

S&P Global

Commodity Insights

Implications of accelerating electricity demand

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North American Power and Renewables

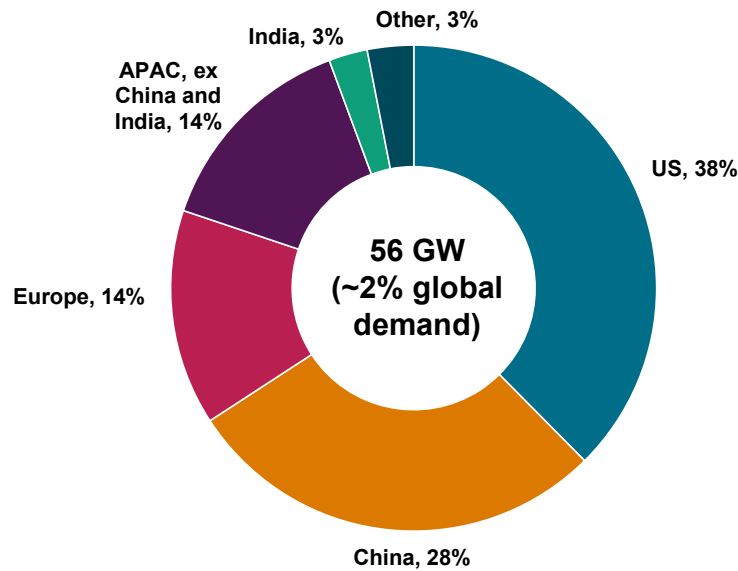


Topics

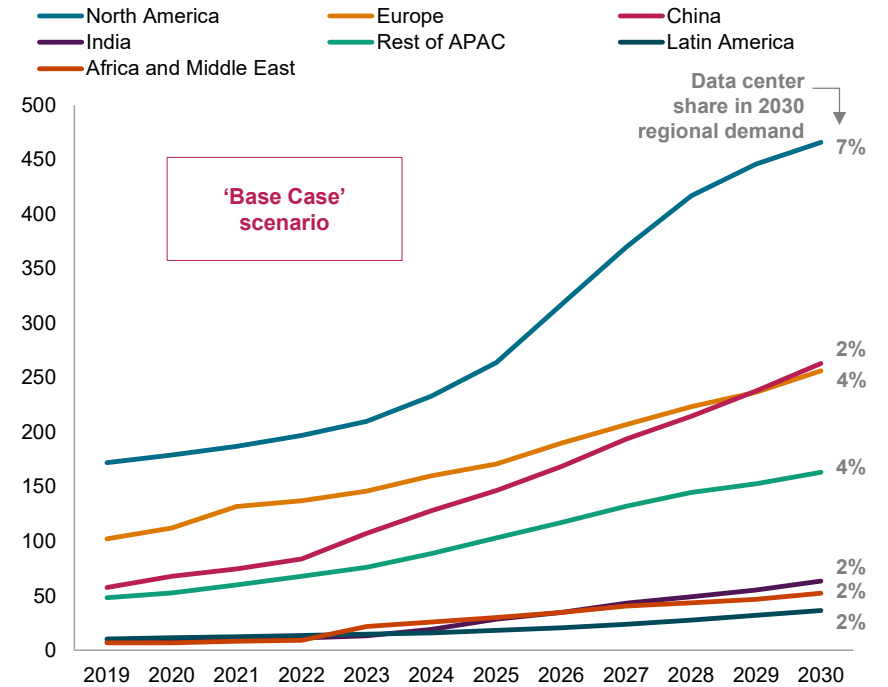
- Global data center electricity demand
- US data center electricity demand and outlook implications
- Emerging supply side trends

US is home to the largest fleet of data centers globally

Global operational data center capacity by region, 2023



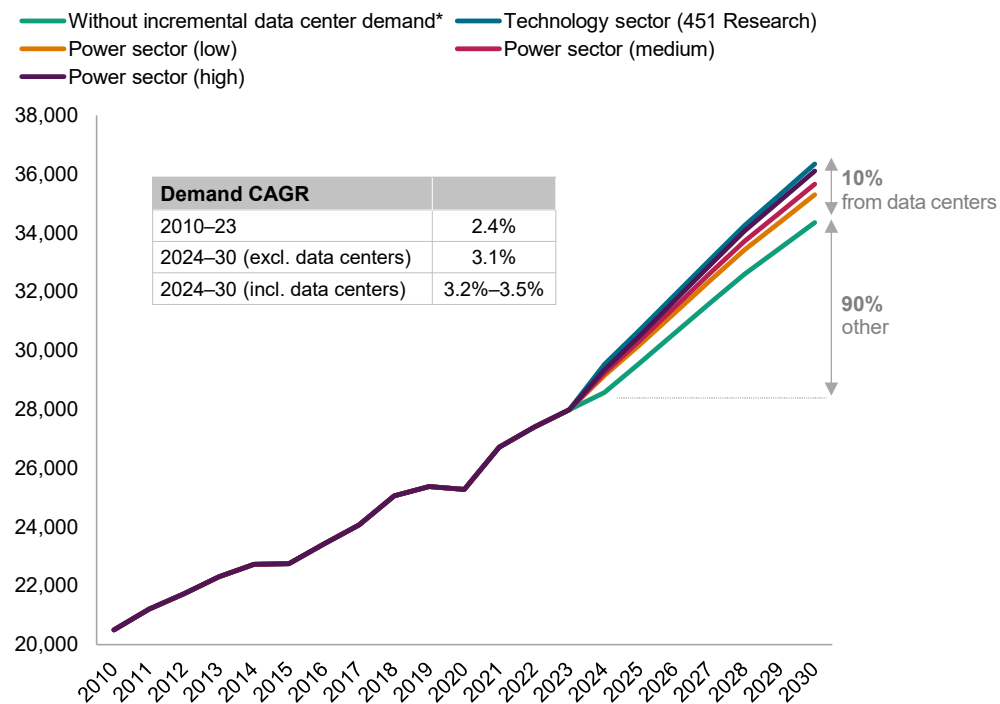
Global data center power demand, by region (TWh)



Data compiled September 2024.
 Notes: Includes leased and hyperscale owned data center capacity
 Source: S&P Global Commodity Insights, 451 Research Datacenter Market Monitor June 2024.

Data centers provide only a modest boost to global power demand

Outlook for global total power demand, by scenario (TWh)



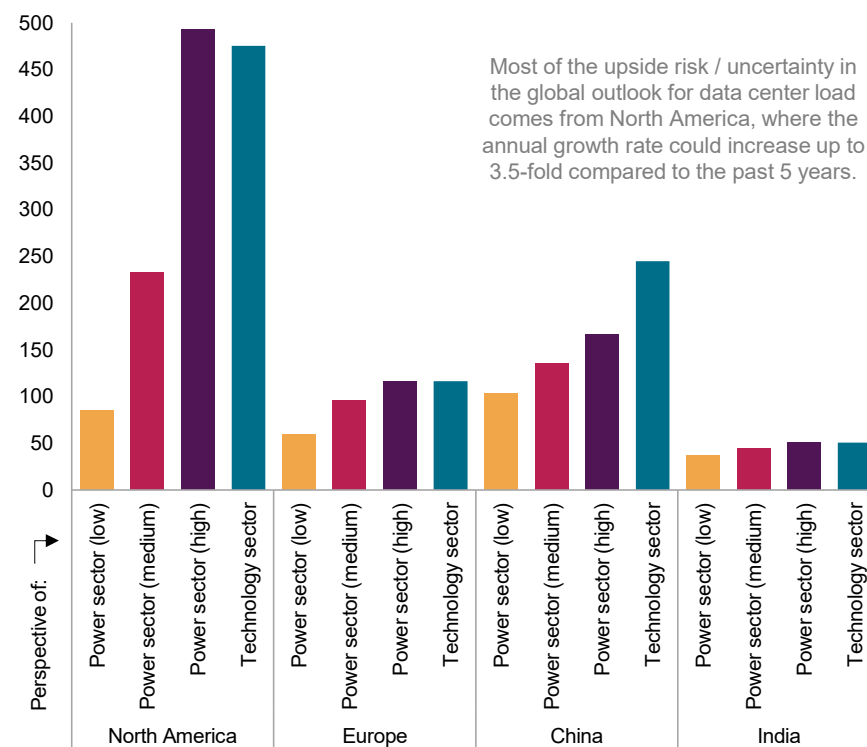
Data compiled September 2024.

Note: The outlook "Technology sector perspective (451 Research)" is calculated to 2029; the value for 2030 is extrapolated.

* Incremental = above 2023 levels.

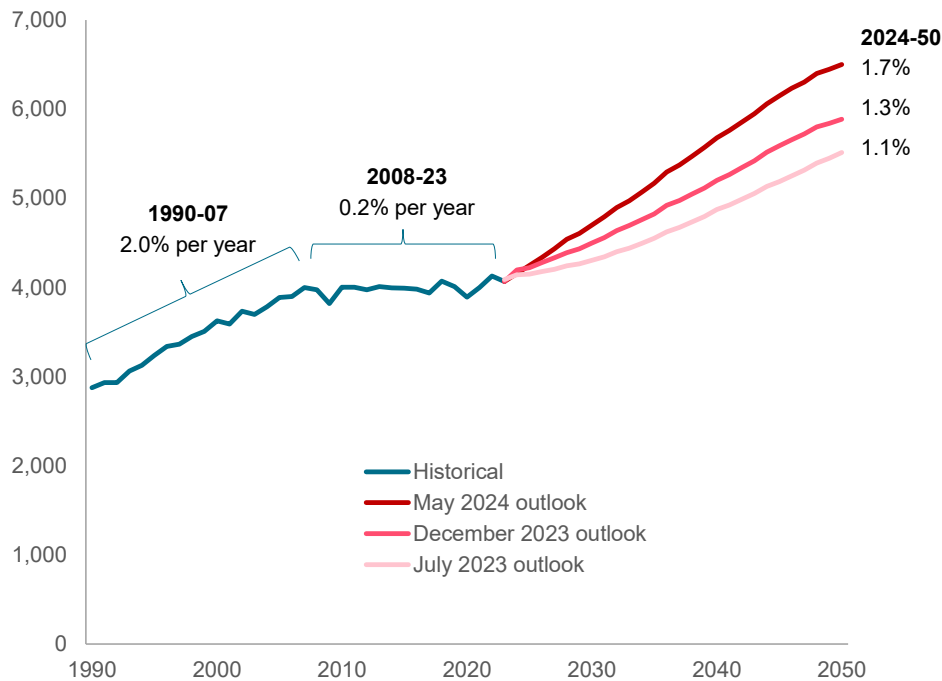
Source: S&P Global Commodity Insights, 451 Research Datacenter Market Monitor June 2024.

2024–30 increase in power demand from data centers, by region and scenario (TWh)

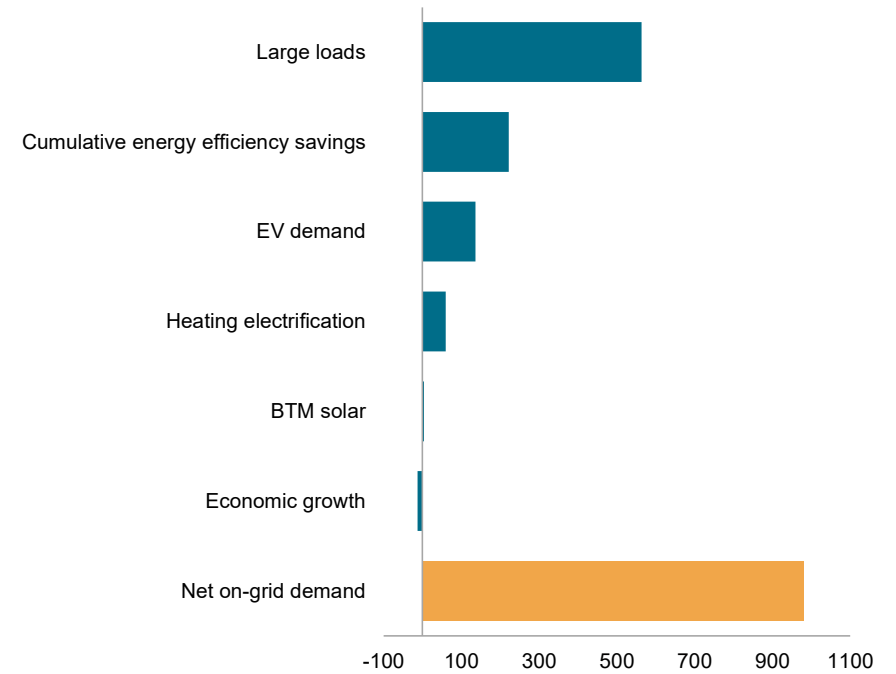


Datacenters and electrification have lifted the outlook for electricity demand growth over the past 12 months

US Lower 48 net on-grid electricity demand by outlook vintage (TWh)



Change in US lower-48 electricity demand (relative to July 2023 outlook), 2050 (TWh)



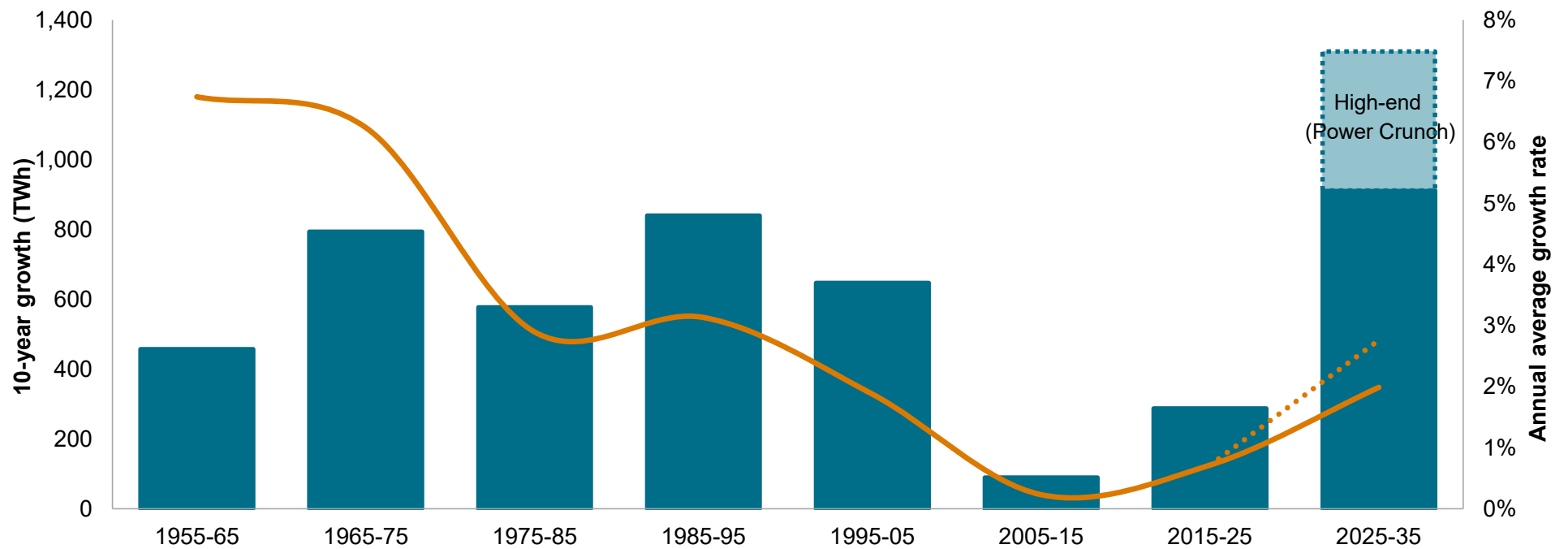
Data compiled June 2024.

Notes: Large loads include incremental demand from datacenters, new manufacturing (e.g., battery, steel, semiconductors, and others), the electrification of oil and gas operations, electrolysis, and cryptocurrency mining.

Source: S&P Global Commodity Insights and The US Energy Information Administration (EIA)

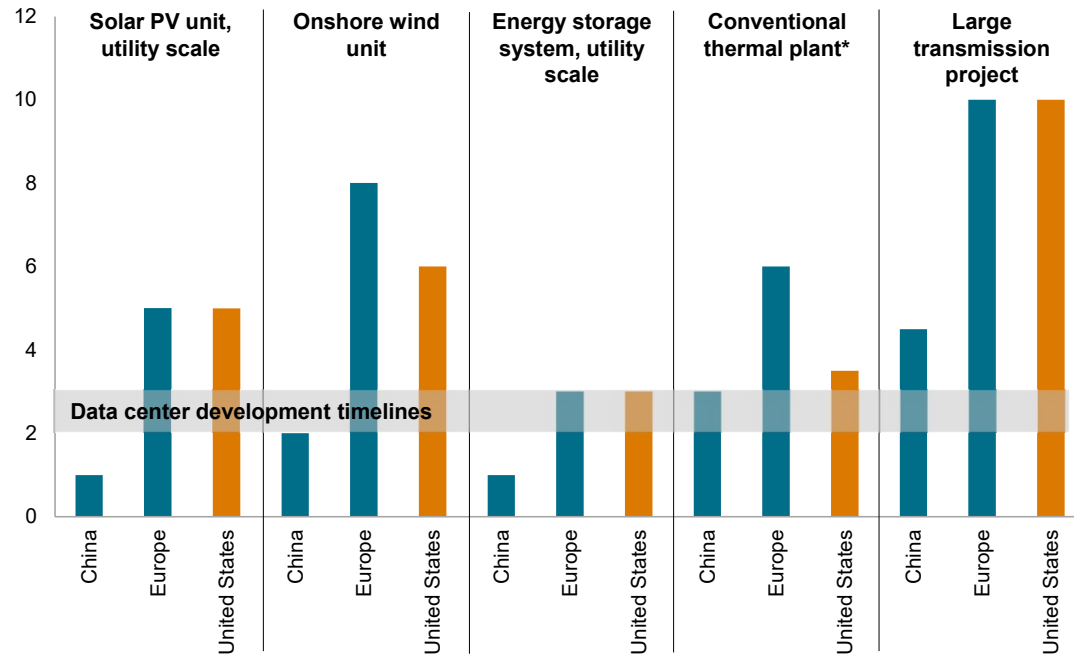
The next ten years may see more load growth than during any other decade in US history

Growth in US electricity consumption, 10-year periods (TWh)



Data center development timelines are misaligned with those of power systems

Indicative average time to market for power system infrastructure (in years)



Data compiled September 2024.

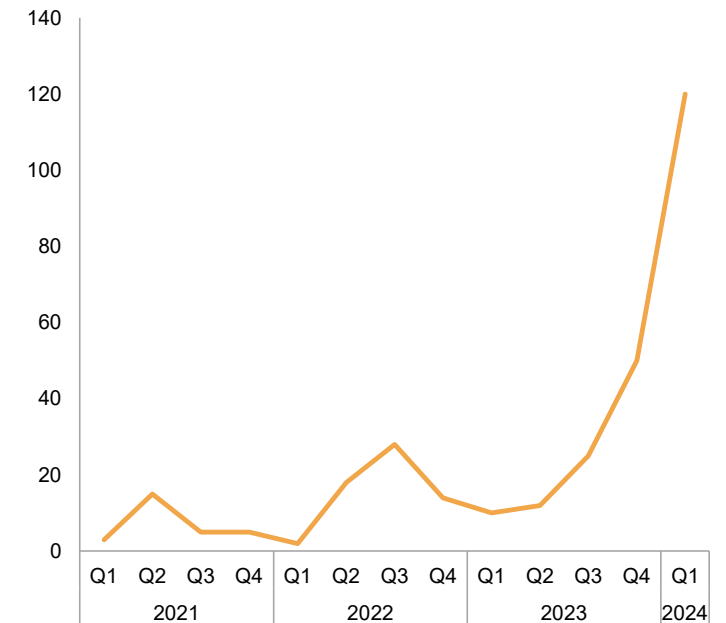
Note: Development timelines consider project planning (early design prior to seeking approvals by relevant authorities), permitting, pre-build (e.g., finalizing financing, gathering contractors, site preparation), and build phases (project under construction or in testing phase).

Note: Timelines vary significantly around these averages, depending on local regulations, site characteristics (local opposition, grid connection issues), and technical characteristics (e.g., length of transmission lines).

* For China we assume a conventional coal plant; for Europe and the US we assume a brownfield combined cycle gas turbine.

Source: S&P Global Commodity Insights

Number of "data center" mentions in utilities' earnings call transcripts since 2021



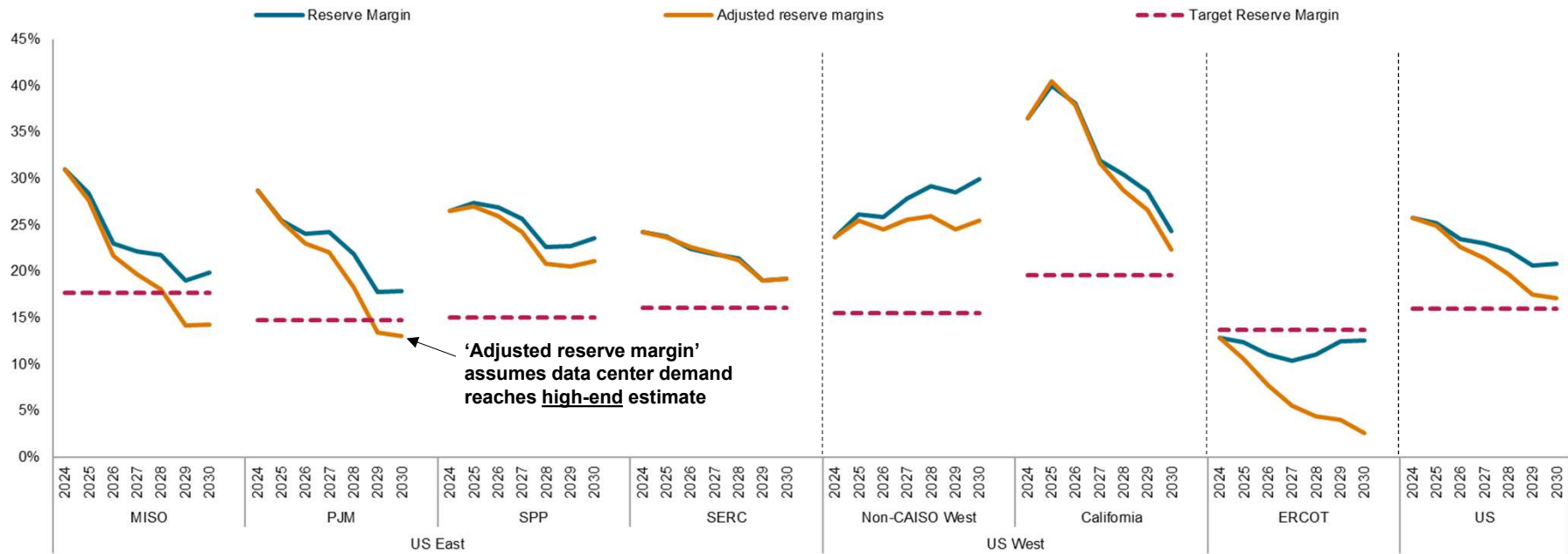
Data compiled March 2024.

Note: Analysis limited to companies classified by the Global Industry Classification Standard of S&P Global Market Intelligence as utilities that are included in the S&P500. Analysis is based on calendar quarters. Transcripts for fiscal Q4 2023 calls held during the first calendar quarter of 2024 are tagged to Q1 2024. Keyword mentions are based on automated scans of earnings call transcripts.

Source: S&P Global Market Insights

Supply-demand misalignment will more rapidly tighten markets, especially in ERCOT, PJM, and MISO

Planning Case reserve margins accounting for incremental peak load, 2024-2030 (%)



Data compiled October 2024

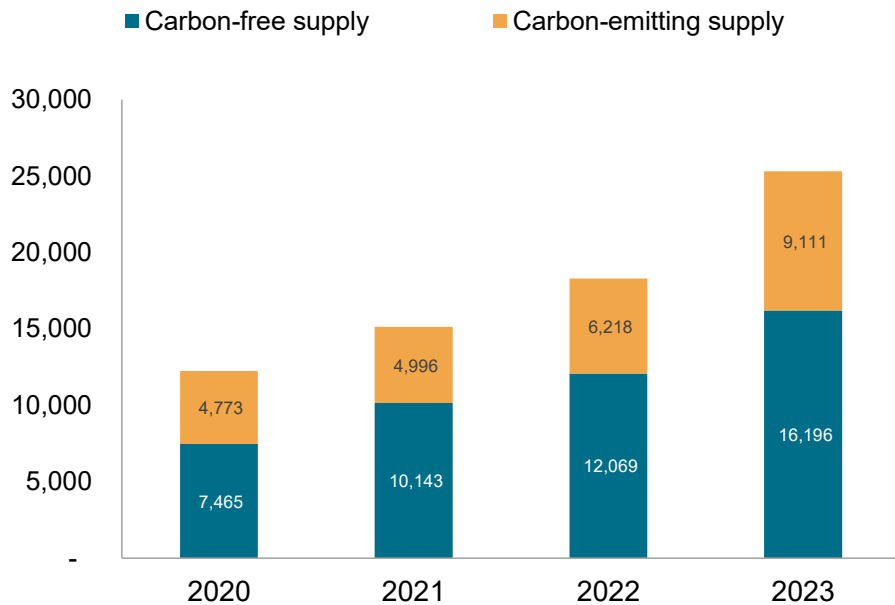
Note: 'Adjusted reserve margins' reflect a doubling of incremental data center peak load in the base case by 2030 and no supply-side response. Reserve margin accounting does not align with the latest ELCC accounting methods from regional grid operators.

Source: S&P Global Commodity Insights

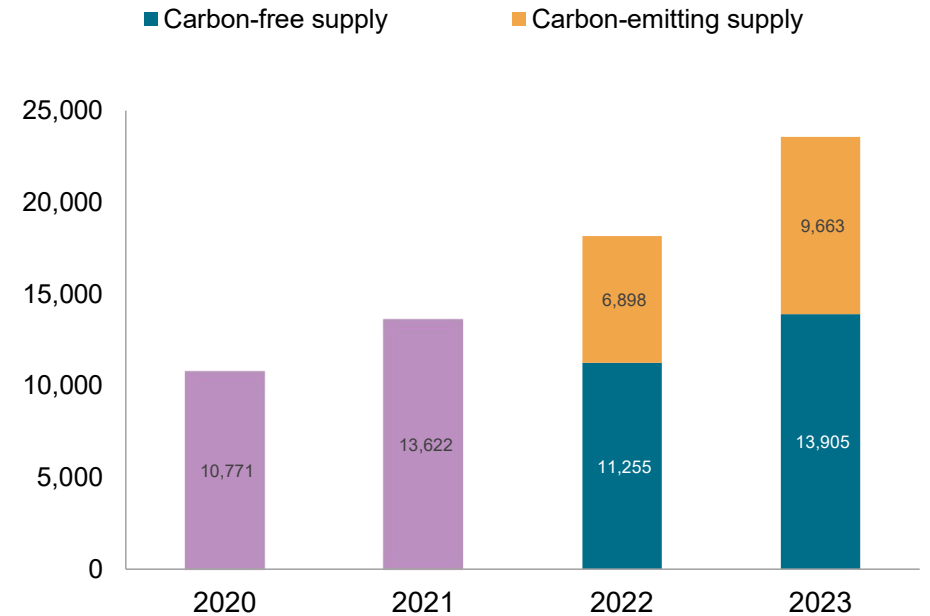
Data centers have increased fossil generation in recent years

Since 2020, carbon-emitting sources supplied 30-40% of power demand from Google and Microsoft

Google global electricity consumption by supply type, GWh



Microsoft global electricity consumption by supply type, GWh



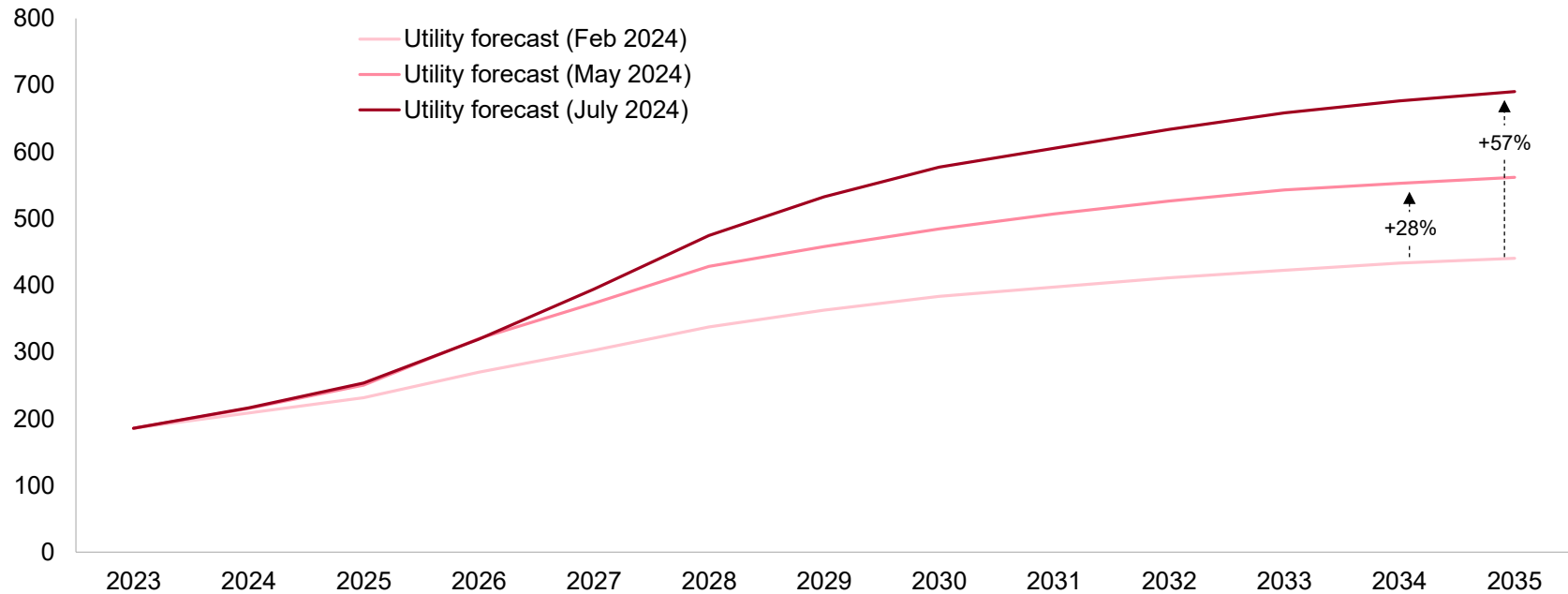
Data compiled October 2024.

Note: Microsoft's Fiscal Year (FY) includes data from the 12 months ending on June 30.

Source: S&P Global Commodity Insights, Google 2023 Environmental Report, Microsoft 2024 Environmental Sustainability Report (Data Fact Sheet).

Utility datacenter load forecasts have pushed higher in recent months

US datacenter load forecast (aggregate utility), TWh



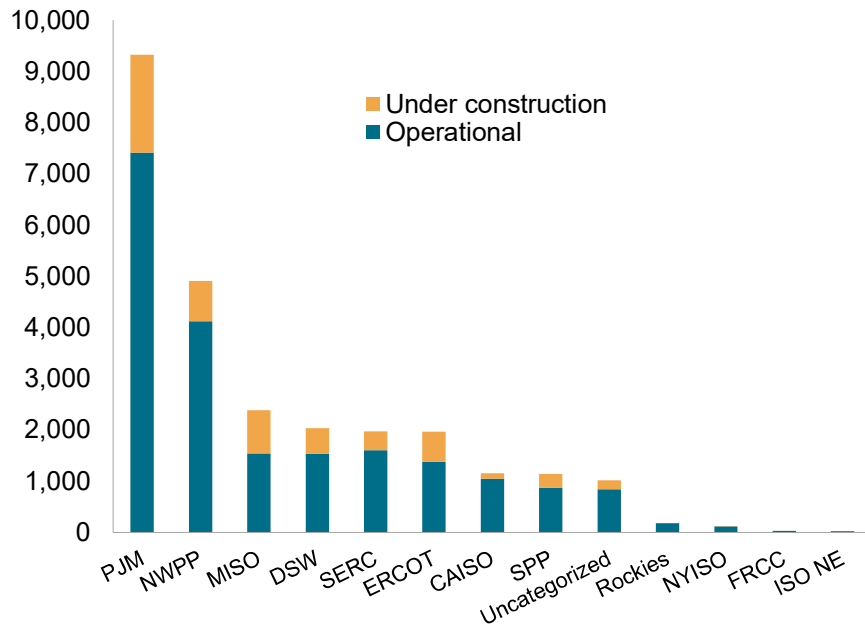
Data compiled July 2024.

Note: Utility forecast includes data center load forecasts from various ISO/RTOs and electric utilities. Excludes cryptocurrency mining datacenters

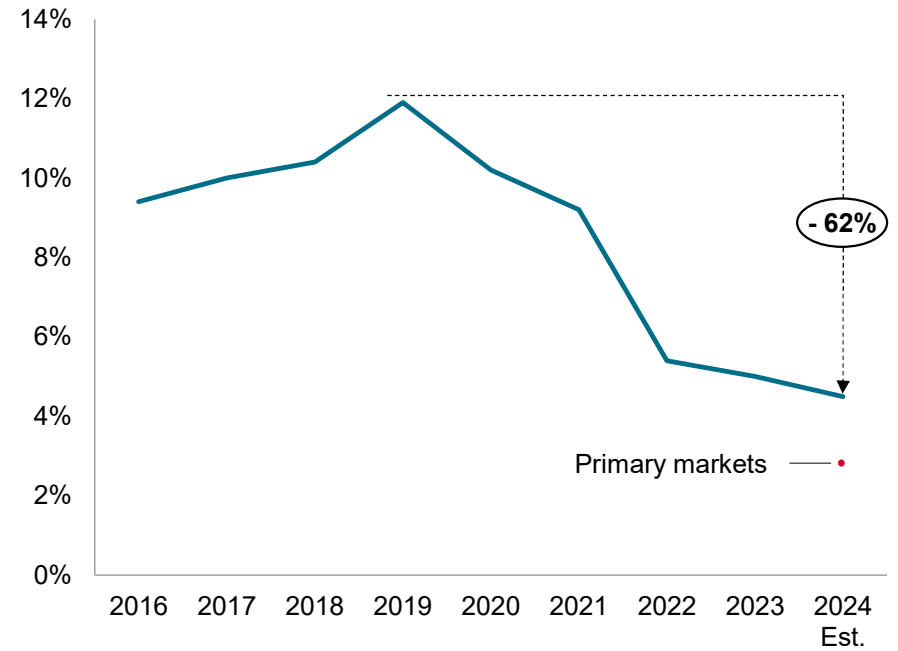
Source: S&P Global Commodity Insights

Data center load growth is real

US: Data center capacity by power market and status



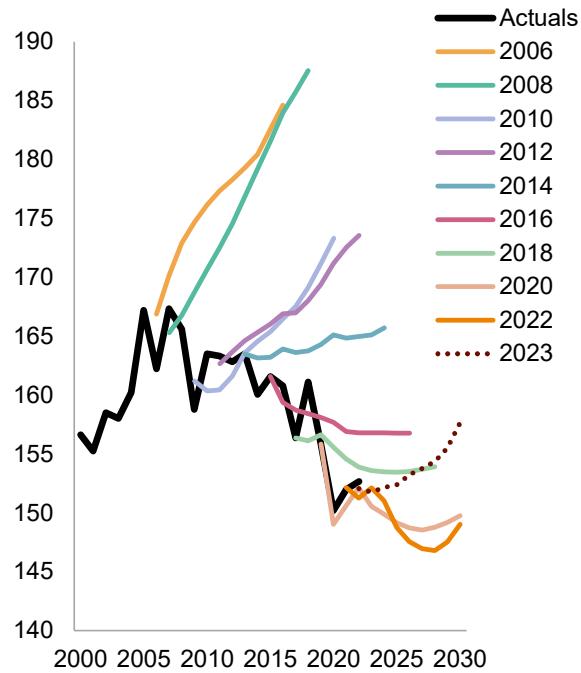
US: Leased data center vacancy rate



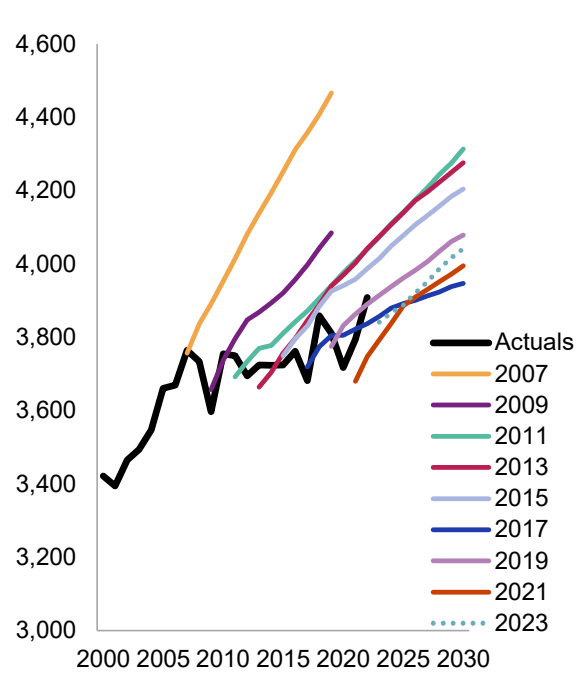
Data compiled August 2024.
Source: S&P Global Commodity Insights, 451 Research, CBRE

Industry stakeholders have a history of over-forecasting electricity demand

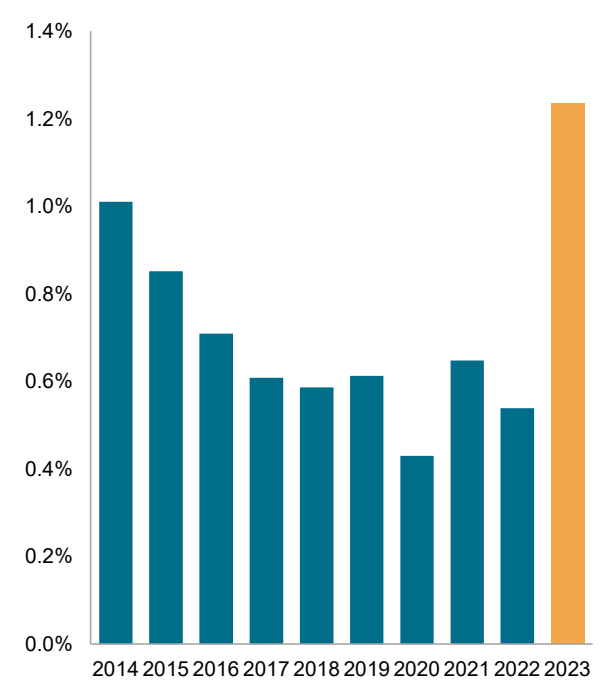
NYISO electricity demand projections by vintage TWh



EIA electricity sales projections by vintage TWh

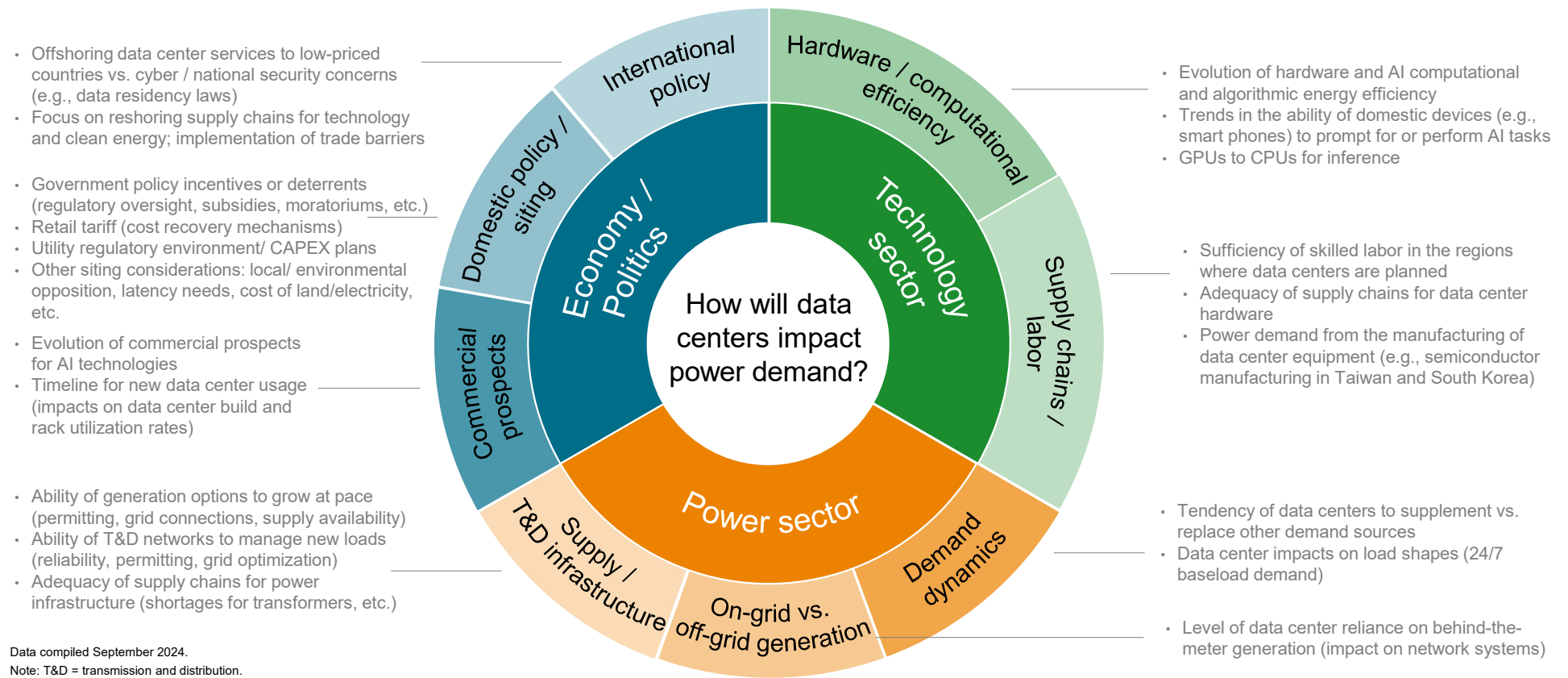


NERC net energy for load, 10-year annual average growth rates



Data compiled April 2024.
Source: S&P Global Commodity Insights, NYISO Gold Books, NERC and EIA Annual Energy Outlooks.

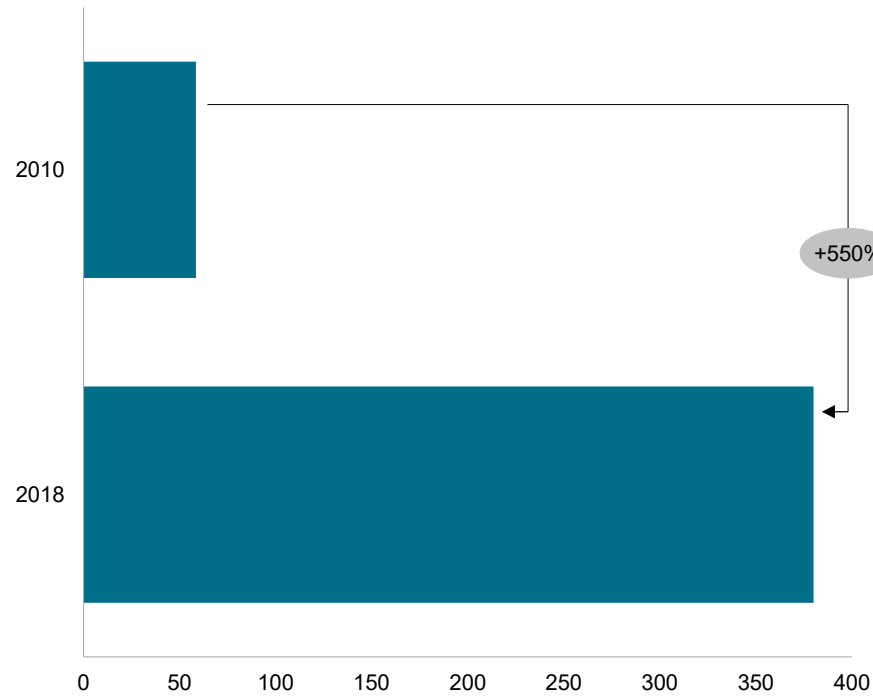
Data center impacts on global power demand will depend on drivers that span the technology sector, power sector, and broader economy



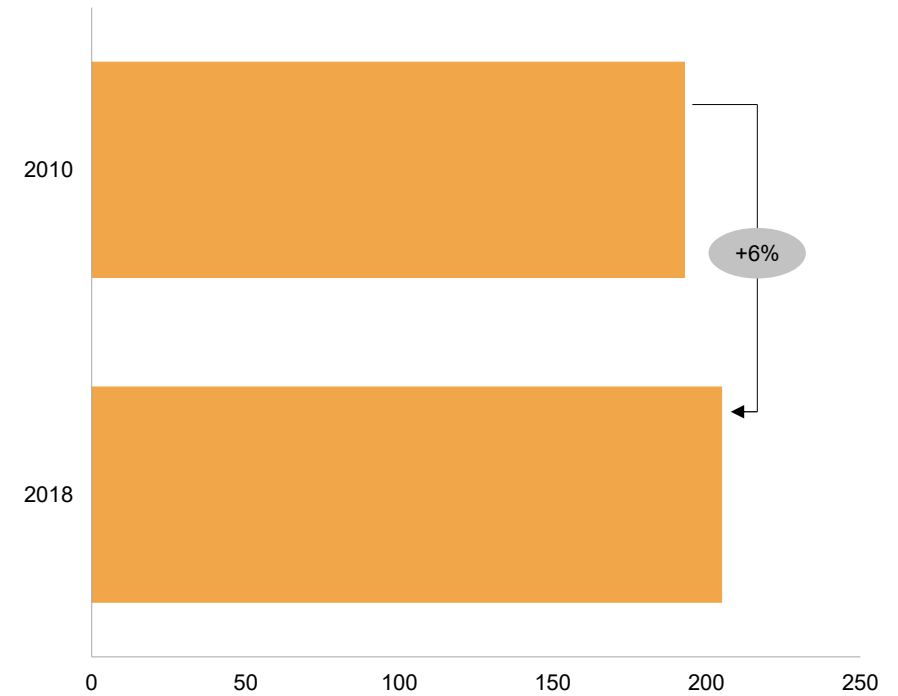
Data compiled September 2024.
 Note: T&D = transmission and distribution.
 Source: S&P Global Commodity Insights

Historically, global computing efficiency has far outpaced associated power demand; the same could occur with data centers

Global data center compute instances, millions



Global data center electricity use, TWh/year



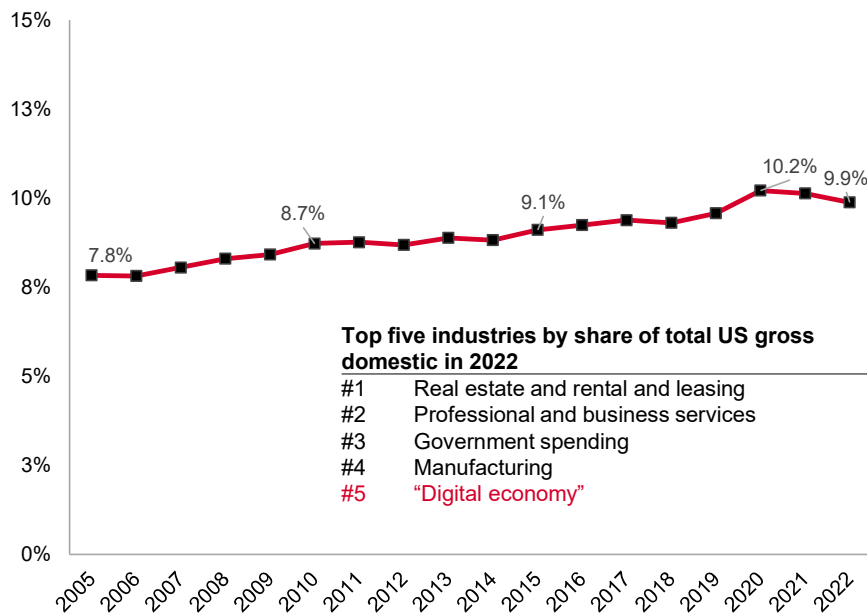
Data compiled May 2024.

Note: A compute instance is defined as a virtual machine with its own set of resources (CPU, RAM, and storage) running on physical hardware. Data center electricity demand includes electricity consumed by traditional, hyperscale, and cloud data centers

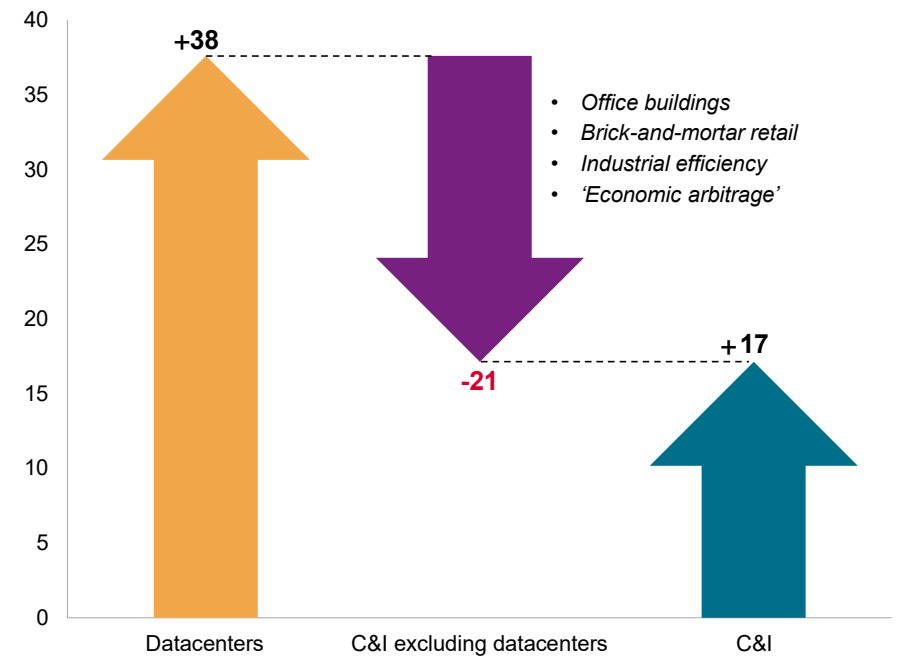
Source: S&P Global Commodity Insights, Eric Masanet et al., Recalibrating global data center energy-use estimates, Science, February 28, 2020, accessed from: https://datacenters.lbl.gov/sites/default/files/Masanet_et_al_Science_2020.full_.pdf

As datacenters underpin a greater share of economic activity, how might they support shifts in patterns of electricity consumption in other economic subsectors?

US "Digital Economy" share of GDP



Increase (decrease) in retail electricity sales from 2018 to 2023 by component, TWh



Date compiled: September 30, 2024

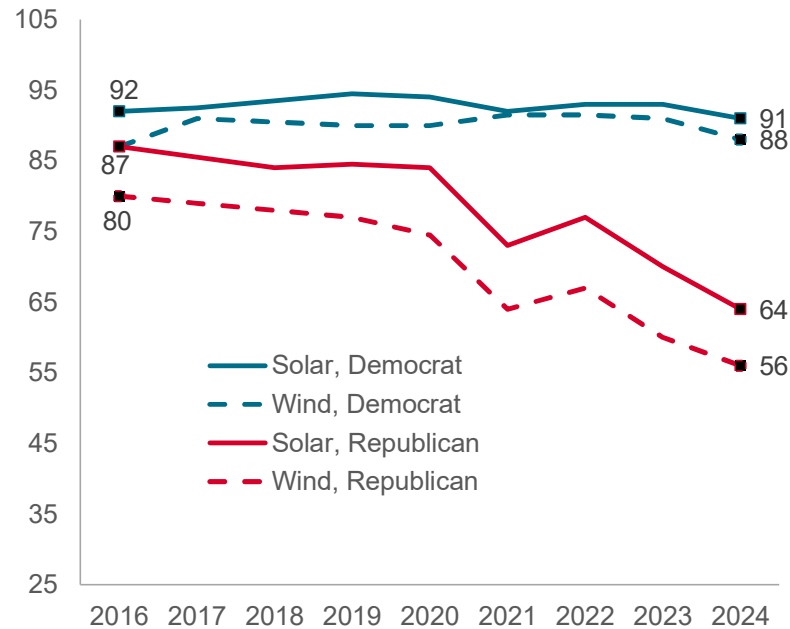
Notes: The "Digital Economy" share of US GDP is based on current-dollar value added. According to the Bureau of Economic Analysis, the 'Digital Economy' is comprised primarily of the following three components: Digital enabling infrastructure (e.g., hardware, software, and telecom networks), e-commerce and digital transactions, and digital media and content (e.g., streaming services).

Source: S&P Global Commodity Insights, U.S. Bureau of Economic Analysis, U.S. EIA

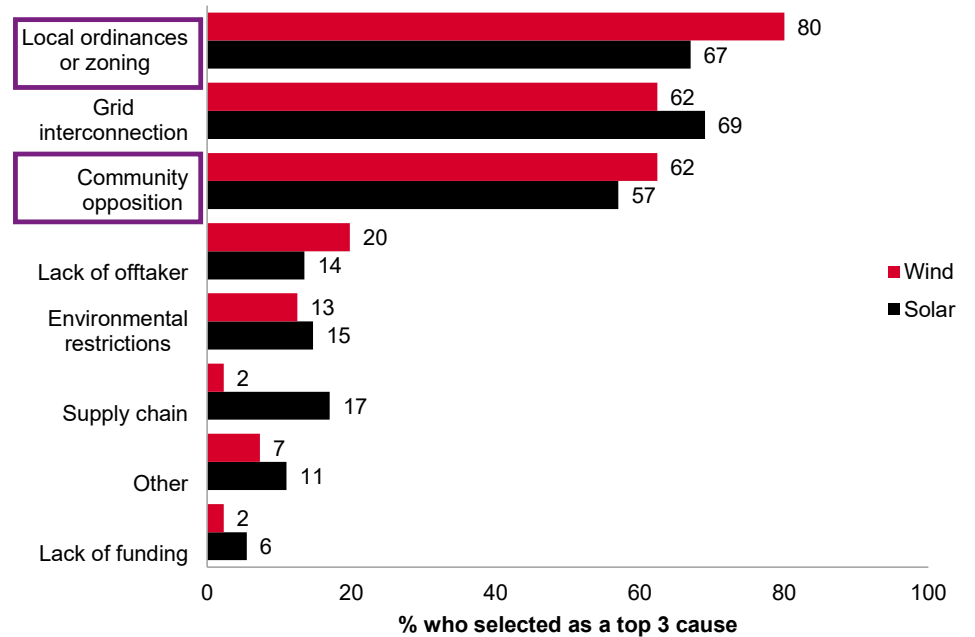
Surveys reveal ‘favorability’ for renewables has declined in rural areas as local opposition has emerged as a leading risk to renewable development

Favorability of solar and wind power among US adults, by affiliation

% who favor more__ in the country”



Berkeley Lab survey results: What are the leading causes of project cancellation?

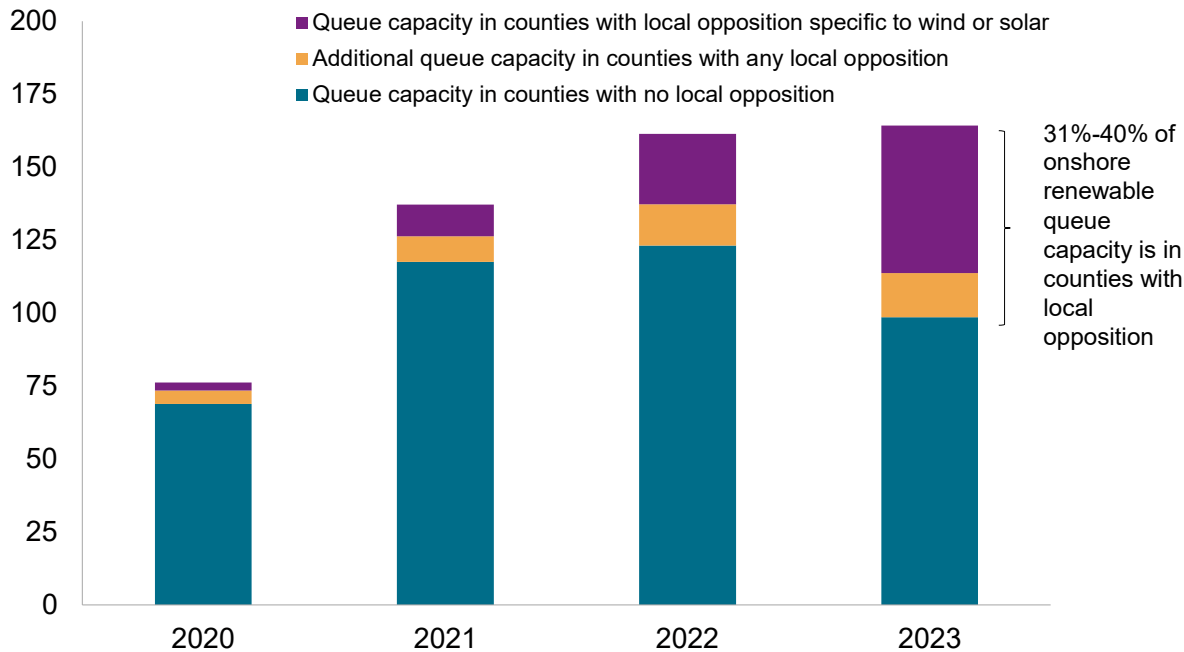


Data compiled Oct. 01, 2024.

Sources: S&P Global Commodity Insights, Pew Research Center, "How Americans View National, Local and Personal Energy Choices", June 27, 2024, accessed from: <https://www.pewresearch.org/science/2024/06/27/how-americans-view-national-local-and-personal-energy-choices/> on October 1, 2024; and Berkeley Lab, Survey of Utility-Scale Wind and Solar Developers Report (2024), access from: <https://emp.lbl.gov/publications/survey-utility-scale-wind-and-solar> on October 1, 2024.

Headwinds to land-based renewable development have emerged rapidly and threaten the ability to achieve clean energy commitments

PJM: Onshore wind, solar, and hybrid solar queue capacity in counties with local opposition from 2020-2023, GW

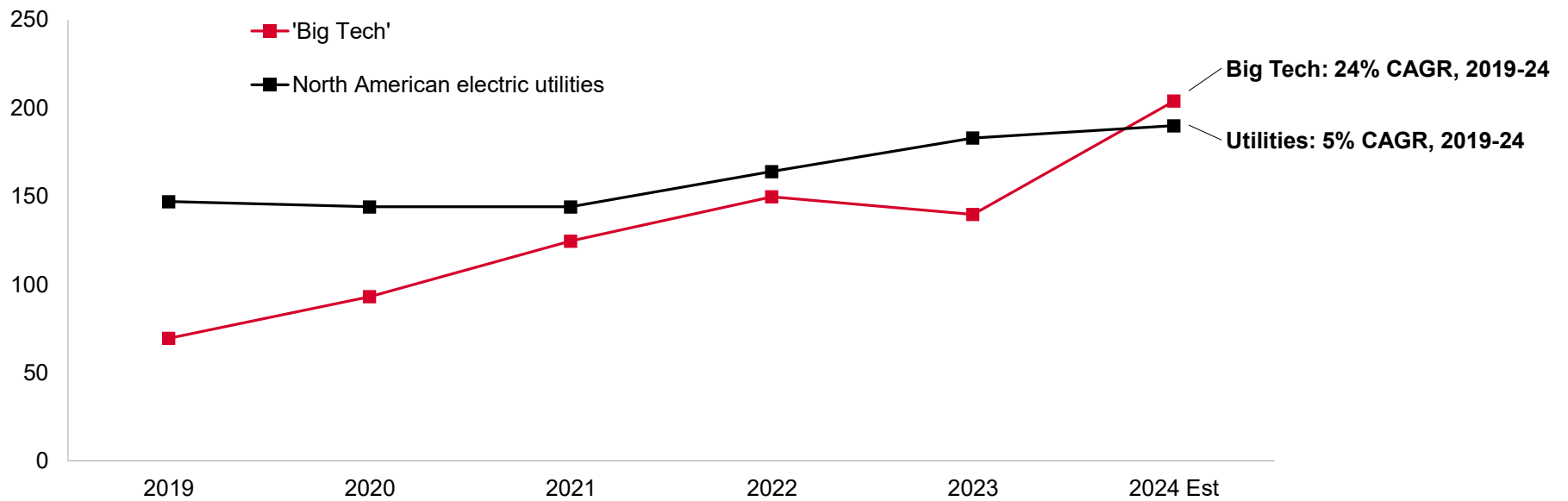


- A recent survey of utility-scale wind and solar developers cited local ordinances, grid interconnections, and local opposition as the leading causes of cancellations of both wind and solar projects over the past five years.
- S&P Global's analysis of the PJM region found that escalating local opposition threatens a significant share of solar and onshore wind projects in the queue. Counties where new wind or solar projects face significant new restrictions or bans account for 31%-40% of all PJM onshore wind and solar queued capacity.
- States with clean energy mandates are fighting back against local opposition. Several states in PJM have implemented or proposed policies to limit the ability of local authorities to restrict renewable development. While effective, these policies reduce local autonomy and raise the risk of political backlash.

Data compiled Oct. 01, 2024.
Sources: S&P Global Commodity Insights, PJM, Columbia Sabin Center

How data center developers respond to challenges building renewables in the East could reshape North American power and gas markets

Annual capital expenditures: four technology companies vs North American electric utilities, \$ billion



Data compiled October 14, 2024.

Note: 'Big Tech' = Alphabet, Amazon, Microsoft, and Meta. North American electric utilities includes 44 publicly traded utilities in the US and Canada, for which regulated vertically integrated operations or electricity transmission and distribution make up the majority of business operations.

Source: S&P Global Commodities Insight, company financial disclosures

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Q&A

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