives), computer nodes organized in aisles of racks, internal and external networking, environmental controls (mainly cooling and dehumidification), and operations software (especially as concerns load balancing and fault tolerance).

Google is building more data centers in more places than ever before. It opened new data centers in Northern Virginia and Tennessee in 2019, and broken ground for future campuses in Texas, Ohio, and Nevada. The company has announced plans for a site in Nebraska but has yet to confirm a location (although it is the prime suspect in a huge "codename" project near Lincoln). Google has also negotiated an incentive package to join the crowd of data center developers planning to build in Mesa, Arizona.

The building boom extends overseas as well. In September 2019, Google announced that it would invest US\$3.3 billion over the next two years to expand its data center footprint in Europe, along with 10 new projects to generate renewable energy for its servers.

Google's 2019 investment is notable for both the geographic breadth of its new deployments and the drive for a greater scale seen in the expansion of existing cloud campuses. The search leader is expanding upon existing cloud computing nodes in Oklahoma, South Carolina, and Finland.

The scale of Google's infrastructure is remarkable. Up till 2019, the company has had 19 data center campuses around the globe, with 11 in the United States, 5 in Europe, two in Asia/Pacific, and one in South America. These cloud campuses house multiple buildings, each approximately twice the size of a Wal-Mart and filled with servers and storage to manage data. Google typically spends more than US\$1 billion to complete an entire campus, with some sites exceeding US\$2 billion in investment.

Apple

Before COVID-19, Apple planned to invest US\$10 billion in U.S. data center construction over the next five years. It expected to have spent US\$4.5 billion of the ten in 2019 and 2020. How that plan has changed since COVID-19 is unknown.

The company revealed the plan as part of a broader investment in staff and facilities expansion across the US. That broader plan includes a new 133-acre campus in Austin, Texas, expected to eventually have enough room to house 15,000 employees and make Apple the largest private employer in town.

The announced Apple data center investment includes expansion projects at the company's data center campuses in Maiden, North Carolina; Mesa, Arizona; and Sparks, Nevada. It also includes the cost of a new data center in Waukee, Iowa, where preparations for construction are underway, the company said in a statement.

In addition to the three Apple data center campuses mentioned above, the company has data centers in Newark, California, and Prineville, Oregon, and leases space in other locations from commercial data center landlords. It's also been building a data center in Denmark and announced plans to build a second one there.

Verizon

In April 2019, Verizon Media announced that it would spend €28 million on expanding its Lockport data center campus which came with its acquisition of Yahoo a couple of years ago. Yahoo built two data centers on the New York state site before it was acquired by the communications giant.

Around US\$500m has been plowed into Lockport over the last ten years, which currently employs around 200 staff. The latest investment, which includes a 75,000 square feet "data pod", will be a fillip to the workforce there, who have seen the Verizon Media group recently announce 800 redundancies elsewhere.

To help get its expansion plans through, Verizon has agreed with town officials to start paying some specific property taxes in 2020, instead of waiting until 2024. These had been reduced as part of a previous building deal, but Verizon has agreed to sign a new one.

The firm is keen to carry on benefiting from the conditions that Lockport offers, including natural equipment cooling from the local weather, worker availability, and access to cost-effective energy supplies.

Verizon Media will continue to be exempt from paying sales taxes on building materials or equipment for the data center campus. The exemption will save the firm around US\$17.3m going forward.

All the financial incentive details are expected to be voted on by town officials in June 2020. Verizon wants to start building this spring and the first phase, including kit installation, is expected to be complete by the year-end.

Equinix bought most of Verizon's data centers for US\$3.6 billion in 2017 when Verizon gave up trying to build its public cloud, but it still leases capacity in many of them to sell its own services.

Alibaba

Alibaba Cloud is one of the top cloud providers in the Asia-Pacific market and is striving to rival public cloud titans Amazon Web Services and Microsoft Azure as the worldwide cloud computing leader. As China's biggest cloud computing provider, it will invest a whopping US\$28.2 billion in cloud infrastructure and the construction of data centers over the next three years starting 2020 as it prepares to help digital transformation efforts in a "post-pandemic world."

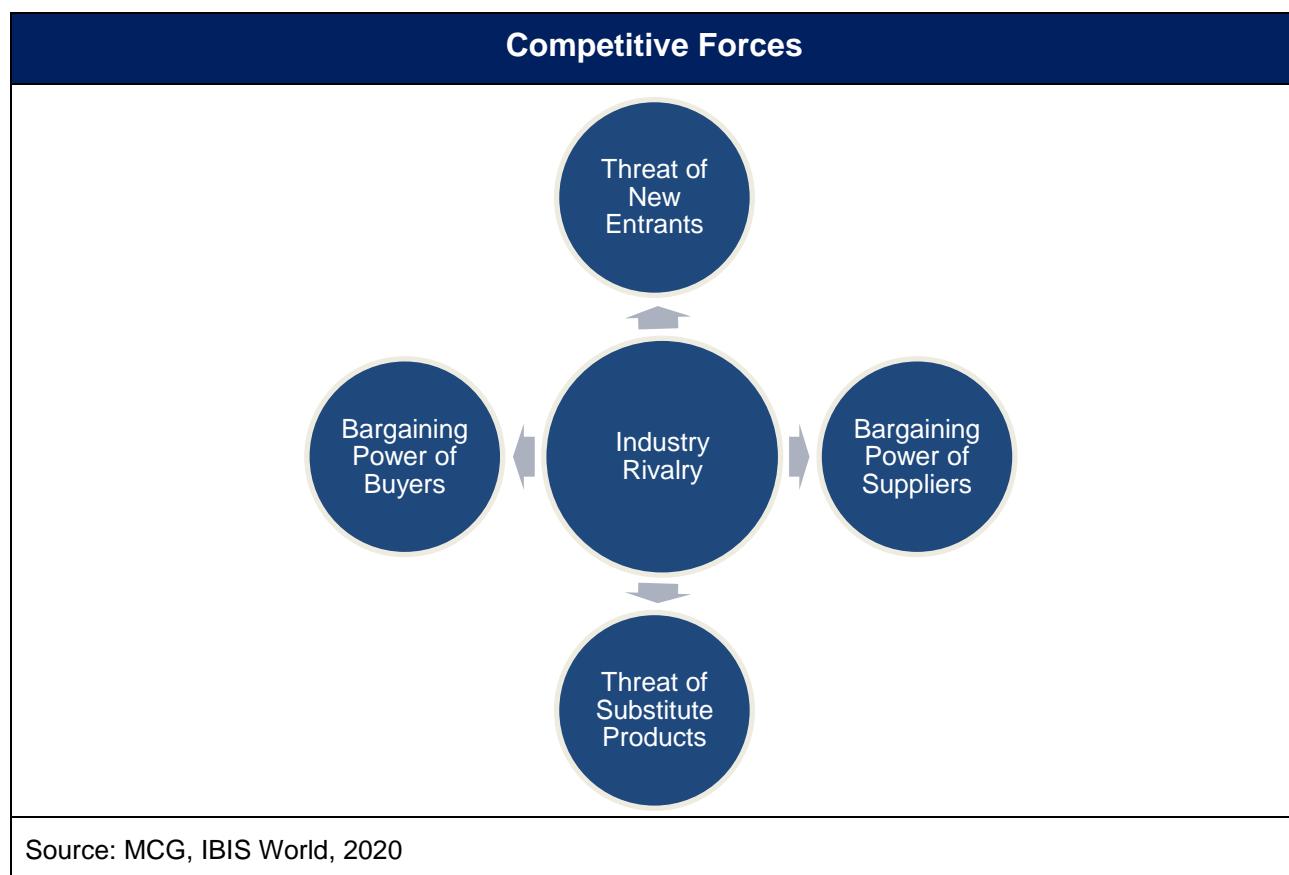
Aimed at building next-generation hyperscale data centers, Alibaba Cloud will invest US\$28.2 billion in innovation and the development of operating systems, servers, and chips for its data center infrastructure. Alibaba Cloud plans to build additional data centers on top of its existing 63 availability zones covering 21 regions across the globe including Australia, Indonesia, Malaysia, and Singapore.

Alibaba Cloud has helped combat the coronavirus in China by providing access to on-demand cloud computing and artificial intelligence services to support government departments, businesses, research institutes, and students during the pandemic. Alibaba Cloud made its AI-powered platform available for free to research institutions to accelerate CT image analytics, gene sequencing, and services to treat and prevent the coronavirus.

COMPETITIVE DYNAMICS

Competitive Forces

Four critical competitive factors drive the market and reflect the state of the data center market. The situation and strength of the four competitive forces determine the competition intensity of industry and the industry profitability. Based on the analysis of these four forces, industry rivalry in the data center market is considered moderate, with an expected acceleration in the near future.



Moderate Bargaining Power of Buyers

The buyers in the data center market are end-users (as in the retail colocation mode), large corporations, or hyperscale providers (as in the wholesale mode). As the market hasn't reached equilibrium with demand constantly larger than supply, buyers have moderate to low bargaining power when it comes to price negotiation. However, this is less the case in the wholesale mode than in the retail mode as wholesale buyers tend to have higher bargaining power and attain lower rental rates through a much higher deployment size. In the retail colocation mode, if the end-users are able to "split" their contract between multiple retail data centers, they could potentially increase bargaining power.

Low to Moderate Bargaining Power of Suppliers

Suppliers of data centers have a natural advantage in terms of negotiation power due to the undersupplied market reality. However, as the development pipeline kept being robust and active for the past years, this situation will likely change in the near future. In a retail colocation mode, a supplier can differentiate its facilities through the implementation of technologies, high quality environmental control systems, and value-added services in order to gain higher bargaining power. In the wholesale mode, suppliers are harder to differentiate its facilities from other wholesale suppliers as not much technical support and services are involved.

Moderate Threat of New Entrants

The entry barrier for the data centers market is considered low to moderate due to the high costs of infrastructure and technical nature of the business. However, as discussed in the previous section, technology companies like Google and Alibaba has the technical advantages to enter the market, should they decide to focus on developing cloud service data centers through the expansion of their physical data center networks. This development will be most detrimental to suppliers with the retail colocation business mode, as small end-users can quickly migrate to hyperscale cloud-based data centers like Alibaba and Amazon Web Services that are unparalleled in the industry, abandoning the traditional physical retail data centers.

Very Low Threat of Substitute Products

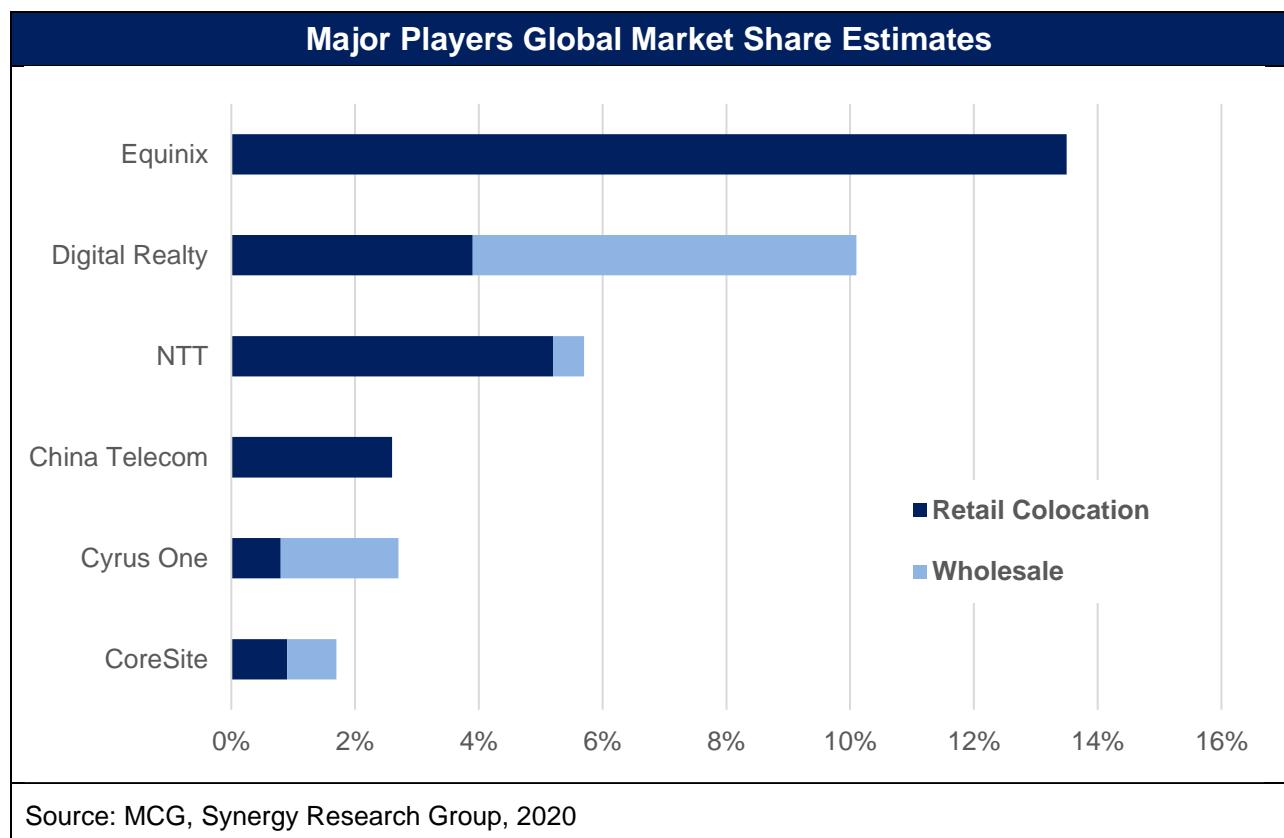
The substitute product for data centers are traditional types of data management systems that are outdated and abandoned by more and more companies. Thus, in this aspect we consider the threat of competition to be very low.

Industry Segmentation and Consolidations

The data center industry is considered moderately fragmented with none of the major suppliers reaching a global market share above 10% due to different supplier's different focuses on retail vs. wholesale. As shown in the above discussion, the industry is going through heavy consolidations as leading players acquire smaller facilities at an increasing pace.

This trend of merger and acquisition activities is expected to continue into the next five years as all leading suppliers piled up with capital from PE investors, public offerings, as well as debt issuance to prepare for further expansions.

On the other hand, large IT companies that entered the cloud-based data center market like Google, Amazon, and Alibaba have created a much less fragmented market as the technology and size of these platforms are unrivaled by smaller participants in the cloud sector, attracting most of the cloud end-users. Acquisition of smaller cloud companies by these IT giants has also been active for the past few years.

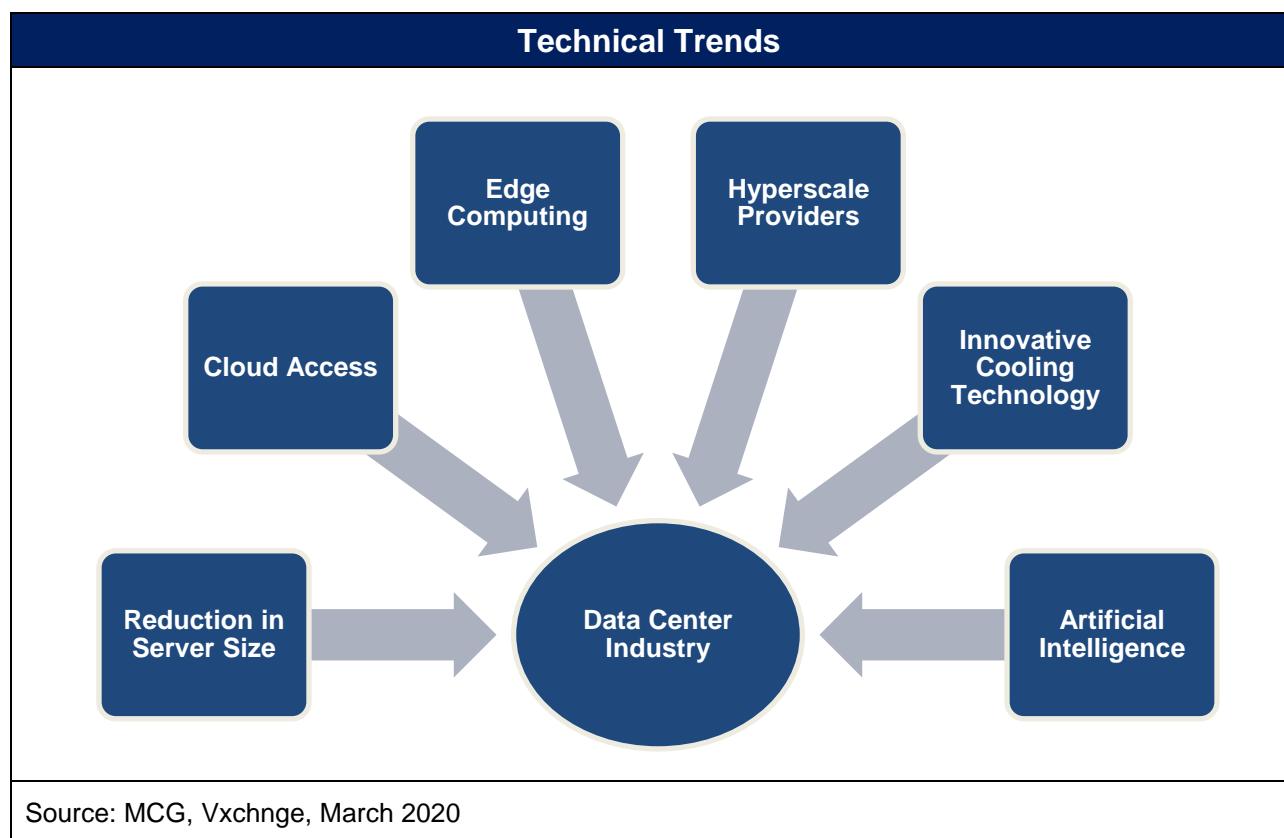


INDUSTRY TRENDS

Technical Trends – mostly apply to Retail Colocation

Today's data centers do not resemble the mainframes familiar to previous generations of IT personnel. Modern facilities are wonders of computing technology, featuring state-of-the-art high-density servers and revolutionary cooling systems. They also offer a wide range of services that are accessible to even some of the smallest startups, providing them with infrastructure resources that would have been unthinkable in previous decades.

Keeping pace with the next generation of data center trends can help companies identify which services are right for them and learn how data centers can push their businesses forward. If these organizations don't know what is available to them, they will have difficulty charting the future course of their IT and digital transformation strategy. Listed below are 5 trends that data center providers and users should be aware of.



Reduction in Server Size

High costs regarding construction and energy associated with developing and operating data center facilities has incentivized industry innovators to conserve physical space through the reduction of server sizes. Recent generations of processors and disk drives have seen huge increase in processing speed, as well as decrease in physical sizes. This trend is most definitely

going to continue in the next five years, which will help to cut on the cost of property as future data center facilities get developed. However, the growth in processing capacity and the minimizing in size of data centers has been outgrown by the rapidly rising data storage needs from the customer's side. Thus, this technology trend is not expected to reverse the positive outlook of the overall industry growth.

Cloud Access

As the costs of building a private data center continue to escalate and the versatility of third-party data centers expands, small to medium sized companies are looking at colocation solutions as an IT infrastructure. While renting space in a facility might not sound like it would qualify as a data center technologies trend, it's important to note that current data centers are improving and one of the most popular improvements among customers is the provision of multi-cloud access to the data centers. It combines the cloud computing technology and the colocation data centers, providing benefits from both.

In most cases, colocation data centers give customers the tools to manage and oversee their infrastructure that is far beyond anything they could afford to put in place in their own private facilities. From business intelligence software that gives unparalleled visibility into the actual usage patterns of their network to robust asset tracking and 24/7/365 remote hands support, colocation allows small to medium-sized companies the resources to compete directly with their bigger, more resourceful competitors.

Edge Computing

If cloud computing is the darling of the previous decade, edge computing might well be the next major trend for the data center industry. Edge computing architectures expand the reach of a typical cloud network by pushing key processing functions to the edge of the network, closer to where the data itself is gathered. Traditional cloud computing requires collected data to travel back to the core of the network where it can be processed by the central server. Since data travel speed is constrained by the laws of physics, it results in latency that slows streaming content services, medical devices, industrial scanners, and other devices.

By processing data closer to the edge of the network where it's collected, edge computing can greatly increase speed and responsiveness. As IoT devices become more common each year, the number of devices capable of handling that processing load is increasing to the point at which edge computing is more viable than ever. Edge data centers are also being used to extend network reach and increase speed, providing more powerful processing resources that can handle tasks too big for IoT devices, but not large enough to be sent back to the core of the network.

Hyperscale Providers

As more organizations turn to cloud computing solutions, the demand for the data center infrastructure that supports them is increasing as well. Hyperscale facilities are substantially larger than most enterprise data centers, sometimes housing thousands upon thousands of servers. Most of them are operated by the big names in the tech industry such as Google, Apple,

and Microsoft because these companies offer the type of cloud computing services at an immense scale unparalleled in the industry. Microsoft's Quincy, WA data center, for example, utilizes 24,000 miles of network cable, the equivalent of six Amazon Rivers.

With demand for cloud and social media services showing no sign of decline, companies are investing in the construction of more of these massive facilities. There were more than 500 data centers that could be classified as hyperscale at the end of 2019, and another 151 are scheduled for construction in 2020. These facilities will be crucial to managing the massive amounts of data generated by virtual reality services, big data social media analytics, and the information being gathered by IoT devices.

Innovative Cooling Technology

As rapid technology advancements in hardware lead to decreasing server sizes, the concentration of power-intensive servers in data center facilities makes cooling systems and technology a key consideration for the design and development of data center facilities.

Data centers have long relied upon conventional air conditioning infrastructure to meet their cooling needs. Considering that cooling is responsible for a huge percentage of data center energy consumption (up to 40 percent), it's hardly a surprise that many facilities have focused on improving their cooling strategies as a way to become more cost-efficient. As rapid technology advancements in hardware lead to decreasing server sizes, the concentration of power-intensive processors generate more heat than traditional cooling infrastructure can handle, forcing data centers to take new approaches to meet their cooling needs. Fortunately, AI-applications provide an ideal solution with their ability to dynamically monitor and regulate the environment of a data center. Google recently handed over control of the environmental system in one of its hyperscale data centers to a DeepMind AI program after several years of successful testing. The program's minute adjustments in cooling performance translated into significant energy savings within the first several months.

Liquid cooling technology has also come into its own, both in the form of direct to chip and full-immersion solutions. As high-performance processors begin to generate too much heat to be managed by air-cooled systems, liquid cooling will surely become a more cost-effective and practical means of regulating the data center environment efficiently.

Artificial Intelligence

Both artificial intelligence and more specialized machine learning applications have proliferated in recent years, and 2020 promises to unleash a new frontier of innovation in the field. The challenge for many organizations is securing the massive amounts of processing power needed for these applications. With sophisticated, adaptive algorithms being utilized for tasks that might once have been seen as trivial, the demand for processing power will continue to grow. The efficient infrastructures and connectivity capabilities of today's data centers provide the ideal platform for organizations to access those resources. Whether they're storing their powerful servers in an efficient colocation environment or using their facility as a direct on-ramp to access the expansive power of cloud computing, data centers have an important role to play in the ongoing growth of AI technology and applications.

Commercial Trends – apply to both Retail Colocation and Wholesale

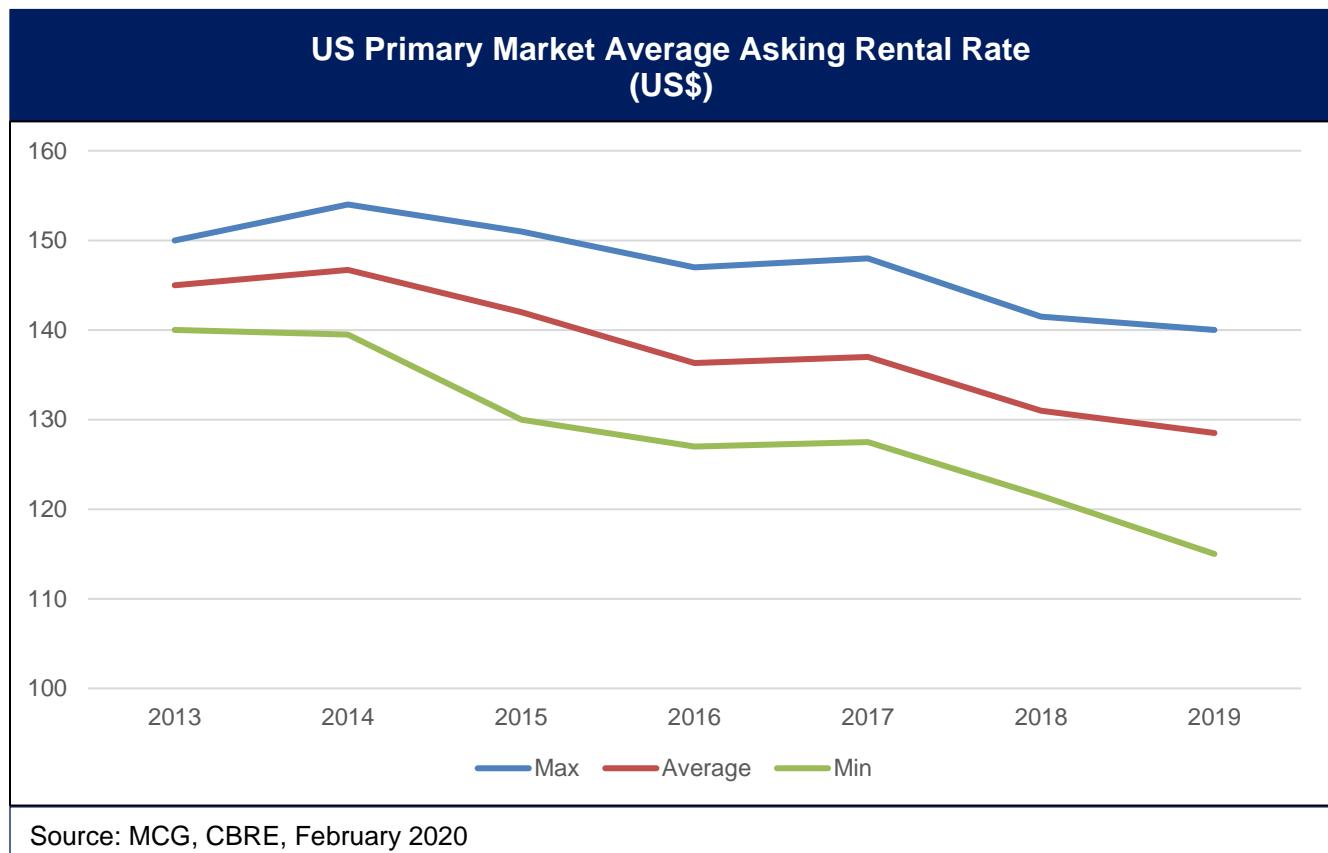
The current technological development also leads to the data centers industry experiencing new commercial trends. New providers' entry into the market, better technology, as well as increasing demand are all changing the industry's commercial landscape.

U.S. Rental Rate Changes

For the North American market specifically, data center rental rates compressed in markets across the United States in 2019. This trend was driven by more providers entering the markets, large megawatt deals executed at lower rates, and robust supply pipelines.

In Northern Virginia, second-generation inventory and a robust supply pipeline were driving downward pressure on rental rates. Rental rates for less than 250kW (all in) ranged from US\$120 - US\$140. In 2018, the rates ranged from US\$175 - US\$250. Northern California recorded a slight dip in rental rates for larger transactions. Rental rates for greater than 250kW ranged from US\$120 - US\$150 in 2019. Rental rates from the previous year ranged from US\$125 - US\$160. While prices have compressed, building and operating costs have remained virtually flat. This can add downward pressure on yields moving forward in 2020.

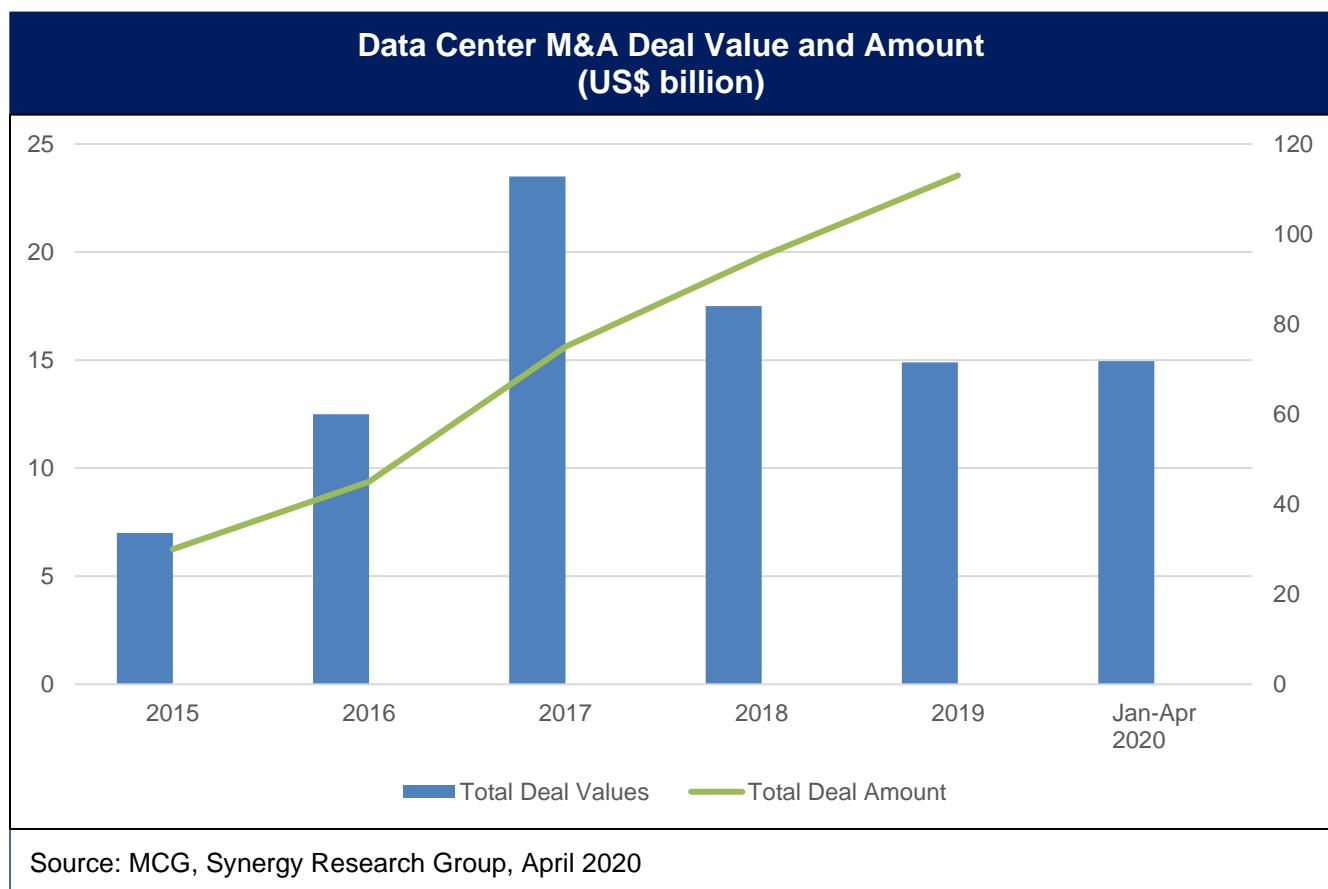
With plenty of megawatts under construction and much planned, rates are expected to continue its downward trend in the United States. The provider competition is driving conditions to be more favorable for the data center's end users.



Global Investment and Consolidations

Despite the COVID-19 pandemic, the value of data center-related M&A deals that closed in the first sixteen weeks of 2020 has already surpassed that of the 2019 total, reflecting investors' confidence in data centers. In the past four years, the trend has been for the number of deals to increase sharply, while in the last two years the aggregate value dropped off due to a relative lack of mega-deals being closed, according to data from Synergy Research Group. This situation has reversed in the first months of 2020, largely due to the US\$8.4 billion acquisition of Interxion by Digital Realty, which is the largest ever data center transaction. Two other billion-dollar-plus deals have closed so far this year as well as two that were valued at over US\$500 million.

So far, Synergy Research Group has identified 28 data center-oriented M&A deals that closed in 2020. Since the beginning of 2015, the research group said it has identified 388 closed deals with an aggregated value of US\$90 billion. Over the period, the aggregated deal value has been split equally between public companies and private equity buyers, which have accounted for 57% of the total deal volume.



Regardless of COVID-19, investment activities in the industry, in general, are driven by a few partial-interest trades and select operator-leased Powered Shell data centers.

Select transactions in H2 2019 and H1 2020 include:

Select Data Center Transactions ⁽¹⁾ (H2 2019 & H1 2020)						
Deal Type	Acquirer/Buyer	Target/Seller	Market	Deal Amount	Deal Date	Pct. Acquired
Acquisition	Digital Realty	Interxion	Europe	\$8.4 B	12-Mar-20	100%
Joint Venture	Mapletree Investments & Mapletree Industrial Trust Management	3 Turn-Key Flex Hyperscale Facilities from Digital Realty	Europe	\$811 M	Nov-19	80%
Acquisition	Equinix	13 Bell Data Center Sites from BEC Inc.	Canada	\$750 M	1-Jun-20*	100%
Acquisition	Mapletree Investments & Mapletree Industrial Trust Management	A portfolio of 10 data centers from Digital Realty	N/A	\$557 M	15-Jan-20	100%
Joint Venture	Blackstone Real Estate Income Trust	7 data centers from Corporate Office Properties Trust	U.S.	\$265 M	Jun-19	90%
Acquisition	Landmark Dividend	A 184,000 sq. ft. data center campus in Phoenix, Arizona	U.S.	\$122 M	1-Feb-20	100%
Acquisition	Compass Datacenters	Root Data Center	Canada	\$ 115 M	23-Jul-19	100%
Acquisition	Vantage Data Centers	Next Generation Data	Europe	Un-disclosed	7-Apr-20	100%
Acquisition	Stack Infrastructure	T5 Data Center in Atlanta	U.S.	Un-disclosed	15-Jan-20	100%
Acquisition	Peterson & Company	Tier III data center in Ohio from Stack Infrastructure	U.S.	Un-disclosed	31-Oct-19	100%

⁽¹⁾ Transactions listed in descending order by deal amount; * presents transaction announcement date instead of closing date.

Source: MCG, PitchBook, Data Economy, Yahoo! Finance, 2020

In recent years, a series of large global investors have entered the industry, using acquisitions to create business platforms for the data center industry. The strategy is usually to create a national footprint supported by a back-office support operation, and service offerings to address common customer needs. Examples include:

- Cyxtera and its security-focused colocation network, backed by BC Partners and Longview Asset Management.
- Macquarie Infrastructure Partners and its growing portfolio of data center companies, including Aligned, Netrality, and AirTrunk.
- STACK Infrastructure, created by IPI Data Center Partners.
- Evoke Data Center Solutions, a platform play from Brookfield Infrastructure Partners.

- EdgeCore Internet Real Estate, a wholesale data center platform backed by Singapore sovereign wealth fund GIC.

Furthermore, KKR & Co. Inc. is setting aside US\$1 billion from its third global infrastructure fund to invest in a new data center venture in Europe. The private equity firm will team up with data center industry veteran Franek Sodzawiczny to form Global Technical Realty, an entity that will build data centers for large European technology companies. KKR expects to further inject US\$2.5 billion, including debt financing, into GTR over the coming years.

KKR's move is the latest in a string of upcoming investments across the global data center industry, following earlier commitments from Alphabet Inc. unit Google LLC in the U.S. and Equinix Inc. in Japan.

COVID-19 IMPACT

Economic disruptions are times of both peril and opportunity. This is certainly true of the COVID-19 pandemic, which is altering demand for data centers, as well as the availability of capital and the competitive landscape.

The pandemic of 2020 has accelerated some activity. Leading players have raced to close deals and raise capital amid the economic chaos from lockdowns. One provider slashed debt with a quick trip through bankruptcy.

It is known from the industry's previous economic dislocations – the dot-com bust and the 2008 financial crisis – that the strongest data center players adapt and develop new strategies. The nuclear winter of 2001-2003 reformatted the competitive landscape, wiping out many incumbents and seeding future giants, while the 2008-2009 downturn saw an acceleration of new business models, as the wholesale data suite became the building block for the enterprise market, as corporations sought to conserve capital by migrating IT infrastructure to colocation and cloud platforms.

In essence, financial strength and patient capital provide a distinct advantage in this environment. Besides, the data center sector will likely be a beneficiary of the shift to a socially distant, contactless economy. Infrastructure funds with deep pockets have been active investors in digital infrastructure. Merger activity is likely to continue, with deals driven by both strategy and opportunity.

What is more, COVID-19 presents opportunity amid chaos for the data center industry. The data center industry of today is more mature, with a tenant base dominated by huge tech companies rather than startups. However, the competitive playing field is dynamic, and the barrier to entry and growth is lower than ever before. Capital is dear and markets are spooked, particularly in commercial real estate. Digital infrastructure is capital-intensive, so the ability to line up funding will be a key differentiator. That financing could be traditional debt or equity, but will also include transactions that monetize existing assets, such as securitized debt offerings and joint ventures.

Leading data center players have moved quickly to lock down deals to fund strategic initiatives or reduce debt. These include:

- Equinix announced issuance of US\$1.5 billion of common stock in May 2020, alongside its US\$1 billion joint venture partnership with Singapore sovereign wealth fund GIC to build hyperscale data centers in Japan.
- Developer Sabey Data Centers arranged US\$800 million in funding in April 2020, through securitized notes to arrange low-cost capital for continued expansion of its data center campuses in the U.S.

- Regional data center provider TierPoint closed US\$320 million equity investment in April 2020 from three global infrastructure funds – Argo Infrastructure Partners, Wafra, and Macquarie Capital Principal Finance, as well as its existing investor group.
- CoreSite issued US\$150 million in senior notes in a private placement closed in June 2020, which allows the company to refinance existing debt and fund future development projects.
- Aligned expanded its existing credit line to a total of US\$575 million in May 2020 to support expansion to meet the continuous and consistently strong customer demand for adaptive infrastructure solutions.

Several other providers acquired property and facilities to expand their geographic reach (refer to the recent transaction table in the above “Industry Trends – Commercial Trends” section).

Meanwhile, data center provider INAP addressed its debt challenges with a quick trip through Chapter 11 bankruptcy, completing a prepackaged restructuring in just seven weeks to strengthen its bottom line.

In essence, COVID-19 has dramatically compressed the digital transformation that was thought to be a multi-year evolution and in turn, increased the demand for data center a lot. Meanwhile, the COVID-19 pandemic will drive innovation in data center operations, forcing companies to embrace automation to manage some duties that currently rely on close human interaction. Software and robotics will play larger roles in aspects of operations, as contactless, “lights out” strategies gain new urgency in maintaining existing mission-critical facilities and building new ones.

GROWTH PROSPECTS

According to Synergy Research Group, the coronavirus pandemic will not affect IT spending in hyperscale data centers, as the world's leading Capex spenders—including Amazon, Google, and Facebook—will continue to spend billions on data centers in 2020. Hyperscale Capex spending on data centers reached over US\$120 billion in 2019.

Before COVID-19, the worldwide public cloud services market is forecasted to grow 17% in 2020 to a total of US\$266.4 billion, which is up from US\$227.8 billion in 2019. The global data center market size in total is poised to grow by US\$284.44 billion during 2019-2023, progressing at a CAGR of more than 17% according to leading global technology research company Technavio.

Given the impact of COVID-19, it is expected that more companies will have the need for data centers with cloud services, driving up the demand. However, given the current drop in corporate profitability, it is unclear how many more companies will have the capital to spend on IT infrastructure and the data centers.

While cloud services are expected to be more popular in the coming year, the global retail and wholesale market is also expected to grow considerably across all regions, especially in the U.S. where new data center capacity in the primary U.S. markets is set to increase total inventory by 17.3% this year, accelerating competition among providers. Regionally, a lot of attention is being paid to South East Asia this year, when the market is predicted to grow to revenues of US\$11.8 billion, up from US\$6.28 billion in 2016, according to Technavio.

Several data center projects are announced for 2020, including Turkcell's US\$350.5 million hub in Turkey, NTT's data center in Indonesia, STT's Thailand facility, CyrusOne's Ireland data center and Oracle's new 20 cloud regions.

Growth Drivers

Increase Data Traffic

Increasing data traffic arising from a multitude of devices is driving the growth of data centers. This also implies the need for secured connectivity for critical data and confidential information. According to Cisco, global cloud data center traffic is likely to reach 20.6 zettabytes ("ZB") per year by 2021, up from 6.0ZB per year in 2016. They expect to see 628 hyperscale data centers globally in 2021, compared to 338 in 2016.

Improvement in Connectivity

Contemporarily, enterprise users are focusing on strategies that integrate cloud computing into traditional colocation data services and allow customers to take advantage of the flexibility and convenience provided by the cloud access as well as the efficiency and affordability offered by physical data centers. With the impact of COVID-19, such strategies focused on accessibility and connectivity will become even more popular as a trend in 2020 considering the benefits provided. Low-latency solutions and flexibility remain a staple in the industry as they enable the

integration of current technologies to maximize performance. Providers likely will offer diverse options that enable an enterprise to establish a streamlined, secure, and flexible environment.

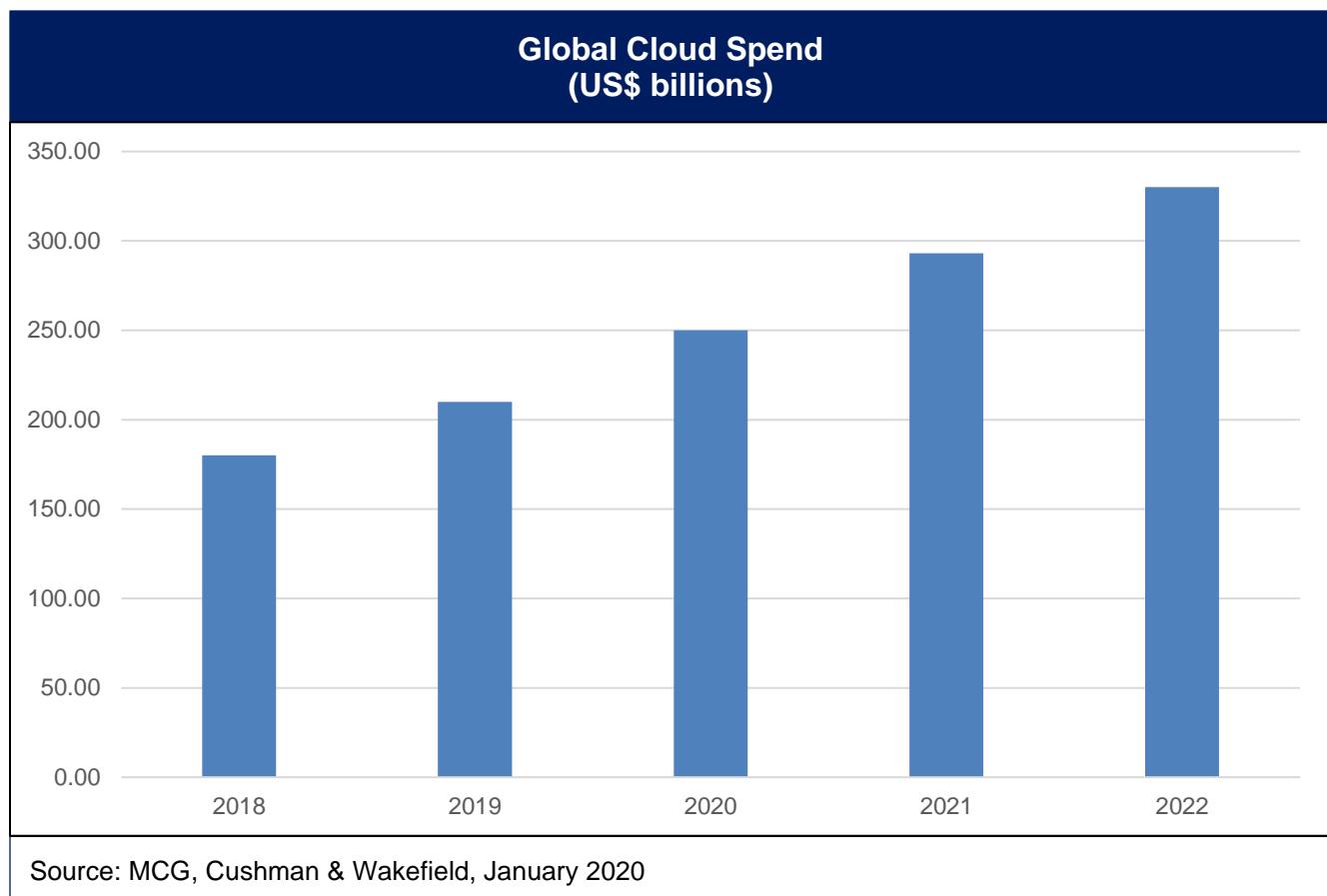
In addition to agility and flexibility, end-users are focusing on scalability and connectivity as they evaluate 5G and edge deployments in their portfolios. The integration of these new technologies should have a meaningful impact over the next few years, but for now, implementation remains slow.

Increase Cloud Demand

Cloud demand continues to dominate the global markets. In the US, Northern Virginia and Northern California recorded the largest share of cloud-driven absorption. They also represent the largest increases year-over-year. In 2018, only 42% of absorption was cloud driven in Northern Virginia; it now stands at 83%. Likewise, the share of cloud absorption increased from 50% to 80% in Northern California year-over-year. There will be more opportunities to work with cloud providers in Reno who want to be close to their customers who have existing space within a colocation. This has to do with the new Superloop, lower power cost and their 5-millisecond latency to the Bay Area.

As for European market, 201MW of absorption was recorded in the FLAP markets (Frankfurt, London, Amsterdam, Paris) during 2019, a new European record. 2019's exceptional performance was largely down to Frankfurt securing 90MW, which is higher than the combined absorption of all four markets in any year prior to the new-norm in 2016. The extent of Frankfurt's performance is underlined by the fact that the market's 2019 absorption was 52MW above its average for the three previous years. This exemplifies the binary nature of absorption.

The hyperscale companies have been driving the demand in Europe for four years now and there is now a sense of consistency in their activity. Consequently, service providers are making major investment decisions based on this customer group.



Furthermore, cloud as a whole continues to strengthen its grip on European markets. The sector was again responsible for 79% of total absorption in the FLAP markets. The major effect was felt in Frankfurt, which saw cloud increase its share of annual absorption in the city by nearly 20 percentage-points in 2019, to 85%.

In Q4 2019 alone, FLAP market absorption was 65MW, the second highest quarterly figure on record. Frankfurt and London were responsible for a combined 82% of this figure as the hyperscalers continued to be active in both markets simultaneously.

Meanwhile, the Asia Pacific market is expected to grow at an expected rate of over 12% in the next 5 years. Much of the demand comes from global cloud providers, social media platforms, media content and video streaming, and e-commerce platforms as internet users in Asia are increasing at a speed of 10% year on year. Last but not least, the demand in Latin American and African markets are also growing and shows strong growth potentials.

North American Markets Overview



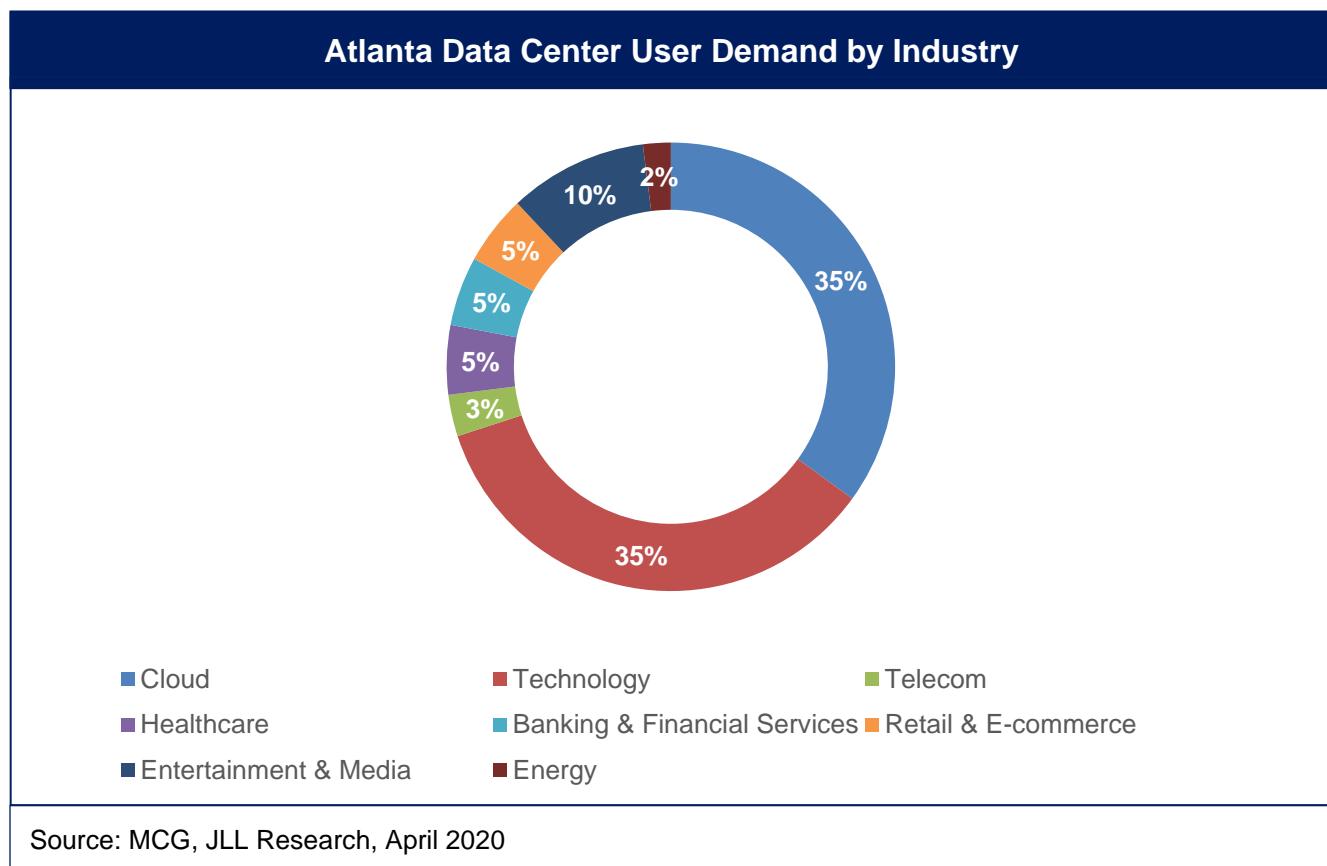
INTRODUCTION

The North American data centers market is further segmented in regions in the U.S. and Canada. Market by market overview is provided for the following 16 regional markets in the North America:

ATLANTA

In Atlanta, supply continued to increase in the second half of 2019 as Switch delivers new colocation product. QTS is under construction for Phase I of its mega campus expansion build of 72 MW; T5 is clearing its site starting a 13 MW build. In the meantime, the majority of the demand was squarely driven by expansions and consolidations of hyperscale and enterprise users. QTS signed a 12 MW hyperscale deal elevating absorption numbers to a record high.

Atlanta has been “rediscovered” as a viable and key data center location. After being early to the data center game in the 1990’s with enterprise data centers, Atlanta was moderately active with the advent of the colocation industry. Most recently Atlanta is thriving as a healthy and more mature data center market as new colocation operators steadily deliver new product.



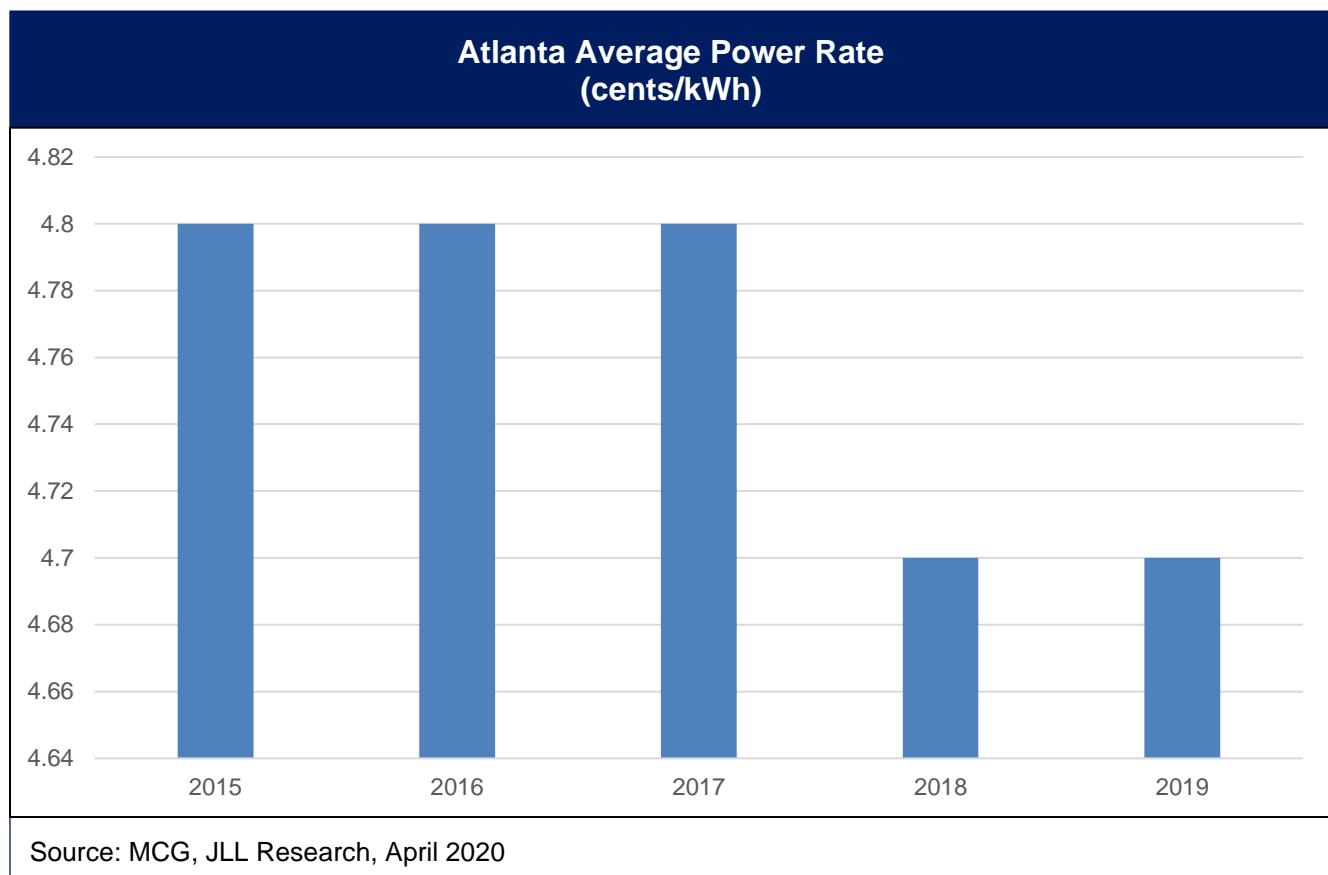
Outlook

for Users

- New options for efficient, purpose-built colocation product
- Influx of service providers brings favorable terms
- Increased supply is creating a competitive rate environment

for Providers

- Demand to remain steady throughout 2020
- Many colocation operators positioned to expand
- Enterprise users continue to migrate out of their owned data centers



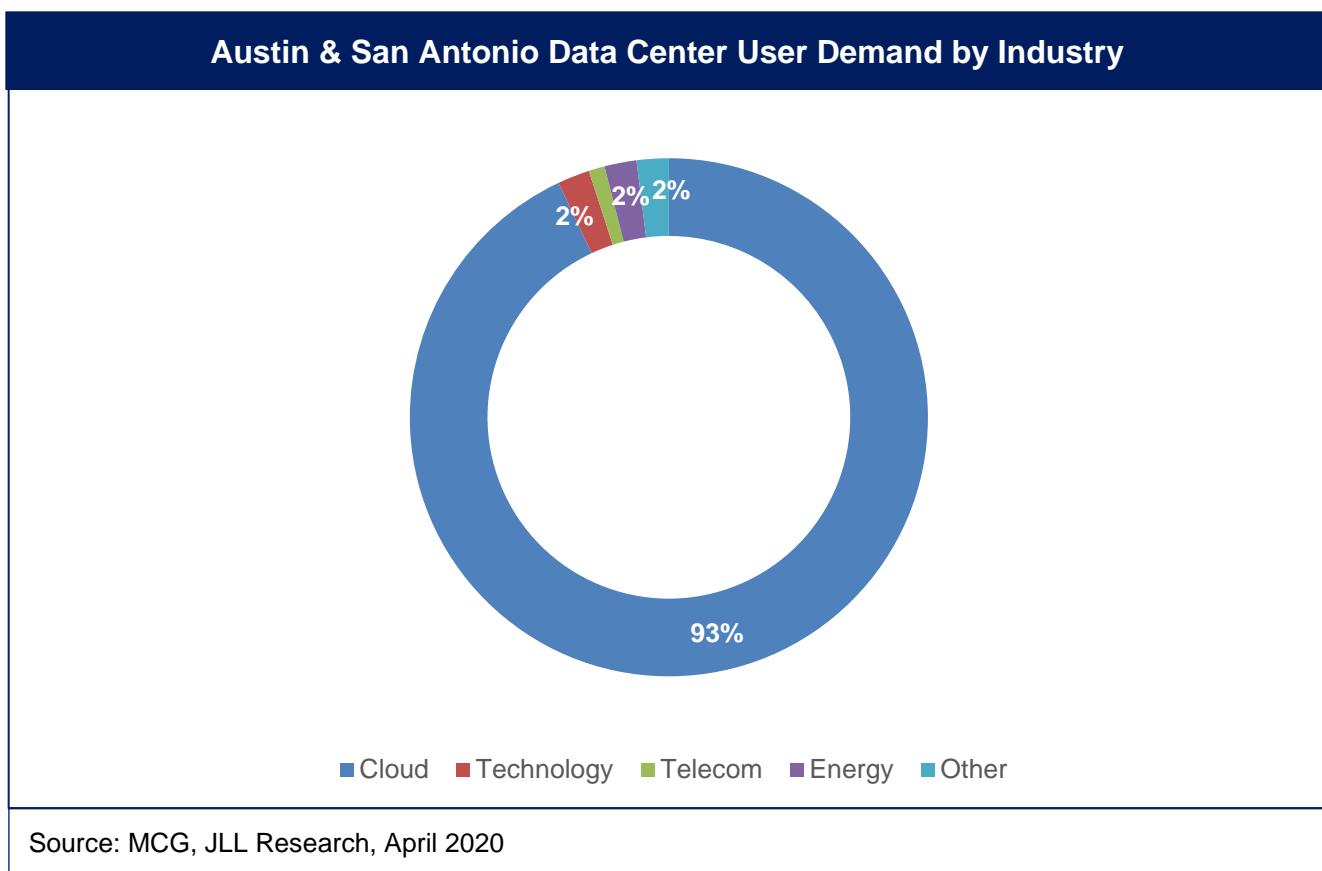
Key Competitive Advantages

- **Low Land Price:** A national hub for many industries, Atlanta has abundant land at an affordable price.
- **High Fiber Connectivity:** Atlanta is on the cusp of first-tier status, with existing infrastructure to assist in forward movement.
- **Strong Incentives:** Georgia incentives launched in 2018 to great fanfare thanks to a strong push from the data center industry.

AUSTIN & SAN ANTONIO

Supply in both Austin and San Antonio continues to be tight, with few providers with available capacity today. Large anchor tenants are driving providers to deliver new supply to accommodate. H5 entered the San Antonio market with the acquisition of 100 Taylor Street, and Lowe's San Antonio data center is currently being marketed for sale. A balance of large enterprise and cloud provider activity represents the bulk of demand in Austin and San Antonio overall. Several multi-megawatt cloud and enterprise deals are actively in the market.

With demand driven by large anchor tenants, providers in the Austin & San Antonio markets, while possessing healthy land positions, are not speculatively building turnkey space. Market supply constraints may potentially yield increased rental rates in the future. Expansive tech sector growth in Austin will drive new demand.



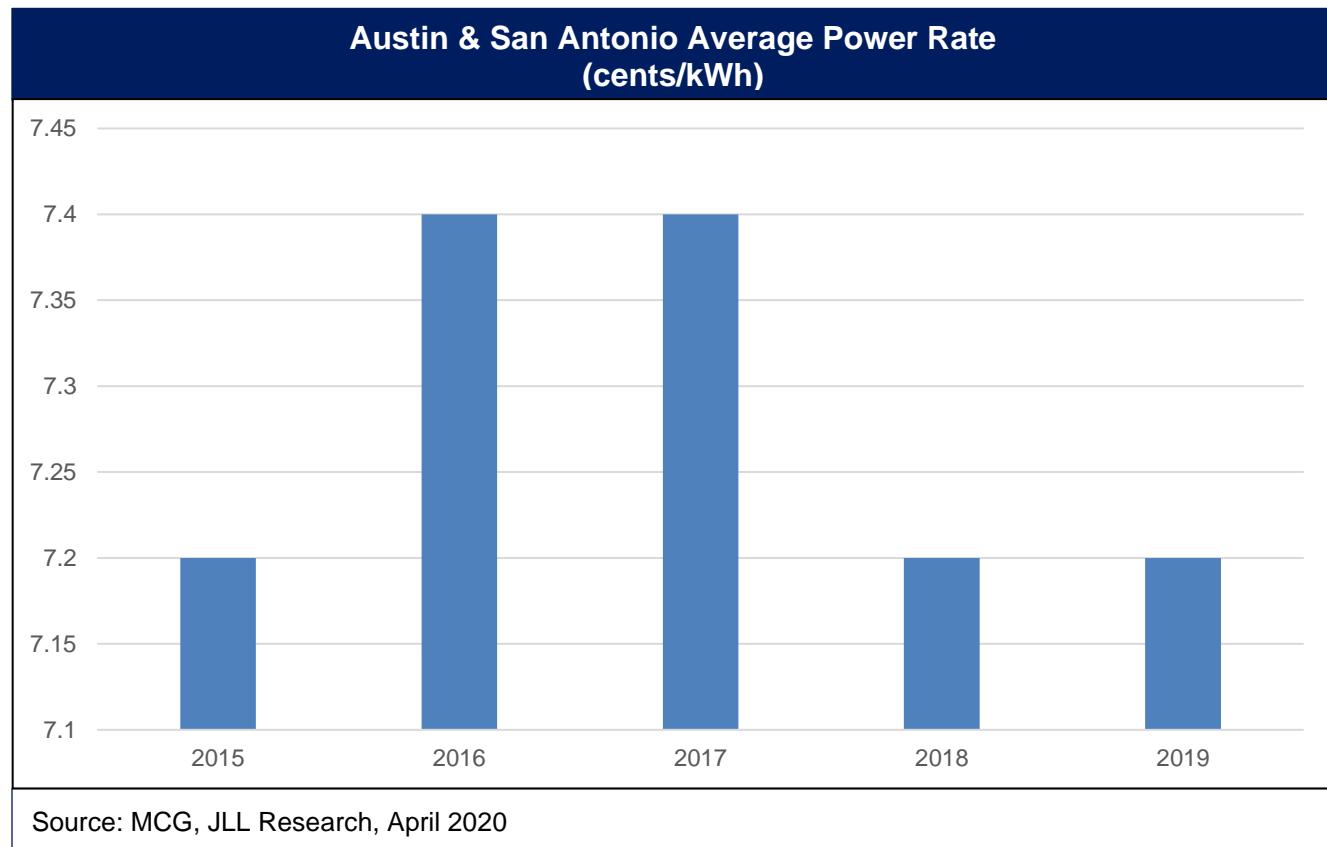
Outlook

for Users

- Lack of turnkey space requires longer-term capacity planning
- Consistent absorption of limited supply may drive rental rate increases
- Growth in tech sector employment may yield enhanced labor pool

for Providers

- Lack of turnkey space would suggest an opportunity for a provider to build on spec
- Upfront utility planning is key to timely delivery of new supply
- Scalable space is critical to meeting current and future hyperscale demand



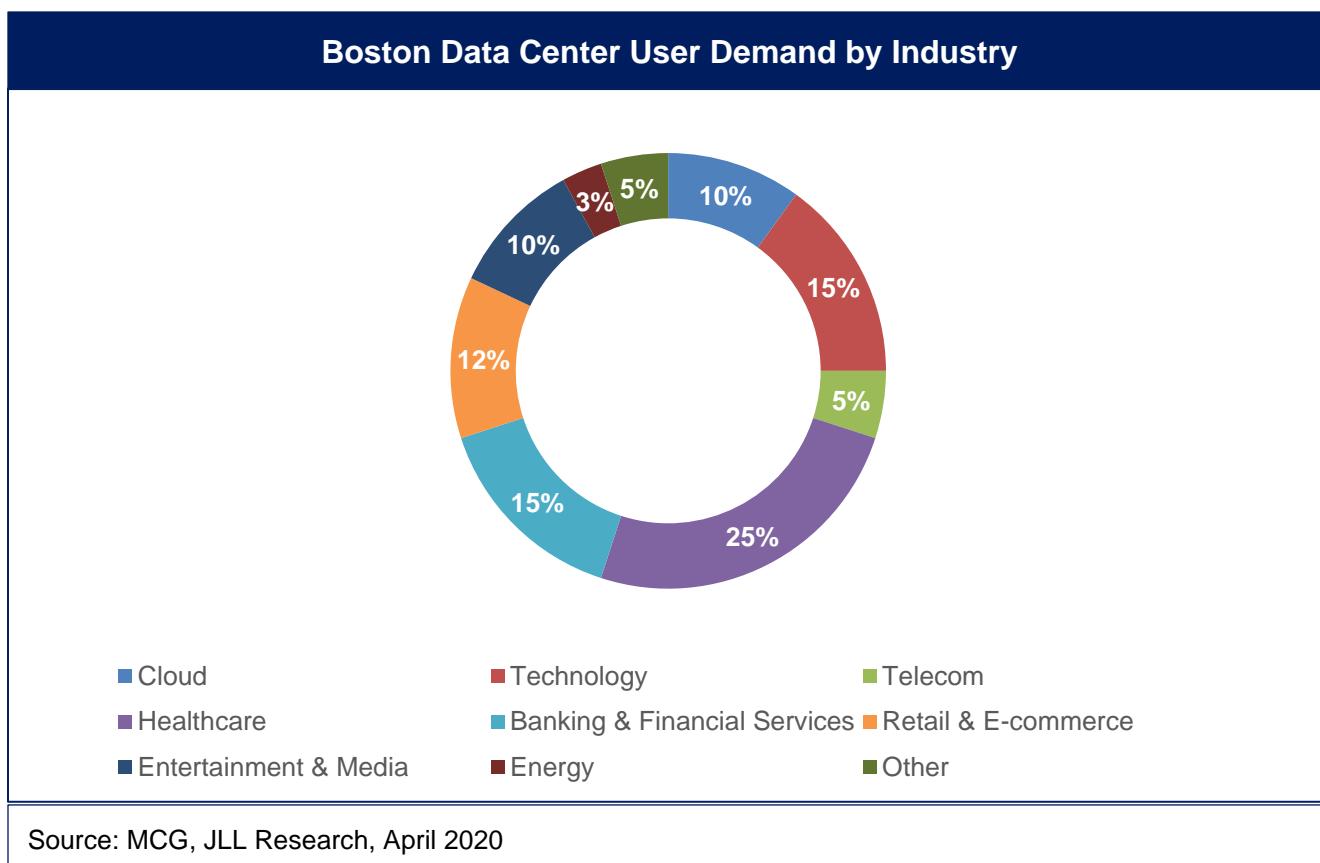
Key competitive advantages

- **High Cloud Availability:** Over 90% of data center users in the region are using it for cloud services.
- **High Fiber Connectivity:** The existing infrastructure in Austin is of high quality and can support further growth of the industry in the region.

BOSTON

In Boston, market supply remains healthy with next generation vacancy at 70 Innerbelt Rd (CoreSite), One Summer (Markley), Digital Realty in Needham, Cyxtera in Waltham, and Tierpoint in Marlboro. Meanwhile, demand has picked up particularly amongst enterprise users as commercial rents have risen, making it less desirable to maintain data onsite in their offices. Demand is also driven by approaching turn down of TierPoint in Charlestown and Equinix in Waltham.

Cloud migration continues across all classes of end users but slowed somewhat as enterprise customers began to show caution about new projects and skepticism over actual savings from cloud migration.



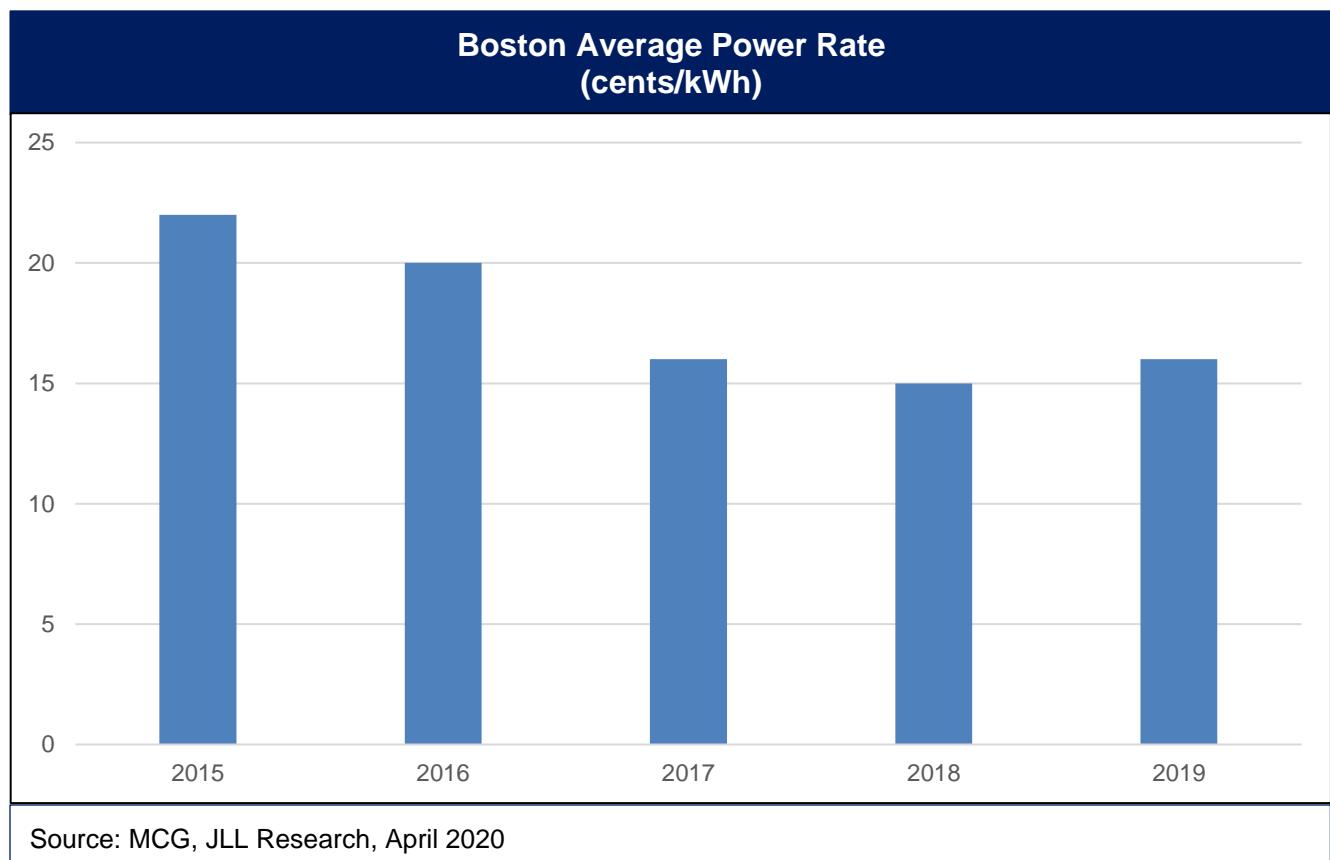
Outlook

for Users

- Prices are reaching a bottom point
- Next generation product offers better energy efficiency and lower cost
- There continues to be attractive out-of-market options

for Providers

- Prices will stabilize
- Next generation space will be more attractive to customers
- Need to renew efforts to reduce electricity cost and taxes



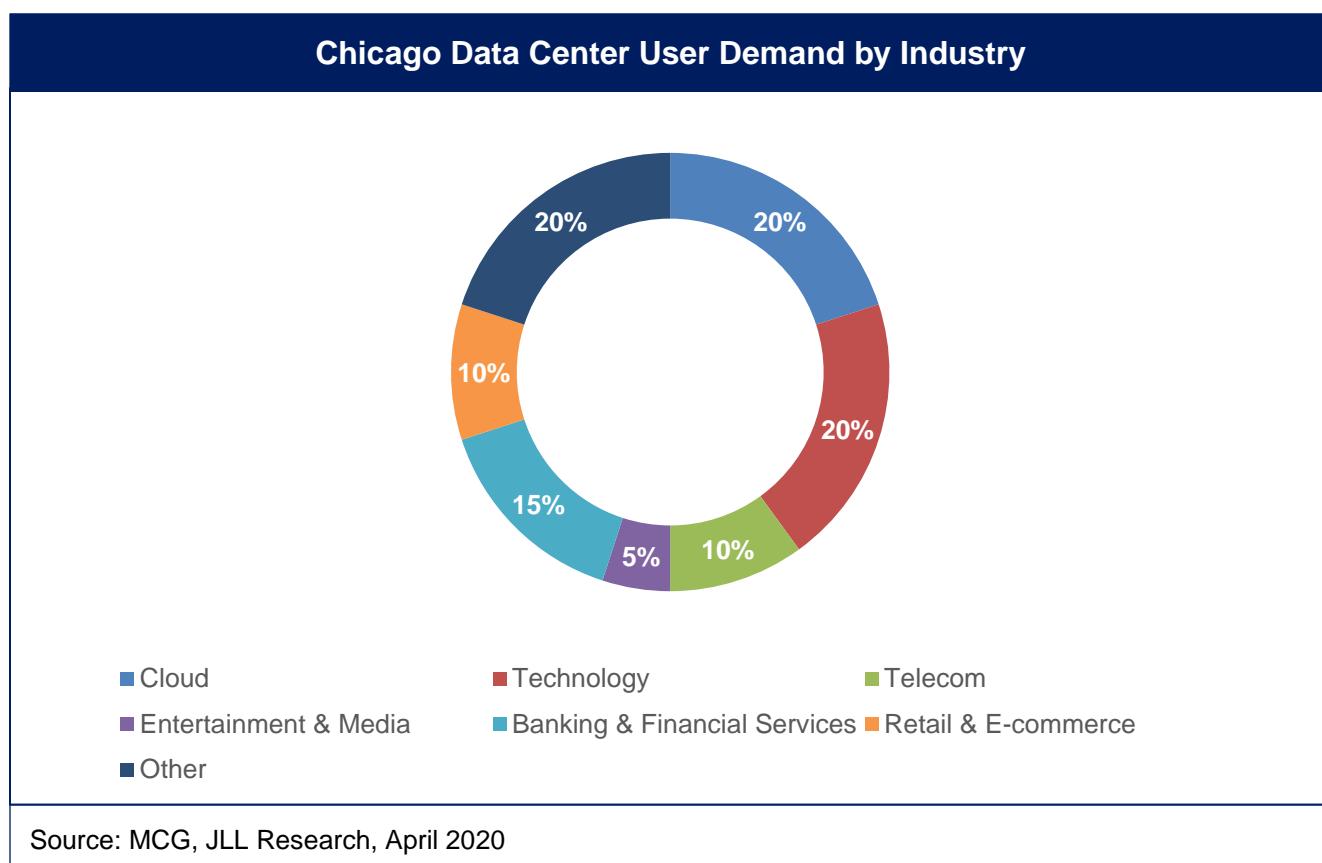
Key competitive advantages

- **Low Taxes:** Boston's low taxes offset the high power costs in-market.

CHICAGO

Supply remained stagnant during 2019 with limited new capacity being delivered without a lease in place. Operators who previously had projects on hold subsequently moved forward and expect to deliver capacity in 2020 including RagingWire, Stream and Digital Cross Roads. In the meantime, Chicago saw a reduction in colocation demand by major cloud companies. However, the market continued to see steady organic growth of <1 MW users across all submarkets. 47% of the absorption can be attributed to two transactions, one being a retail colocation provider who will release space to the market.

Absorption slowed in the first half of 2019 considerably, however it picked back up in the second half. It is anticipated that an uptick in activity will occur in 2020 due to the recently established Illinois tax incentives and refreshed cloud demand.



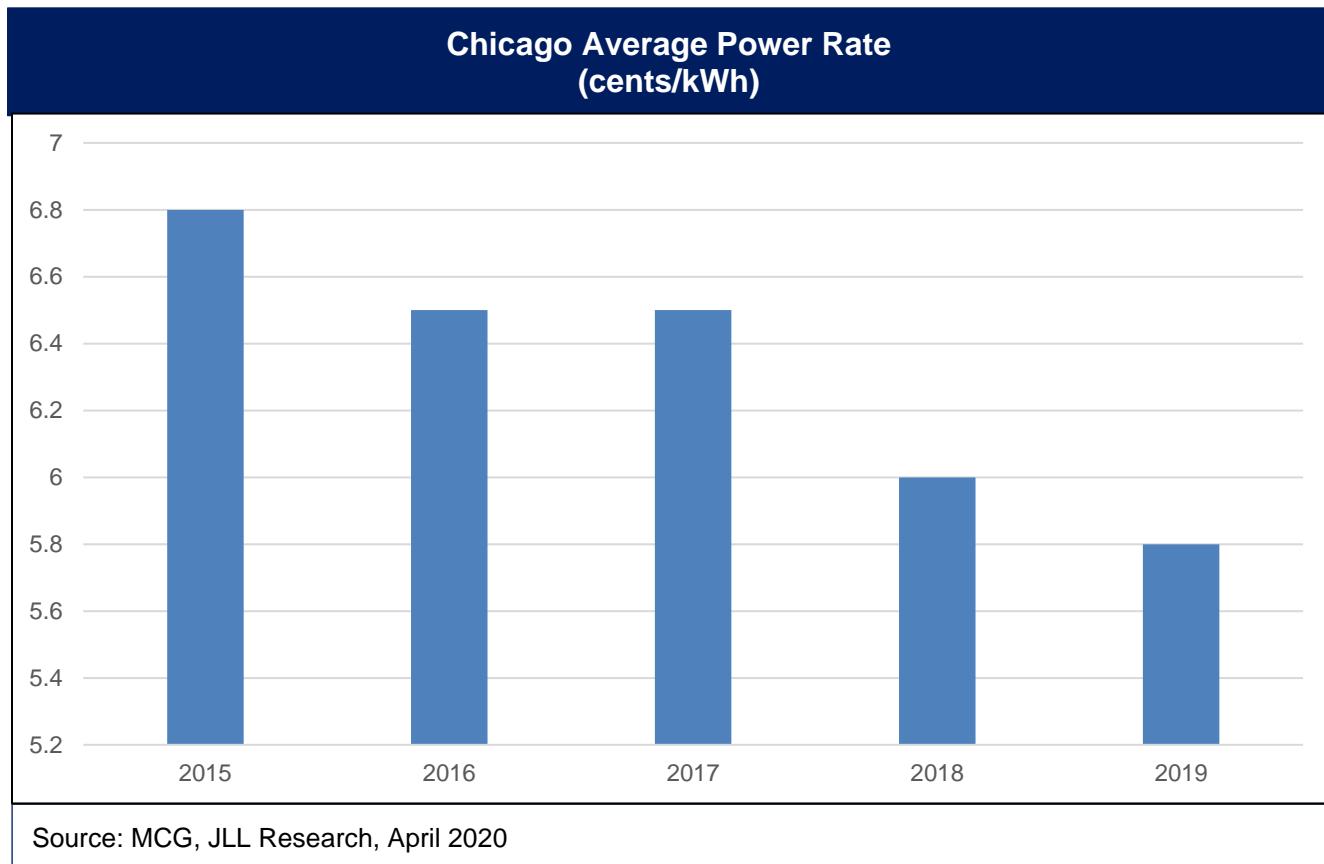
Outlook

for Users

- Reduced demand and vacant capacity have led to rate compression
- Further flexibility in leases established
- Tax incentives make Chicago one of the cheapest markets nationally

for Providers

- Extremely limited land acquisition opportunities in key submarkets
- Continued aggressive deal metrics and pricing on all deal sizes
- Cloud companies looking at building greenfield rather than colocation



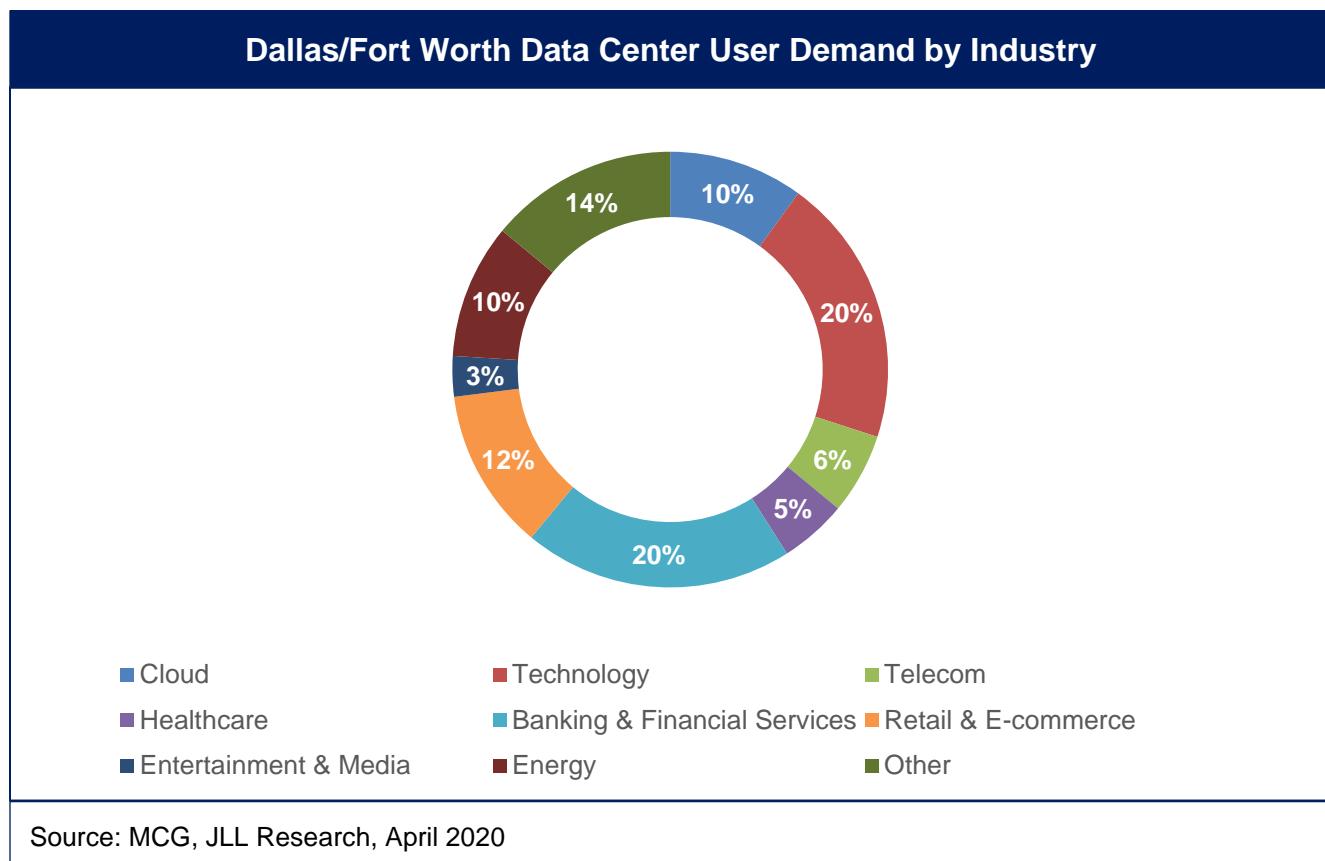
Key competitive advantages

- **High Cloud Availability:** A well-connected business hub with large cloud market and technology in the US.
- **Strong Incentives:** Chicago looks to benefit from a new package launched by the State of Illinois in 2019 for invested amounts of \$250 million and 20 permanent hires.

DALLAS/FORT WORTH

Supply in Dallas/Ft. Worth ("DFW") continues to be robust, with providers/enterprises completing shell construction on new builds in Q1-Q2. Stream is under construction in Garland, and Equinix has begun Phase I of a new, 4-story 40 MW build at INFOMART. Google has broken ground on its campus in nearby Midlothian, and Facebook has finished its last building in Ft. Worth. Though enterprise demand continues to dominate in DFW, large social media players have been quietly absorbing space in the market at scale. Organic growth from existing customer base expansions remains a consistent driver of absorption in the market.

As providers, such as Stream, QTS, CyrusOne, and Digital Realty complete construction on their latest builds, supply in the market remains well-positioned to meet user demand. Absorption by traditional enterprises and major social media players in the market signal opportunity for providers.



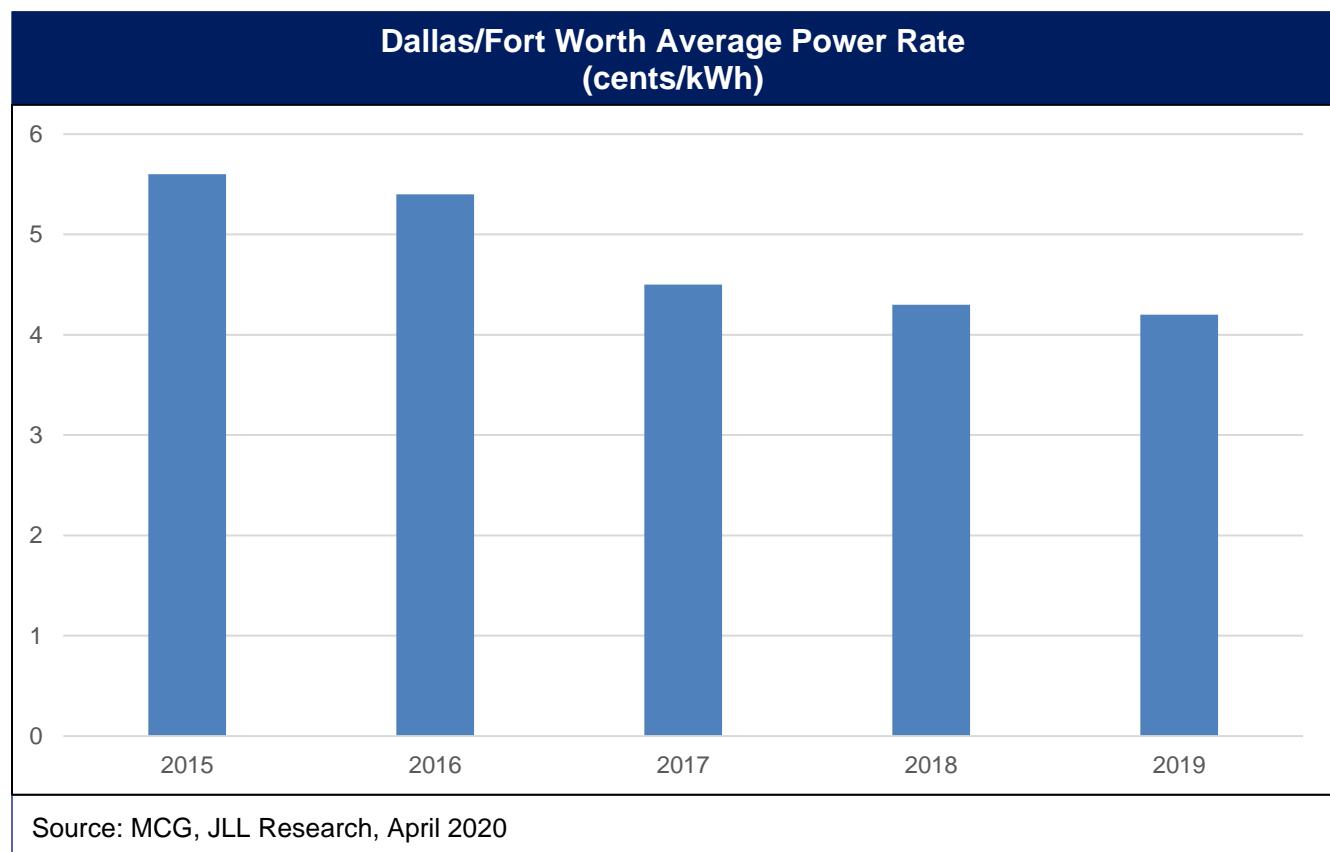
Outlook

for Users

- Attractive rental rates obtainable on expiring colocation contracts
- Users locking in lower rates and more flexible terms
- Extremely competitive rates for new, credit-worthy logos

for Providers

- Organic growth from existing customers feeling expansion
- Users are valuing higher density infrastructure
- Cloud access and services are key differentiator



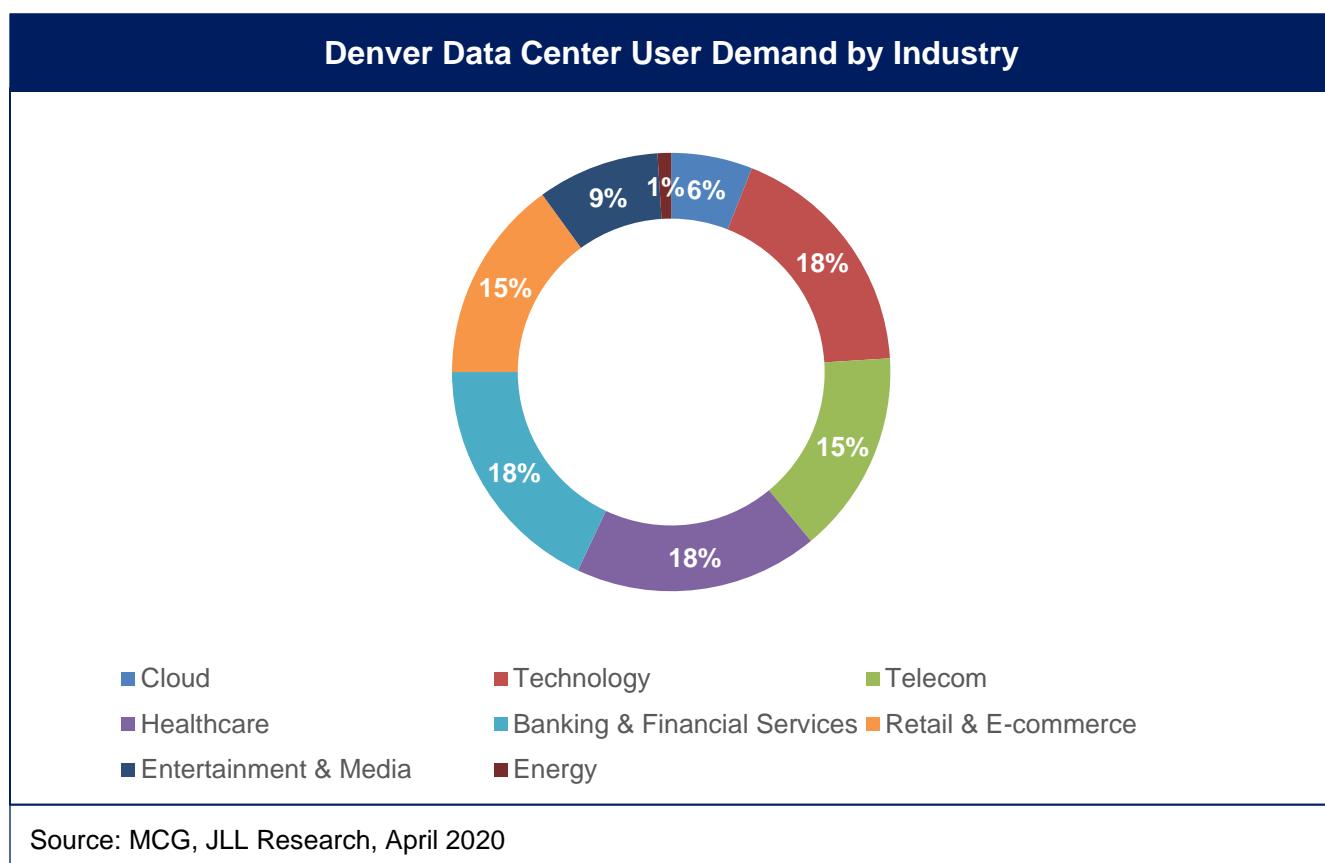
Key competitive advantages

- **Low Environmental Risk:** Dallas has a low risk of having earthquakes, an environmental disaster that is detrimental to data centers.
- **Higher Fiber Connectivity:** Dallas is the geographic midpoint for the United States and a convenient fiber pathway.
- **Low Power Cost:** Power cost below US\$ 6 cents/kWh is lower than most other US cities and is still among the lowest in the world.

DENVER

In Denver, Flexential, followed by Zayo, Iron Mountain, and Cyxtera, currently have the most available space in the market. At the moment, there is no future supply currently under construction. The demand trend in Denver hasn't changed. Most of the demand is coming from smaller retail-sized deals with expansion options for a couple mega-watts. There were no major deals exceeding 1 MW seen in Denver. Most of the customers taking space are looking at 1 to 40 racks.

Denver continues to stay stable and attract retail type customers with little to no deals exceeding 1 MW. Most of the deals have been in the 500kW range. Denver has started to find better ways to incentivize clients to enter their market, such as their new power bill. The bill allows the public utilities to charge economic development rates. Details to be finalized in 2020.



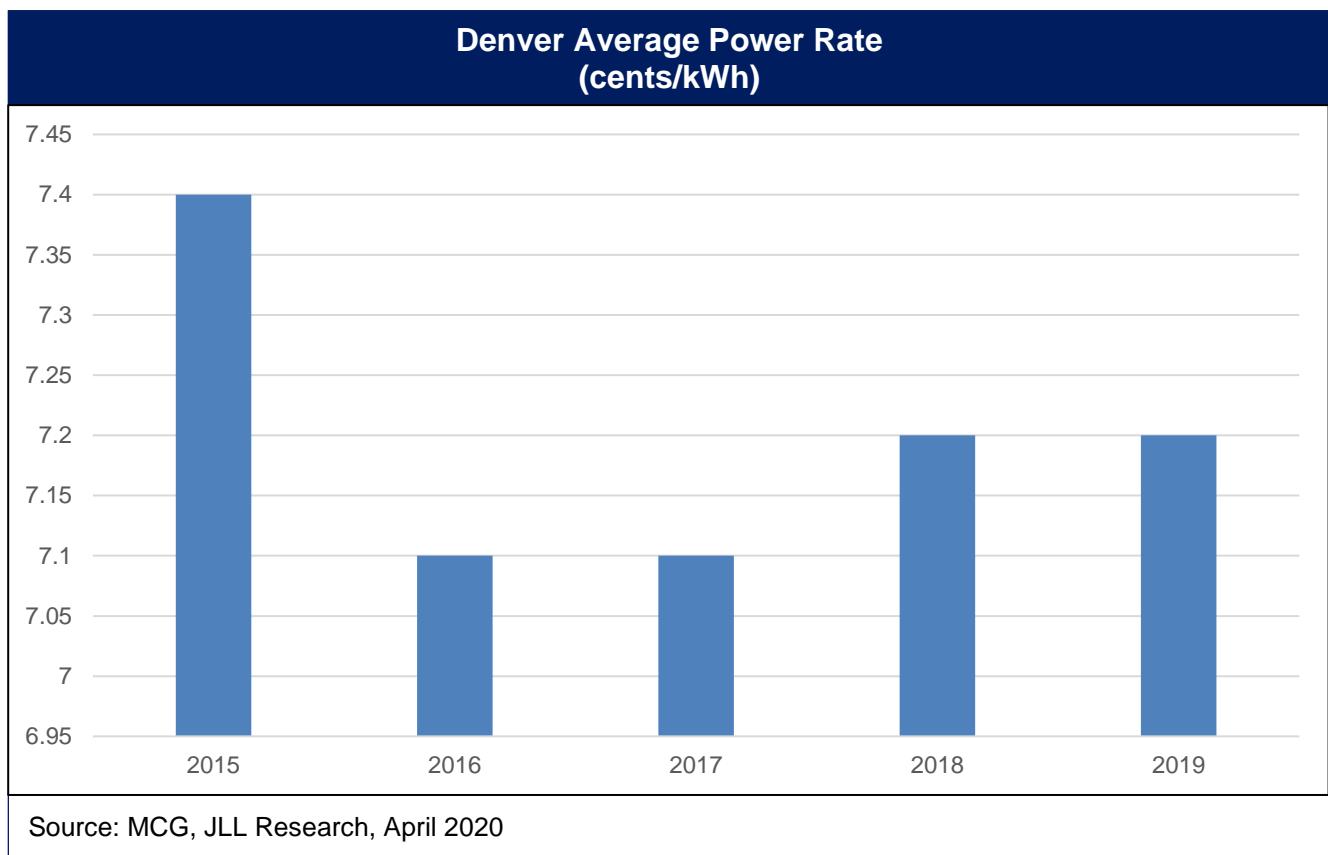
Outlook

for Users

- Continue cloud strategy pressures from the C-Suite
- Colorado continues to push for data center tax incentives

for Providers

- Continue to provide quality managed service offerings to the end users
- Start strategizing to leverage new power bill and lower rates
- Be prepared to deliver space and services within 90-180 days notice to win business



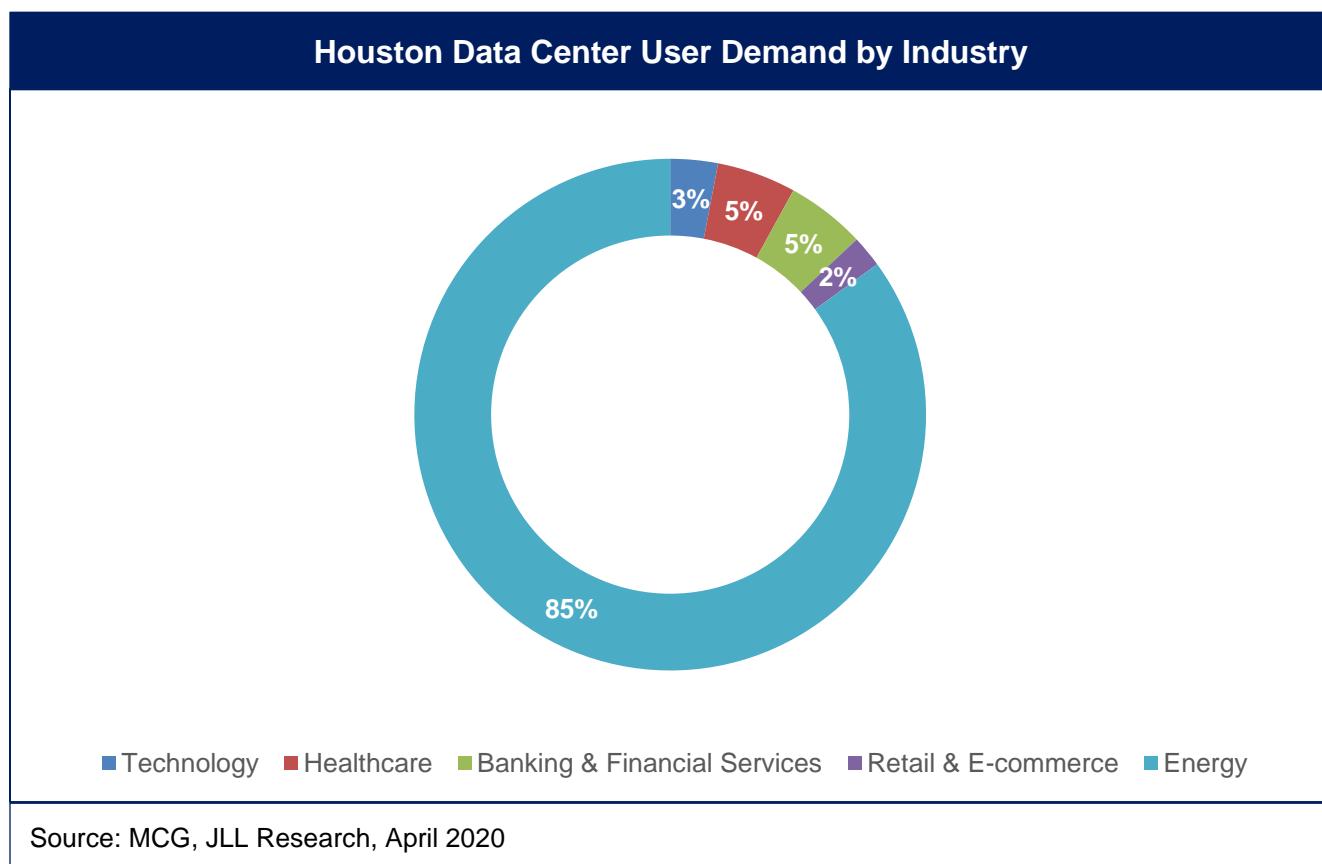
Key competitive advantages

- **Low Land Price:** The hometown of many key data center operators has lower overall land costs than other large markets in the Western U.S.

HOUSTON

Supply has stabilized in Houston, with no new construction delivered in the first or second half of 2019. This trend may not continue in 2020 as two providers have announced modest expansions of inventory. Demand increased slightly but was hampered by some providers experiencing negative absorption. The energy industry historically has driven data center demand in Houston and that has not changed.

The Houston market will improve with little supply coming to the market. If the energy industry improves, there will be a shortage of supply in a short period of time with a stabilization and potential increase in rents.



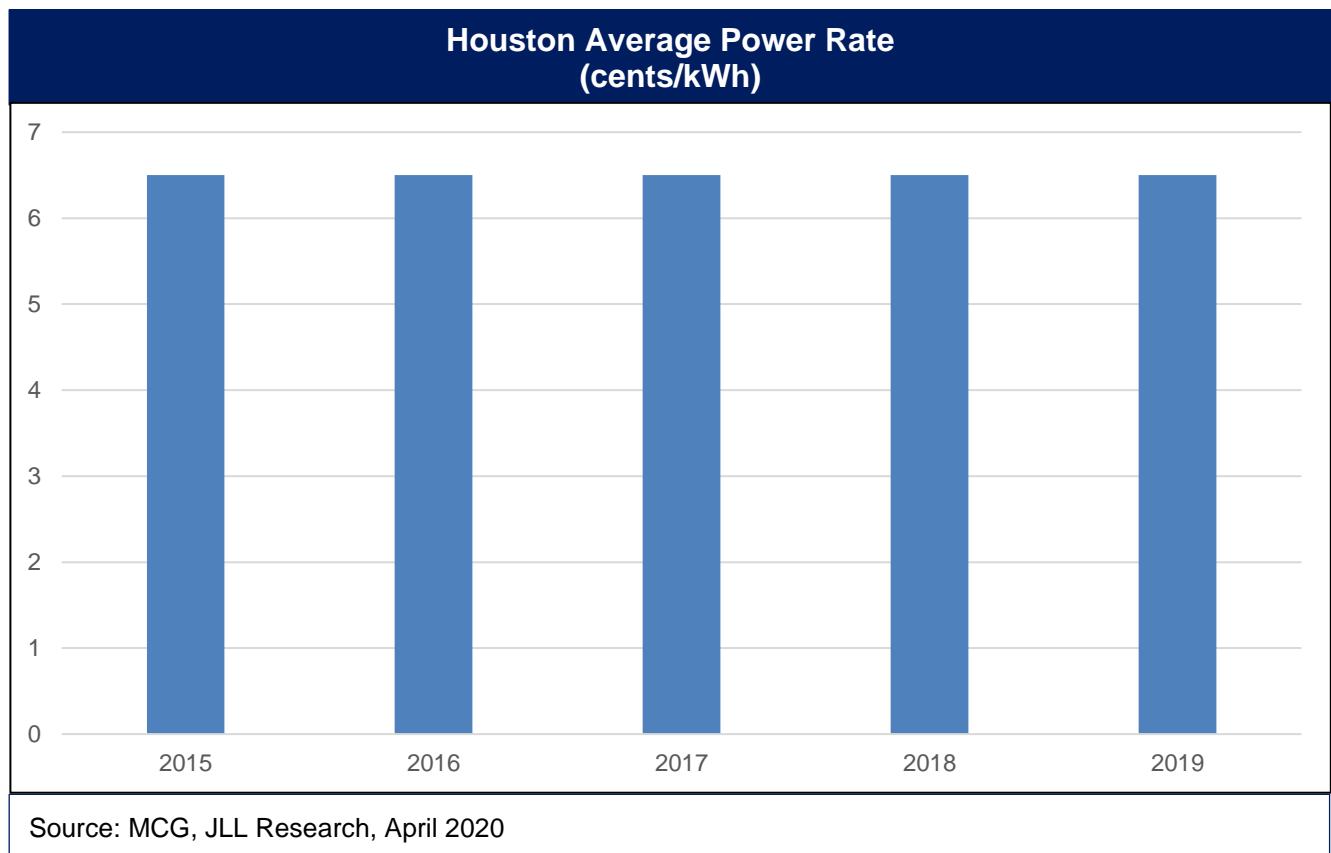
Outlook

for Users

- Lack of new supply will soften price compression
- Quality space available at competitive pricing
- Users leveraging market to renegotiate terms

for Providers

- Providers connecting Houston facilities with their other markets
- Access to cloud providers and services key
- Providers focusing on retaining tenants



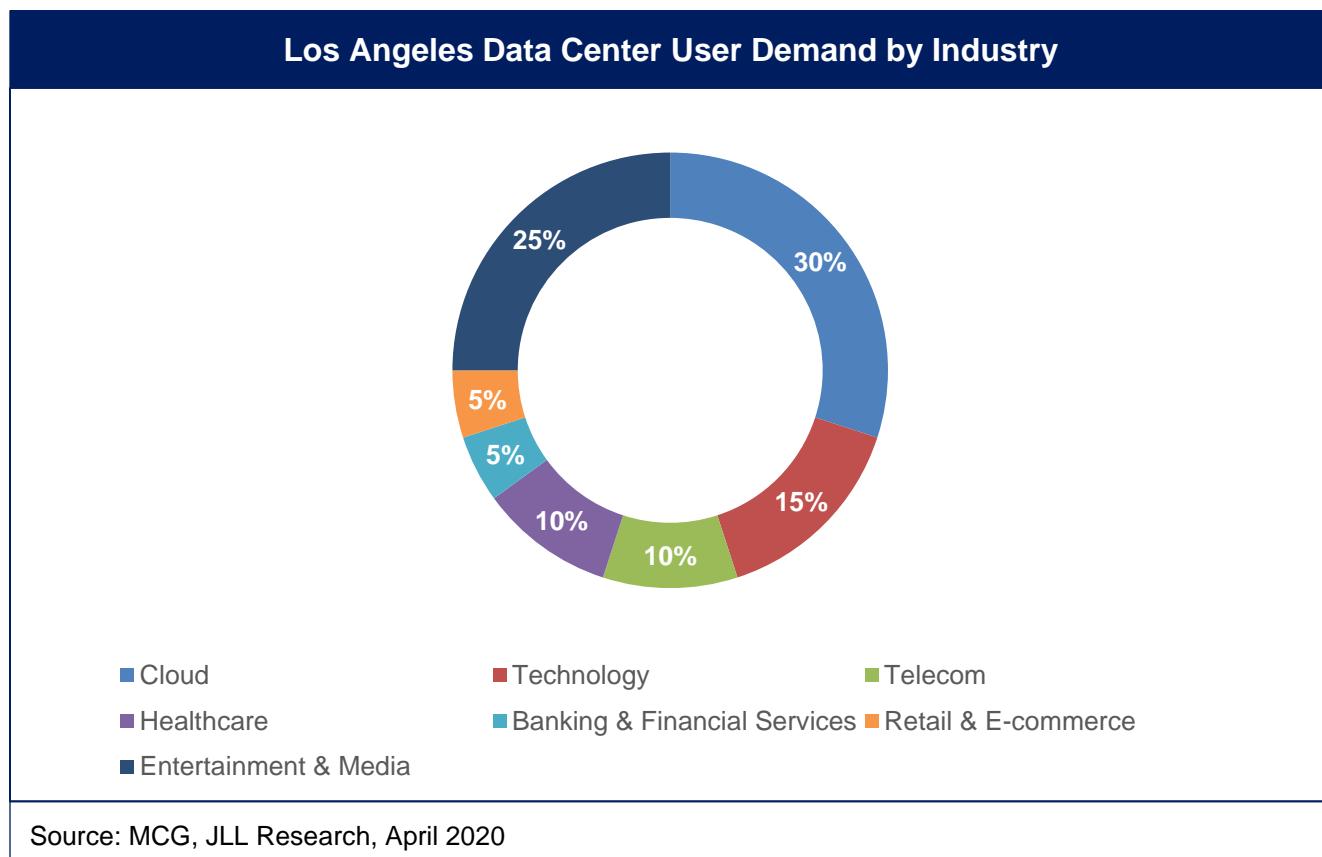
Key competitive advantages

- **Low Power Cost:** Although not as low as Dallas, the power cost of US\$ 6.5 cents/kWh is still considered to be low among the primary markets
- **High Fiber Connectivity:** As a new hub for technology companies, Houston have a strong technology infrastructure.

LOS ANGELES

In Los Angeles, several major cloud providers finalized transactions to further tighten the market, but new construction will soon change this. Overall, the market has remained flat as the market consistently produces small sub-25kW transactions to support local users and new overseas demand, however larger cloud deals will land.

The demand from CSPs continue to be the only positive news in the market.



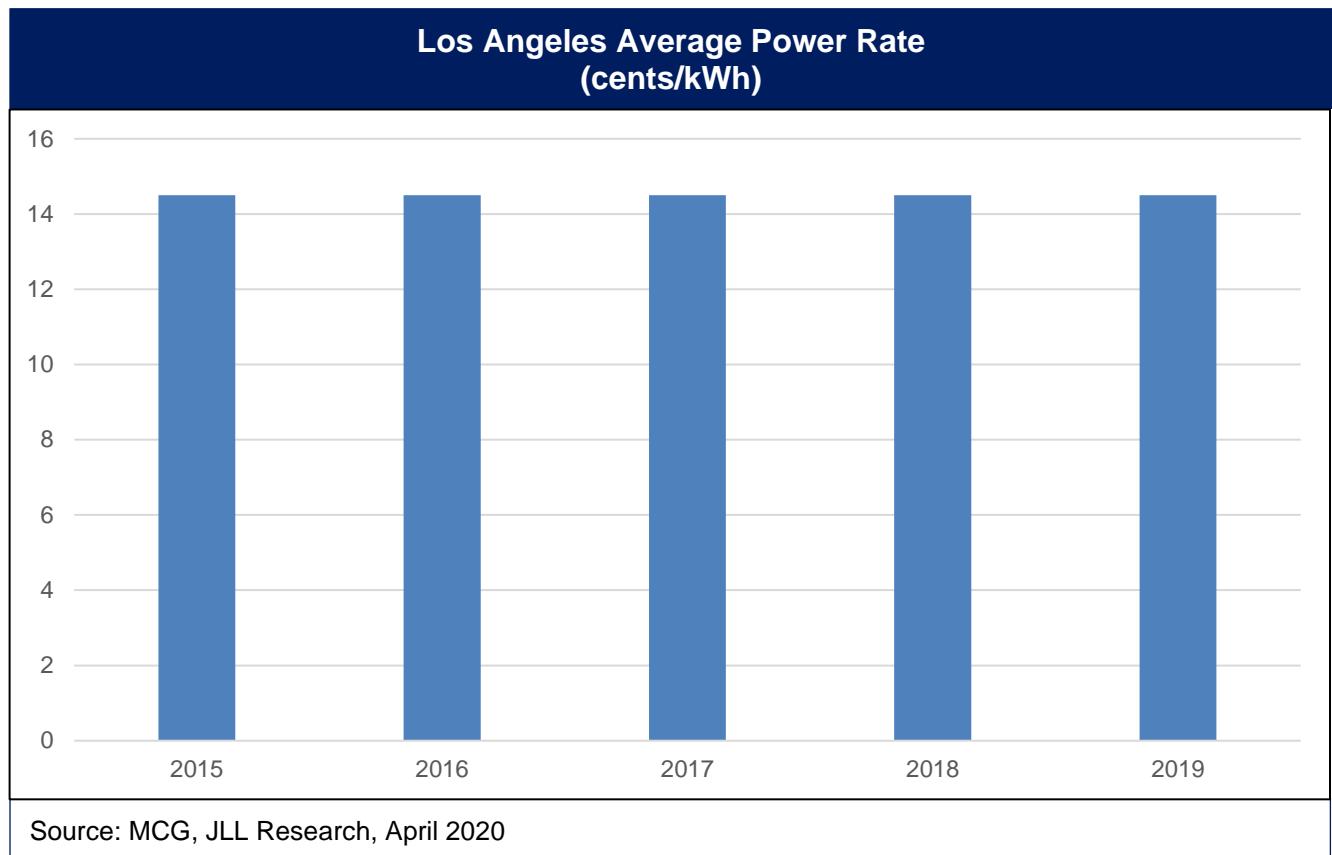
Outlook

for Users

- New inventory to come online
- Continued rate compression amongst colocation providers
- More options in market to further reduce rates

for Providers

- Providers need to upgrade infrastructure
- Expect more efficient environments to combat high energy rates
- Higher return from investments in critical infrastructure from higher level clients



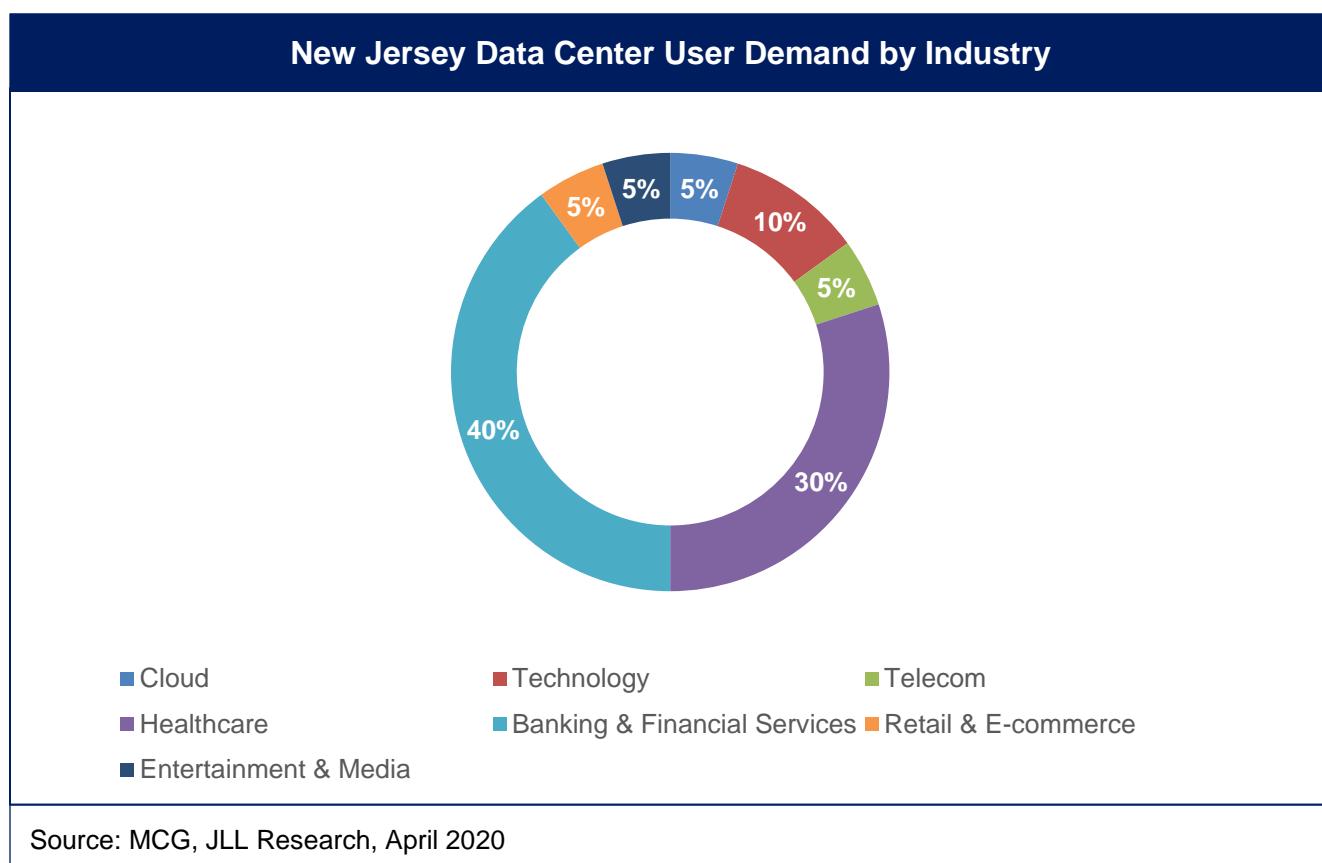
Key competitive advantages

- **Low Vacancy:** This major West Coast hub is in demand but difficult to develop in.
- **High Cloud Availability:** A massive and diverse US coastal market with access to all major providers.
- **High Fiber Connectivity:** Dense fiber and a large, densely packed population with access to many undersea cables.

NEW JERSEY

In New Jersey, Digital Realty, CyrusOne, QTS, CoreSite and Equinix had healthy absorption rates in 2019 in available turnkey space. In 2020, Digital Realty has a new campus in Totowa in development and QTS, CyrusOne and CoreSite are expanding onsite shell space to replenish supply. The New Jersey market had a strong year as financial services continued to lead, with expanded footprints in close proximity to headquarters and local operations. Several enterprise level wholesale deployments ranged from 300 kW- 1.5 MW.

Tenants are requiring flexible contracts. Service and location portability, power expansion and reduction on demand are being offered to attract users to stay locally. More managed services are entering the New Jersey market to support hybrid cloud workloads. Carrier Edge Deployments are surfacing in Northern New Jersey to support carrier's 5G network deployments.



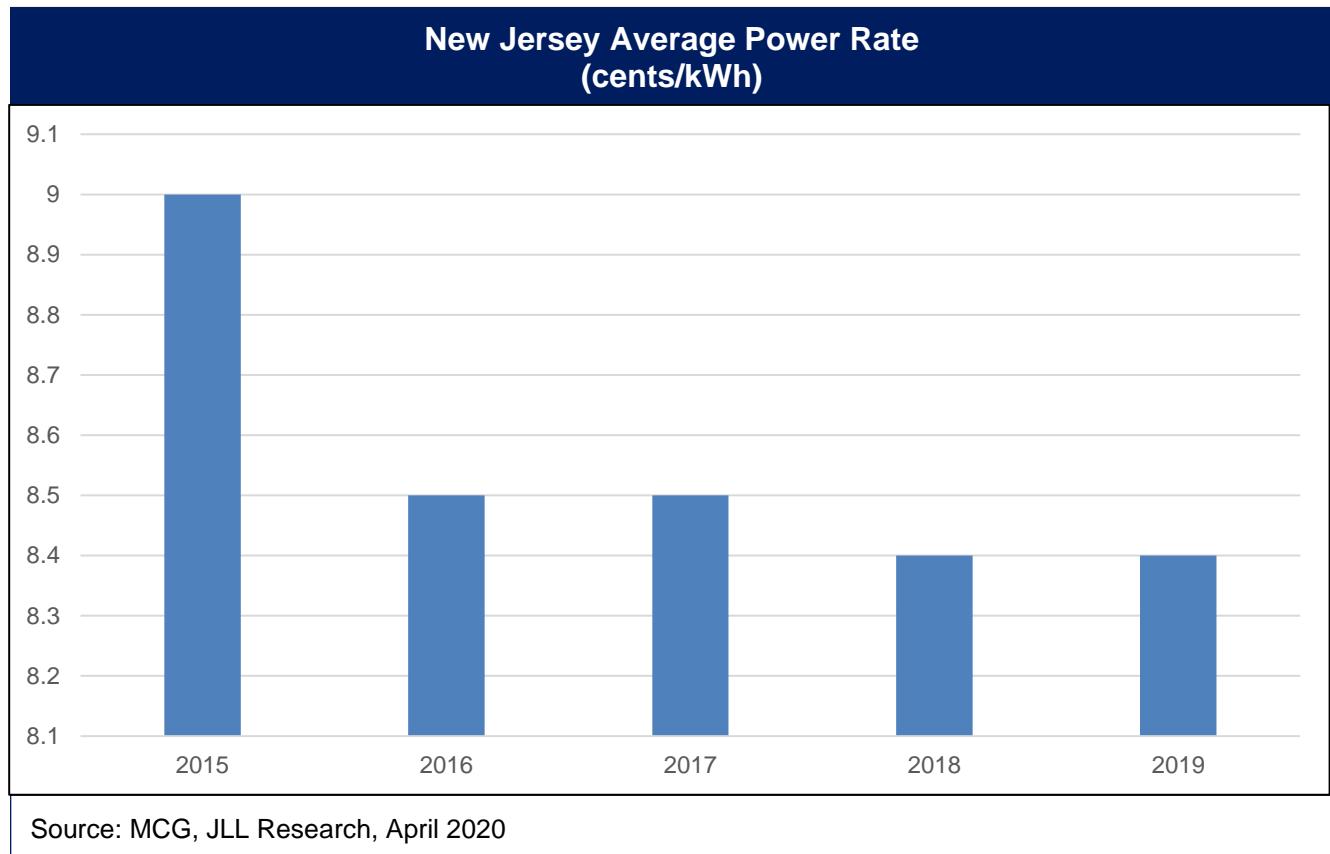
Outlook

for Users

- Competitive market that will offer flexible terms to expand and contract
- Energy sustainability will gain traction as tenants require 100% renewable energy
- Improved utilization and portal capabilities for improved service and reporting

for Providers

- Shell to turnkey conversion delivery intervals will be priority in early 2020
- New greenfield developments in Northern New Jersey are emerging
- Carrier and edge deployments are getting momentum in network-centric areas

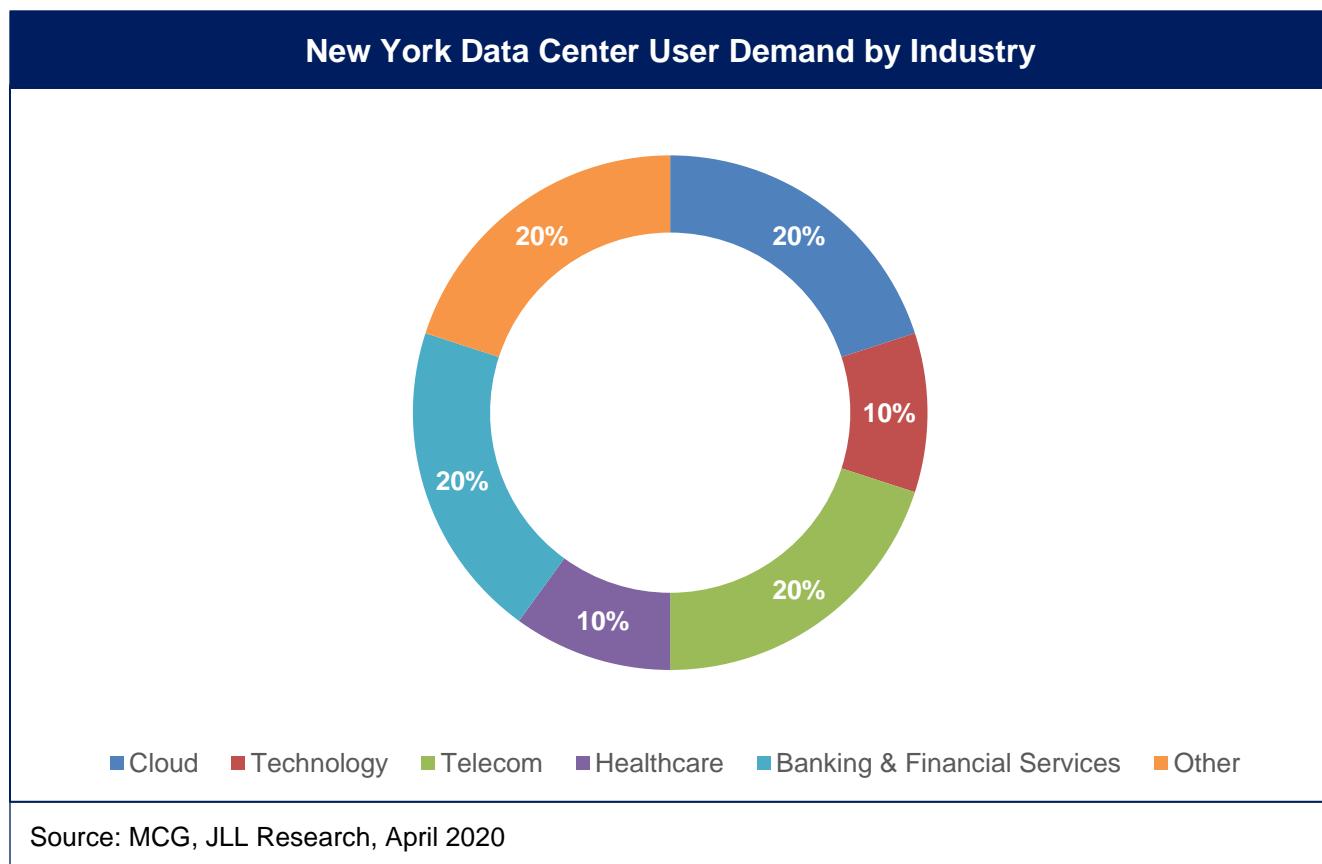


Key competitive advantages

- **Low Taxes:** Comparatively lower sales tax rate at 6.6% makes New Jersey a good place for data centers.

NEW YORK

In New York, the leading carrier hotels and colocation points continue to position network colocation deployments as fixed line and tier 1 wireless carriers ramp up for NYC 5G, CBRS and small cell rollouts. 1547 Data Centers continues to be the leading Wholesale provider with powered shell capability. WebAir and NYI continue to see small growth from the SMB needs for managed services. Carriers, mobile virtual network operators, third-party wireless and WiFi operators are increasing the demand for sub-50 kW deployments at strategic locations to centralize headend space to support optimal Wireless Spectrum Coverage among users and building portfolios.



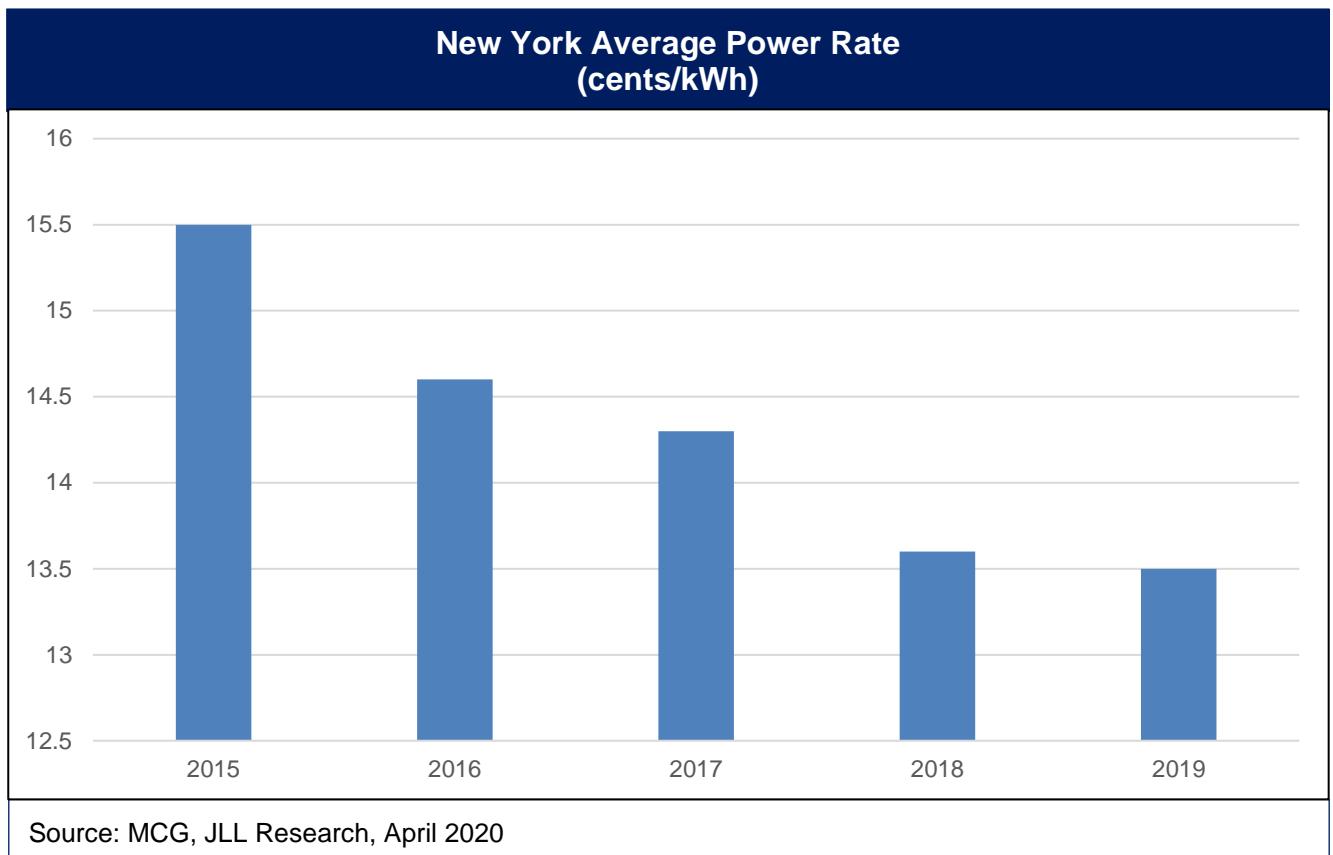
Outlook

for Users

- Small new footprints are being developed to support wireless carrier headend space
- Abundance of managed cloud services are readily available for hybrid strategies
- Local tax incentives and discounted power in suburbs

for Providers

- Wireless carriers will be developing centralized headend space to support 5G density
- Commercial office growth in NYC is accelerating sublease & excess space conversions
- Enterprise clients are requiring connectivity to AWS & Azure access points in NYC



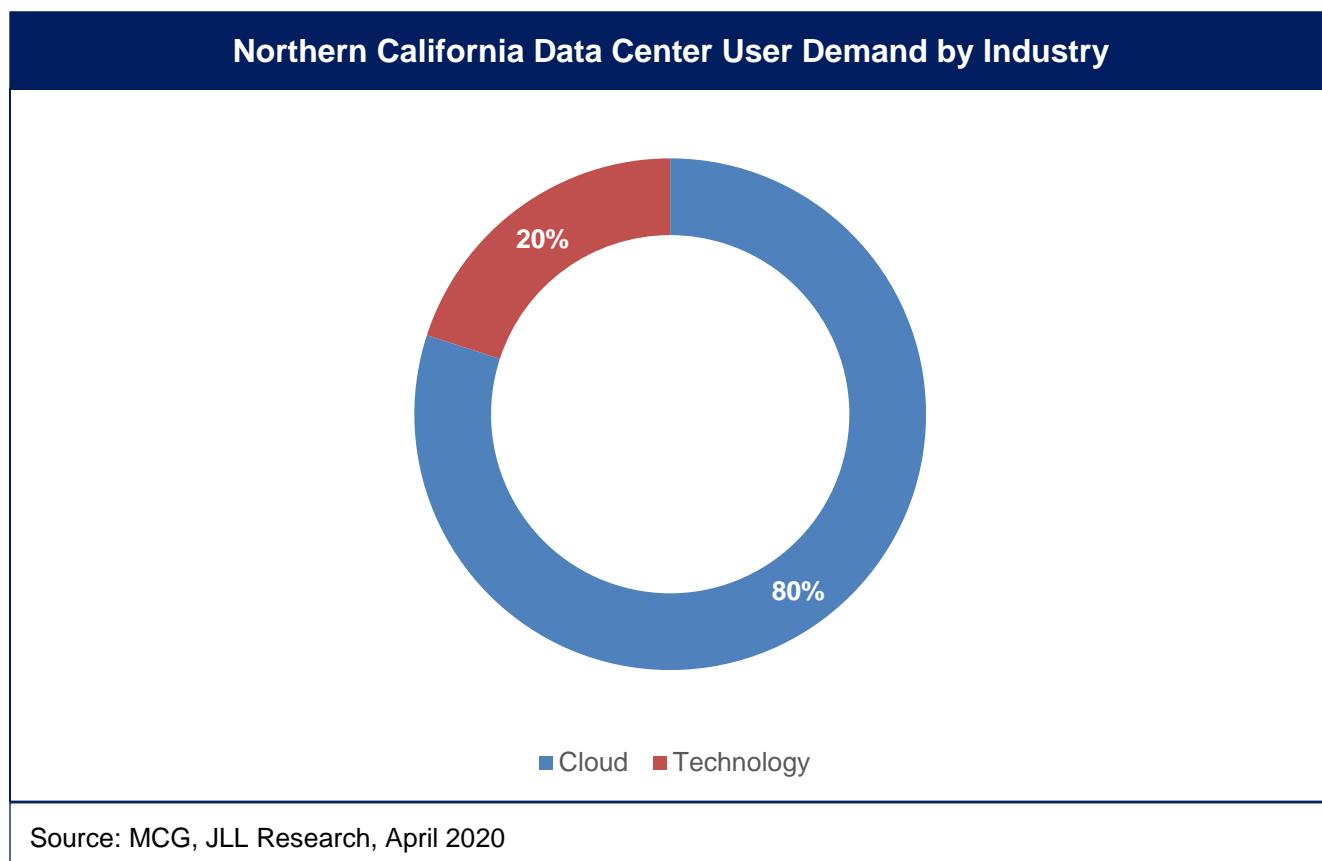
Key competitive advantages

- **High Fiber Connectivity:** As the world's largest financial hub, New York has strong data center connectivity and technology infrastructure.
- **Large Market Size:** The strong financial service sector stimulates the market size for data centers to be much bigger.

NORTHERN CALIFORNIA

In Northern California where Silicon Valley is located, nearly every major existing operator is building, has purchased, or is looking for a new site. Vantage, Digital Realty, and CoreSite are leading the way with new product being delivered in the next eight quarters. A significant block of rollover space is affecting supply. Two hyperscale cloud operators account for the vast majority of absorption. Nearly all absorption was taken in new product which was delivered in 2019.

There is a healthy amount of supply coming online over the next eight quarters. Given the reliance on several users for the vast majority of absorption, a supply/demand imbalance could occur should one or more of these users slow their growth plans. Users vacating the market for markets with lower TCO remains a risk.



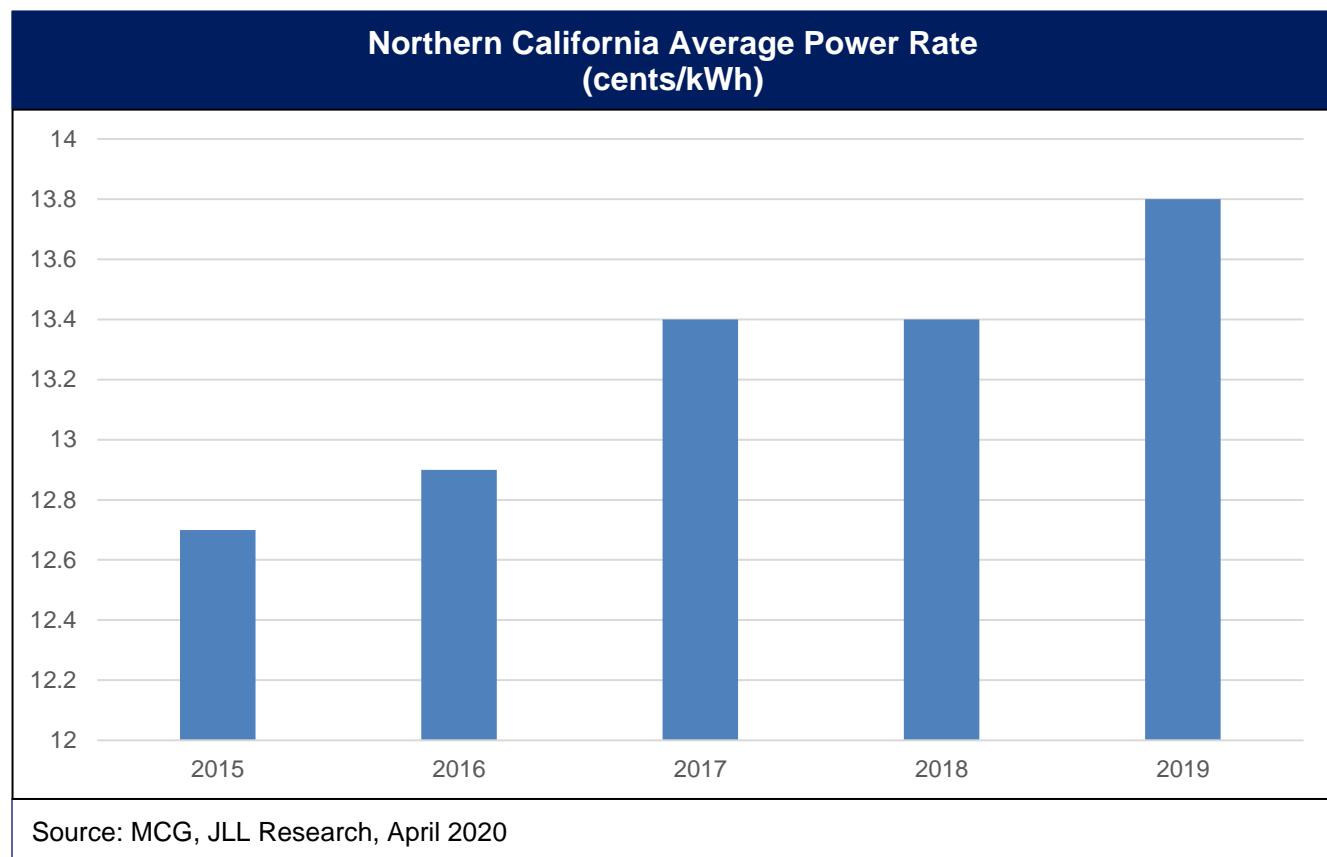
Outlook

for Users

- Scarce options for larger deployment means fewer concessions
- Expect pricing to remain stable in the short term
- If overdevelopment occurs, leverage could shift to users

for Providers

- Need to be mindful of competitive supply coming online
- Need to determine how much supply to bring online and why
- Need to be realistic about development costs and timelines



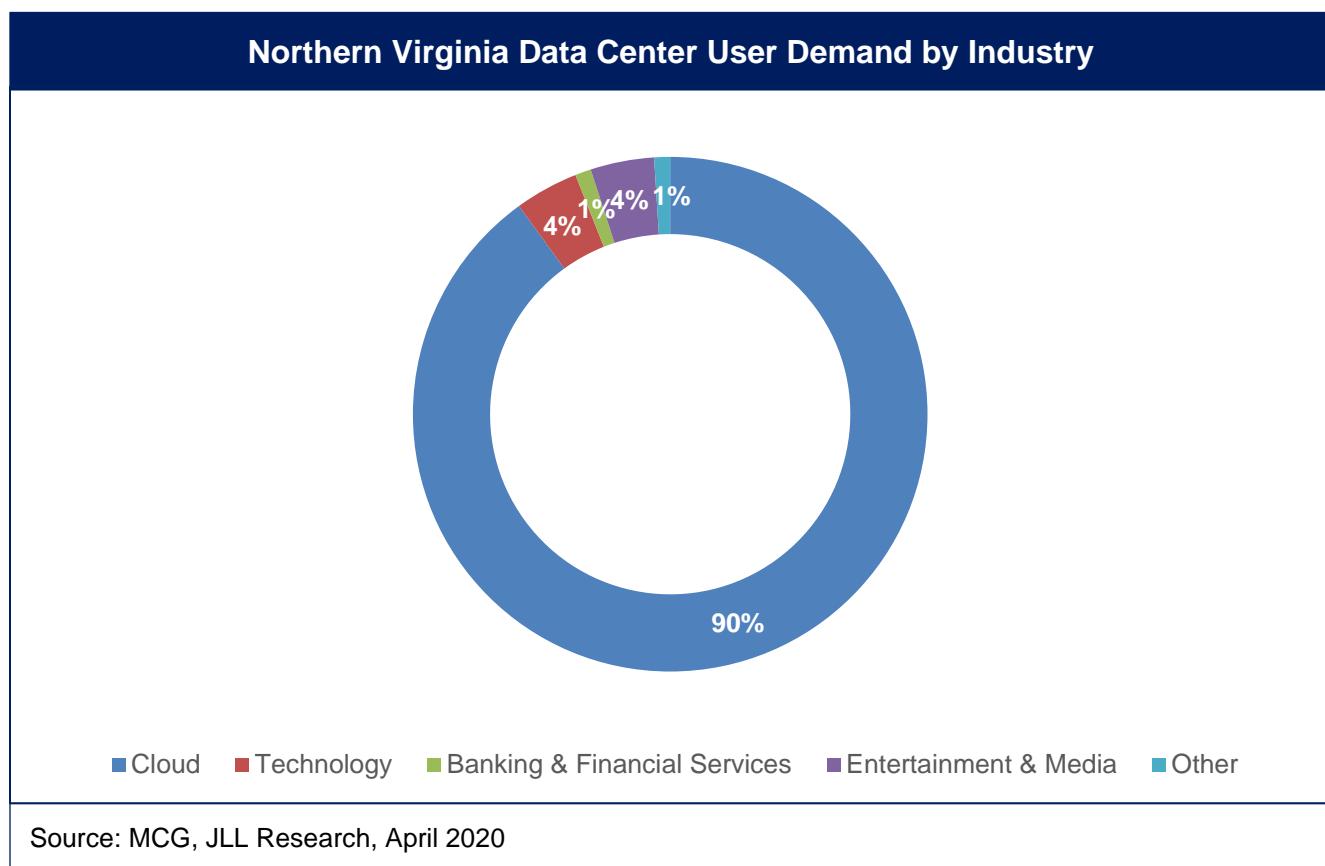
Key competitive advantages

- **Strong Development Pipeline:** The world's tech capital continues to produce a strong development pipeline and tenants with which to fill it.
- **Low Vacancy:** The global tech capital enjoys perennial demand from locally based mega-companies.
- **High Cloud Availability:** The global tech capital has the most advanced cloud services sector in the world.
- **High Fiber Connectivity:** The densest fiber runs through the technology capital of the world.
- **Large Market Size:** Silicon Valley continues to get the most out of legacy assets with more campus development upcoming.

NORTHERN VIRGINIA

In Northern Virginia, supply of available and under construction product exceeds 180 MW, or approximately 1.5 years of net absorption at 2019 levels. There was 124 MW of net absorption in 2019, down from a historic 2018, but still in line with 2016-2017. Hyperscale deployments accounted for much of the absorption, as there were three deals signed greater than 15 MW.

Large scale deployments, build-to-suit activity, 2nd generation inventory and new market competitors backed by aggressive capital, have placed downward pressure on rents and increased concessions creating an unprecedented opportunity for end users.



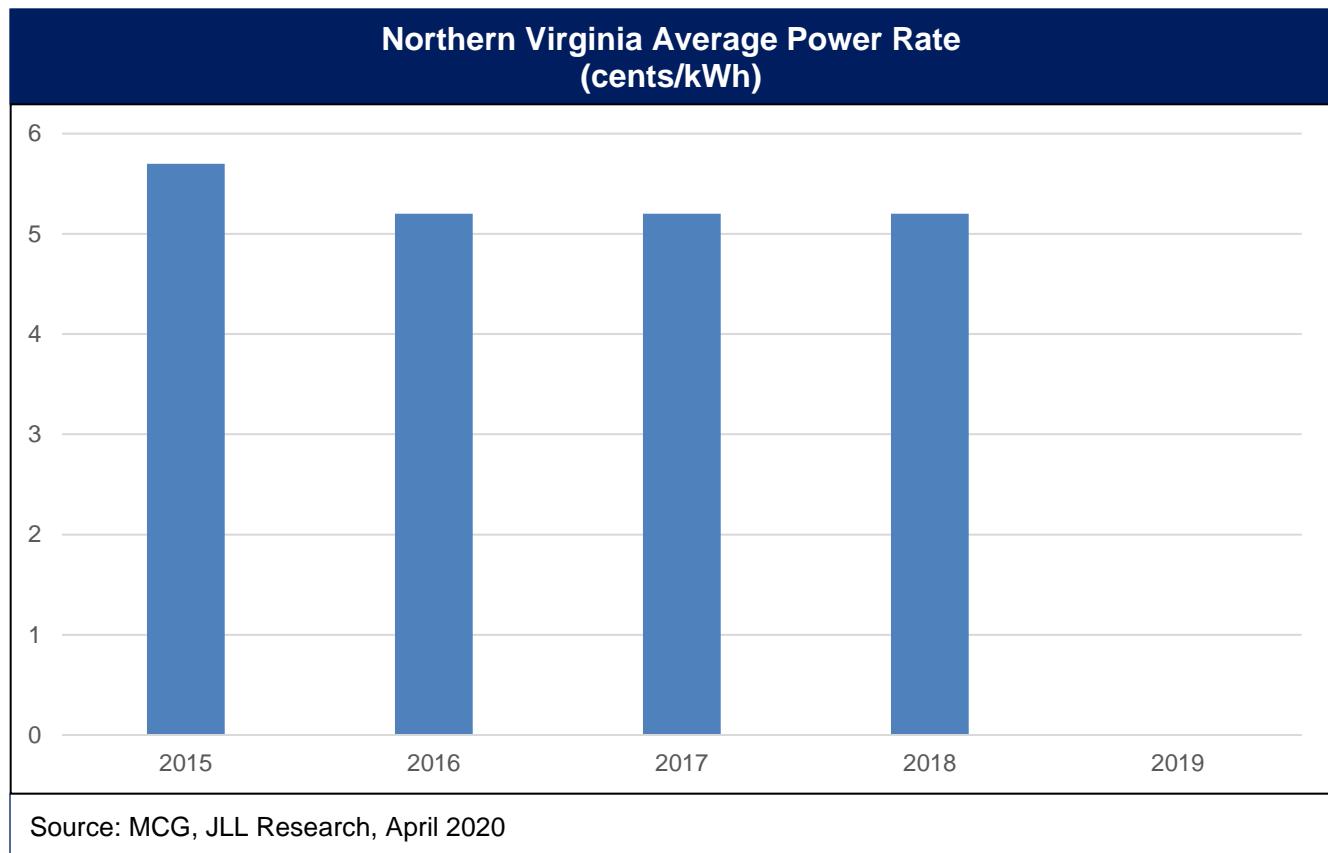
Outlook

for Users

- Historically aggressive rates/concessions from world-class facilities
- Requiring greater flexibility as options increase
- Stronger focus on service offerings and public cloud on-ramps

for Providers

- Margins decreasing for providers due to aggressive new competitors
- Still the top market for hyperscale "elephant hunting"
- Must be more flexible, offer more services and highlight "on-ramps"

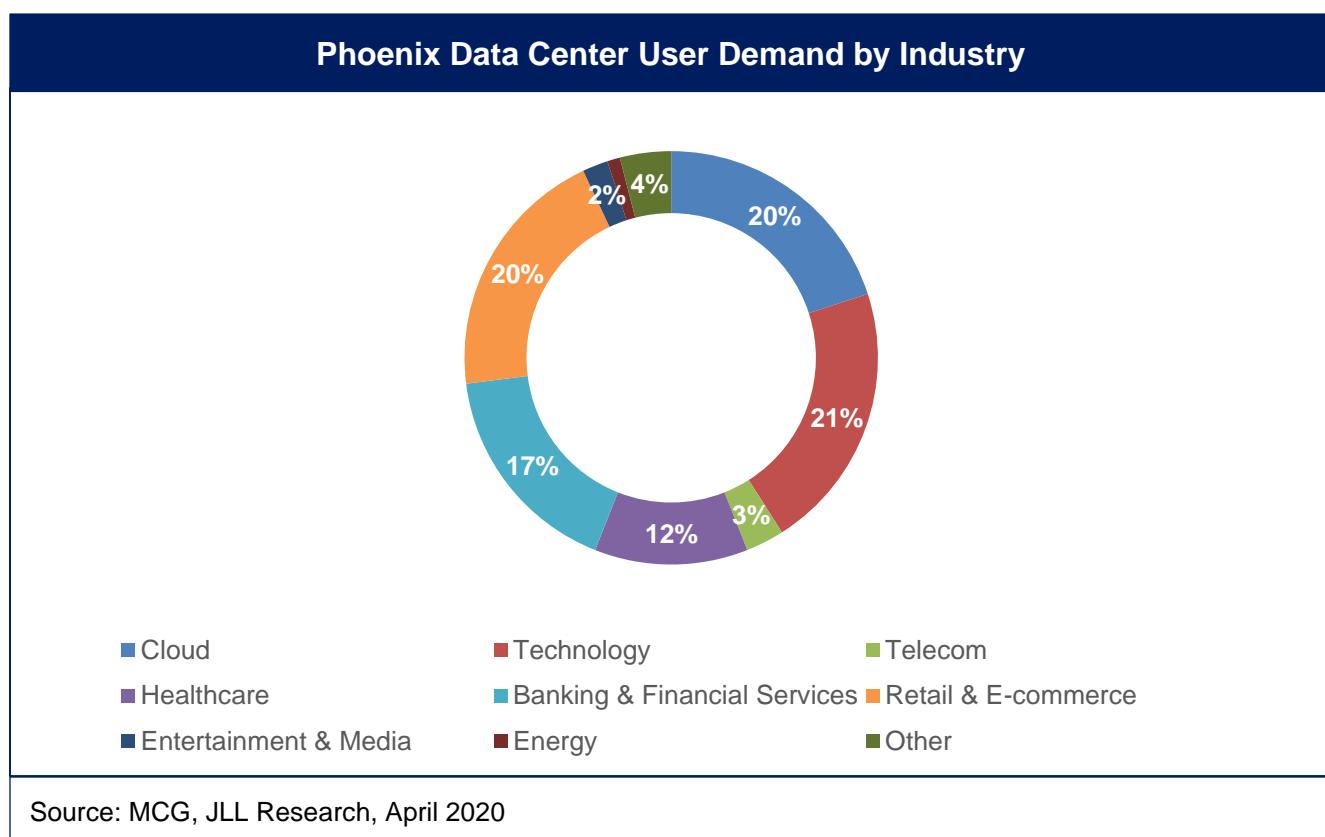
**Key competitive advantages**

- **Strong Development Pipeline:** The largest data center market looks to extend its sizable advantage over the next two years.
- **Low Land Price:** The land price remains half the price of Canadian market, and a tiny fraction of deeply constrained market in West Europe or Asia.
- **Low Vacancy:** Much of the new capacity here is pre-leased long before construction begins as demand remains insatiable.
- **High Cloud Availability:** The largest data center market in turn has a large amount of cloud services available.
- **High Fiber Connectivity:** The largest data center market in the world comes with some of the most robust fiber.
- **Large Market Size:** The past, current and future leader of the data center world.
- **Low Taxes:** Very low sales taxes are another key reason for locating in Northern Virginia.

PHOENIX

In Phoenix, Iron Mountain and Aligned Energy brought new space online in the third quarter. Compass and Stream, in the West Valley, are the only companies building out new space. Aligned continues to build out their existing building, with 30 MW under construction. Microsoft is building out all three of their sites in the West Valley and Google is getting their permits for their site. Although hyperscale deployments have slowed down, there are still smaller deals in the pipeline that continue to take space. These retail-sized deals will continue to be in demand to operators in Phoenix. Since there is more supply available now than there was last year, an increase in activity and absorption could be seen in 2020.

The way cloud has been changing the data center industry has been a major conversation. Many enterprises and smaller companies are evaluating or have decided to move to the cloud instead of on-premises. Companies such as Microsoft, Google, and Oracle, as well as other public and hybrid cloud companies, are looking to take space in Phoenix for their deployments.



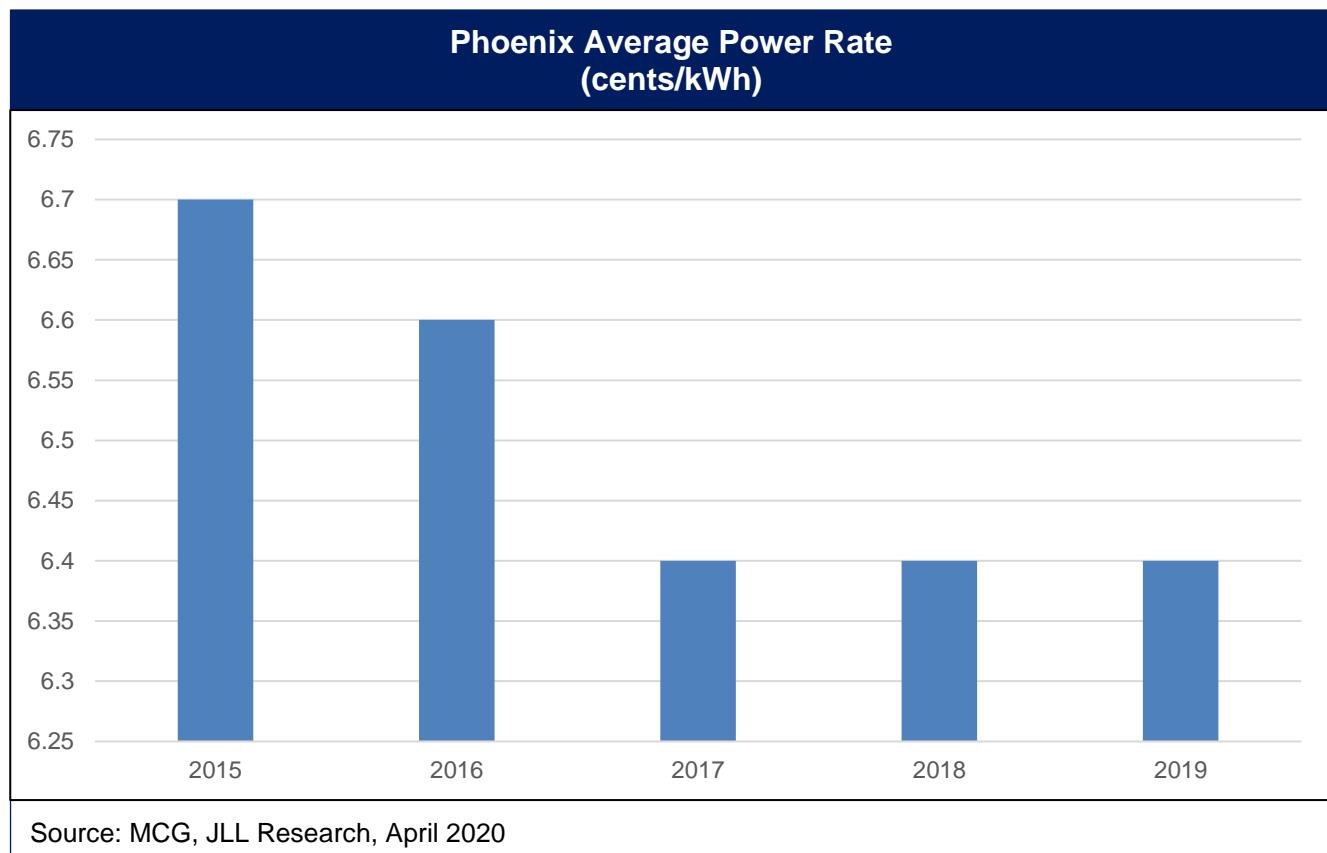
Outlook

for Users

- Several options to consider with new supply coming online
- Cloud developments will provide better latency and service options for enterprises

for Providers

- One of the lowest TCO's in the US to deliver to customers
- Positioned to deliver within 90-180 days



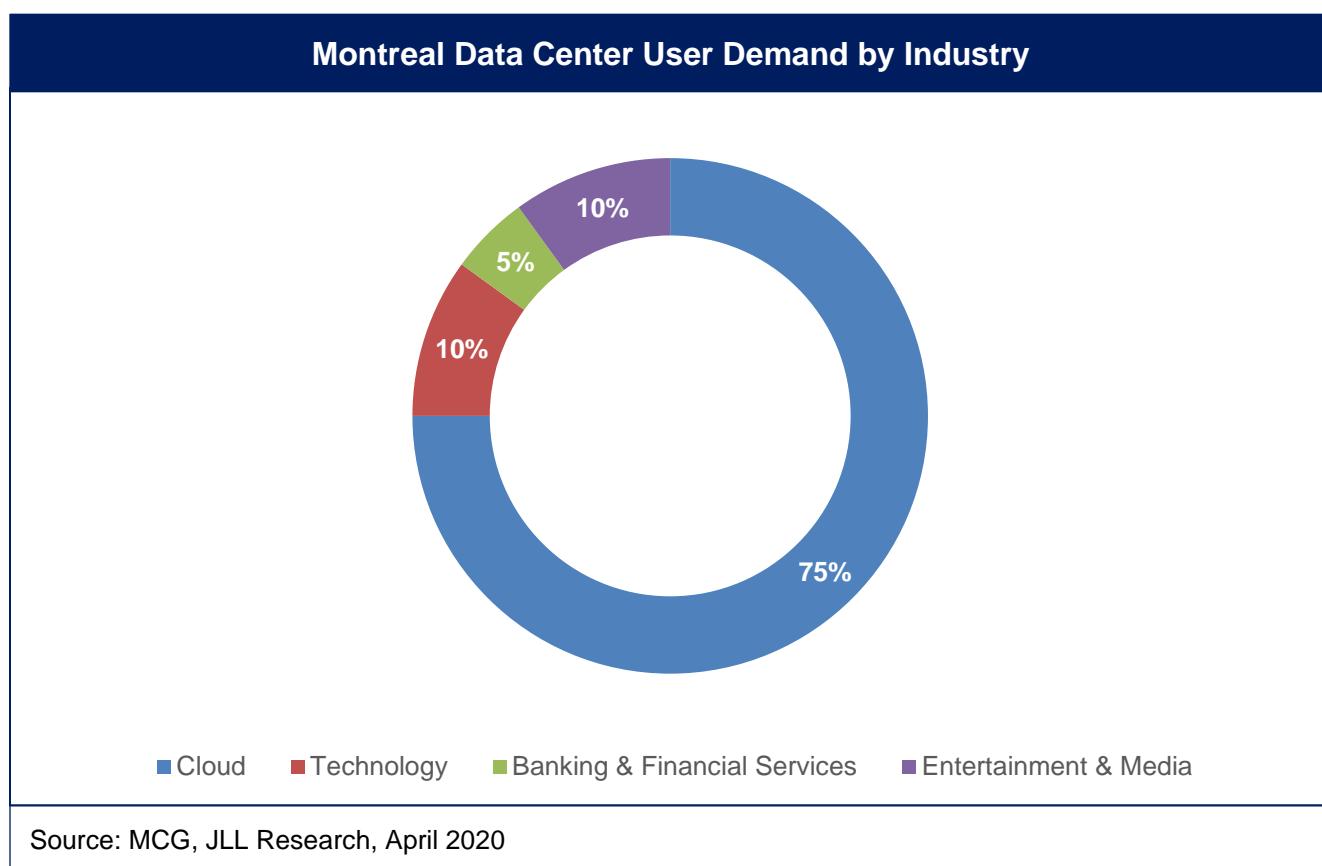
Key competitive advantages

- **Low Vacancy:** The city's data center has one of the lowest vacancy rate even in the global market.
- **Strong Incentives:** Aggressive incentive packages and proximity to California have drawn multiple new operators over the last two years.

MONTREAL

There is modest supply currently available as U.S. tenants and cryptocurrency/blockchain entities consumed the majority of product. However, there is nearly 50 MW of expansion projects underway to deliver N+1 product. The demand in Montreal remains the highest in Canada from a number of applications types such as US cloud/content providers, visual effects studios, gaming, and software as a service provider both Canadian and from the U.S.

Mid-year absorption is due largely to existing US cloud providers who are currently undergoing expansions. The moratorium set on cryptocurrency has created a disruption and that demand has diminished as a result.



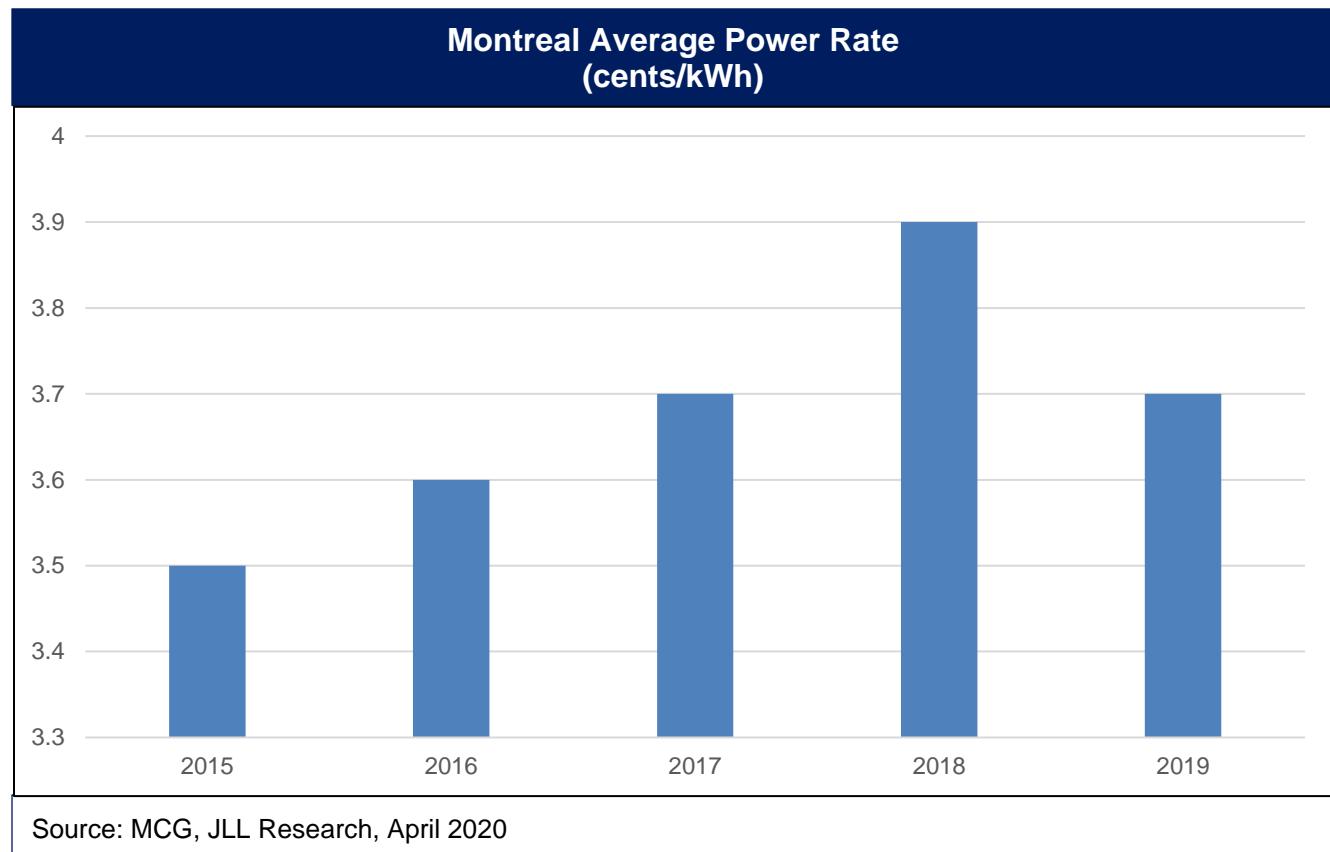
Outlook

for Users

- Multiple options to compete for users searching for less than 1 MW
- Expect significant supply to come online in 2019
- Anticipate better telecommunications connectivity as telecoms enhance offerings

for Providers

- The new surge of US colocation operator interest will in affect drive business there
- Expect M&A activity in this market very soon
- Rental rates will remain steady



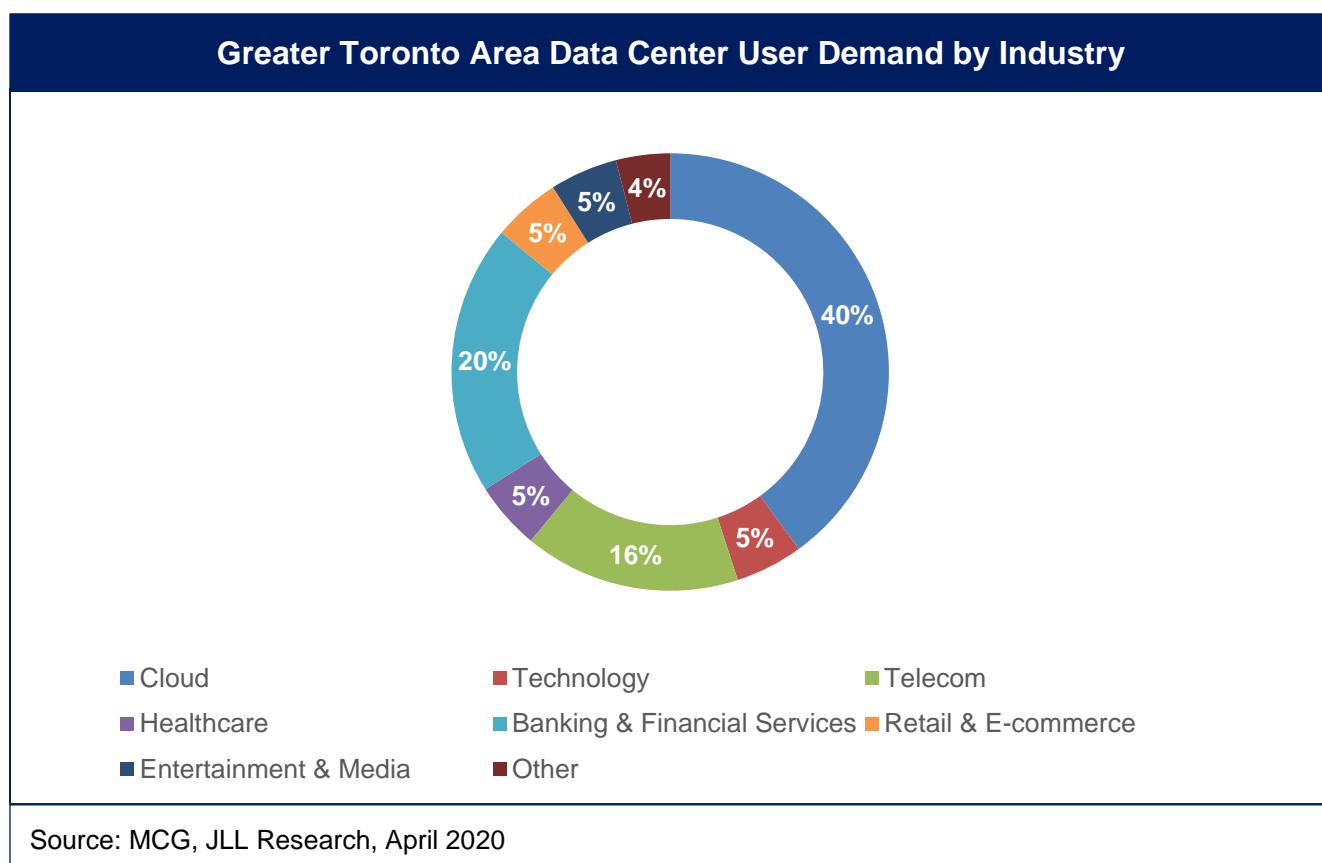
Key competitive advantages

- **High Sustainability:** Hydroelectric power runs the entire province and particularly the local data center sector.
- **Good Political Stability:** Cleanliness and cost effectiveness also applies to government in Montreal.
- **Low Power Cost:** The lowest cost power in North America is also the greenest thanks to the abundance of hydroelectricity.

GREATER TORONTO AREA

New supply to the market offers prospective requirements great opportunities for users in the market. Lagging deal volume over the last twelve months has increased pressure on providers looking to transact on existing vacancy. Demand has been lagging for the last twelve months with many retail users assessing transitions to hybrid cloud / cloud solutions. Wholesale requirements have been limited with some requirements assessing out-of-province options driven largely by utility pricing.

Cloud and financial services requirements continue to dominate the local market. Some Crypto deals are being entertained in the GTA which seems to be an implication of the Quebec hydro bidding process for large crypto requirements. Over time crypto requirements may progressively mature and through that maturation, deals outside of Quebec may become more cost neutral.



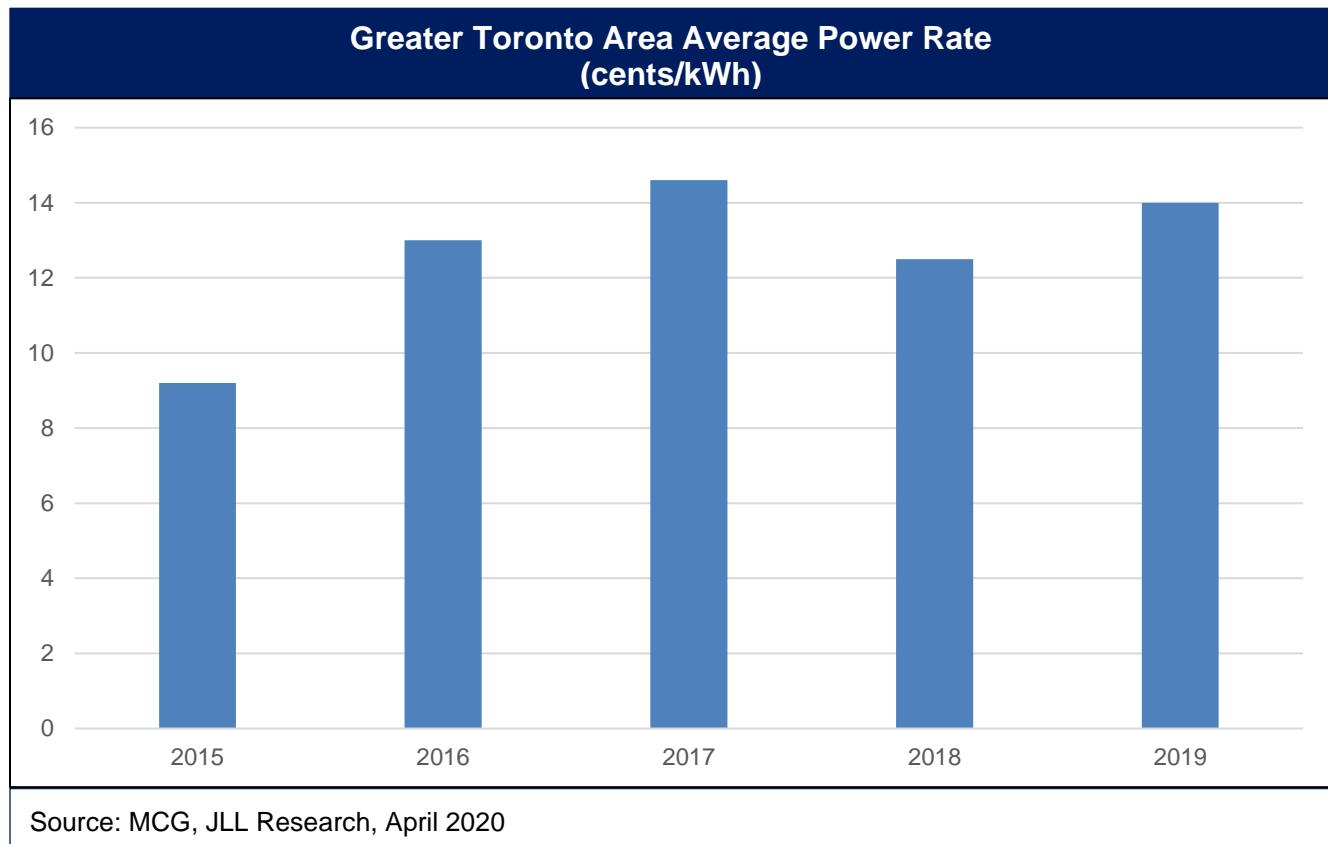
Outlook

for Users

- Sluggish market offers larger requirements possible leverage on deal terms
- New construction options offer large requirements improved opportunities

for Providers

- Demand beyond 2019 is expected to improve
- Demand may improve with Hydro Quebec's bidding process on large utility requirements



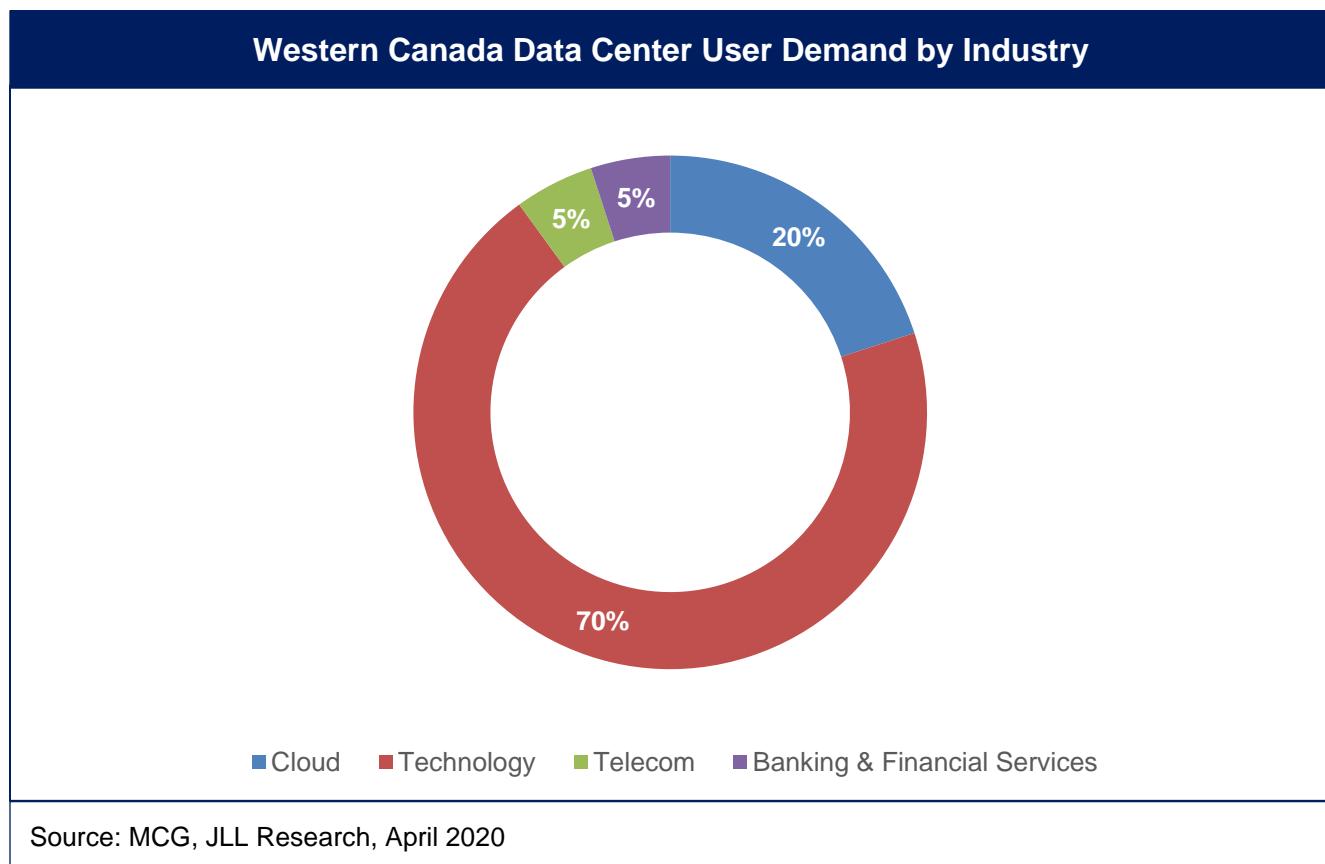
Key competitive advantages

- **High Cloud Availability:** The financial and business hub of Canada has abundant cloud services available.
- **Good Political Stability:** The financial and business hub remains highly stable.

WESTERN CANADA

Data center supply has been historically low in the Vancouver surrounding region, but operators beginning to expand by acquisition such as EstruXture or by construction such as the Cologix largest new build in the region. Calgary continues to push unleased inventory while Edmonton joins the watched markets as Rogers and others increase their offering in the north. Meanwhile, demand In Western Canada has increased, driven by telecom, hyperscale, and US entertainment and film industry users. The market has seen a few large new transactions executed by operators such as Q9. Net absorption remains low as current end users migrate to the cloud or managed hosting, freeing up cage space.

In general, Demand has increased significantly in Western Canada, the acquisition of Allstream by Zayo, as well as some new planned long-haul routes, have increased CA offerings and better connect US based operations to their respective US data center.



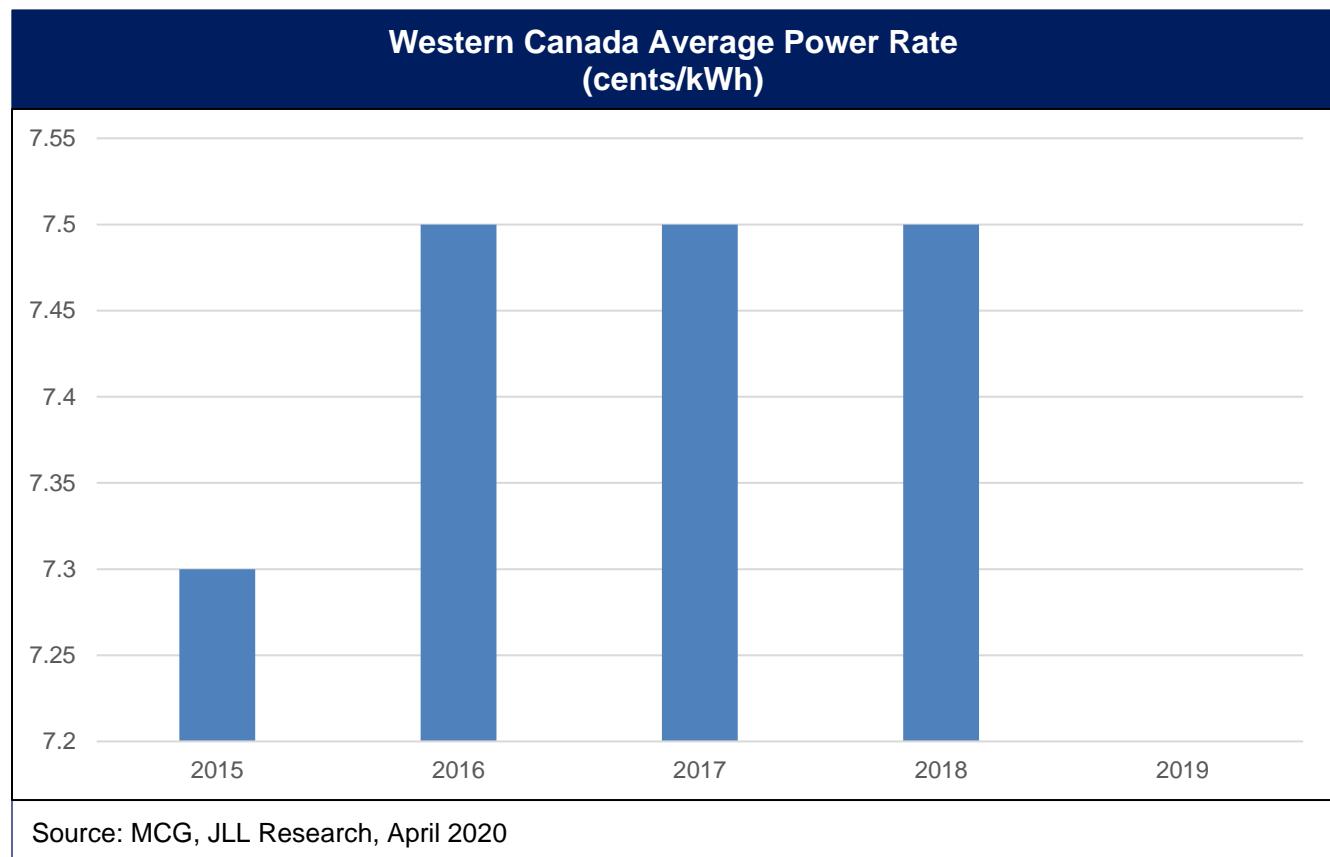
Outlook

for Users

- Ample product in Calgary to consider
- No significant size options in Vancouver region until 2019
- In-row water cooled racks are becoming the norm in Vancouver

for Providers

- New inventory delivered in 2019 will not have negative impact on rental rates
- Very little planned product means additional delivery not likely until 2020
- Rental rates vary market-to-market, expect continued downward pressure in Calgary



Key competitive advantages

- **Low Environmental Risks:** A coastal market that has also largely chosen to build outside local flood zones.
- **Low Vacancy:** The market is utilized by content providers and the tech industry.
- **High Sustainability:** Rainy weather provides plenty of waterpower for the data center market.
- **Low Power Cost:** Hydroelectricity works well throughout the Northwest corner of the North America continent, and Western Canada is no exception.

Global Markets Overview



INTRODUCTION

Besides the North American markets, the European markets take 31.3% of the global data center market, while the emerging markets take the remaining 29.9% of the total market. In general, the European markets are more developed and have a strong development pipeline for data centers. In addition, most of the European markets have low levels of environmental risks, and technological development equips them with high cloud availability. Nevertheless, high power cost, high land price, as well as high sales taxes also lead to higher vacancy rate in the European data centers.

Of the emerging markets, the Asia Pacific markets are considered to have the highest growth potentials. According to JLL, it is expected that the region's data center market will grow by 27 percent annually – exceeding its European counterpart in size by 2021. The rise and ubiquity of cloud computing in the region is driving the demand for data centers more than ever. Rapid urbanization and the Internet of Things will further push demand for data centers as businesses, cities and individuals themselves continue to voraciously consume data in the pursuit of new technologies such as driverless cars and sensors. Moreover, e-commerce and social media have yet to come close to reaching their potential in Asia.

It is, therefore, not surprising that secondary and emerging markets in Asia such as Thailand, Indonesia, India, Malaysia are on the fast track to improve their infrastructure in a bid to get in on the data center action. Alibaba Cloud has announced plans to set up data centers in Jakarta and Mumbai and is debating locating another datacenter in Malaysia's Cyberjaya. With modernization of its data center facilities through a new cloud data center, the Thai market has become increasingly relevant in recent times with the almost-completed site by global giant Supernap, located just outside of Bangkok, highlights opportunities outside of the primary markets.

As for the Middle East market, while the climate is not the most ideal for data centers, data center development activities are taking place. Etisalat, Khazna, Amazon Web Services (“AWS”), Khazna, Gulf Data Hub, and Datamount are the prominent investors in the region. Managed services continue to dominate the Middle East data center services market, where colocation has been gaining increased traction in the last two years. Hyperscale data center providers contribute to market growth through cloud investments include Oracle, AWS, IBM, and Microsoft. What is more, initiatives such as Saudi Vision 2030, Dubai Vision 2021, and New Kuwait Vision 2035 are likely to aid in the growth of cloud, big data, and IoT services in the market. The UAE and Saudi Arabia are the major contributors to the market, while Bahrain, Kuwait, and Oman are in the nascent growth stage.

Last but not least, the Latin American market and the African market also presents interesting and promising development and investment dynamics. Besides Google’s data centers in Uruguay and Chile, and Amazon Web Services’ data center in Argentina, Equinix also confirmed in October 2019 that it was buying three data centers in Mexico from the telecommunications company Axtel. As for Africa, Djibouti and South Africa are top markets for data centers. The Djibouti Data Center is the first and largest Tier 3 carrier-neutral data center in East Africa with direct access to all major international and regional sub-marine cable systems connecting the European, Middle Eastern and Asian markets with Africa. While the number of data centers currently in Africa is small, the drastically increasing number of internet users indicate a promising market future accompanied with uncertainties and unknown risks.

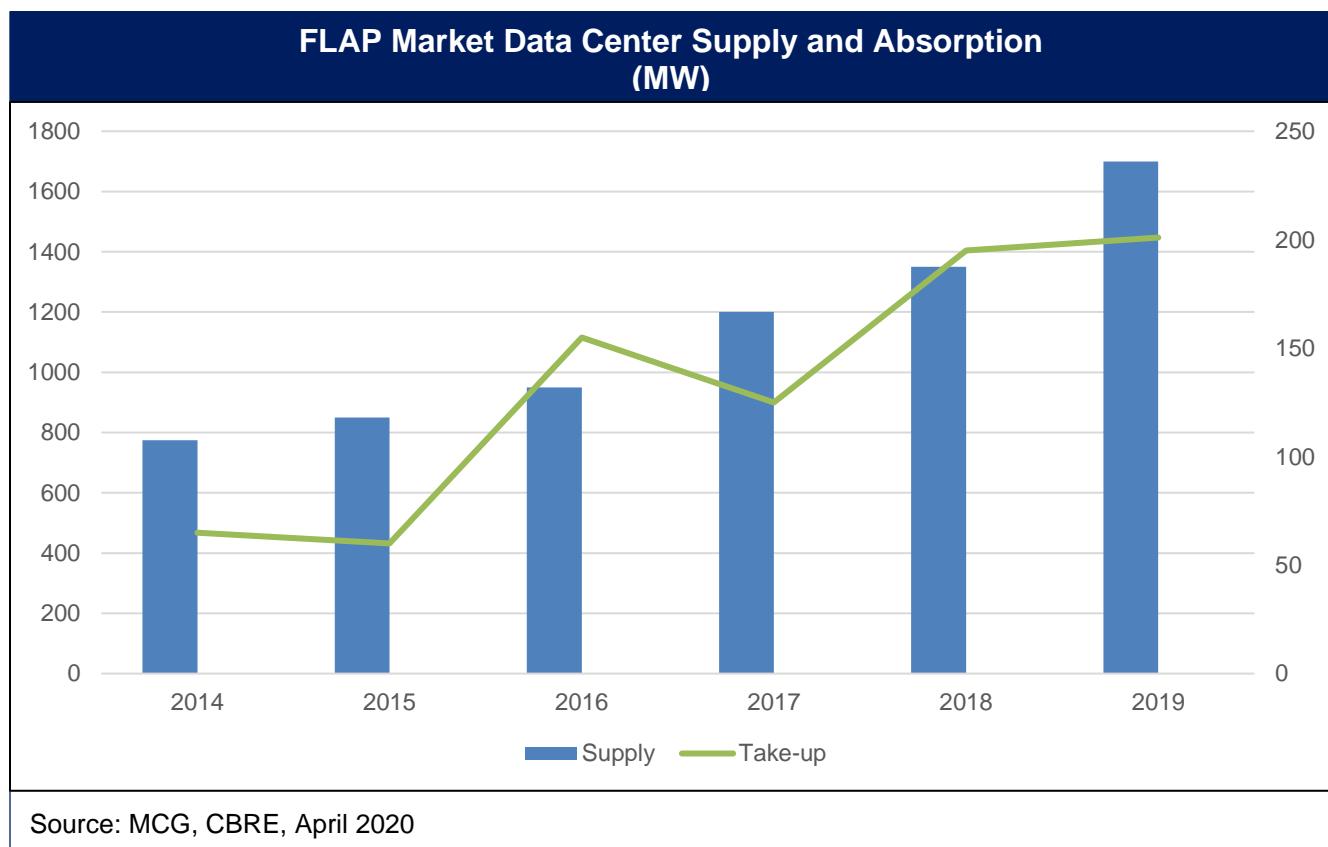
Considering that investors activities are mostly concentrated in Europe and Asian Pacific, the following sections will thus focus on these two regions and provide overviews on select major markets in the respective regions.

EUROPEAN MARKETS

Introduction

Currently, Frankfurt, London, Amsterdam, and Paris (“FLAP”) are the top 4 markets in Europe. In 2019, absorption in the FLAP markets hit its highest ever level, surpassing 200MW for the first time on record.

In addition to the 201MW of annual absorption, there was a further 66MW of pre-lease procured in facilities that have not yet been developed. This unusually large amount of pre-lease will be added to the absorption figures when the individual facilities are built. Furthermore, there is over 50MW of capacity that is currently under option in the FLAP markets. This 116MW of identified absorption underpins that regardless of COVID-19, it is likely that 2020 will repeat the strong performance of 2019. Meanwhile, cloud continued its domination of the European markets, responsible for 79% of absorption in the year.



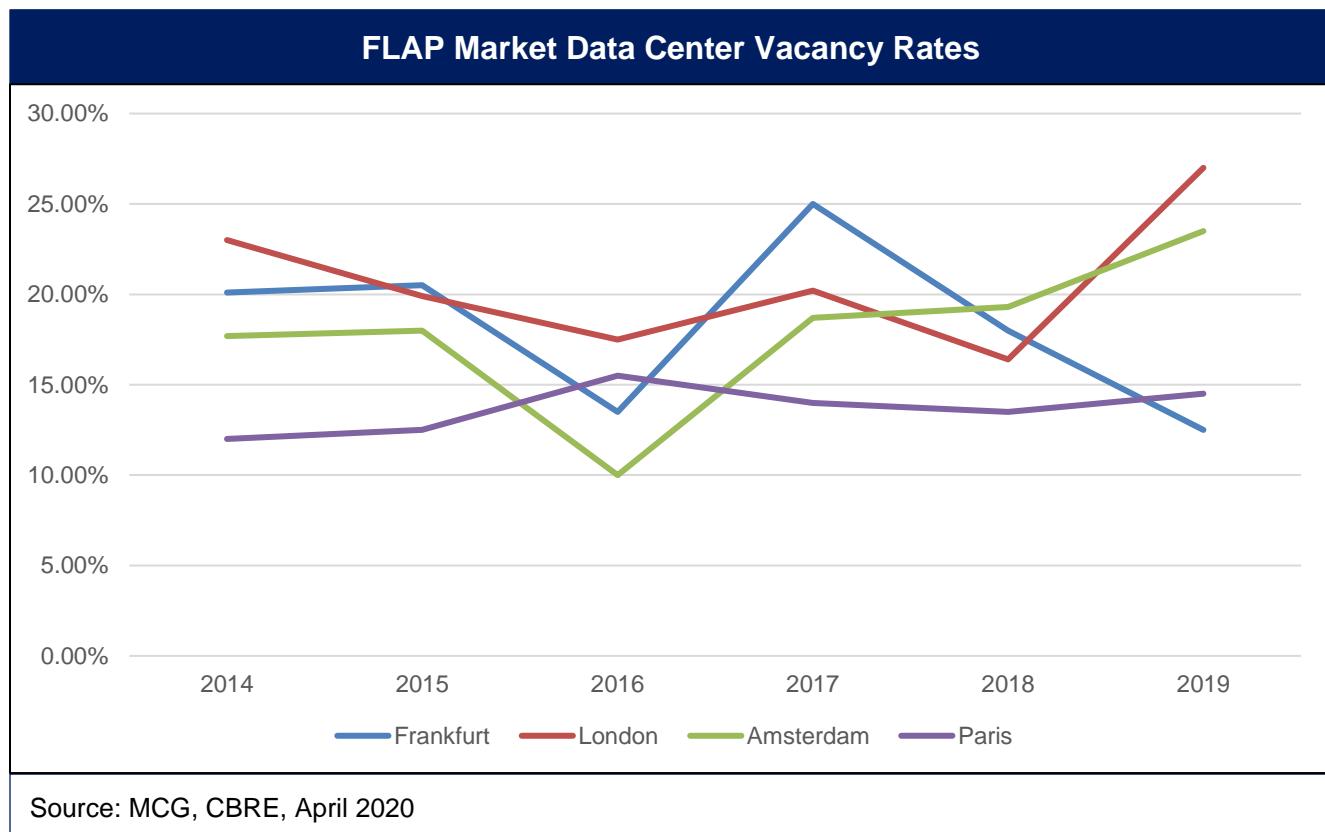
Nevertheless, total available capacity in the FLAP markets rose to 355MW at year-end 2019, from 229MW. This is the first time that availability has increased by over 100MW in a single year. Consequently, vacancy rates across the markets increased by 4 percentage-points to 21%.

The most noticeable increase was in London where the vacancy rate increased by 11 percentage-points to reach 27%, the highest level in the market’s history. This is due to several

large wholesale facilities coming online in Q4. Amsterdam was the other market to end the year with a vacancy rate above 20%, an increase of 4 percentage-points during 2019.

True to form, Paris's vacancy rate remained steady, between 13% and 14%, throughout the year as new supply and absorption were equally matched. Conversely, vacancy rates in Frankfurt dropped by 5 percentage-points as strong absorption this year was higher than the amount of new capacity brought online, a marked difference from the other markets.

Market absorption across the four FLAP markets reached 3.0 years on aggregate, the highest year-end absorption rate. This is largely down to the dominant effect of London on the overall outcome. The city became the first FLAP market since 2010 to have a market absorption rate of over 4.0 years.



Market by Market Overview

Frankfurt

Frankfurt's absorption of 90MW comfortably beats the previous European record – London's 77MW in 2018. Frankfurt's previous best performance was 49MW. The German customers of the hyperscale companies largely require serving from inside Germany, which increases the need for the hyperscalers to procure significant capacity within the country.

As a consequence of heightened take-up, Frankfurt's vacancy rate is at its lowest since 2013, when it was 11%. It is also the lowest vacancy rate in the FLAP markets. It is forecasted that Frankfurt will have the newest capacity brought online in Europe from 2020 to 2021, with 168MW.

As for competitive advantage, Frankfurt has high cloud availability as well as good political stability.

London

London needed a big Q4 to ensure that it had a good year, and it delivered. Hyperscale commitments in West London during Q4 were responsible for nearly 50% of the market's total for 2019. London welcomed nearly 150MW of new capacity in the year. This means that there is now 190MW of available capacity in the market. This in-turn gives London the highest vacancy rate and market absorption in the FLAP markets.

Like Frankfurt, all three hyperscalers are looking for significant capacity in London today. However, even strong absorption in 2020 may not have a significant effect on vacancy and market absorption, which will remain high over the next 12-18 months. It was forecasted that London would witness its second year of absorption above 60MW in 2020. Whether that will come true in the current pandemic situation remains unclear.

Strong development pipeline, high cloud availability, and large market size are key competitive advantages for London.

Amsterdam

Amsterdam had a solid year for absorption, finishing on par with its four-year average. In each year where absorption in Amsterdam has been 40MW or more, one transaction has been responsible for around 50% of absorption each time. 2019 was no different, as a single transaction in H1 was responsible for 45% of the market's total absorption in the year.

Given a slowdown in development in the Amsterdam market over the next 12 months, vacancy rates are expected to fall in the year as the capacity in existing buildings is sold. It was forecasted that vacancy rates in Amsterdam would drop to just below 20% for 2020 and 2021.

Amsterdam's main competitive advantage are high cloud availability as well as good political stability.

Paris

Absorption and new supply were evenly matched in Paris during 2019, which led to market conditions remaining stable through the year. The relatively consistent lower level of absorption in Paris has meant that developer-operators have tended to bring capacity online to serve specific transactions rather than significant amounts speculatively.

There is a sense that the hyperscale companies will increase their procurement of colocation capacity in Paris over the next two years. Developer-operators are expected to begin developing

larger scale sites in the market to serve these requirements. These facilities will start to be delivered in 2021. It was forecasted that market absorption rate in Paris at year-end 2020 during would have fallen below 2.0 years or the first time since 2015.

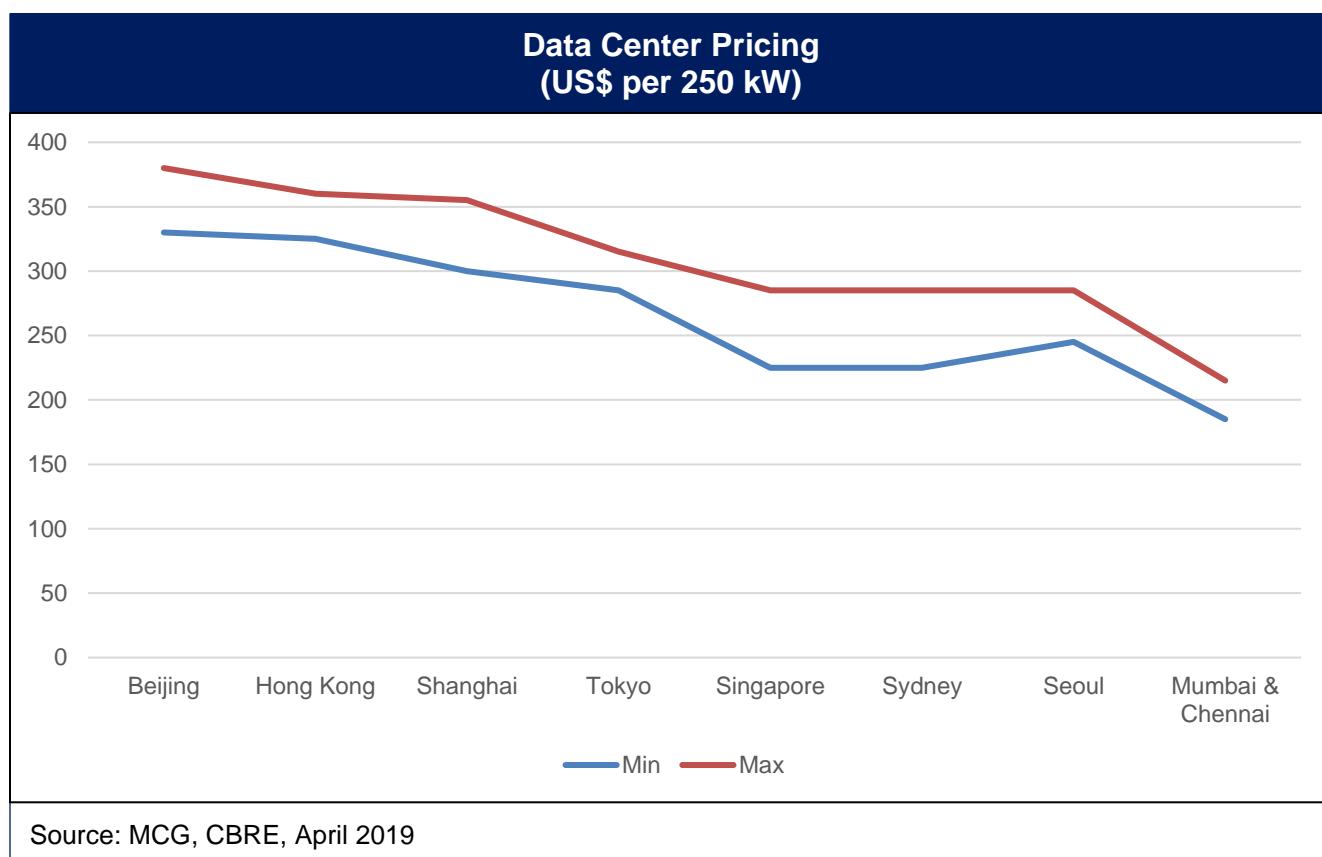
For Paris, its main competitive advantages are low environmental risks, high cloud availability, as well as strong government incentives.

ASIA PACIFIC MARKETS

Introduction

The Asia Pacific data center market continues to expand. Supply across the primary 10 Asia Pacific markets totaled 1,772 MW in Q1 2019. Meanwhile, demand is predominantly coming from large technology and global cloud corporates from the U.S. and China, ensuring fitted capacity remains tight across the region.

The pipeline is totaled for about 800 MW which will help to ease the tight availability over the past few years. Nonetheless, Singapore, the largest data center market in this region, will remain as a tenants' market with the ample supply.



Market by Market Overview

Singapore

With 20 submarine cable systems landing, Singapore is the best-connected tier I market in Asia Pacific. Strong connectivity along with reliable power supply sources has helped Singapore become a data center hub. The city-state's conducive business environment has also allowed the data center industry to flourish and created a highly competitive market. The presence of

reputable international and local operators with strong track records has ensured end-users have greater leverage and options for their deployments.

Absorption & Demand Large-sized technology and cloud companies have been the major demand drivers, displaying large and unprecedented requirements and accounting for a significant amount of colocation space in the last 18 months. Supply CBRE expects significant new supply to enter the market in the next three years, with an estimated pipeline of 177.2 MW, equivalent to around half of existing supply. Pricing Singapore will remain an end-user market over the next 24 months due to its ample pipeline. However, data centers with strong connectivity will still be able to command premium rents for retail colocation requirements.

Its key competitive advantages are strong development pipeline, low environmental risks, high cloud availability, as well as low taxes.

Hong Kong

The largest cluster of data centers in Hong Kong is located in Tseung Kwan O (“TKO”), which is home to an industrial estate with an estimated 70% of Hong Kong’s total IT MW capacity residing in 11 data center facilities. Absorption and demand for colocation space is primarily driven by Chinese cloud companies looking for cross-border expansion. Other key drivers include U.S. tech giants seeking a foothold in Asia, as well as financial institutions. Supply The occupancy rate is high, at 92%. Supply is constrained due to the tight real estate market.

However, new supply of 50MW located outside of TKO will relieve some pressure for diversity in the short to medium term. Diversity from TKO The majority of new supply has been located in TKO due to the area’s relative availability of land. However, end-users with deployments in TKO are increasingly seeking capacity in alternative locations of Hong Kong to ensure diversity in fiber and redundancy. This has resulted in higher pricing outside TKO due to the limited availability of facilities that can cater to these increasing requirements.

Hong Kong’s competitive advantages are high cloud availability, large market size, as well as low taxes.

Tokyo

Tokyo remains a highly attractive tier I market for both operators and end users due to its dense connectivity and large number of cable landing stations connecting it to Asia Pacific and the U.S. However, long development periods and the time required to secure power from the grid, which can take as long as 24 – 36 months, have hindered the supply pipeline. **Absorption & Demand** While local enterprises constitute a significant portion of demand, requirements for cloud services have driven new growth. Cloud players are looking to fulfil this demand quickly via self-builds or deployment via hyperscale operators, usually in locations outside of Metropolitan Tokyo. Supply Capacity is relatively tight, with 89% of fitted capacity occupied and just 7.8 MW available as shell capacity.

Nonetheless, six new data centers are scheduled to be completed within the next three years, almost doubling existing capacity. Pricing The tightening of supply over the last two years has

driven up pricing, especially within Metropolitan Tokyo. The lack of contiguous capacity within existing data centers has also exerted upward pressure on pricing. However, new supply is mostly located outside Metropolitan Tokyo, meaning that pricing is expected to be stable over the next three years.

Tokyo's competitive advantages are high cloud availability, large market size, as well as high fiber connectivity.

Sydney

Despite its geographical remoteness from other global markets, Sydney remains an attractive location for the acquisition and development of data centers due to its speed to market, which usually takes six to eight months less than other tier I markets. Demand Australia is seeing growing data center demand from financial services, internet and tech companies. The bulk of demand is being driven by requirements to service the local market.

Cloud demand is currently very focused on Sydney where it is relatively easy to build capacity. Supply Total fitted occupancy is very high at 97%, while overall occupancy (including shell capacity) is 61%. Pricing is expected to remain relatively flat over the next few years. Growth will be driven by rental escalation terms under existing leases. Hyperscale Demand Many data center operators are benefitting from the expansion of hyperscale data center providers, which are generally opting for colocation deployments rather than self-built facilities.

Sydney's competitive advantages are sustainability, political stability, as well as relatively lower land price and power cost.

Beijing & Shanghai

Key markets in China are experiencing limited pipeline supply. Shanghai is the dominant location and offers more colocation capacity. However, most operators are now considering satellite cities, due to the difficulty in obtaining permits to build and operate date centers within Shanghai and Beijing. While demand in Shanghai is largely driven by multinational financial and tech companies with corporate headquarters in the city, capacity in Beijing is dominated by domestic end-users. Overall, tier I cities are reporting strong end-user demand, with local hyperscale players especially prominent.

- **Beijing:** Demand in Beijing is firm but the market largely caters to domestic end-users. The cost of power is becoming increasingly expensive and is pushing operators towards Hebei, where it has been easier and cheaper to secure power.
- **Shanghai:** For Shanghai specifically, with most existing supply already occupied and upcoming supply being filled quickly, pricing is expected to tighten over the next three years. Furthermore, any new hyperscale requirements are more likely to be fulfilled by new data center builds in Jiangsu and Zhejiang provinces.

The main competitive advantage for both Beijing and Shanghai is the large market size.

Seoul

Due to the absence of international colocation players, the Korean data center market is dominated by owner-occupiers such as government bodies, large conglomerates and local IT service providers including system integrators and telecom companies. Meanwhile, increasing requirements from cloud services and mobile technology are driving robust demand for data centers in Korea. This has driven new data center construction, with cloud players looking to enter the market in locations close to subsea cable landing stations such as Chungnam.

Upcoming new supply consists of owner-operated data centers, mainly belonging to local financial companies, which are integrating older facilities scattered across the country. While it remains challenging for foreign operators to enter Korea, Equinix plans to open its first data center in the country by Q3 2019.

Pricing in Seoul remains low compared to other Asia Pacific markets. This is due to the types of services offered by existing operators and pricing targeted at local end-users. However, pricing is expected to increase marginally over the next three years amid rising demand from foreign parties.

Seoul's primary competitive advantages are comparatively lower power cost, as well as increasing market size.

Mumbai & Chennai

Pricing is consistent across Indian markets as the same local players are prevalent. Demand is relatively flexible at present and is enabling end-users to leverage arbitrage opportunities across different cities.

- **Mumbai:** For Mumbai, Data centers are spread across the Mumbai Metropolitan Area (“MMR”), which includes Mumbai City, the Suburbs, and Satellite Towns. The surge in land prices within Mumbai City has pushed operators to seek locations in the latter two areas, with a strong focus on Navi Mumbai. Supply in Mumbai remains buoyant with overall occupancy levels at 79% and fitted capacity at 12%, indicating considerable room to cater to demand if required. Upcoming supply in Mumbai of 121MW is expected to help alleviate some demand pressure.
- **Chennai:** Chennai is especially attractive to international cloud data center players due to its coastal location providing cost arbitrage through the use of direct submarine lines, as well as government subsidies for data center development.

Mumbai and Chennai's primary advantages are the lowest data center vacancy throughout Asia as well as the lower costs.

APPENDIX.

INDUSTRY SPECIFIC TERMS AND DEFINITIONS

Data Center Power	– usually measured in kilowatts (“kW”) and megawatts (“MW”).
Inventory	– square footage and power that is either leased, planned for future development, under current development, or in a vacant turnkey/conditioned available today.
Absorption (Net)	– the amount of new data center square footage and power leased less the total amount of square footage and power no longer occupied between the current and last measurement periods.
Power Shells	– purpose-built or hardened shell with power and fiber connected to the site but no equipment included. This is commonly seen in wholesale data center development.
Hyperscale Provider	– multi-megawatt provider, typically 5+ MW and larger that operates a wholesale facility and further leases to end-users either on-site or on cloud platforms.
Hybrid IT	– refer to the combination of cloud services, third-party data center outsourcing, and on-premises data infrastructure. This is a practice seen in large corporations to minimize costs while ensuring security, as well as corporations in the transition from one mode of data storage/management to another.

¹ Sources: from various sources – M Capital Group Research, including data from “North American Data Center Report H2 2019”, CBRE, February 2020; “Europe Data Center Q4 2019”, CBRE, February 2020; “Data Center Outlook”, JLL Research Report, March 2020; “The Next Decade. How The Data Center Sector Will Change Year By Year Up To 2030”, Data Economy, January 2020; “Data Center Global Market Comparison”, Cushman & Wakefield, January 2020; “Data Center M&A Deals For 2020 Surpass 2019 Numbers Despite COVID-19 Pandemic”, Data Economy, April 2020; “Alibaba Aims To ‘Speed Up’ COVID-19 Recovery With \$28 Billion Data Center Investment”, CRN, April 2020; “Private Equity Firms Are Taking Over The Data Center Market”, CRN, January 2020; “KKR Plans to Invest \$1 Billion to Build Data Centers in Europe”, Bloomberg, May 2020; “How Data Centers Work”, HowStuffWorks.com, 2013; data from various articles and reports from Technavio, Arizton, Markets and Markets, 2020.



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