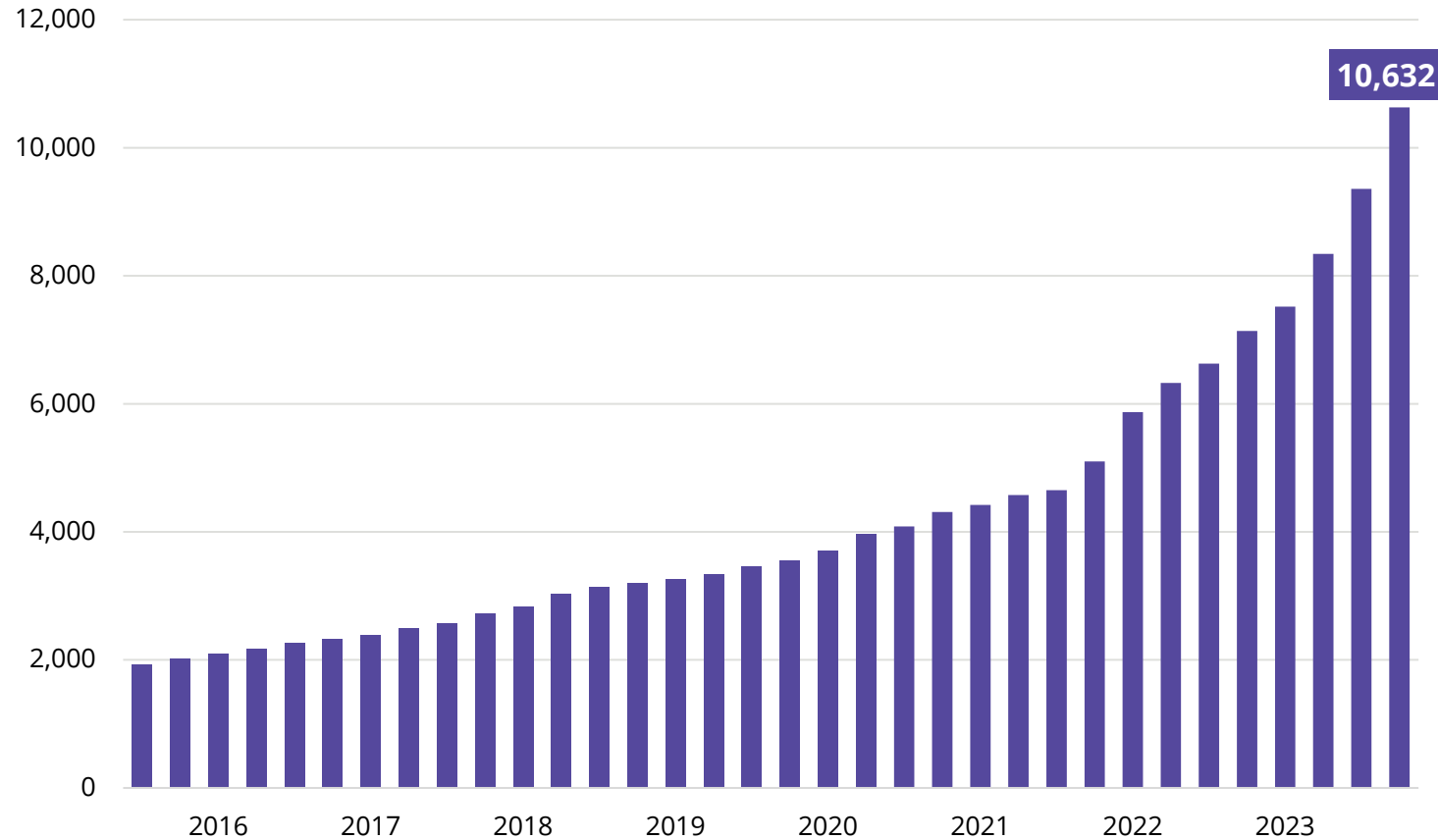# U.S. data center update

Leasing and
Capital Markets trends

Q4 2023

AVISON
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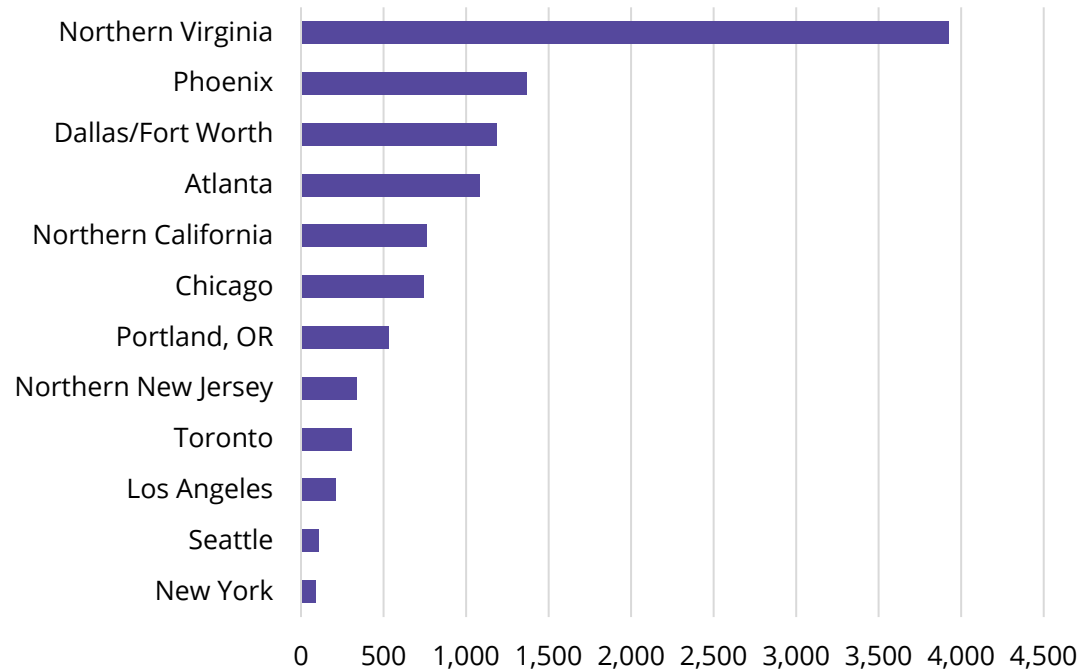# Inventory

Inventory by quarter (MW)

Inventory growth in North American markets has sped up in response to a significant surge in demand. Total data center inventory in the top 12 markets has increased by nearly 50% in 2023.

Top 12 North American Markets; Includes all facilities that have delivered or have a committed tenant
Source: DatacenterHawk
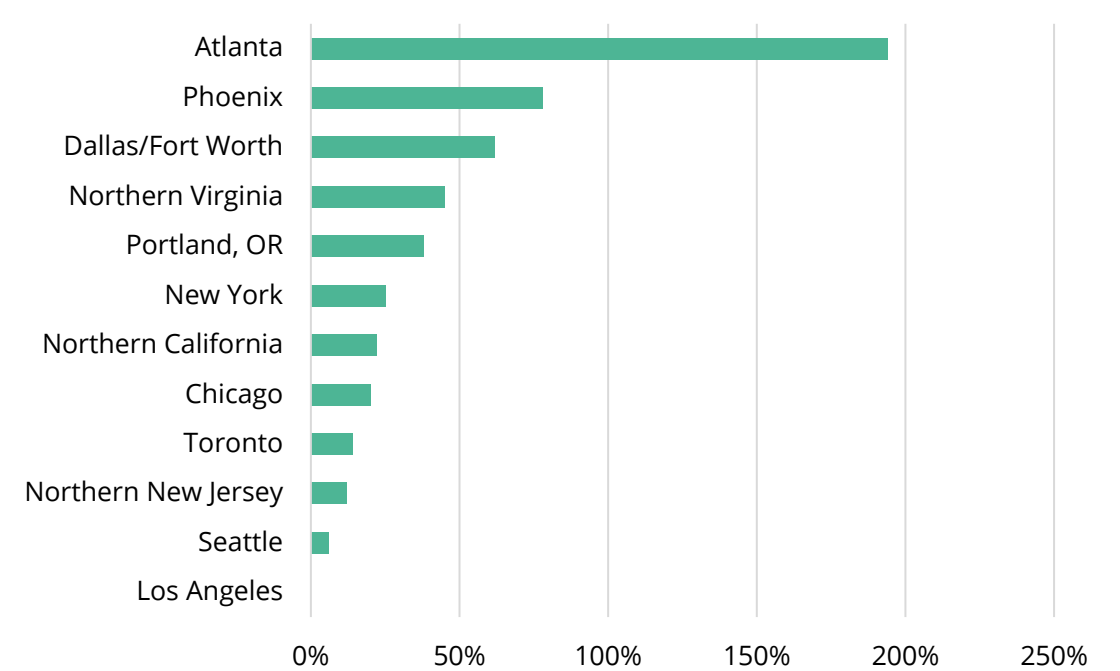
U.S. data center update | Q4 2023

Inventory

Northern Virginia continues to extend its lead in overall market size, as its globally-unmatched concentration of data centers continues to attract users seeking strong connectivity and low latency. In proportional terms, Atlanta and Phoenix are currently experiencing the fastest growth, year over year.
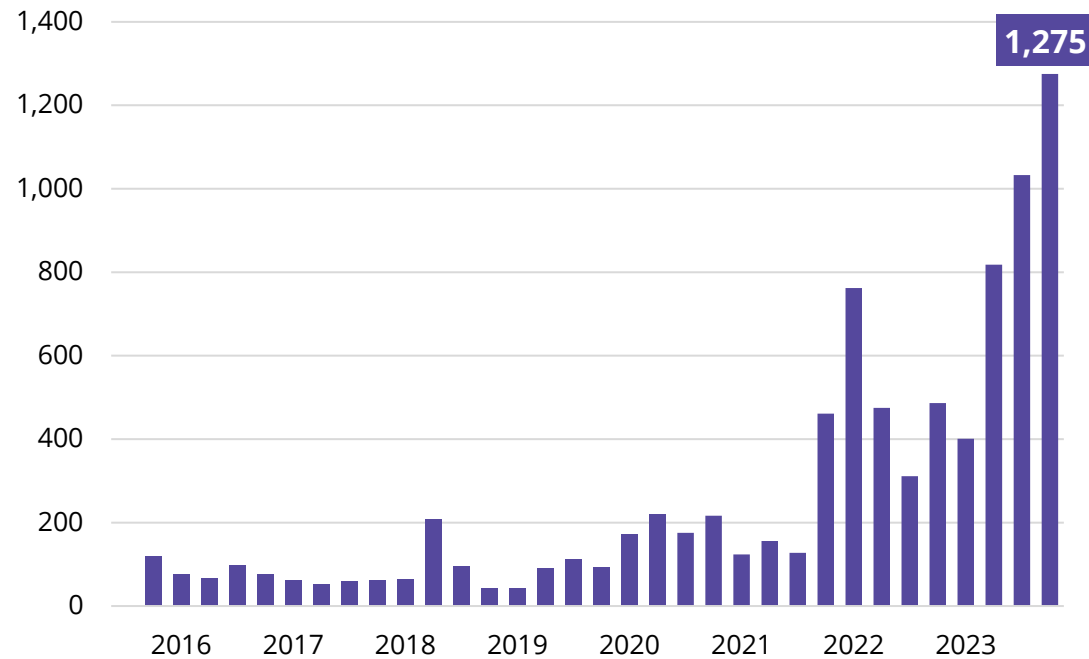
Inventory by market (MW)

YoY inventory growth (Q4 2022 - Q4 2023)

Top 12 North American Markets; Includes all facilities that have delivered or have a committed tenant
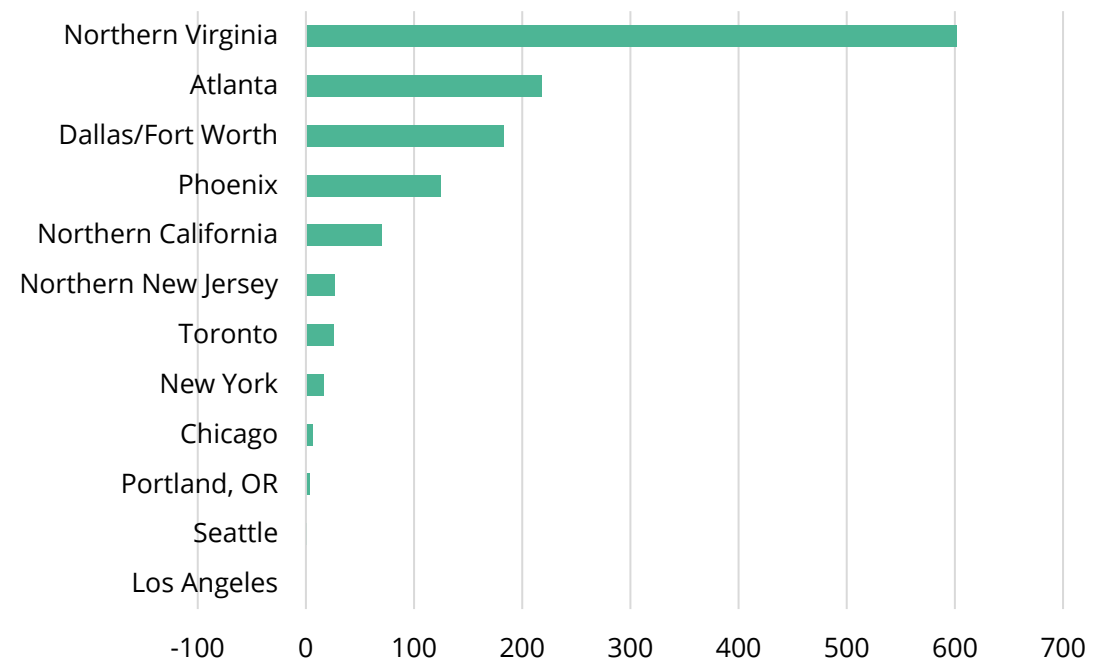Source: DatacenterHawk

Absorption

The fourth quarter of 2023 marks a new record high for North America primary markets with 1,275 MW of net absorption. Northern Virginia accounted for nearly half the net absorption in Q4 2023.
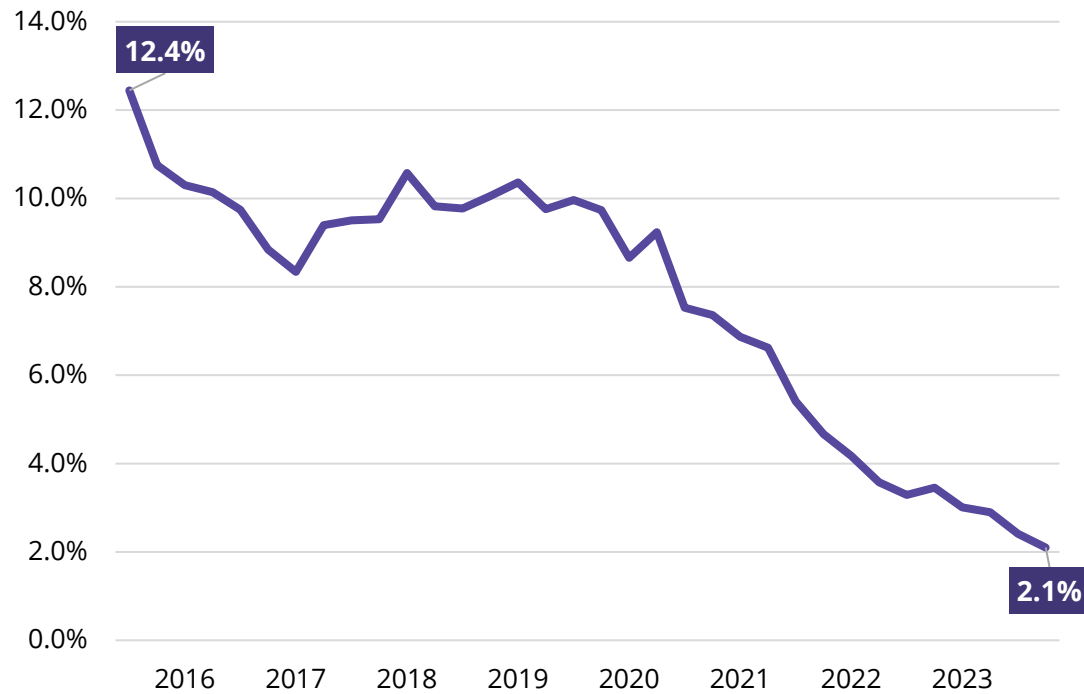
Net absorption (MW)

Q4 2023 net absorption by market (MW)

Top 12 North American Markets; Includes all facilities that have delivered or have a committed tenant
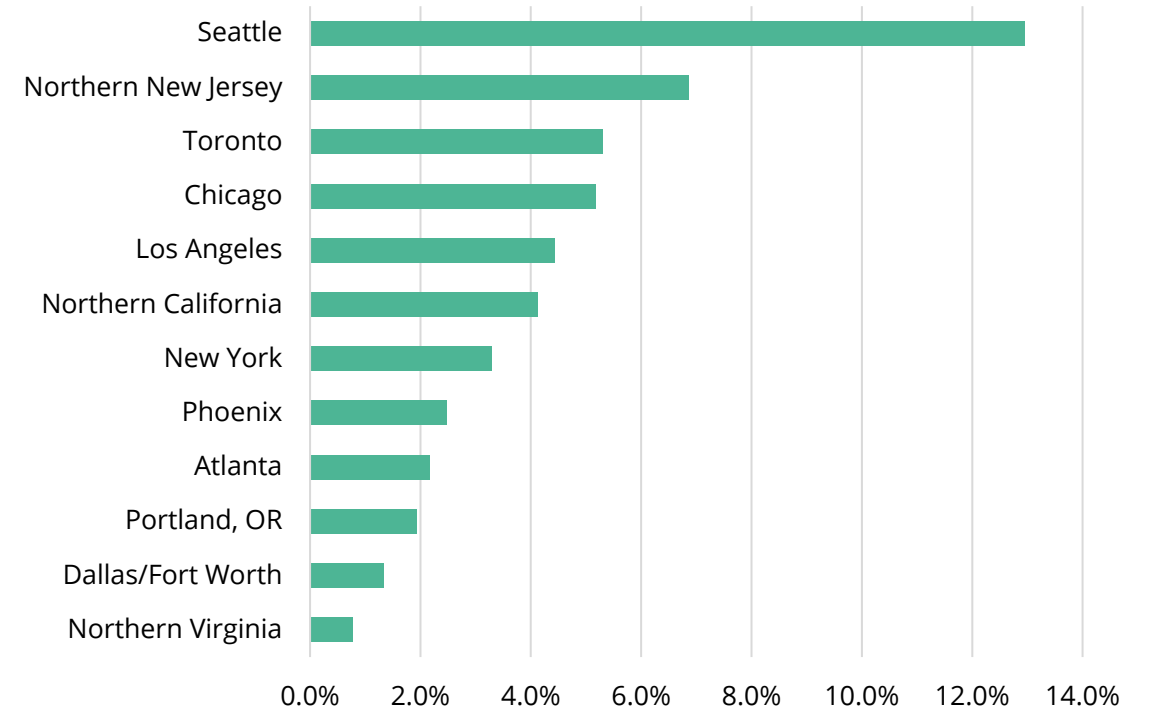Source: DatacenterHawk

Vacancy

Despite a flurry of construction and deliveries in Q4, demand continues to outpace supply. Vacancy rates have reached a new low at just 2.1%

Vacancy rate by quarter

Vacancy rate by market

Top 12 North American Markets; Includes all facilities that have delivered or have a committed tenant
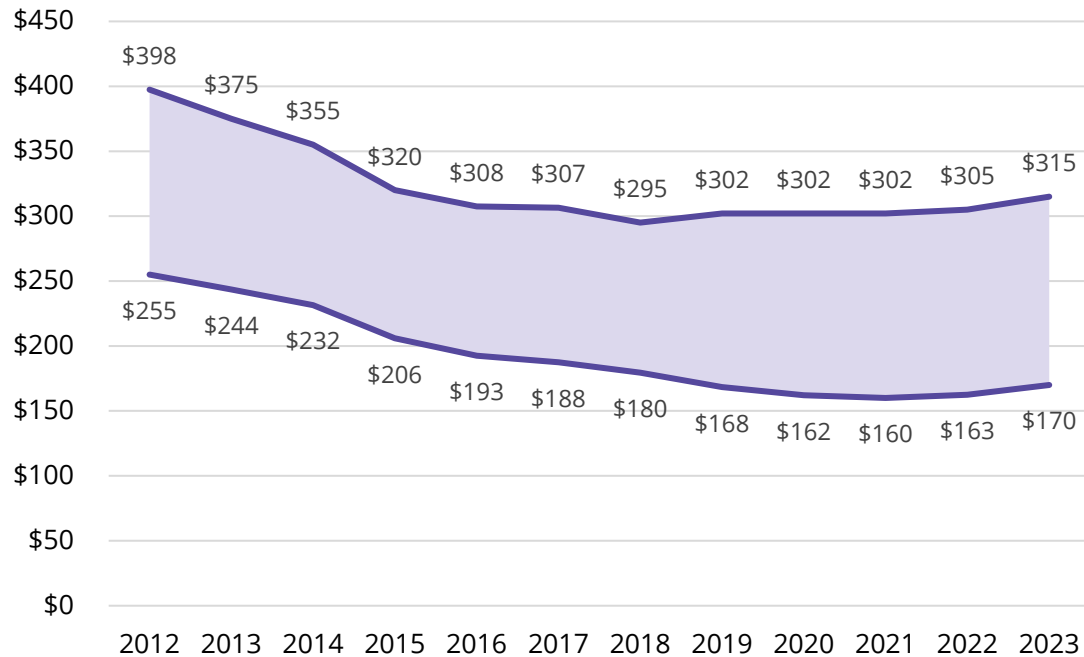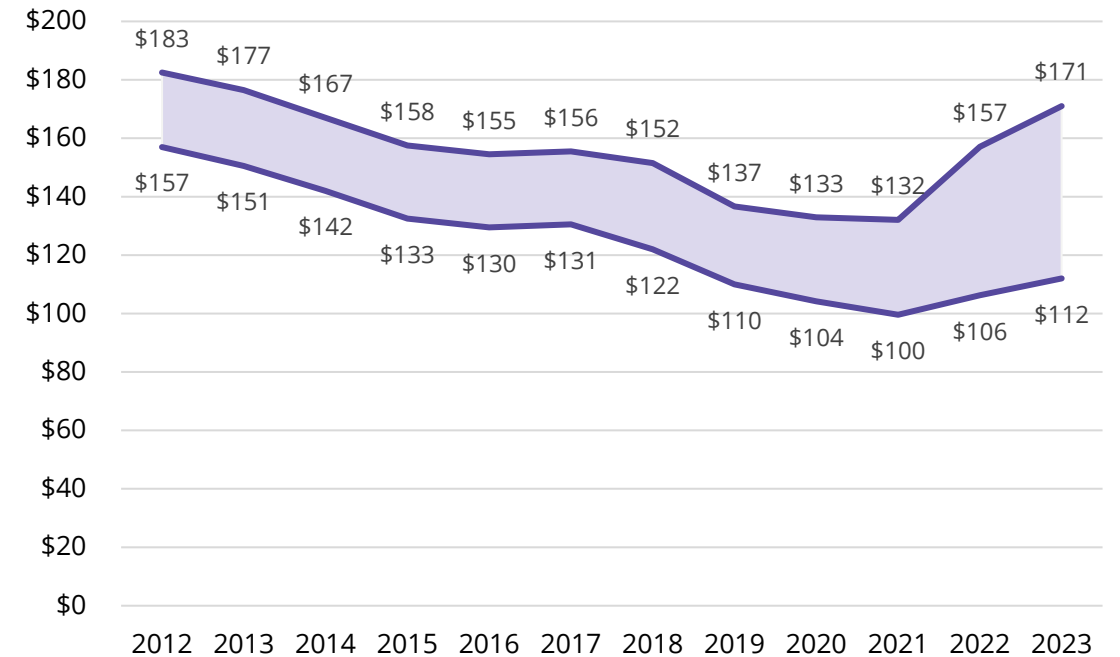Source: DatacenterHawk

Historical pricing

Turnkey rents are beginning to move upward in response to tightening market conditions. Pricing for large requirements has seen a greater increase, as large existing availabilities are few and far between in most mature markets.

Average retail range ($/kW)

Average wholesale range ($/kW)

Source: DatacenterHawk

Vacancy

Year over year change in vacancy rate

Legend: Q4 2022 (purple), Q4 2023 (teal)

Markets (left to right): Seattle, Northern New Jersey, Toronto, Northern California, Los Angeles, Chicago, New York, Phoenix, Portland, OR, Atlanta, Dallas/Fort Worth, Northern Virginia

Top 12 North American Markets; Includes all facilities that have delivered or have a committed tenant
Source: DatacenterHawk
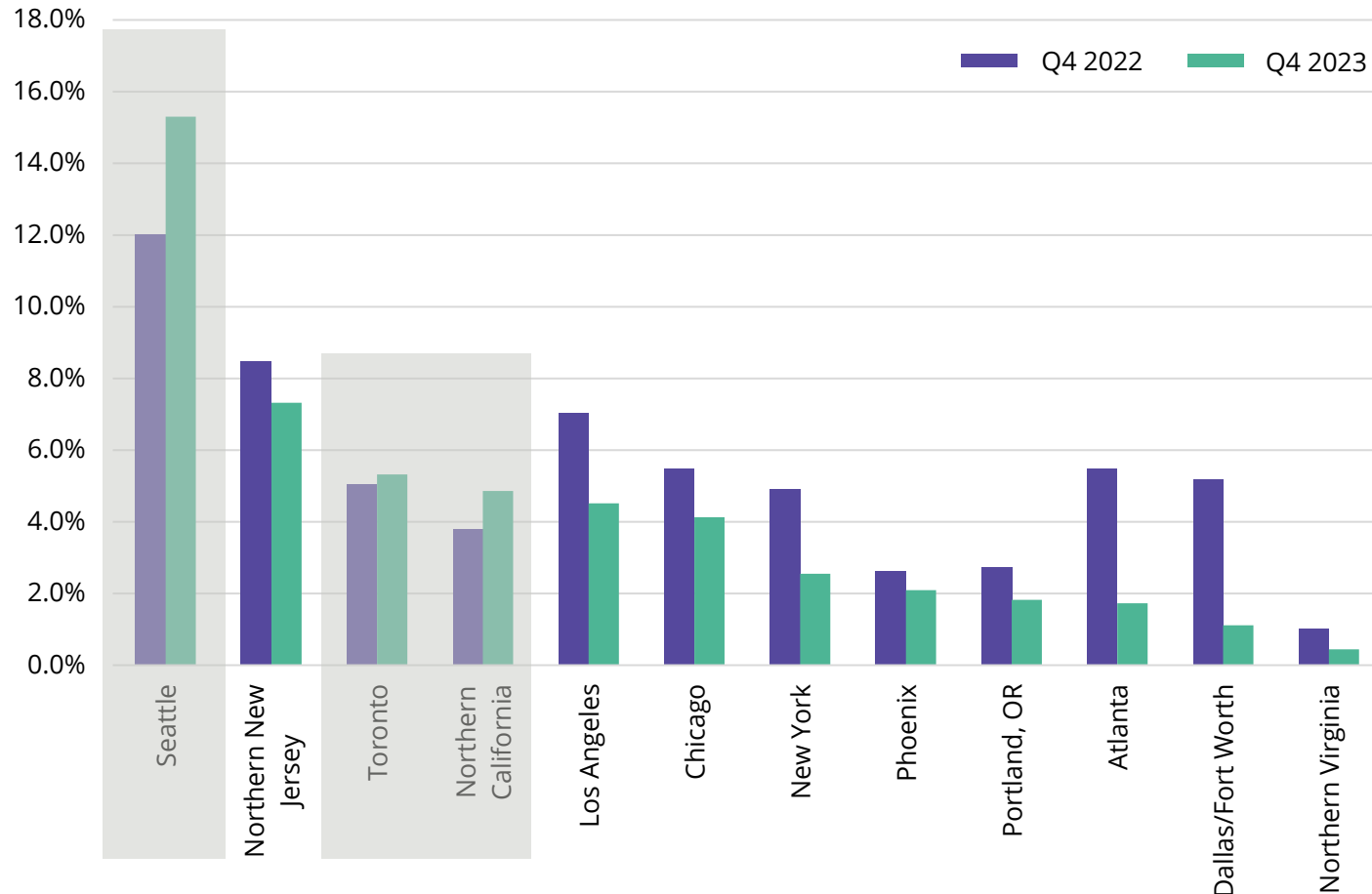
All major markets except for Seattle, Toronto and Northern California have seen vacancy fall over the past 12 months as demand has outpaced the rate at which new supply can be delivered.

Capital markets trends

Acquisitions have slowed

Entity-level transactions have decelerated in 2023, following a busy year of activity in 2022. Large-sized transactions of the likes seen in 2022 has yet to been materialize this year.

Cap rate reversal

Cap rates have finally begun to respond to sharply rising interest rates, reversing the years-long trend of compression, though only slightly. Shells are typically trading in the range of 4.50% to 5.50% while turnkey facilities generally range from 6.50% to 7.50%.

New players

As the sector matures, private & public equity is seeking to enter the space. PE and institutional capital both continued to account for a larger share of data center investment in 2023.
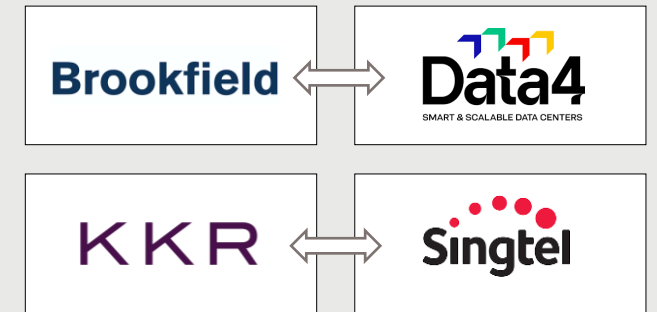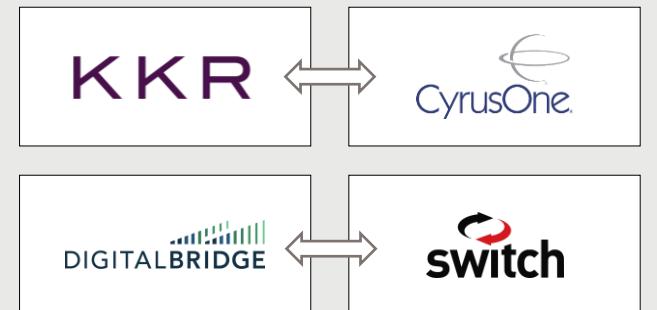
Sale/leaseback

Enterprise & telecom users will capitalize on increased investor interest by selling off data centers to redeploy capital into core business elements.

M&A deals

2023

| Brookfield | ⟺ | Data4 |
| KKR | ⟺ | Singtel |

2022

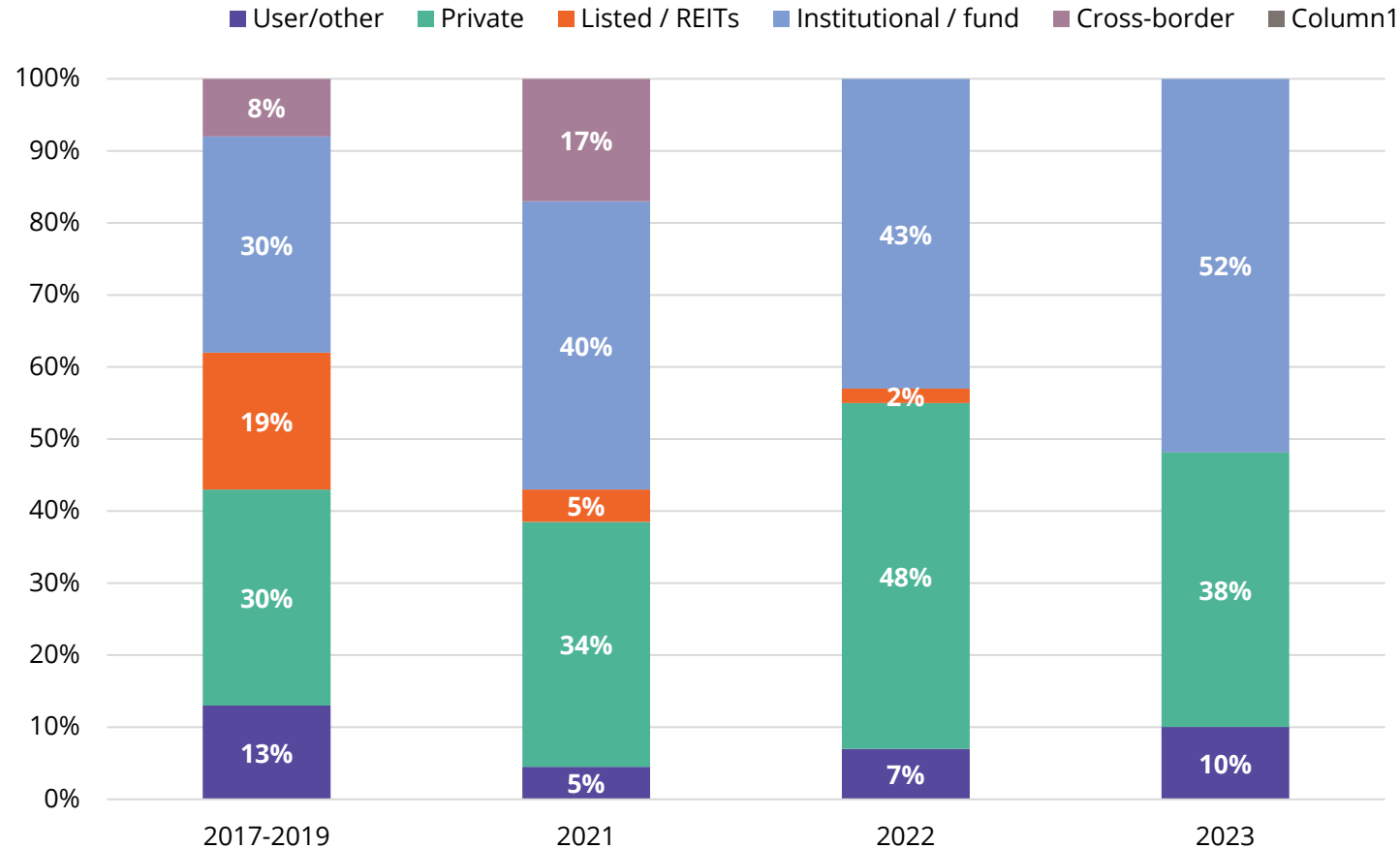| KKR | ⟺ | CyrusOne |
| DIGITALBRIDGE | ⟺ | switch |

Buyer composition

**Data center buyer composition** (single-asset trades)

Private and institutional buyers have rapidly become the dominant players in the data center market, with nearly all the sales volume in 2023 evenly divided between them.

U.S. data center update | Q4 2023   Source: Real Capital Analytics

Capital markets trends

Investor sentiment toward commercial real estate (across all product types) has fallen back below pre-pandemic levels after experiencing a surge in 2021. An enduring lack of confidence in traditional asset classes could push more capital toward the data center sector, though investment demand will be tempered by elevated interest rates.

CRE sentiment index[1]
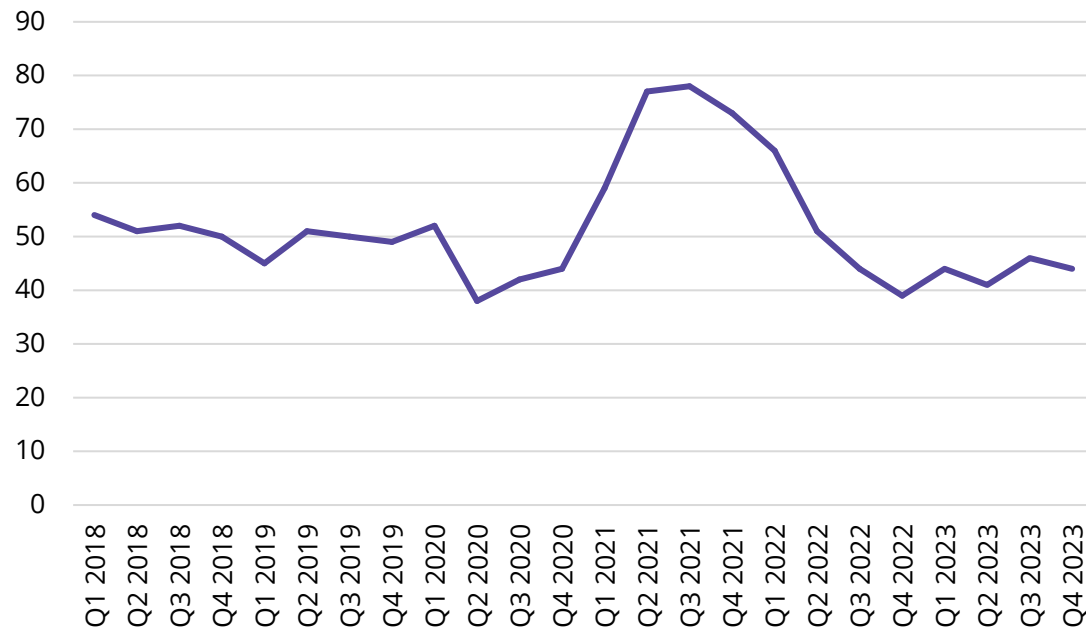
Bond yields and fed funds rate[2]

— Baa corporate bond — 10-year treasury (DGS10) — Fed funds rate
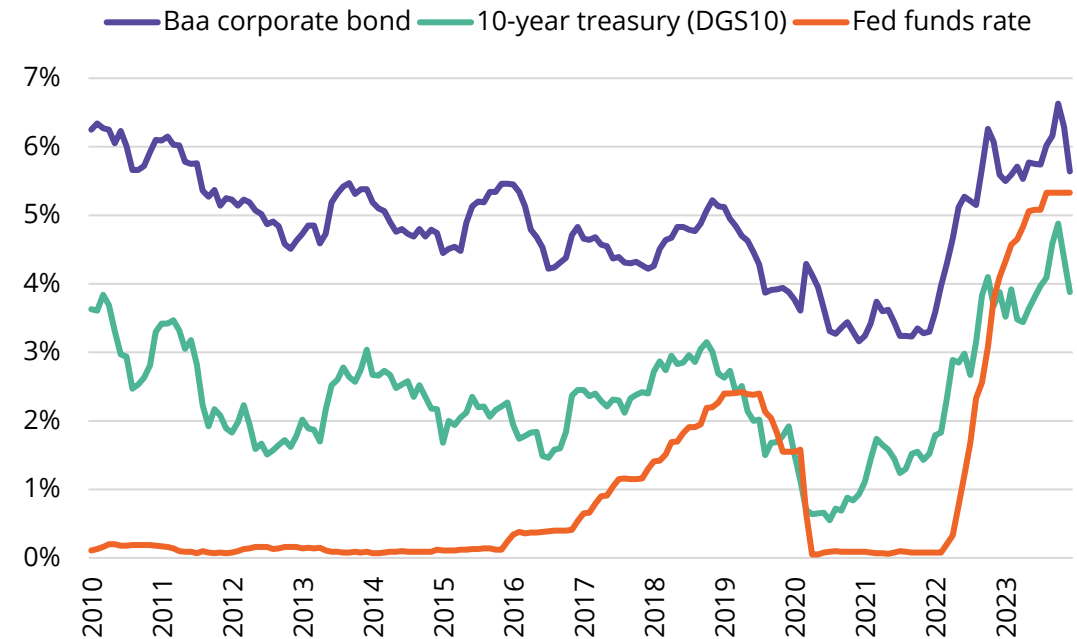
[1]Real Estate Round Table, CRE Sentiment Survey (Q4 2023), "Overall" Sentiment (current and future outlook)
[2]St. Louis Fed

Cap rates

Typical data center cap rate
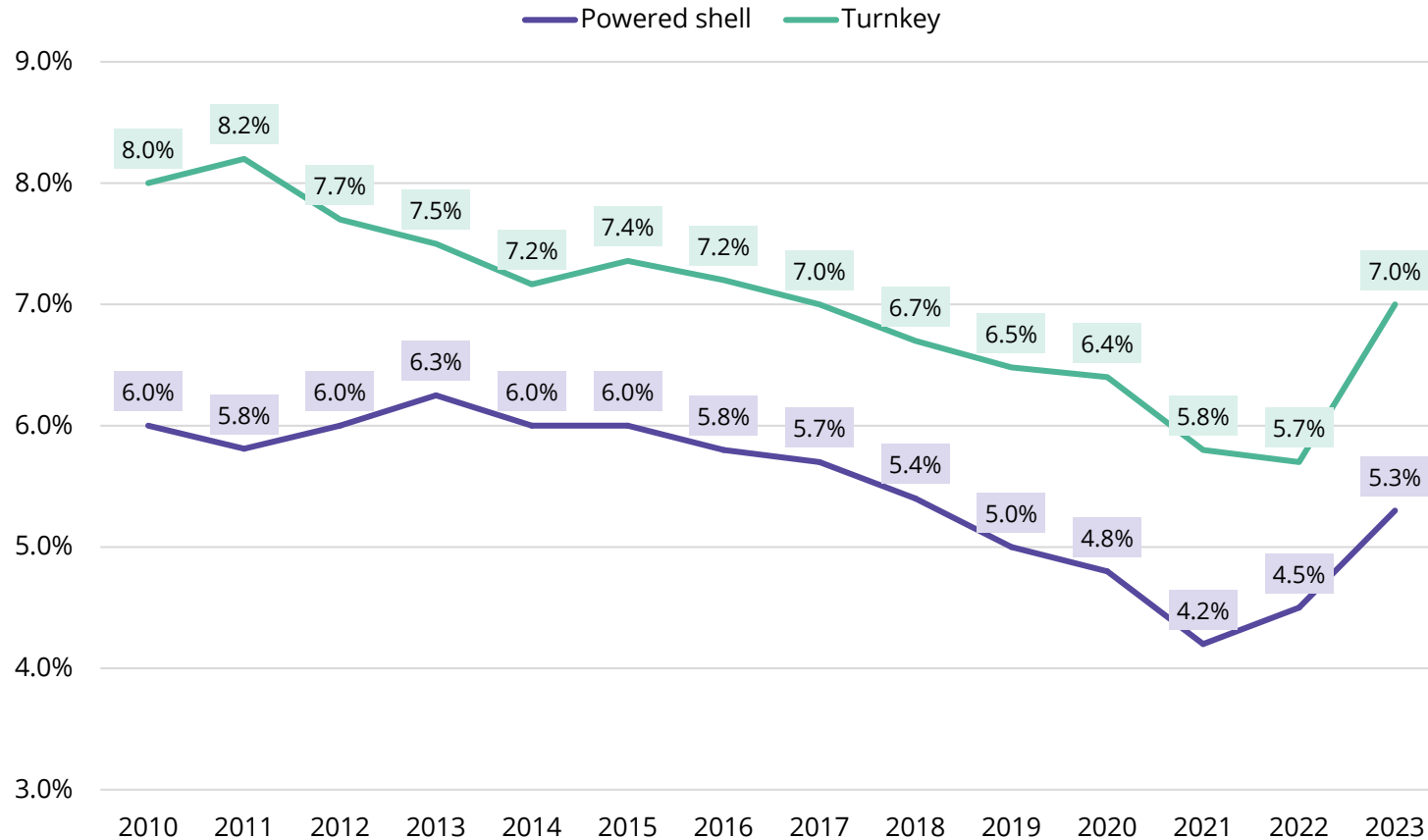
After more than a decade of consistent compression, cap rates have finally begun to reverse course in response to sharply rising interest rates, with assets typically trading 120-150 bp higher than at 2021-2022 lows.

Note, typical cap rates are not necessarily averages of all market transactions; to handle small sample sizes, we have made adjustments to remove outliers and/or correct for deal nuances that may impact cap rate.

Looking Ahead

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Cloud Repatriation

Key workloads under consideration to move from public cloud

Legend: ■ 2023 ■ 2022

Workload	2023	2022
BI/Data Warehouse/Data Analytics	92%	78%
AI or Machine Learning Applications	92%	68%
IoT, Connectivity & Management	84%	69%
Storage/Archive/Backup/File Server	81%	69%
Mobile Apps	81%	64%
Security/Cyber Security	80%	70%
CRM	80%	69%
Development/Test	79%	67%
HRMS	68%	51%
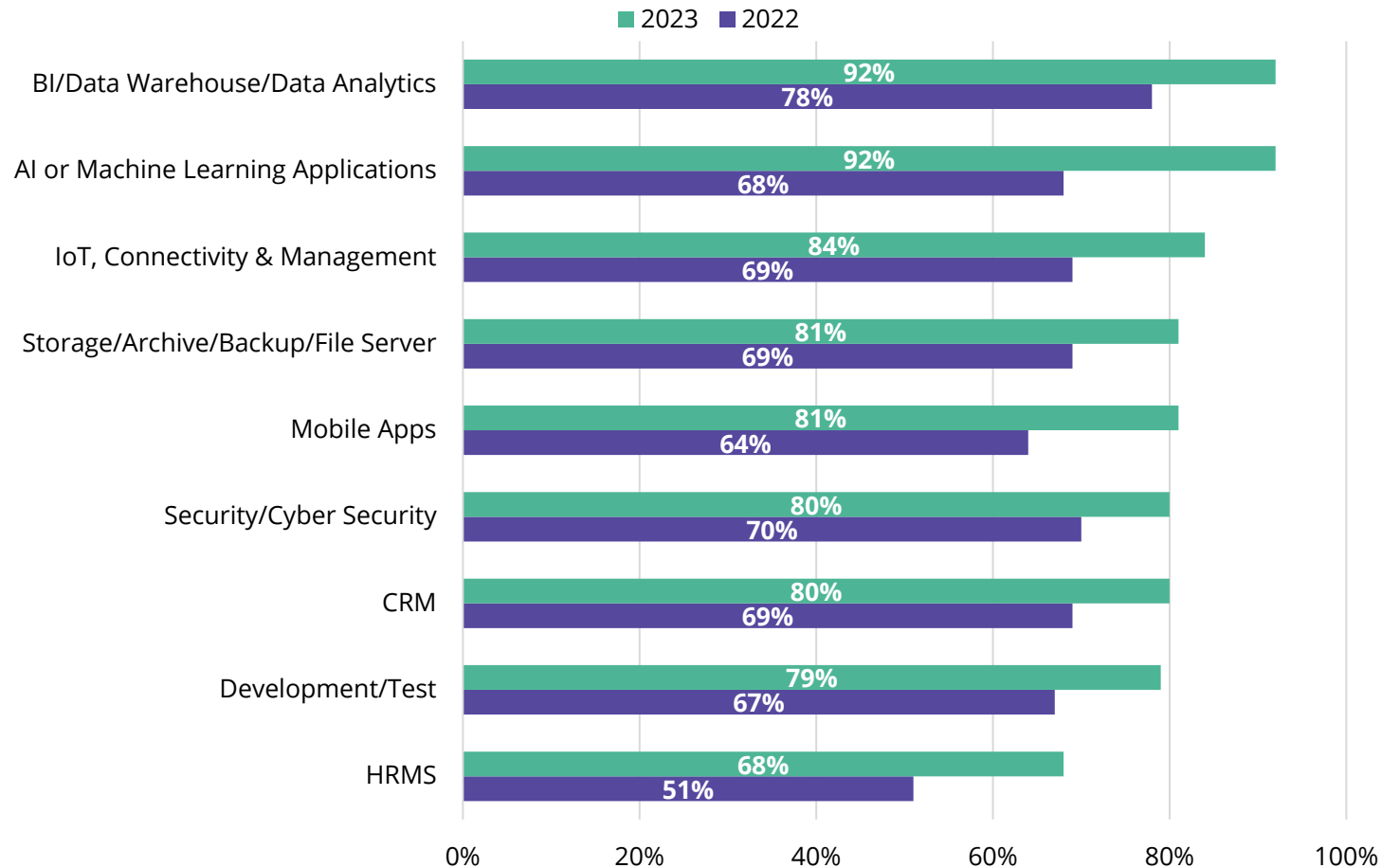
A survey of IT leaders and line of business operators show that data center users are more open than ever before to moving their critical workloads from public cloud to colocation.

Source: Foundry, *2023 State of the Data Center Report*

Demand drivers

Data created and replicated worldwide (zettabytes)[1]

Bar chart — Data created and replicated worldwide (zettabytes):

Year	Value
2010	2
2011	5
2012	7
2013	9
2014	13
2015	16
2016	18
2017	26
2018	33
2019	41
2020	64
2021	84
2022	101
2023	123
2024	149
2025	182
2026	221
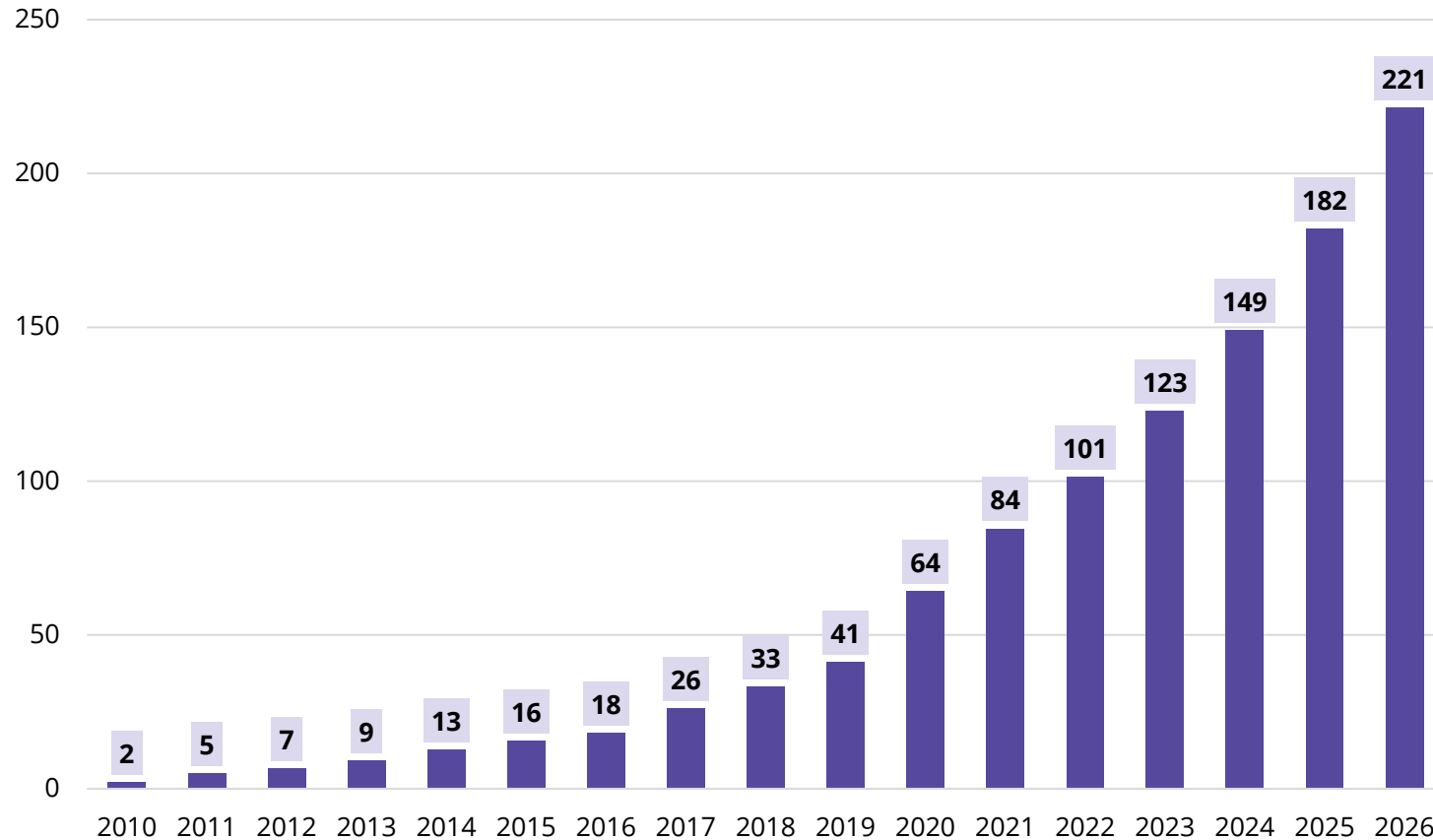
The global datasphere (data created/replicated worldwide) is growing rapidly, projected to more than double by 2026 relative to the end of 2022. Several new technologies are emerging that have the potential to consume orders of magnitude more data than typical applications today, including:

Internet of things: previously "dumb" devices are now connected and generating data

Advancing technology: existing technologies require more data as sophistication increases (e.g., photo file size)

Autonomous vehicles (AVs): require storage/processing of extraordinary amounts of sensor data (est. 4 TB/car/day)

Artificial intelligence (AI): AI and machine learning necessitate the collection, storage and processing of massive data sets

Virtual and augmented reality: a 1-hour VR experience requires the data of 17,000 songs
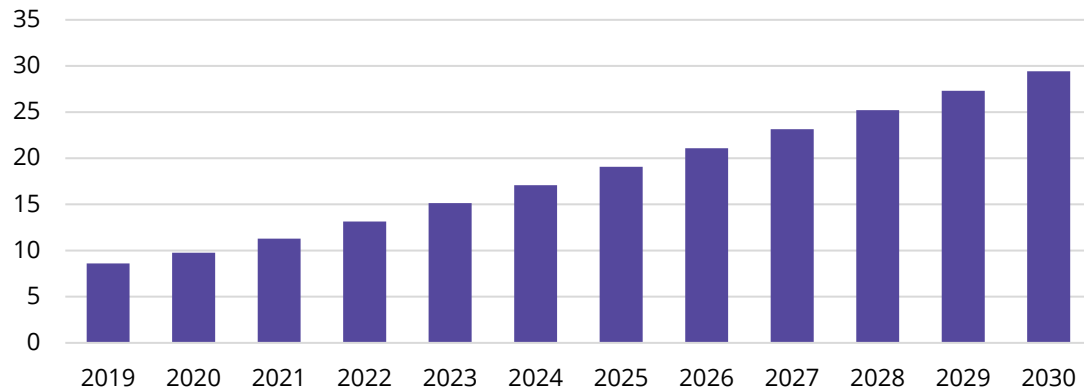
5G connectivity: enhanced mobile connection speeds have enabled new use cases that rely on quick communication with edge data centers (necessitating many more such edge data centers)

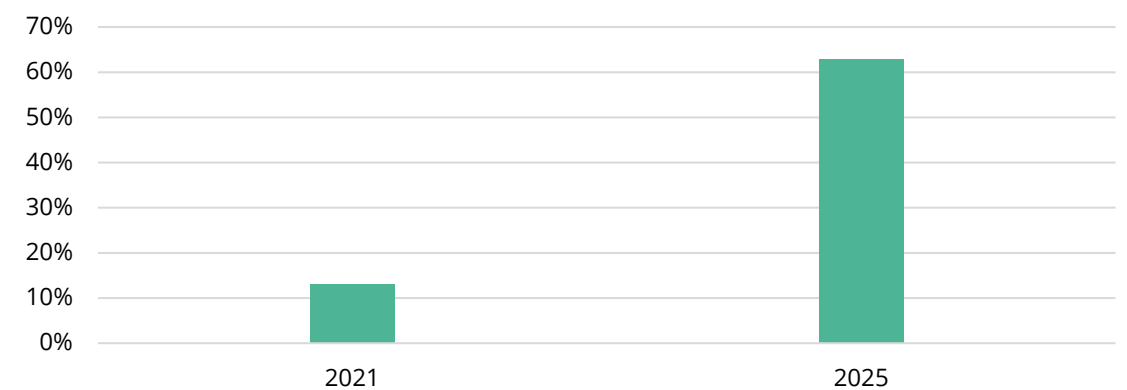[1]Source: IDC Global DataSphere Forecast, 2022-2026

Demand drivers

A host of factors will lead to an explosion in the amount of being created, stored and processed worldwide, ensuring that today's exceptional pace of data center demand continues.

Customer IoT devices worldwide (billions)[1]

Internet of things

Across households and commercial industries, devices that were previously "dumb" are now generating data. From smart appliances at home to inventory management in warehouses to patient monitoring in hospitals, the use cases for connected devices are multiplying.

5G share of all mobile connections (North America)[2]

5G enables data growth

5G is poised to proliferate in the next few years and will offer connection speeds 13x faster than the average mobile connection today, according to Cisco. 5G will enable the other technologies we've mentioned (like self-driving, VR, IoT) to proliferate on mobile networks and generate massive amounts of data.
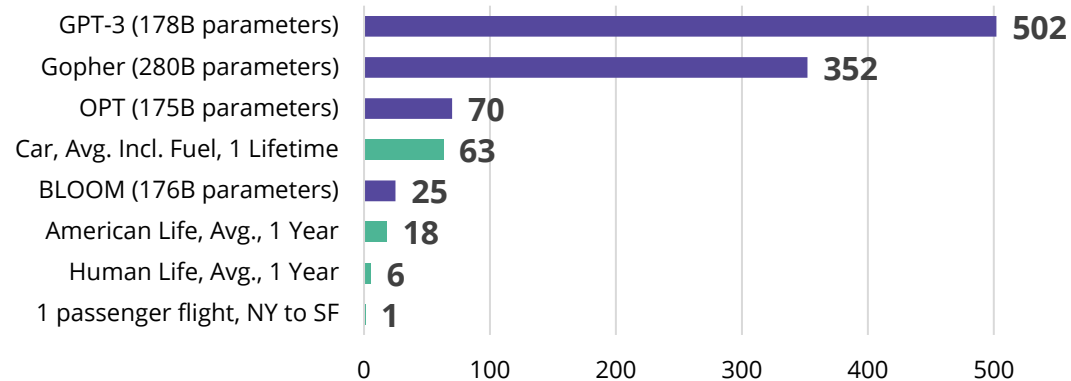
[1]Source: Transforma Insights, *IoT Connections Forecast 2019-2030*
[2]Source: Cisco Annual Internet Report (2018–2023)

Demand drivers – Artificial Intelligence

A host of factors will lead to an explosion in the amount of being created, stored and processed worldwide, ensuring that today's exceptional pace of data center demand continues.

CO2 emissions equivalent of energy use (Tonnes)[1]

Category	Value
GPT-3 (178B parameters)	502
Gopher (280B parameters)	352
OPT (175B parameters)	70
Car, Avg. Incl. Fuel, 1 Lifetime	63
BLOOM (176B parameters)	25
American Life, Avg., 1 Year	18
Human Life, Avg., 1 Year	6
1 passenger flight, NY to SF	1

Number of parameters of significant ML systems[2]

AI training draws immense power

Training GPT-3, the language model powering OpenAI's ChatGPT, is estimated to have resulted in 502 tonnes of CO_2 equivalent emissions from data center operations. This is roughly equivalent to the energy consumed by the average American over 28 years. GPT-4, the successor to GPT-3, is rumored to use over 1.7 trillion parameters.
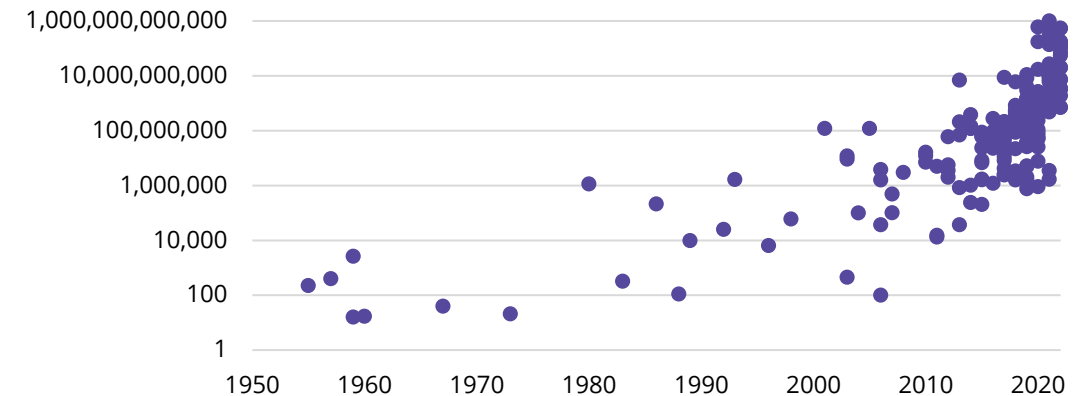
ML complexity is growing rapidly

The number of parameters in significant machine learning models has grown exponentially. As artificial intelligence technology grows in complexity, the requirement for computational power and data centers grows alongside it.
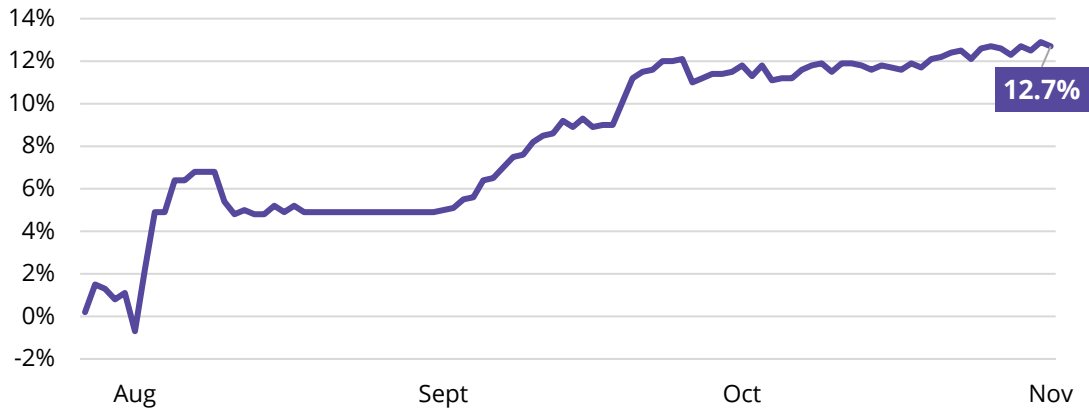
Transformative technologies on the horizon

The rise of commercialized AI applications, and recent breakthroughs in nuclear fusion brings potential to significantly boost data center efficiency and capabilities, potentially driving more cost-effective and environmentally friendly operations in the years ahead.
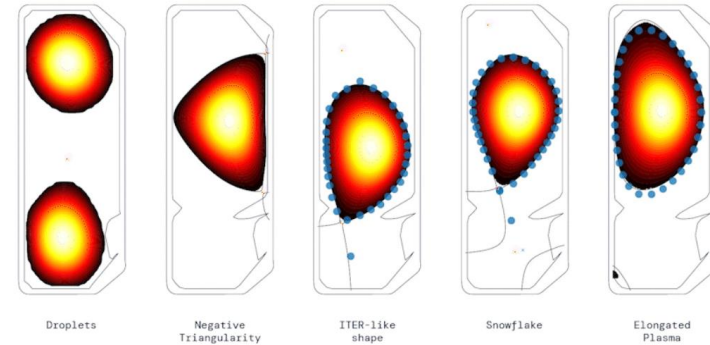
BCOOLER experiment energy savings[1]

12.7%

Nuclear Fusion

Droplets · Negative Triangularity · ITER-like shape · Snowflake · Elongated Plasma

Source: DeepMind, 2022

In 2022, DeepMind partnered with the Swiss Plasma Center to train a deep reinforcement learning algorithm using simulation[2]. They were able to successfully control and manipulate plasma in a tokamak device, a significant stepping-stone in nuclear fusion research.

DeepMind's BCOOLER experiment

Google's AI-focused subsidiary, DeepMind, unveiled the results of their 2022 experiment involving the training of BCOOLER (BVE-based COnstrained Optimization Learner with Ensemble Regularization). This project aimed to optimize cooling for Google's data centers. After a three-month trial, BCOOLER delivered an impressive 12.7% reduction in energy consumption.

Nuclear fusion opens new horizons

A long time coming, nuclear fusion has gotten closer than ever before to being a viable source of sustainable, clean, and nearly limitless power. Milestones like Lawrence Livermore National Library's feat of yielding net positive energy for the second time[3] with laser fusion in December 2022 coupled with the potential for AI-driven research acceleration, offer hope for a transformative shift in energy production

[1]Source: Transforma Insights, *IoT Connections Forecast 2019-2030*
[2]Source: Scientific American, *What Is The Future of Fusion Energy? (2023)*
[3]Source: Lawrence Livermore National Laboratory *(2022)*

Building design – Small Modular Reactors

Commercialized nuclear power holds immense promise for revolutionizing data centers. Small modular reactors (SMRs) present an unparalleled opportunity for these centers to access safe, localized, clean, sustainable, and highly efficient power sources. With SMRs, traditional barriers such as inadequate infrastructure and power grids, as well as delays in power delivery, become obsolete. Moreover, SMRs offer the added advantage of affordability and reliability, enabling data centers to operate independently from municipal power grids and mitigate issues like load-shedding or weather-related outages. Their lower construction costs, enhanced logistics, and expedited delivery times, facilitated by extensive pre-fabrication off-site, further solidify SMRs as a game-changer in the quest for optimized energy solutions in data center operations.

NuScale to provide SMRs for two data center sites

The future of data centers is rapidly unfolding as Standard Power made a groundbreaking announcement in October 2023, revealing its collaboration with NuScale Power Corporation and ENTRA1 Energy to develop two data center sites powered by SMRs. NuScale's historic achievement of receiving the first-ever SMR design certification from the U.S. Nuclear Regulatory Commission in January of the same year paved the way for this ambitious endeavor. NuScale is set to deliver 24 units of 77 MW modules, a combined output of nearly 2 GW across the sites in Ohio and Pennsylvania. While a specific timeline for the project is yet to be disclosed, this milestone marks a significant leap forward in the commercialization of nuclear power, poised to revolutionize the realm of data centers and propel them into a new era of sustainability and efficiency.

[1]Source: Business Wire. (2023, October 6). *Standard Power Chooses Nuscale's approved SMR technology and ENTRA1 Energy to Energize Data Centers*
[2]Source: Office of Nuclear Energy. (2023, Jan 20). NRC Certifies First U.S. Small Modular Reactor Design

Looking ahead

Lease, then build

Given sharp vacancy declines across all major markets, expect nearly all future leasing to take place in projects under construction or have yet to break ground.

Transformer shortage

The ongoing shortage of transformers in the United States has considerably extended lead times for deliveries. This will impact data center development, potentially causing delays of 2 to 3 years.

Cloud repatriation

Public cloud users have become increasingly receptive to migrating critical workloads to colocation options. This shift is primarily driven by the need for improved security, performance, and scalability.

Outward push

Near-zero vacancy in Northern Virginia, the largest market by far, could have a spillover effect to other large markets. As these markets densify, they, too will push data center development to outlying areas.

Covered land

Given land scarcity and the potentially long timeline for rezoning/permitting and power, covered land plays will become a key strategy for groups that have the agility to acquire and convert other asset types.

Pricing will keep rising

Low vacancy will persist as supply chain and utility constraints keep deliveries from meeting demand, which will create upward pressure on rents.

For more market insights and information visit **avisonyoung.com**

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