2024

GLOBAL DATA CENTER
MARKET COMPARISON

A PUBLICATION OF CUSHMAN & WAKEFIELD'S
DATA CENTER ADVISORY GROUP

CUSHMAN &
WAKEFIELD

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POWER
BECOMES PARAMOUNT

INTRODUCTION

Welcome to our 2024 Global Data Center Market Comparison Ranking. Last year was an incredible year for the industry across all regions, with substantive growth across both established and emerging markets. With commercial real estate and the overall economy facing mounting challenges, data centers remained in strong growth mode as the surge of interest in AI deployment, along with robust cloud demand, maintained confidence in the sector. The sector still encountered its share of challenges, however, with the availability of power and the availability of land (in certain markets) having become the preeminent consideration for hyperscalers and colocation providers searching for sites to swell their portfolios. As a result, data center operators have increasingly turned to secondary and tertiary markets around the world. Markets that only a few years ago were not present in any industry discussions have risen to the forefront and are seeing hundreds of megawatts (MW) in their pipelines.
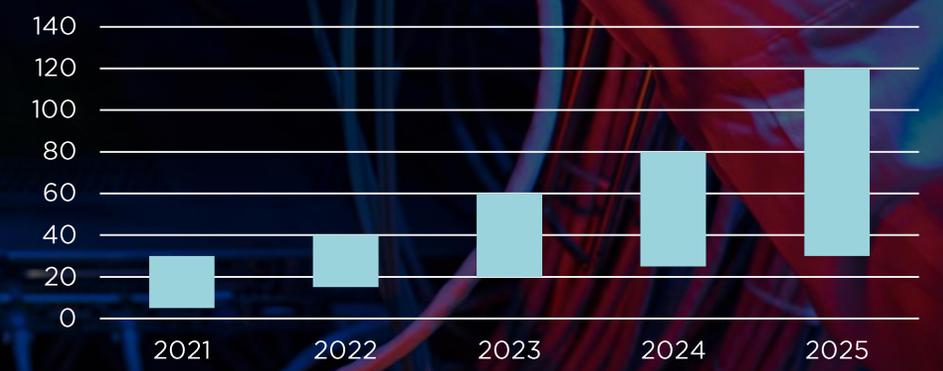
The rise of generative AI has had a major impact on the sector, resulting in several data center players reevaluating how they strategize data center development. AI data centers can be divided into two categories: 1.) training facilities where AI models learn their applications on large datasets and 2.) inference facilities that deploy AI applications for users. Notably, training facilities will be less latency-dependent than traditional data centers. Site selection has changed as model training-focused facilities do not generally require as low latency as cloud deployments, while inference-focused facilities will remain proximal to cloud regions. The design of data centers will need to change as well; as rack densities will increase, so too will the intensity of cooling technologies. Many data center developers have opted for multiple avenues for cooling within their facilities, and many expect direct "to-the-chip" liquid cooling to rise to prominence. As cloud growth moderates on an annual basis going forward, AI will prove to be significant to the growth of data centers.

Cloud & AI driving demand for power, increasing server densities, cooling requirements

Forecasted Annual Cloud & AI Revenues 2020 - 2028

Legend: ■ Non-AI Global Colocation ■ AI Demand
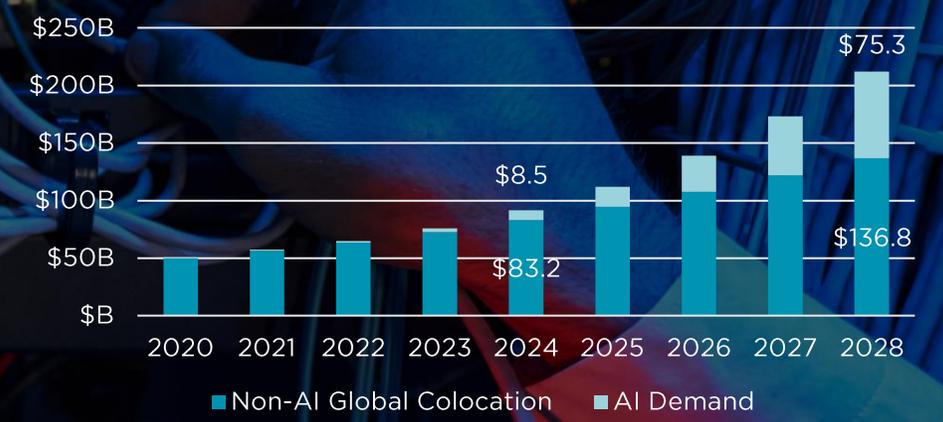
Average Server Rack Density Ranges (kw / rack)

Source: Cushman & Wakefield Research, Structure Research

REGIONAL
GROWTH

Total capacity is expected to continue its growth across regions, with each expected to double or more with current pipelines underway.

AMERICAS
2.5X
increase in total capacity

EMEA
2X
increase in total capacity

APAC
2.2X
increase in total capacity
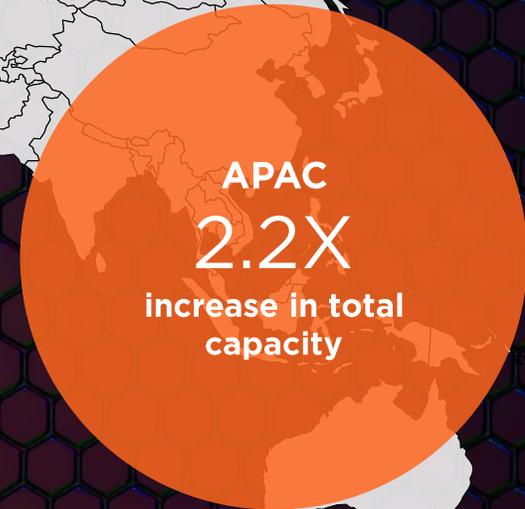
KEY ASSUMPTIONS:

- Development pipeline excludes developments currently at land stage
- Vacancy is only calculated on Operational Colocation IT Load
- The size of the bubble directly co-relates to the size of the regional markets
- 'Others' comprise of the telecom & edge operators

- **Operational Capacity: 16,820MW**
  - o Colocation: 8,909MW
  - o Cloud: 6,835MW
  - o Others: 1,076MW
- **Vacancy: 5%**
- **Development Pipeline: 24,794MW**
  - o Colocation: 20,963MW
  - o Cloud: 3,431MW
  - o Others: 400MW

- **Operational Capacity: 6,218MW**
  - o Colocation: 4,659MW
  - o Cloud: 1,286MW
  - o Others: 273MW
- **Vacancy: 9%**
- **Development Pipeline: 6,528MW**
  - o Colocation: 5,468MW
  - o Cloud: 1,008MW
  - o Others: 51MW

- **Operational Capacity: 10,584MW**
  - o Colocation: 8,819MW
  - o Cloud: 1,514MW
  - o Others: 252MW
- **Vacancy: 16%**
- **Development Pipeline: 13,281MW**
  - o Colocation: 10,707MW
  - o Cloud: 2,486MW
  - o Others: 87MW

INCLUDED
MARKETS

* New market in 2024 report

AMERICAS

Atlanta	NY-Northern NJ
Austin	Phoenix
Bogota	Oregon
Boston	Querétaro
Chicago	Quincy*
Columbus	Reno
Dallas	Salt Lake City
Denver	SF Bay Area
Indianapolis	Santiago
Iowa*	Sao Paulo
Kansas City	Seattle
Las Vegas	Toronto
Los Angeles	Vancouver
Minneapolis	Virginia
Montreal	
Nashville	
North / South Carolina	

APAC

Auckland*	Kuala Lumpur
Bangkok	Manila
Batam*	Melbourne
Beijing	Mumbai
Bengaluru	Osaka
Brisbane*	Perth*
Busan	Pune*
Canberra	Seoul
Chennai	Shanghai
Delhi NCR	Singapore
Guangzhou	Sydney
Hanoi	Taipei*
Ho Chi Minh	Tokyo
Hong Kong SAR	
Hyderabad	
Jakarta	
Johor	

EMEA

Abu Dhabi*	London
Amsterdam	Madrid
Athens*	Marseille
Barcelona	Milan
Berlin	Munich
Brussels*	Nairobi*
Copenhagen	Oslo
Dammam*	Paris
Doha*	Prague*
Dubai*	Reykjavik
Dublin	Riyadh*
Frankfurt	Stockholm
Istanbul	Vienna*
Jeddah*	Warsaw
Johannesburg	Zaragoza*
Lagos*	Zurich
Lisbon*	

INCLUDED
MARKETS

Many major markets have expanded beyond their traditional clusters and now encompass large swathes of area.

Access to liquidity and transaction volumes have slowed for a host of CRE sectors as interest rates rise. While data centers have not been completely immune to this, there's been consistent momentum for further expansion of institutional capital in the space. Over the past year, we saw some major acquisition events: Brookfield Infrastructure and Ontario Teachers Pension Plan acquired Compass Datacenters for $5.5B and Aligned Data Centers acquired LATAM-based ODATA for $1.8B. While 2022 was a record year in terms of fundraising, with over $41B raised by funds targeting the data center space, 2023 was far closer to historical averages with $7B raised to target the sector. With many of the primary colocation providers now paired off with key institutional investors, there are few prospects for large scale acquisition opportunities remaining in established markets. Investors seeking entrance into the space may want to focus on partnering or acquiring emerging operators, ones who are less mature in their expansion plans or focused on specific regions.

As predicted in last year's report, the momentum for self-performing hyperscale assets continues. Hyperscalers are also some of the first movers into emerging markets, taking advantage of their ability to execute vertically integrated self-builds as well as key partnerships with local governments and telecom companies. This year, hyperscalers made major announcements across Southeast Asia, the Middle East, South Asia, Sub-Saharan Africa and Latin America. While there have been a few cases of projects being paused or cancelled, fears of a complete halt of expansion plans in the wake of worldwide economic stress have been largely unfounded. Secondary markets are anticipated to continue their growth in importance as certain primary markets have run into constrictions, with power usage and sustainability scrutinized more carefully.

For established markets, growth momentum has continued in most markets despite the rise of power challenges and regulatory factors that began in 2022. In the Northern Virginia market, development marched quickly into areas not constrained by the infrastructure challenges of power distribution faced in the traditional clusters of Loudoun County. At this point, the market encompasses the entirety of Virginia with substantial developments announced for Prince William County, Culpeper, Spotsylvania and as far as Richmond. This trend of moving to farther outlying areas to establish new data center clusters has become common across larger markets worldwide.

Data center developers around the world continue to face increasing pushback from government and local communities when it comes to development. Challenges have arisen from grid power availability versus competing uses, resistance, real or perceived, that data centers may not be bringing the level of economic betterment in the form of employment and taxes that local communities desire. Operators for their part have made increasingly stronger commitments to renewable power usage, providing investments that work to benefit their surrounding communities. In Singapore, the government has approved new data center builds to commence since lifting the development moratorium in 2022. In European markets like Frankfurt, Dublin and Amsterdam, discussions on the numerous projects proposed there continue.

INTRODUCTION TO THE
RANKING

The 2024 Global Data Center Market Comparison reviews a newly modified set of factors compared to previous editions of the report. With rapid changes in both tailwinds and headwinds of the space, the ranking model has been recalculated based on surveys we conducted on dozens of experts around the world, adjusting both the included variables and their rankings. Additionally, we have split the ranking between a list of established and emerging markets, as well as highlighted smaller markets that are of growing interest. For each factor, we will investigate the key trends globally with further commentary on a region-by-region basis.

With this fifth edition of the report, we hope to provide members of the data center community with a better understanding of how the industry is rapidly changing and expanding across the globe. Additionally, we aim to provide readers with an understanding of the differing dynamics of major and minor markets.

METHODOLOGY

The 2024 Global Data Center Market Comparison reviews the same factors outlined in the previous two editions. We scored each data center across 14 weighted categories enabling us to assign each metropolitan area with an overall market score.

HIGH-WEIGHT

- **Power Availability**
- **Land Availability**
- **Market Size**

MID-WEIGHT

- **Development Pipeline**
- **Land Price**
- **Fiber Connectivity**
- **Vacancy & Absorption**
- **Regulations & Incentives**
- **Power Cost**
- **Cloud Availability & Operator Presence**
- **Renewable Power Options**

LOW-WEIGHT

- **Environmental Risk**
- **Taxes**
- **Water Availability**

RANKING
COMMENTARY

This year, we saw some substantial movement in exact rankings—with some familiar faces remaining in the Top Ten Established Markets while several newcomers entered our Top Ten Emerging Markets.

No longer defined as Northern Virginia, the Virginia mega-market now includes outlying submarkets such as Culpeper, Richmond, Spotsylvania County and Fredericksburg. Keeping Virginia securely in the top spot are its heightened available power infrastructure and land options. Across the Americas, Atlanta, Dallas, Phoenix and Oregon remained in the Top Ten Established Markets, while shuffling their exact positioning. Chicago remained just outside, ranking 11 while Silicon Valley fell to 15 due to quickly rising power costs and limited land availability. For emerging markets, Kansas City, North / South

Carolina and Indianapolis have all been on the rise in terms of hyperscale development—all due to their significant available acreage and being connected to either largely untapped power grids or renewable energy development.

In the Asia Pacific region, Mumbai, Tokyo and Jakarta have jumped up the rankings as some of the most rapidly growing markets with each of them scoring well in absorption, development pipeline and vacancy among a host of other factors. Constriction with available land has pushed both Singapore and Hong Kong off the Global Top Ten Established Markets Ranking. For emerging markets, Osaka, Chennai, Hyderabad and Johor have benefited from high competition for sites in their nearby neighbors of Tokyo, Mumbai and Singapore.

In EMEA, while Frankfurt, London, Amsterdam, Paris and Dublin (FLAPD) markets continue to be challenged when it comes to future growth, markets such as Madrid have picked up the slack. London, as the largest European market, steadily remains on the list at 8. A host of emerging markets are growing in the region, with interest in Southern European markets like Milan and Mediterranean coastal markets, spurred by subsea connectivity to Africa, the Middle East and Asia Pacific. Meanwhile, the Nordic countries have seen interest as a result of large renewable energy reserves, leading to growth in Copenhagen, Stockholm and Oslo and more rural locations close to major renewable power connections.

GLOBAL ESTABLISHED
MARKETS RANKING

1. Virginia
2. Atlanta
3. Tokyo
4. Dallas
5. London
6. Phoenix
7. Mumbai
8. Oregon
9. Sydney
10. North/South Carolina

GLOBAL EMERGING
MARKETS RANKING

1. Kansas City
2. Milan
3. Nashville
4. Osaka
5. Iowa
6. Zurich
7. Minneapolis
8. Hyderabad
9. Austin
10. Bangkok

TOP 10 MARKETS
BY REGION

ESTABLISHED MARKETS RANKINGS

	AMERICAS	APAC	EMEA
1	Virginia	Tokyo	London
2	Atlanta	Mumbai	Madrid
3	Dallas	Sydney	Paris
4	Phoenix	Beijing	Frankfurt
5	Oregon	Jakarta	Amsterdam
6	North/South Carolina	Singapore	Dublin
7	Chicago	Johor	Oslo
8	Columbus	Kuala Lumpur	Brussels
9	Toronto	Shanghai	Stockholm
10	SF Bay Area	Hong Kong	Johannesburg

EMERGING MARKETS RANKINGS

	AMERICAS	APAC	EMEA
1	Kansas City	Osaka	Milan
2	Nashville	Hyderabad	Zurich
3	Iowa	Bangkok	Copenhagen
4	Minneapolis	Chennai	Warsaw
5	Austin	Delhi NCR	Riyadh
6	Queretaro	Taipei	Zaragoza
7	Salt Lake City	Guangzhou	Abu Dhabi
8	Indiana	Batam	Athens
9	Santiago	Manila	Lagos
10	Denver	Pune	Dammam

POWER
AVAILABILITY

HIGH-WEIGHT CRITERIA

Over the past year, power has become the number one consideration for data center operators as they conduct site selection to rapidly grow their portfolios. Many utility providers are suggesting wait times of 2-3 years or more for sizable power to be delivered to their developments. As data center campus sizes have grown on average, we've seen power requirements grow as well. In 2023, it was not uncommon to see power purchase agreements (PPAs) signed for 200, 300 or 400MW for new developments. Google set a record data center agreement when it signed a purchase of over 600 MW for its Texas self-build facilities.

Many operators have begun to canvas counties and utility providers across regions in search of large tracts of untapped, ready-to-go power in the range of hundreds to thousands of megawatts. Additionally, markets with available power from renewable sources such as wind, solar and hydroelectric have become prioritized.

The challenge of available power has led operators to invest in new power technologies. Battery storage facilities have become more commonplace; many renewable sources are now supplemented with battery storage to ensure more consistent power output. In Nevada, Google has tested a novel way of generating geothermal power through circulating and heating water through the earth's crust. Historically, geothermal power has been highly limited to markets with volcanic activity, such as Iceland. Now, states like California have added geothermal as a key source to the future energy mix of their markets.

For our estimates, we utilized estimates of current availability along with capacity additions directly from utilities (from published resource plans where available) as well as additions from private energy developers that could form direct partnerships.
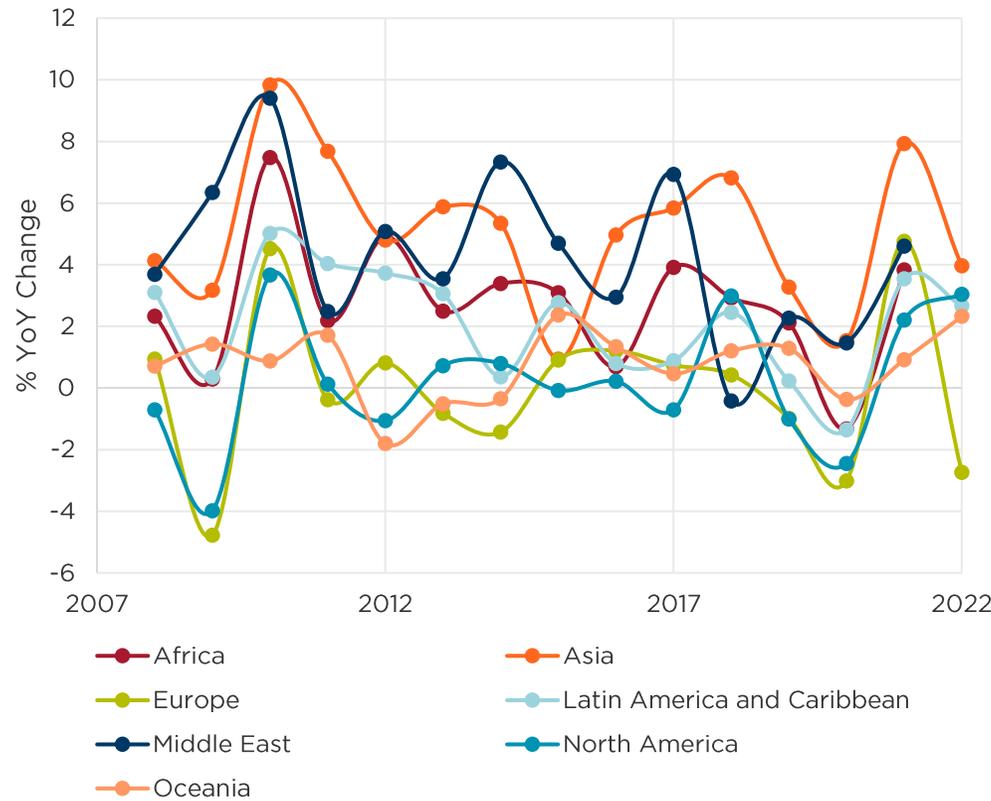
Multiple markets have received requests for power exceeding current grid capability
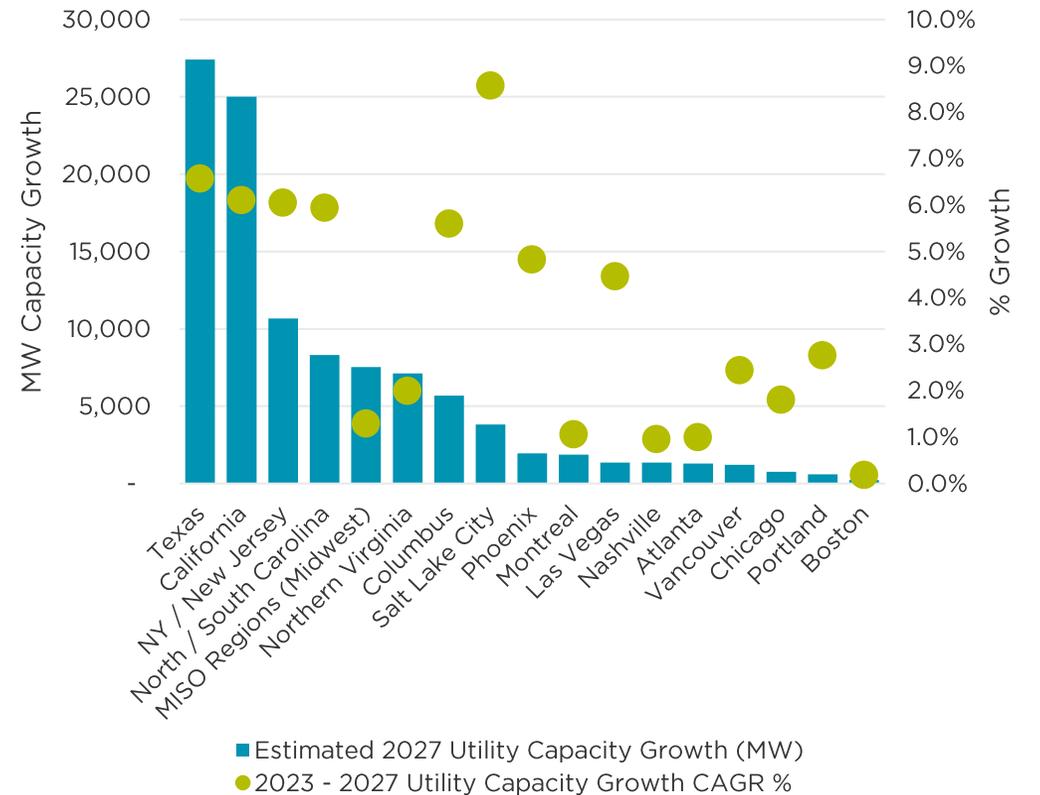
TOP MARKETS

Dallas

Mumbai

North / South Carolina

Frankfurt

Stockholm

Jakarta

Atlanta

Virginia

Oslo

Madrid

POWER
AVAILABILITY

HIGH-WEIGHT CRITERIA

% YoY Change in Total Utility Demand by Global Region

Legend:
- Africa
- Asia
- Europe
- Latin America and Caribbean
- Middle East
- North America
- Oceania

Case Study: US Utility Provider Markets Est. Capacity Growth 2023 - 2028

- Estimated 2027 Utility Capacity Growth (MW)
- 2023 - 2027 Utility Capacity Growth CAGR %

Source: Cushman & Wakefield Research, Ember Climate, Local Utility IRPs and Annual Reports (assuming baseline scenarios)

HIGH-WEIGHT CRITERIA

LAND
AVAILABILITY

As cloud demand has risen and with AI demand on the doorstep, operators have sought to build out ever larger developments to satisfy hyperscale users. In addition to demanding larger swathes of power, operators have sought to source larger acreages across all regions. The benefits of these larger acquisitions are two-fold. First, it enables developers to lock-in a land price that shields exposure to speculative demand that often emerges once a major data center development is announced in a market, and would place upward pressure on pricing. Second, it enables the operator to control the phasing of the development, as many of these newer campuses can have anywhere from 2 to 20 structures that could be built over a period of several years. Larger acreages also have some other minor benefits, including having additional land for substation or renewable energy development. We've seen over the past few years land become constrained in a number of the major markets, including Singapore, New York / New Jersey, Frankfurt, Hong Kong and Silicon Valley. The push for available land has led to several secondary markets rising into prominence over the past year.

Availability was based on transaction totals in 2023 as an indicator of market activity and momentum.

TOP MARKETS

Phoenix

Dallas

Atlanta

Sydney

Jakarta

Virginia

Beijing

North / South Carolina

Kansas City

London

While smaller transactions are still frequent, larger 500 – 1,000+ acre transactions are becoming more common.

LAND
AVAILABILITY

Case Study: North America Data Center Land Sales – Average Site Size & Pricing Trend

Legend: Average of Acres — Price / Acre
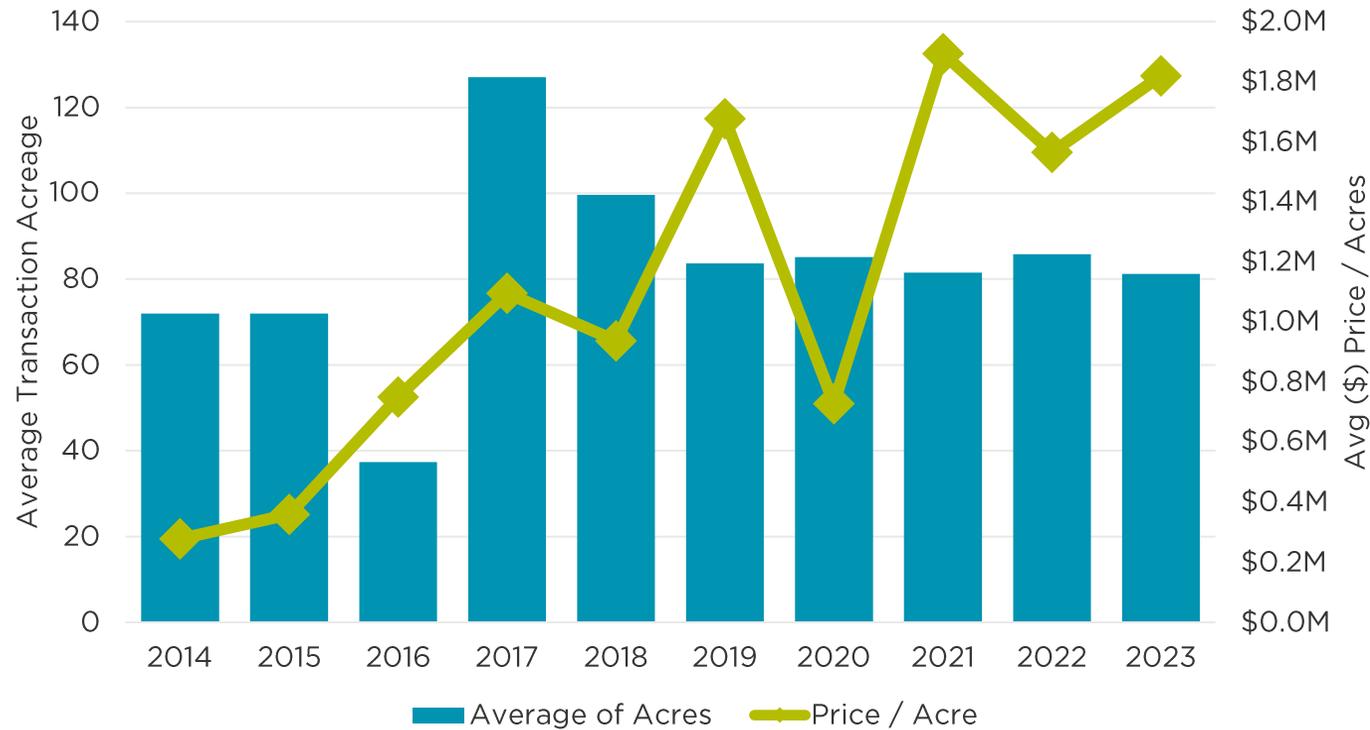
Source: Cushman & Wakefield Research

MARKET
SIZE

An existing major market has a multitude of advantages that appeal to clients and operators alike. After all, the most well-established markets have access to all major cloud services, allowing for high performance and peering opportunities.

There are known operators in these markets, with corresponding experienced talent for hire and knowledgeable sales representatives to assist with filling buildings. Local governments understand the planning approval process, and utilities are not surprised when operators inquire about large power requirements. While the largest markets may find constraints due to power availability or political obstacles, often there are rural outlying submarkets that can be more amenable to development.

For hyperscale cloud services, large markets appeal first as an opportunity to create new business and then to expand thereafter once usage has become commonplace. A number of colocation operators will lease or build a major data center after signing an initial anchor tenant, in the expectation that surrounding enterprises or government organizations that conduct business with the initial tenant will later join on the platform. After a first hyperscaler enters, others follow to compete for market share, swelling the size of the capacity in-market and leading to further construction, with mid-scale cloud services moving in thereafter.

Americas: While Virginia remains far and away the largest market in the world, we've seen sizable growth in the next tier of markets. Dallas, Chicago, Phoenix and Atlanta have all added a large amount of capacity over the past year. Fast-growing markets such as Oregon, Columbus, Salt Lake City and Kansas City have all jumped substantially with hyperscalers expanding campuses.

APAC: The traditional major markets of Tokyo, Sydney, Hong Kong, Singapore and Beijing continue to outstrip inventories elsewhere. While Singapore and Hong Kong have faced regulatory and land availability challenges respectively, they remain highly desirable due to location and infrastructure. Growing digitization and infrastructure deployments in secondary APAC markets has led to growth in places such as Mumbai, Johor, Batam, Kuala Lumpur, Bangkok, Ho Chi Minh and Manila.

EMEA: While growth in FLAPD markets has slowed, Frankfurt, London, Paris and Dublin remain the largest markets in the region. Growth in Nordic and Mediterranean markets has led to quickly rising capacity in markets such as Madrid, Milan, Oslo and Stockholm. These two sub-regions will continue to see high speed growth going forward. In Africa and the Middle East, emergent data center clusters continue to gain momentum.
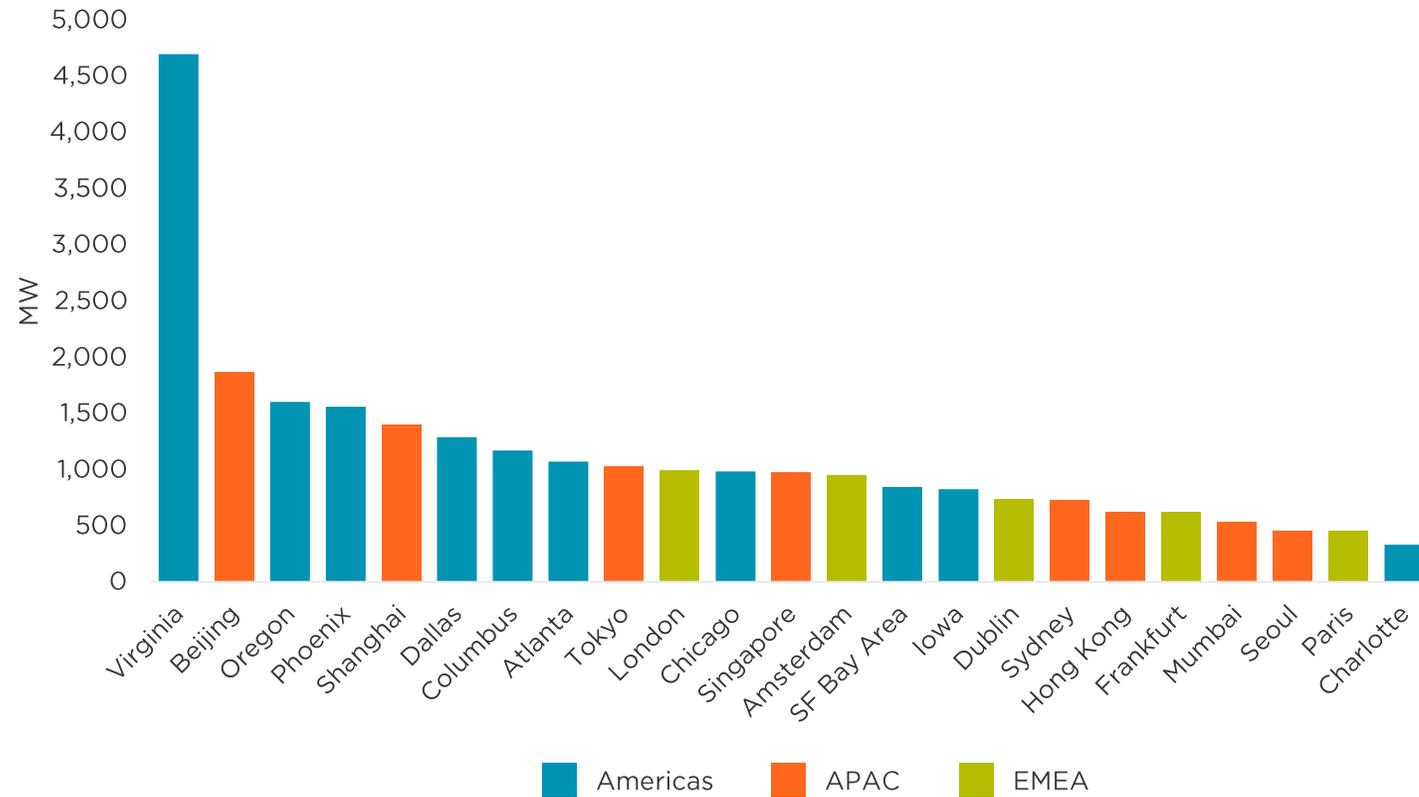
TOP MARKETS

- Virginia
- Beijing
- Tokyo
- Shanghai
- London
- Sydney
- Frankfurt
- Oregon
- Dublin
- Phoenix

MARKET
SIZE

HIGH-WEIGHT CRITERIA

Top Markets by Operational IT Load

Chart: MW (vertical axis, 0 to 5,000) by market

Legend:
- Americas
- APAC
- EMEA

Markets (left to right): Virginia, Beijing, Oregon, Phoenix, Shanghai, Dallas, Columbus, Atlanta, Tokyo, London, Chicago, Singapore, Amsterdam, SF Bay Area, Iowa, Dublin, Sydney, Hong Kong, Frankfurt, Mumbai, Seoul, Paris, Charlotte

Source: Cushman & Wakefield Research, datacenterHawk, DC Byte, Structure Research

DEVELOPMENT
PIPELINE

The continued growth in data center needs globally has led to an ever-growing development pipeline, as formerly secondary and tertiary markets rapidly scale. Last year, there was a record 7.1 GW under development across 63 markets. Since then, that number has grown to over 12GW with substantial growth in both traditional clusters in North America, Asia Pacific and Europe as well as rapid growth in Latin America, Africa and the Middle East.

Several countries around the world have already observed this development, with the strength of Frankfurt leading to development in Berlin and Munich in Germany, or an initial hub of Mumbai in India, leading to growth in Delhi, Chennai, Hyderabad and Bengaluru as examples.

Supply chain concerns, which had been present during the pandemic period, grew throughout the year. Certain projects experienced pauses in development as specific component sourcing faced challenges. In other instances, developers began stockpiling certain components in expectation of further challenges. Disruption will likely continue to be a nuisance over the next several years, as further supply chains are constructed, and vendors adjust manufacturing accordingly.

Americas: Buoyed by new announcements in outlying clusters, the six largest markets (Virginia, Dallas, Chicago, Phoenix, SF Bay Area and Atlanta) have all seen their pipelines reach record levels. Phoenix, Dallas, and Atlanta in particular have seen dramatic growth. In Phoenix's case, the market alone has well over 1GW in recently announced developments.

APAC: Hyperscale activity has continued to add significantly to pipelines across markets like Mumbai, with new announcements in Thailand and Vietnam leading to particular growth in those emergent markets. India recently crossed 1GW in total capacity, with markets like Singapore, Sydney and Hong Kong also approaching the 1GW mark.
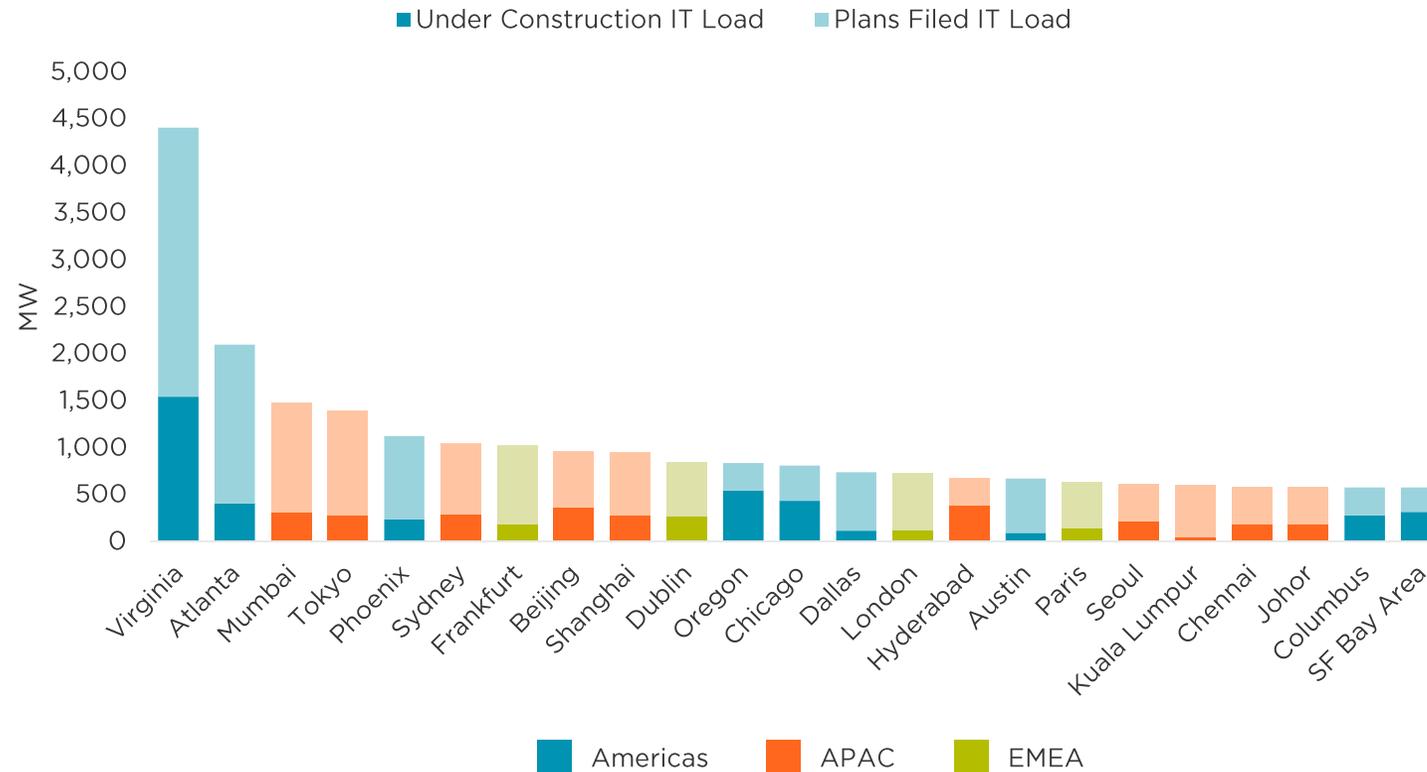
EMEA: In spite of constraints on available power, land and political sentiment, the total pipeline of markets like Frankfurt, Dublin and London has continued to grow. Meanwhile pipelines in Mediterranean markets such as Milan, Madrid, Barcelona and Nordic markets like Stockholm, Oslo and Copenhagen have expanded.

TOP MARKETS

Virginia

Atlanta

Mumbai

Tokyo

Phoenix

Sydney

Frankfurt

Beijing

Shanghai

MID-WEIGHT CRITERIA

DEVELOPMENT
PIPELINE

Top Markets by Combined IT Load Under Construction / Plans Filed

■ Under Construction IT Load   ■ Plans Filed IT Load

■ Americas   ■ APAC   ■ EMEA

Source: Cushman & Wakefield Research, datacenterHawk, DC Byte, Structure Research

MID-WEIGHT CRITERIA

LAND
PRICE

While the cost of land ends up as roughly 10% of the total capital expenditures of a data center development, it remains a key one where developers can have control. Despite being a smaller fraction of overall costs, higher initial land pricing can provide certain barriers of entry and are a concern in several key data center markets that have grown accustomed to the largest deployments. A quality data center site has several factors noted throughout this report; access to power (and a supportive utility to work with), limited exposure to natural disasters, access to networks, provision of water for cooling systems, proper zoning and potentially incentive packages for locating in a particular area. The best markets have all of these and still maintain a low cost of land, a very tricky balance with sites in such demand.

Competition for sites between both data center players and other asset classes has reached a fever pitch over the past few

years. Land pricing has steadily risen for sites with plentiful power, fiber connectivity, proper zoning, water and sewage management. Developers have increasingly sought larger and larger acreages for sites, seeking to control the destiny of their campuses while not being beholden to landbanking and prospecting by third parties aware of data center activity in a submarket. Many acquisitions now range in the hundreds of acres, with developers planning to phase buildout of campuses over several years. Competition for these power plentiful sites are not only in play between different data center developers, but increasing interest to EV battery factories and advanced chip manufacturing as well; asset classes that have been spurred by recent government incentives and needs for significant power.

Americas: Land competition has been high in established data center clusters, with new emergent submarkets seeing

quick action for follow-on acquisitions from other operators in markets such as Columbus, Denver, Quincy, Salt Lake City, Kansas City, Tennessee and North / South Carolina.

APAC: Pricing remains high in the land-constrained major markets of Singapore and Hong Kong. Indeed, land pricing across many Asia-Pacific markets remains relatively elevated. Even minor markets have seen growth with data center entrants increasingly making acquisitions in markets such as Bantam, Perth, Ho Chi Minh and Jakarta.

EMEA: While European markets continue to have relatively high costs. African and Middle Eastern markets continue to have lower cost opportunities for data center developers. Markets such as Johannesburg, Cairo, Casablanca, Riyadh, Cape Town, Lagos and Nairobi.

TOP MARKETS

Hanoi

Batam

Perth

Columbus

Jakarta

Denver

Quincy

Queretaro

Nashville

Oregon

FIBER
CONNECTIVITY

MID-WEIGHT CRITERIA

Fiber density and quality are primary drivers for locating a data center, with fiber serving to connect the facility to others and to the end user. More networks are always better, with the diversity of fiber leading to lower latency and higher performance, even if certain networks connected to a particular data center may have bandwidth issues.

Bandwidth is an increasing discussion point to the edge, considering the move over the past two years to a work-from-home environment and the correspondingly constant usage of videoconferencing platforms for meetings that were once in person. Fiber networks are constructed in an array of formats, with short-haul fiber linking a metropolitan area or long-haul fiber connecting

multiple regions and countries. Undersea cables add to the mix, directly connecting landing points in countries across seas or oceans to transmit information. Like last year, we utilize the Ookla Speedtest Global Index for broadband speeds as an indicator for fiber connectivity and speed.

Results of the Speedtest Global Index analysis show that Beijing and Shanghai have pushed into the top spots, with smaller, highly connected American markets such as Austin, Kansas City, North / South Carolina and Columbus making an appearance. Major Asia Pacific hubs such as Singapore and Hong Kong make an appearance along with regional key data points such as Abu Dhabi and Dallas.

Fiber networks are constructed in an array of formats, with short-haul fiber linking a metropolitan area or long-haul fiber connecting multiple regions and countries.

TOP MARKETS

Beijing

Shanghai

Austin

Kansas City

Abu Dhabi

North / South Carolina

Singapore

Hong Kong

Columbus

Dallas

MID-WEIGHT CRITERIA

VACANCY /
ABSORPTION

A tight market is a general indicator of heavy demand, and the same has applied in the data center world over the past year. Appetite for new capacity from hyperscale cloud services remains unsated, with the largest moving entire markets with one or two large leases. The issue around obtaining capacity is increasingly the same in most primary locations; where the total market may have anywhere from 5-10% vacancy, finding space in large hall- or building-sized spaces is exceptionally difficult for those who require contiguous 10 MW blocks. Often a dichotomy forms between those aiming for hyperscale and those working with the retail colocation market; one side will only aim for leases of 5 MW and above, while the other works with 500-kilowatt (kw) deployments and below.

To remedy this struggle, data center sites continue to trade not only what can be built today, but also what can be constructed in phases over a five- to 10-year period. Extra land allows for build-to-suit completions and expansions by current tenants and ensures staying power for years to come. Markets that have higher structural vacancy often witness

this vanish once an initial hyperscaler moves to the area; in the continued battle for market share, one key service often leads to many, and capacity rapidly disappears as these services compete for local enterprise, government and other organizational clients. Over the past year, pre-leasing of space has reached record levels, accounting for between 60% - 70% of leases in major markets.

Absorption figures have also reached record levels, totaling several gigawatts in each region: 4.2GW in the Americas, 1.7GW in EMEA and 2.3GW in APAC. This has been a result of a combination of both hyperscaler demand for additional cloud capacity as well as the burgeoning interest in artificial intelligence. Indeed, in North America alone, 2023 saw over 2GW of deals signed for artificial intelligence purposes.
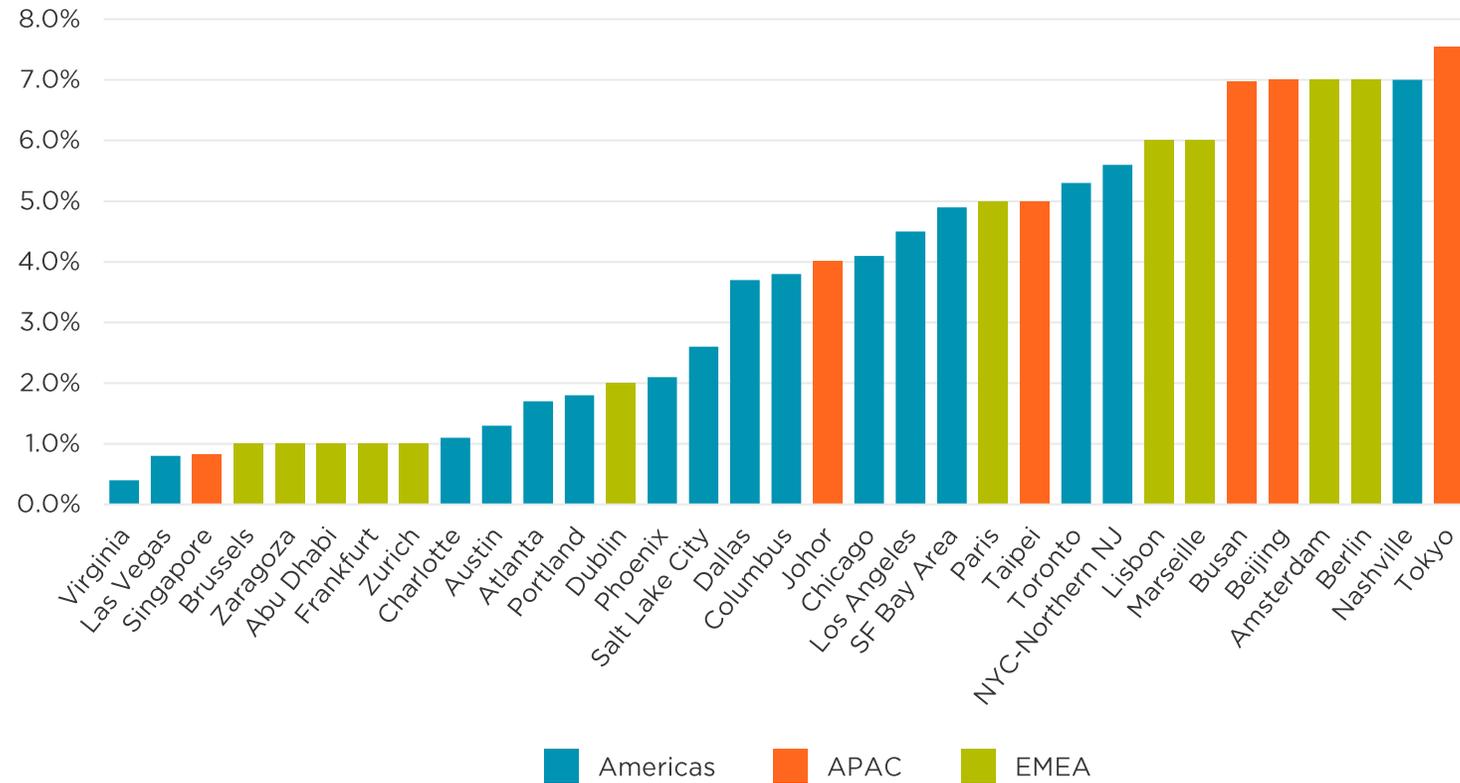
Now most established markets see vacancies under 10%, with the top markets in each region being below 5% vacancy.

TOP MARKETS

Beijing

Shanghai

Austin

Kansas City

Abu Dhabi

North / South Carolina

Singapore

Hong Kong

Columbus

Dallas

MID-WEIGHT CRITERIA

VACANCY /
ABSORPTION

Markets by Lowest Vacancy %

Legend: Americas · APAC · EMEA

Source: Cushman & Wakefield Research, datacenterHawk, DC Byte, Structure Research

CUSHMAN & WAKEFIELD | DATA CENTER ADVISORY GROUP

CLOUD OPERATOR
PRESENCE

MID-WEIGHT CRITERIA

One of the primary drivers of demand is the robust growth of cloud platforms; in nearly any market around the world hyperscale cloud services represent 70-80% of all leasing in any given quarter as the all-out battle for market share continues.

The three largest by market size (Amazon Web Services, Microsoft Azure, Google Cloud) continue to innovate apace, adding an array of services at the edge to join with core hosting, storage and database options, entrenching usage inside the largest enterprises and government organizations. As further entities choose to move more of their workloads to the public cloud for scalability and ease of access, a variety of markets will benefit as the hyperscalers work to bring clients online.

Of continued increase in importance are markets that offer multiple cloud services, as early adopters are now diversifying their workloads to create true hybrid IT. This will often include multiple public cloud instances for varying uses, along with some use of private cloud in a colocation environment for others. Markets that offer services such as peering opportunities and plenty of on-ramps will gain

business from these more sophisticated organizations, especially those that look to access a wide array of options and seek to utilize further specialized applications in the future. One adjustment we've made to our methodology is to include the presence of cloud service providers' edge locations in a market. These edge locations provide direct access to a secure backbone connected to larger availability zones and cache sites that the cloud provider maintains in the region, reducing latency and opening access to high performance for more users.

Of the 92 markets profiled in this report, 37 now offer all three major cloud services, all of which have considerable future expansion planned and land acquired in expectation of further growth. New entrant Hyderabad already has two cloud services present, providing an alternative to Mumbai as a top Indian market with cloud access.

Milan, Bogota, Malaysia and Saudi Arabia rose to have one or more cloud providers expand their footprints in those markets.

TOP MARKETS

Virginia

Iowa

Dublin

Columbus

Amsterdam

Oregon

North / South Carolina

Dallas

Quincy

Singapore

MID-WEIGHT CRITERIA

REGULATIONS &
INCENTIVES

A strong package of data center incentives signals that not only is a local area amenable to supporting the data center industry, but that there are likely existing relationships with local utilities and communities to allow for such development to continue at large scale. Incentives come in many forms, though mainly involve tax relief from property taxes, value added or sales taxes, discounted power with usage of renewables, and other financial support from typical rates charged for smaller- scale purchases. As the largest data center campuses cost nine figures and beyond over time, this tax support enables areas to be considered for development more quickly with long-term expansions planned well in advance.

Americas: Incentives for data center development have recently been added or updated in several states including Pennsylvania and Arkansas. Incentives at a market level have also increased in some cases. However, several submarkets in Northern Virginia and the Pacific Northwest have begun to see local pushback against both development and incentives for data centers.

APAC: With robust data center growth, Singapore, Sydney, Melbourne and Hong Kong established data center policies with strong incentive structures. Additionally, more emergent markets in the region have started to consider potential incentive structures, with a number using free enterprise zone policies along with additional tax relief.

EMEA: As a result of the European Union, incentives between European countries are carefully regulated. Existing incentive structures focus on green data center construction and renewable energy usage. Certain Nordic markets, such as Reykjavik, Oslo, and Stockholm offer packages that lower taxes or provide incentives for using renewables. In France, both Paris and Marseille also offer benefits for those who acquire renewable energy for their projects.

Tax support enables areas to be considered for development more quickly with long-term expansions planned well in advance.

TOP MARKETS

Singapore

Sydney

Melbourne

Amsterdam

Toronto

Stockholm

Montreal

Dublin

Hong Kong

London

MID-WEIGHT CRITERIA

RENEWABLE POWER
OPTIONS

Recent news regarding the lack of progress on carbon emission reduction continues to focus minds on the rapidly increasing need to derive efficiencies from all industries globally, with data centers seen as a key sector. Rising energy demands require a concerted effort to reduce carbon impact. While many industries will have considerable difficulty reducing their carbon footprint, as a high-tech and multilayered asset class data centers have many opportunities to do so, including immersion/liquid cooling, artificial intelligence to manage data center workloads, sourcing renewable construction materials, and much more. These methods are excellent for the environment, and in turn, deliver lower operating costs over the life of the asset, which in the largest data centers can be well past nine figures. Increasingly, creative methods are being discovered to better utilize all parts of a data center, expanding to the reuse of waste heat to warm nearby homes.

As noted in the 2023 Report, the largest hyperscale tenants have all committed to reducing their carbon footprint in all facets of operations, with data centers a primary concern. With 2030 Carbon Net Zero goals on the very near horizon, many hyperscale self-builds and larger-scale developments are being paired with new renewable energy infrastructure development. In multiple instances, wind and solar farm sites are planned alongside 100MW+ deployments. The ability to build out energy infrastructure is becoming a vital component for the largest facilities.

In this report, we've updated scoring to reflect the latest renewable percentage for key markets across the globe. For cities that have committed to fully renewable power, including Montreal, Sydney, Oslo and Reykjavik, this means abundant hydropower and utilities that are able to tap this energy accordingly. With the abundant hydropower in the Pacific Northwest, Vancouver and Seattle follow closely behind.

The largest hyperscale tenants have all committed to reducing their carbon footprint in all facets of operations, with data centers a primary focus.

TOP MARKETS

Montreal

Copenhagen

Vancouver

Stockholm

Oregon

Oslo

Silicon Valley

Mumbai

Sydney

Singapore

MID-WEIGHT CRITERIA

RENEWABLE POWER
OPTIONS

% of Total Energy Fuel Mix is Renewable (Solar, Wind, Hydroelectric, Geothermal, or Other)

Legend:
— Africa
— Asia
— Europe
— Latin America
— Middle East
— North America
— Oceania
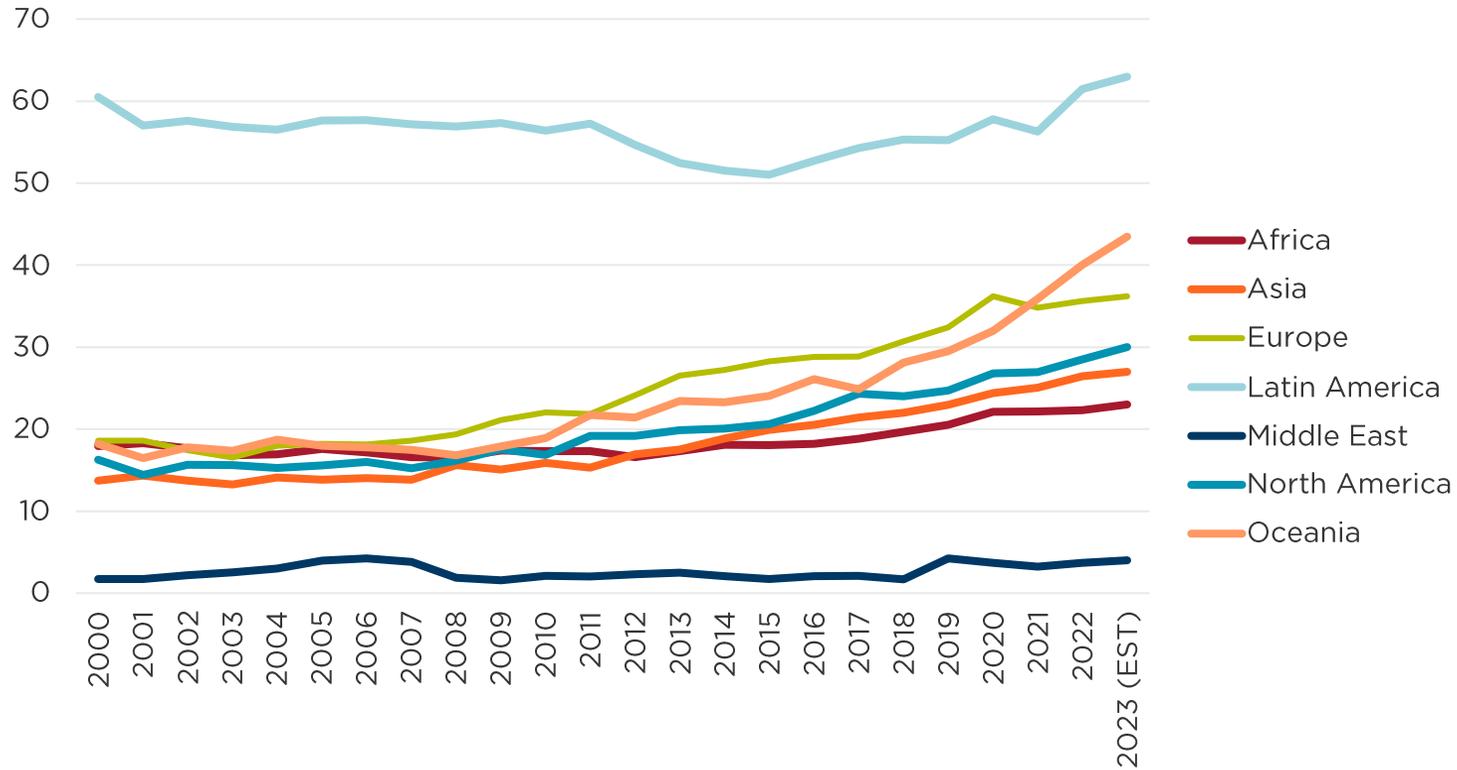
Source: Cushman & Wakefield Research, Ember Climate, note; renewable % does not include nuclear

POWER
COST

MID-WEIGHT CRITERIA

Analysis of data center costs often focus on initial capital expenditure with the costs of planning, permitting, acquiring land, building construction and potentially substations and fiber extensions resulting in a considerable barrier to entry of circa $10-12M per MW. These initial costs end up as a small fraction of the overall operating expenditure over the life of the building, as the consistent need for increasing power over several phases of expansion can lead to spiraling power needs.

As noted in other sections of this report, new technology (or the better use of current technology) from artificial intelligence to predict workload needs and more sophisticated forms of cooling can assist with saving power costs, particularly for the increasingly dense workloads favored by the

heaviest users. Those fortunate enough to operate in certain climates are also able to utilize free cooling in the evenings, with many of these cooler areas also using lower- cost hydropower. The benefit of renewable hydropower cannot be understated; not only does this assist in lowering the total carbon footprint of a data center, it also is available at far lower cost than other methods with a concurrently lower cost of total operating expenditure.
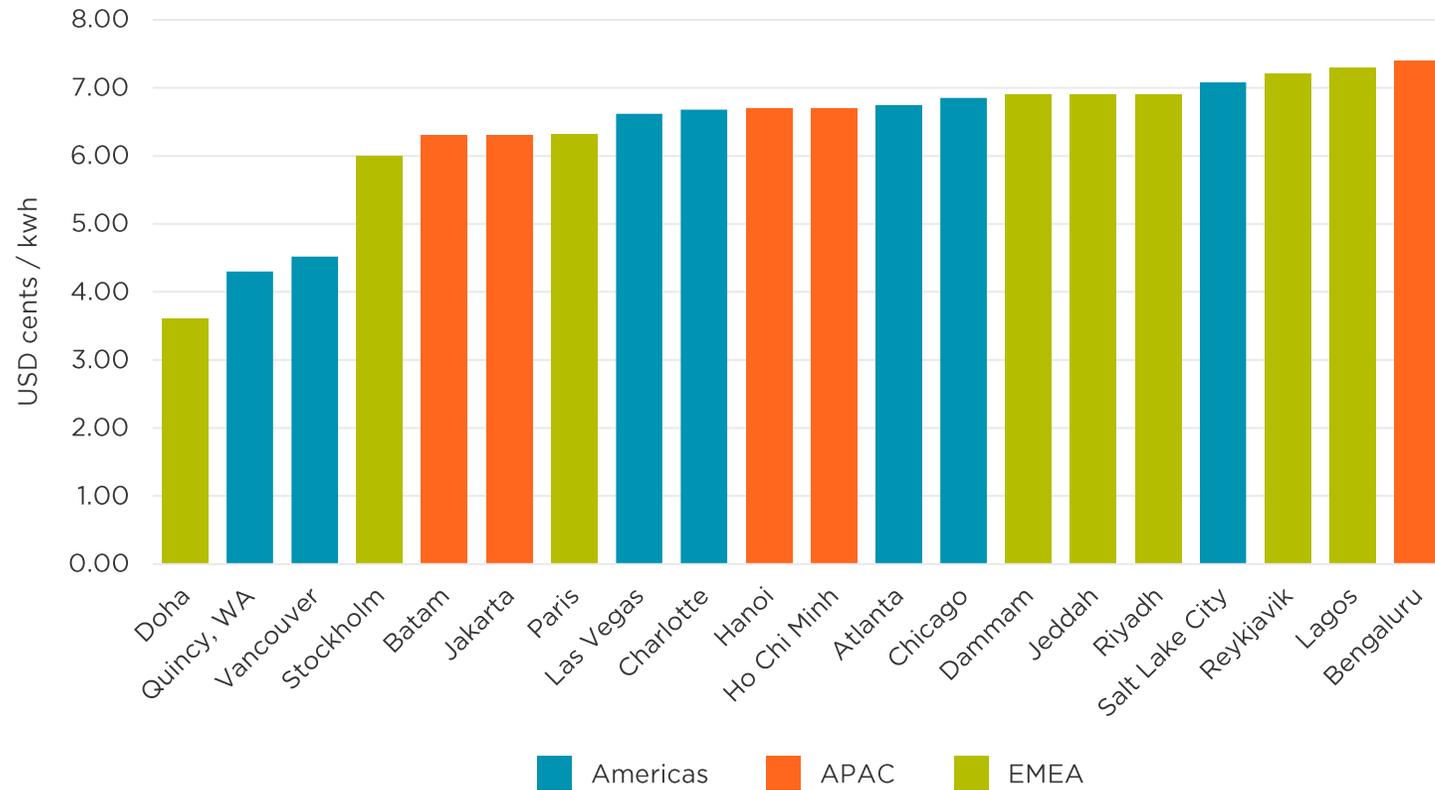
Power costs saw a substantial jump across a multitude of markets over the past year, though have since moderated their growth as energy markets have normalized. For more of an in-depth look at power pricing changes, readers can look into our Power and Lease Pricing Outlook.

New technology (or the better use of current technology) from artificial intelligence to predict workload needs and more sophisticated forms of cooling can assist with saving power costs.

TOP MARKETS

Doha

Quincy, WA

Vancouver

Stockholm

Batam

Jakarta

Paris

Las Vegas

North / South Carolina

Dallas

MID-WEIGHT CRITERIA

POWER
COST

Markets by Lowest Power Cost ($ USD / kwh)

USD cents / kwh

Legend: Americas | APAC | EMEA

X-axis categories: Doha, Quincy WA, Vancouver, Stockholm, Batam, Jakarta, Paris, Las Vegas, Charlotte, Hanoi, Ho Chi Minh, Atlanta, Chicago, Dammam, Jeddah, Riyadh, Salt Lake City, Reykjavik, Lagos, Bengaluru

Source: Cushman & Wakefield Research, findernergy.com, local utilities & government agencies. All are annual average prices as of EOY 2023. Industrial prices for larger-sized power tiers were utilized where available

LOW-WEIGHT CRITERIA

REDUCED ENVIRONMENTAL
RISK

While sustainability comes in many forms, the need to locate data centers in areas which are safe from natural and other disasters is crucial to maintain uptime, particularly if other sectors of the economy are disrupted. The location of gas mains must be scrutinized, flight paths near airports must be reviewed, and a full analysis of the possibilities of failure must be accounted for via engineering and other studies before a site can be selected and construction can begin. As most large metropolitan areas have some or all these preexisting risks, data center builds in densely populated areas come with additional layers of concern beyond those in more rural locations.

Flood maps were reviewed for each facility to determine if the building sits in a 100- year floodplain (a 1% or greater chance of severe flooding each year) or in a 500-year floodplain (a 0.2% chance of severe flooding).

With sea levels rising in coming years due to global warming, many coastal cities may experience heavier flooding. Data centers located in these areas may come under greater peril. Certain cities have succeeded in locating data centers entirely outside of floodplains, including Dublin, Singapore, Mumbai, Denver, Columbus, Vancouver, Madrid, Johannesburg, Queretaro, Oslo, Osaka, Marseille, Lagos, Bangalore, Kuala Lumpur, and Nairobi. As this list shows, data centers can be constructed in coastal cities and still be located away from floodwaters with careful planning.

Earthquake risk is a danger to all buildings, with data centers constructed in areas prone to seismic activity requiring additional support structure. Many organizations that choose to have their main data center in a seismically active area ensure that a full disaster recovery facility exists for backup

purposes in a secondary market, as major earthquakes can prove catastrophic for equipment and business operations alike. Cities studied with the lowest earthquake risk include several primary and secondary markets across Europe (Dublin, Amsterdam, Paris, Madrid, Warsaw, Oslo, Berlin, Stockholm), along with Dallas, Hong Kong, Seoul, and Lagos.

Tornadoes and hurricanes can bring equally catastrophic damage to an area, tearing through buildings and downing power lines and entire electrical grids. As with data centers located in earthquake zones, many organizations choose to have a disaster recovery location outside the area, as obtaining power after such an event can prove problematic. Most locations across Europe and the western United States are free of this risk, as are Vancouver, Singapore, and newly reviewed markets Nairobi and Santiago.

BEST MARKETS

Abu Dhabi

Vienna

Madrid

Berlin

Prague

New York / New Jersey

Denver

Melbourne

Brussels

Paris

LOW-WEIGHT CRITERIA

TAXES

A sales tax is a payment to a local or national government for the total of goods sold, while a value-added tax is paid by the ultimate user at the end of the value chain.

While incentive packages to relieve overall tax burden on a project are attractors for data center development, new phases or smaller builds may not qualify for minimum thresholds to achieve this relief. These projects require the purchase of the same materials (generators, cooling systems, servers, racks and more) but may have to pay full sales or value-added taxes on the costs of all goods purchased. A sales tax is a payment to a local or national government for the total of goods sold, while a value-added tax is paid by the ultimate user at the end of the value chain. Both can rapidly add up as materials are purchased over the cost of a project.

As noted in previous editions of this report, two markets covered have neither of these taxes: Hong Kong and Oregon. Hong Kong is a global financial and business capital, with a long history of pro-business policies and an accordingly robust data center sector.

Oregon is a rapidly growing data center market on the west coast of the United States, with dense fiber and sites available in the local-market cluster in the suburban Hillsboro.

Other large markets have continued to enjoy lower taxation, including the world's largest in Northern Virginia, with Singapore and the data center cluster in Northern New Jersey also offering lower taxes than many primary data center locations.

TOP MARKETS

Oregon

Hong Kong

Virginia

Johor

Kuala Lumpur

Austin

Boston

New York – New Jersey

Bangkok

Columbus

LOW-WEIGHT CRITERIA

WATER
AVAILABILITY

As noted, server rack densities are poised to jump dramatically with new requirements for both cloud and AI deployments. As these densities increase, we can expect cooling requirements to correspondingly rise. Data center designers and operators have already been in the midst of adapting to the new requirements, with new "direct-to-the-chip" cooling becoming increasingly common. Ever wary of shifting trends and requirements, a number of data centers are now designed with both liquid and air cooling options.

Other operators have tested a variety of novel immersion and other cooling technologies, seeking to optimize cost, temperature control or sustainability. Not all of these new technologies with require the use of water. Mineral oil and other chemical coolants are also being deployed through various methods. Even as technology shifts rapidly, access to water can remain a key consideration given how quickly density requirements have been rising. Operators located in deserts or undergoing severe drought conditions will likely face headwinds to acquiring the sufficient water rights to utilize water cooling on a hyperscale data center.

With cooling requirements rising, access to water is becoming increasingly critical for data centers across a variety of markets

TOP MARKETS

Oslo

Prague

Singapore

Kansas City

Dublin

Toronto

Atlanta

Stockholm

Kuala Lumpur

Johor

ABOUT CUSHMAN & WAKEFIELD

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CONTACT

Jacob Albers
Head of Alternatives Insights
jacob.albers@cushwake.com

Vivek Dahiya
Managing Director, APAC Data Center Lead
vivek.dahiya@cushwake.com

Andrew Fray
International Partner, EMEA Data Center Lead
andrew.fray@cushwake.com

Jessica Howe
Vice President, Global Growth Verticals
jessica.howe@cushwake.com