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Pathways

What AI can't build: The enduring role of infrastructure in a disrupted world

June 2026

Executive summary

Infrastructure's physical, capital-intensive nature makes it resilient to AI substitution. AI can enhance these assets but cannot replace them, nor can it provide the real-world services they deliver.

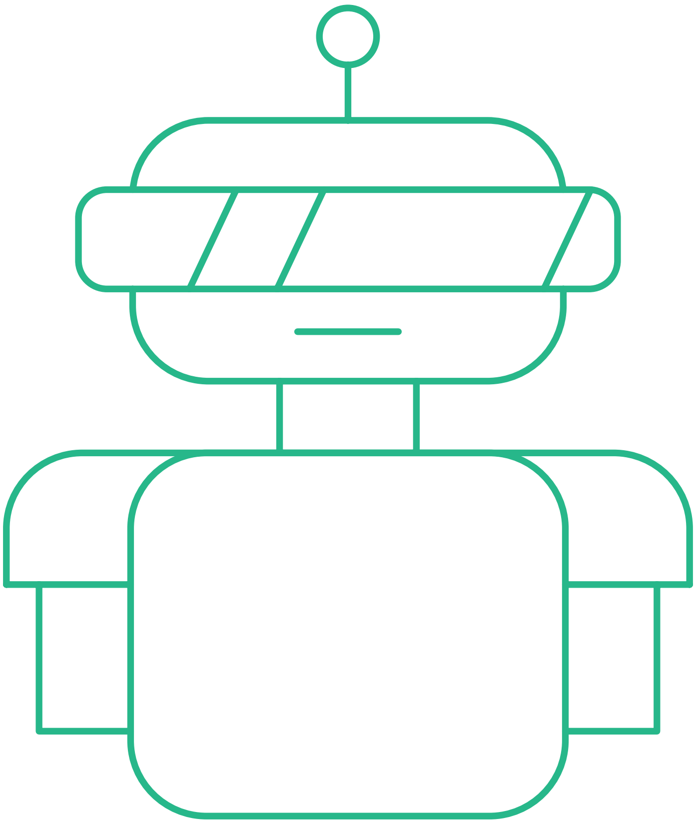
Demand tailwinds from AI are strongest for data centres, electricity grids and renewables. While car parks may face longer-term headwinds, most other sectors see a modest net positive impact.

AI adoption across infrastructure assets can deliver operating expenditure (opex) savings of 5–30% through network optimisation, anomaly detection and process automation.

For investors, AI is expected to augment rather than displace brownfield assets, with the key focus areas being operational efficiency gains, cybersecurity risk and growing performance differentiation between digitally advanced and legacy assets.

The **principal risks** are related to execution: grid interconnection queues, permitting delays and geographic concentration of load could constrain the pace of buildout.

Introduction: AI disruption is repricing risk across sectors



AI is advancing rapidly, raising fundamental questions about how far its impact will extend across the global economy.

While for many sectors it remains a growth tailwind, markets are increasingly aware of, and pricing, its disruptive risk potential (Figure 1). The release of new AI tools has led investors to reassess the durability of many business models, particularly around pricing power and the reliability of existing revenues. Sectors most exposed to AI-driven substitution have seen declines in value, with the S&P 500 Software & Services Index falling by -18.2% year-to-date, while S&P 500 Utilities Index and S&P 500 Industrials Index have delivered 8.6% and 10.7% increases year-to-date, respectively (Figure 2).

Figure 1:
Sectors most exposed to AI substitution risk saw negative performance...

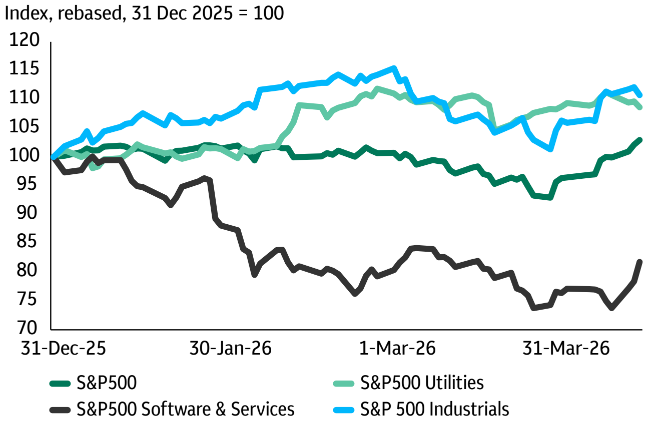
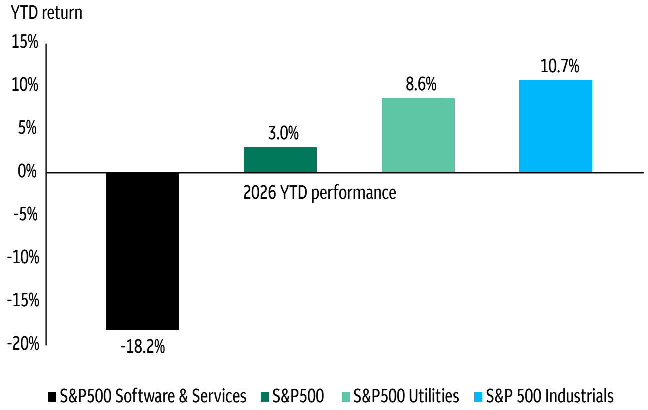


Figure 2:
...while real-asset sectors have showed strong positive performance this year



Source: Bloomberg, Macquarie Asset Management (April 2026).

Why infrastructure is structurally more resilient: HALOID

So far, the market response this year has been captured in the “Heavy Assets, Low Obsolescence” (or “HALO”) framework that reflects a preference for businesses whose value is anchored in physical assets difficult to replicate and unlikely to be displaced by AI. In our view, infrastructure is more resilient than what the traditional HALO definition implies, with an additional inelastic demand (ID) characteristic that is not often present in a conventional HALO business:

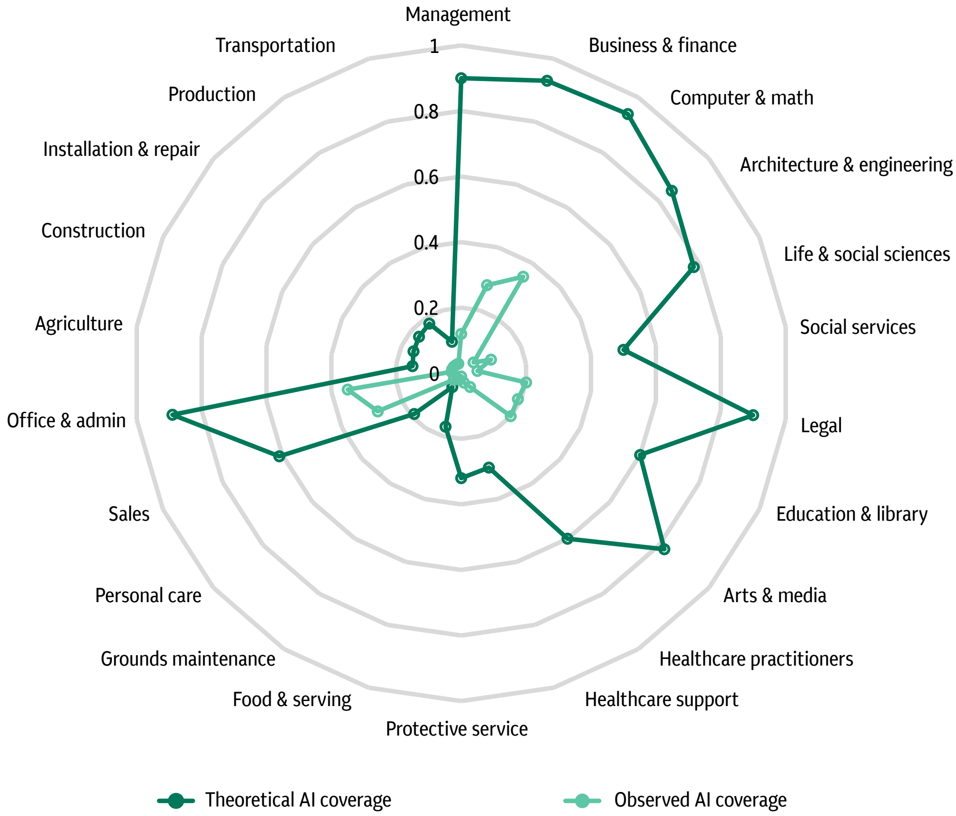
- **Heavy Assets (HA):** Infrastructure assets are capital intensive, long lived, and location specific, making them difficult to replicate, thereby insulating cash flows from AI disruption.
- **Low Obsolescence (LO):** Infrastructure provides real-world, essential services that have limited substitution risk and are not something AI can ‘produce’. For example, AI cannot replace the need for networks (power, water, transport, connectivity), though it can improve their utilisation.
- **Inelastic Demand (ID):** Infrastructure revenues are often backed by long term contracts, monopolistic market positions, or regulatory frameworks, making them relatively resilient to shocks and providing predictable cash flows.

AI's reach in the physical economy

AI capabilities continue to expand, yet many tasks remain beyond AI's reach. According to Anthropic's labour-market analysis published in March 2026, occupations dominated by physical activity and on-site execution (such as transportation, construction, and installation and repair) exhibit some of the lowest observed exposure to AI,[1] even where theoretical capability exists (Figure 3).

Against such a backdrop, this paper examines whether infrastructure sectors (where activities are inherently physical, asset-heavy and often regulated) are more likely to be disrupted or enhanced by AI adoption. We assess how AI interacts with infrastructure demand, operational efficiency and long-term asset relevance across eleven infrastructure sectors. By distinguishing between demand risk and efficiency-enhancing augmentation, the analysis aims to provide a framework for understanding where AI represents a structural threat, where it strengthens existing structural trends, and where its impact is likely to remain incremental over the medium- to long-term.

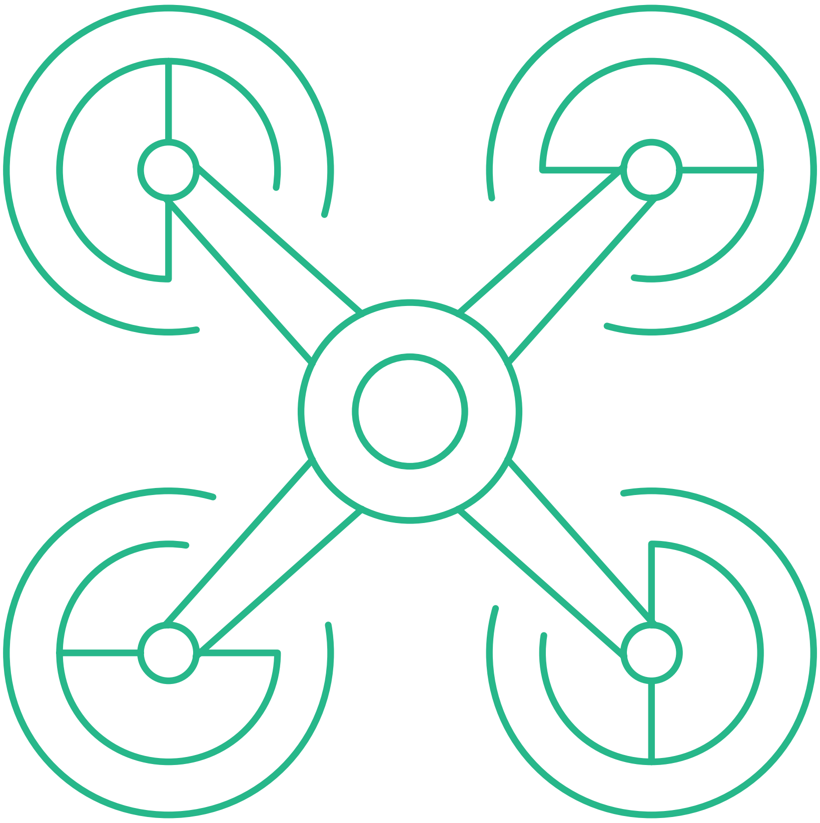
Figure 3:
Theoretical capability and observed exposure by occupational category



Source: Anthropic, "Labor market impacts of AI: A new measure and early evidence" (March 2026).

1. Anthropic, "Labor market impacts of AI: A new measure and early evidence" (March 2026).

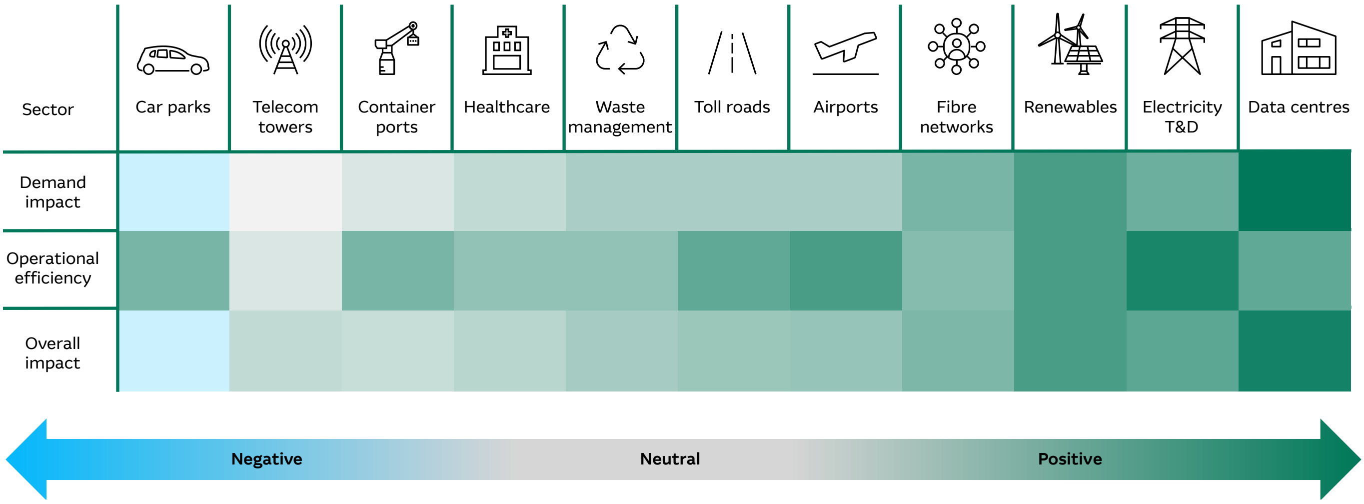
Key findings and AI heatmap for infrastructure



Below, we present a theoretical AI disruption heatmap for infrastructure sectors, ranking each sector by its relative exposure to AI across two dimensions: impact on demand and impact on operational efficiency.

The heatmap (Figure 4) is intended as a high-level, comparative framework, reflecting how AI is most likely to interact with different infrastructure business models.

Figure 4:
AI disruption heatmap for infrastructure sectors



Sources: Macquarie Asset Management (May 2026).

Summary of key findings by sector

Digital infrastructure

AI is driving demand across the sector. For **data centres** it is through strong growth in compute-intensive workloads. For **fibre networks** it is increasing demand to support higher bandwidth and low latency data flows between and within regions. And for **telecom towers**, edge applications increase wireless traffic volumes, boosting demand. That said, there is also higher AI data-centre obsolescence risk, potentially stronger competition in fibre build-out and near-term tower build deferral (due to AI-driven network optimisation by mobile network operators).

Utilities

Utilities face demand tailwinds, as data centre growth and broader electrification are accelerating load and driving a capital expenditure (capex) super-cycle in generation, transmission, distribution and storage. AI also improves efficiency: better forecasting, streamlined dispatch, drone- and sensor-based inspection, and AI-enabled work scheduling can reduce outages. The key risk is execution and system constraint. Large, geographically concentrated loads can outpace interconnection and permitting timelines. This raises congestion and reliability risk and potentially creates affordability pressure, making planning discipline, regulatory alignment and balance-sheet flexibility increasingly important.

Renewables

Renewables are a beneficiary of AI on both the demand and supply sides. AI-related data-centre buildout creates a large, durable pool of electricity demand, supporting stronger corporate PPA volumes and pricing, and expanding opportunities in co-located storage and integrated energy solutions. Operationally, AI improves forecasting, preventive maintenance and grid integration, lifting availability and output while lowering opex and downtime, reinforcing the long-term investment case. The main constraint is grid access: interconnection queues, congestion and permitting delays can slow deployment.

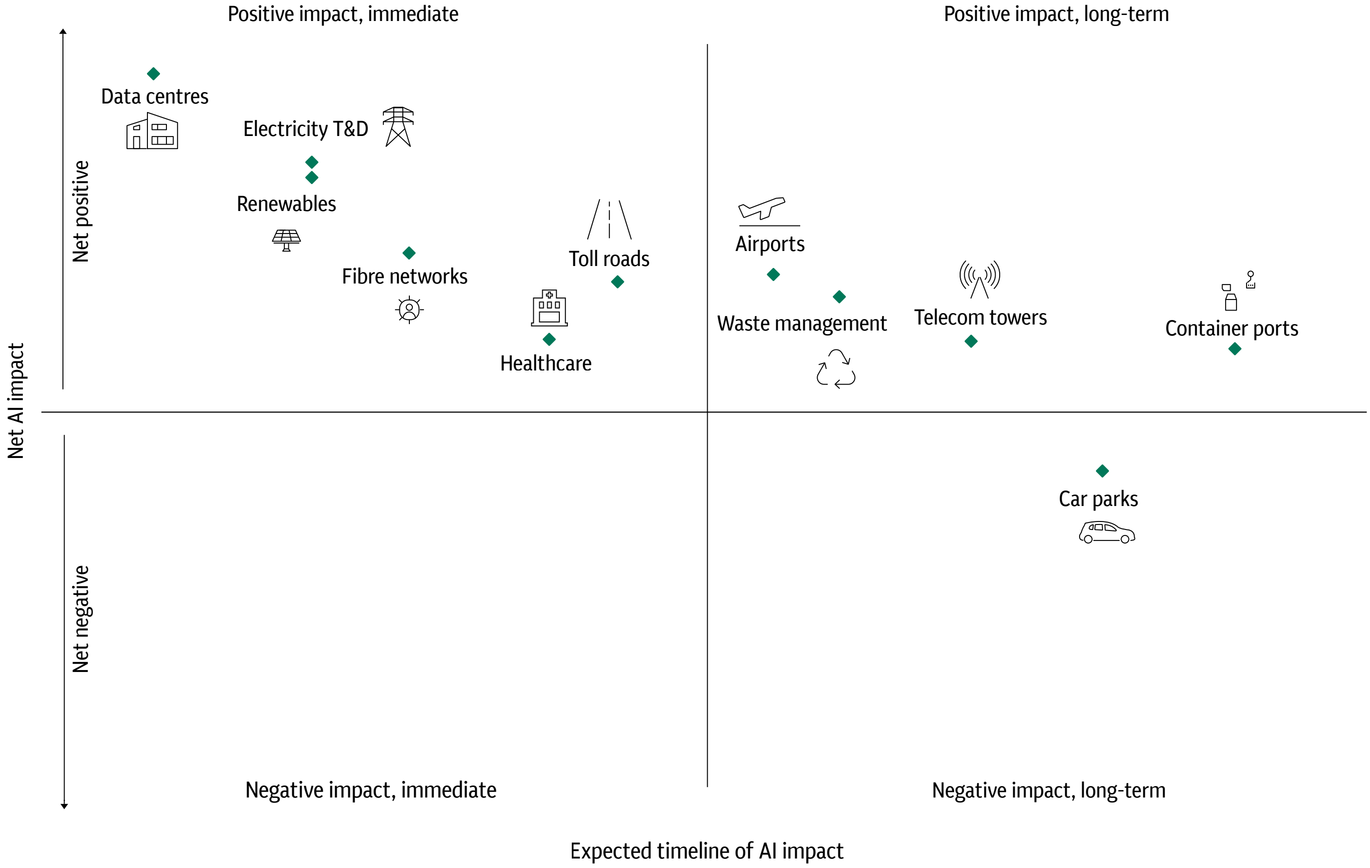
Transport

AI is primarily an operational tailwind for transport assets, but demand impact varies by sub-sector. For **airports**, AI-enabled operations can lift throughput, and GDP growth linkages may contribute to revenue growth. Business travel may potentially be negatively impacted, yet leisure-related travel growth may accelerate and more than offset any softness in business travel. For **toll roads**, the impact is likely positive due to volumes' link to GDP growth, which may accelerate due to AI-driven productivity gains, particularly for roads with heavy-vehicle traffic exposure. The key risk is reduced commuter frequency from AI-enabled remote and flexible work (urban commuter exposure). For **container ports**, AI improves berth planning and equipment utilisation, but automation and AI-enabled reshoring of low value manufacturing could moderate import volume growth in developed markets in the long term.

Diversified infrastructure

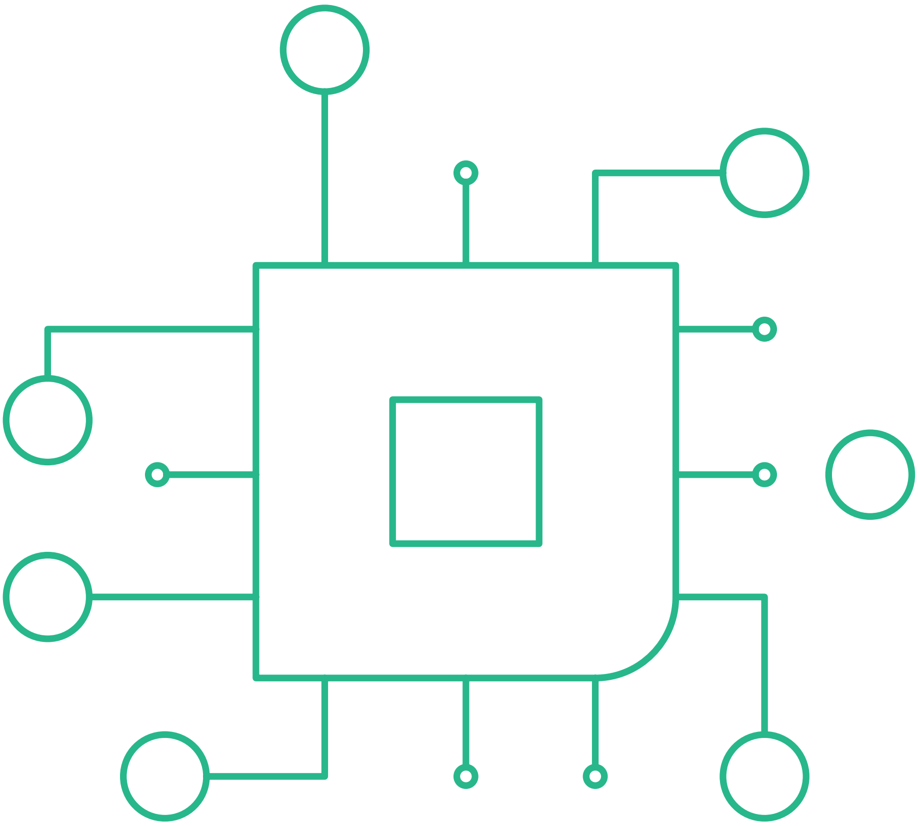
AI's impact across diversified infrastructure is mixed: generally strong operational upside with more idiosyncratic demand risk. **Healthcare** is broadly positive: AI can increase diagnosis and referral accuracy and improve hospital operations (scheduling, patient flow, administration automation), supporting higher throughput. **Waste management** may see meaningful augmentation from AI-enabled robotics and automation that lifts recovery rates and recycle revenues, particularly at material recovery facilities (MRFs), but higher upstream waste reduction may gradually divert volumes away from waste-to-energy plants. **Car parks** may face structural demand headwinds in office-centric locations as AI-enabled autonomous vehicles may reduce commuter parking in the long term (Figure 5), while airport- and retail-adjacent car parks are likely to be more resilient.

Figure 5:
Expected AI impact by infrastructure sector



Source: Macquarie Asset Management (May 2026).

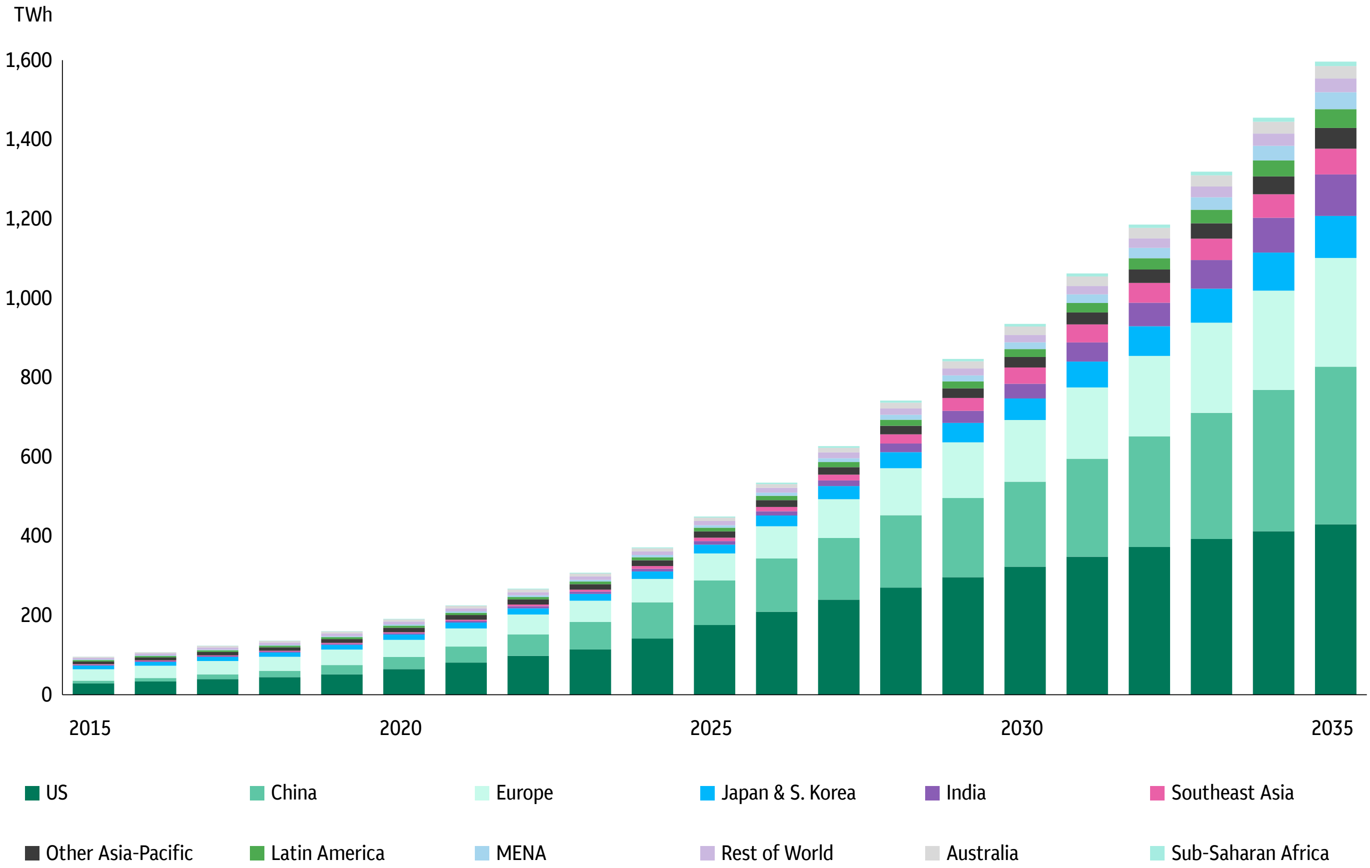
AI impact on infrastructure demand



Data centres: AI accelerates demand with power and design becoming key differentiators

Electricity demand from data centres is expected to grow at a compound annual growth rate (CAGR) of 14.2% to 2035, making data centres one of the fastest-growing electricity users (Figure 6). Data centres could consume 1,600 terawatt-hours (TWh) by 2035[2] – about 4.4% of global electricity. If they were a country, they would rank fourth in electricity use, behind China, the US and India. In key US markets, data centres are outpacing electric vehicles, hydrogen and other emerging technologies in electricity demand growth.

Figure 6:
Data centre power demand is expected to grow at a CAGR of 14.2% to 2035



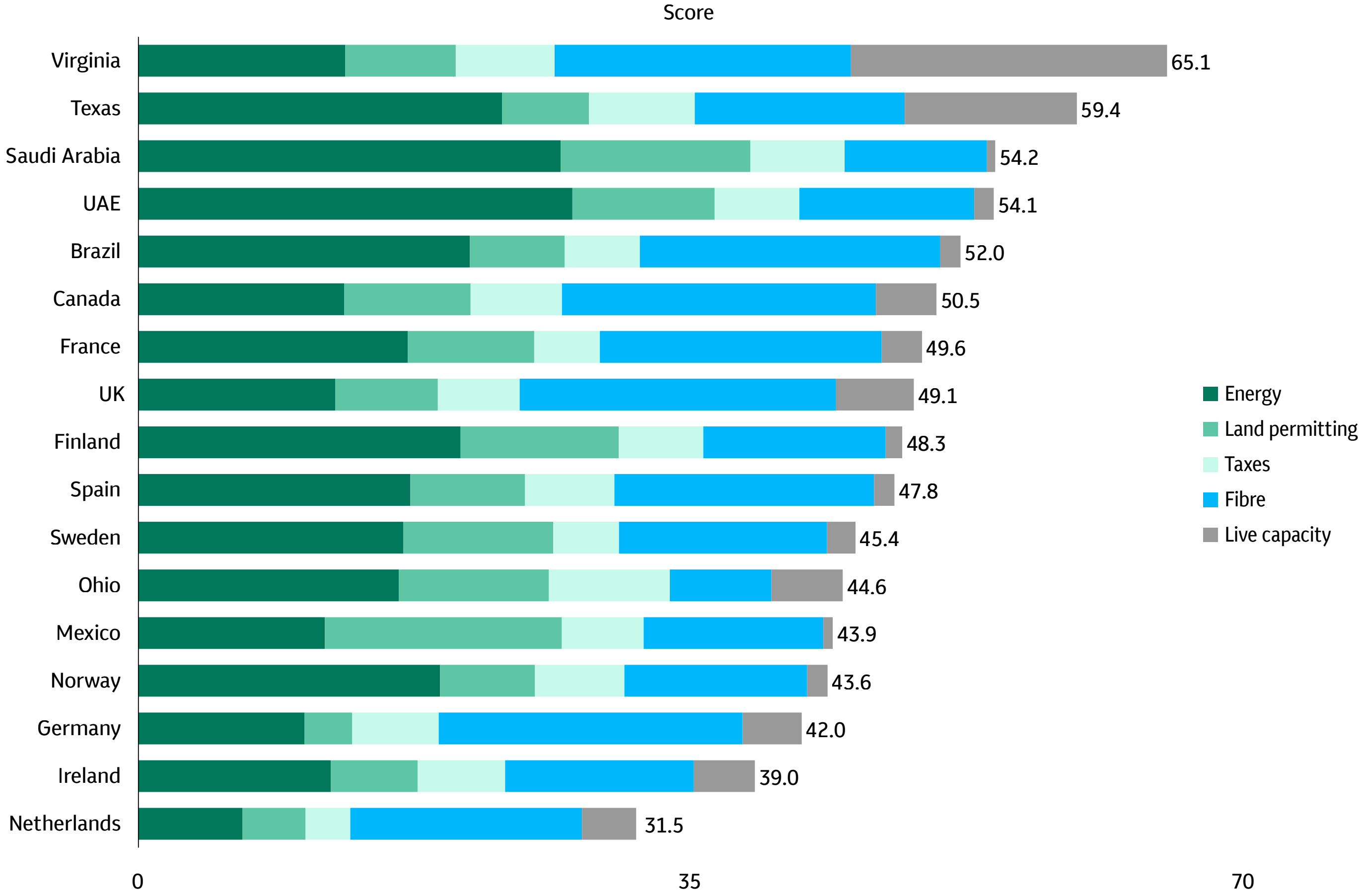
Source: BloombergNEF, "AI data centers fuel quicker growth in power demand" (September 2025).

AI training capacity remains concentrated in a small number of hubs, including the US (Northern Virginia and Texas), China, Japan, Singapore, Ireland and the Nordics. AI inference demand is more geographically distributed and typically closer to end-users. Overall, AI adoption is driving broad-based growth across the sector, supporting continued expansion in both cloud and edge facilities as use cases proliferate. However, going forward, the greatest benefits accrue to locations that combine abundant power availability, high energy efficiency and low latency connectivity.

2. BloombergNEF, "AI data centers fuel quicker growth in power demand" (September 2025).

We expect the US to remain the largest data centre market in the world, with Virginia and Texas remaining favourable for new development. However, grid congestion, high power prices, long interconnection queues and lack of available land now serve as major headwinds in traditional hubs.[3] As a result, we see new data centre development increasingly shifting to other locations that offer land, cheap and clean energy, and supportive policies. In Europe, for example, new data centre development may increasingly grow in second-tier markets, outside of Frankfurt, London, Amsterdam, Paris, Dublin (FLAP-D) locations (Figure 7).

Figure 7:
Locations with abundant power availability, high energy efficiency and low latency connectivity may see the greatest benefits



Source: BloombergNEF, "New Data Center Hotspots Are Emerging: Four Things to Know" (March 2026).

3. BloombergNEF, "New Data Center Hotspots Are Emerging: Four Things to Know" (March 2026).

We believe it is important to distinguish between AI data centres and traditional cloud data centres as they can be exposed to different demand drivers and risks. For example, obsolescence risk could be higher for AI-oriented facilities than for traditional data centres due to the pace of technological change. Power density, cooling systems and floor loading[4] requirements may evolve quickly, making facilities suboptimal within relatively short timeframes. Sites that lack power scalability, advanced cooling and strong location advantages may become functionally obsolete before the end of their physical life. Highly specialised AI campuses may also face re-contracting and stranded capital risk, particularly if located in remote, non-cloud markets. Figure 8 summarises the key characteristics and drivers for AI and non-AI data centres.

Figure 8:
Key differences between AI and traditional cloud data centres

Dimension	AI Data Centres	Traditional Cloud Data Centres
Primary Function	Training and inference of AI models	General-purpose computing, storage, and application hosting
Power Density	Very high (often 2–5x traditional cloud); racks can exceed 50–100 kW	Lower and more standardised (typically 5–15 kW per rack)
Cooling Requirements	Advanced cooling (liquid cooling, immersion)	Air-cooled, with gradual adoption of liquid cooling
Network Requirements	Ultra-low latency, high bandwidth	Lower latency sensitivity; more focused on reliability
Location Strategy	Increasingly co-located with power availability (renewables, grid access) and hyperscaler campuses	Historically located near population centres and enterprise demand hubs
Risk Profile	Higher obsolescence risk, higher capex intensity	More mature demand visibility
Growth Drivers	AI model scaling, inference proliferation, enterprise AI adoption	Digitalisation, cloud migration, enterprise IT outsourcing

Source: Macquarie Asset Management (May 2026).

Over the longer term, advances in AI could also accelerate commercialisation pathways for quantum computing. If deployed at scale, quantum computers could speed up certain computations while using less energy than classical hardware for those workloads. In practical terms, that would mean plugging quantum processors into existing facilities as specialised accelerators take over the most computationally intensive steps in selected AI and simulation workflows.[5]

4. Floor loading refers to the amount of weight a floor structure can safely support. Racks filled with high-density servers and GPUs, along with associated cooling systems and power equipment, can place significant concentrated loads on the floor.
5. McKinsey & Company, “How quantum technologies could rebalance the sustainability equation”, (March 2026).

Fixed networks: AI as a structural demand driver of enterprise and wholesale fibre

Rapid growth in workloads such as cloud to edge inference, real time data transfer, and inter-data centre traffic is pushing up bandwidth requirements and increasing demand for low latency connectivity. In turn, this requires greater fibre densification and supports incremental demand from hyperscalers and enterprises. We therefore expect AI to lift both enterprise and wholesale fibre demand, with additional upside from greenfield backbone build-outs (terrestrial and submarine).

Regionally, AI-driven fibre demand is currently most concentrated in the US, reflecting the location of large scale AI data centres. In the US, the number of needed fibre miles is likely to more than double from 159 million miles in 2024 to 373 million miles[6] by 2029 (Figure 9). This means that long-haul fibre miles are expected to increase by 214 million, with 109 million from fibre for upgrades on existing routes, 66 million for new fibre for connections to new data centres and 38 million for new fibre miles for new long-haul routes (Figure 10).

Over time, we expect the demand for fibre to broaden in two ways: higher international capacity between the US and other regions, and additional intra regional backbone investment to distribute models and support ongoing refinements. As inference becomes the larger driver of demand, in region investment should increasingly shift toward metro and regional fibre build outs closer to end users. At the same time, AI enabled network optimisation and automation can lower operating complexity, reducing entry barriers for efficient operators and intensifying competition in some fibre markets.

Figure 9:
In the US, the number of needed fibre miles is likely to more than double...

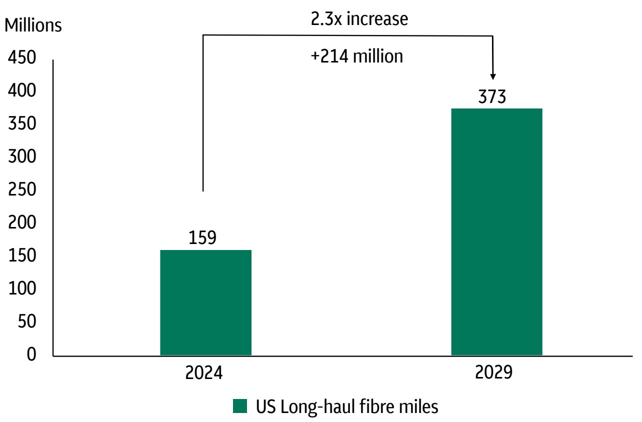
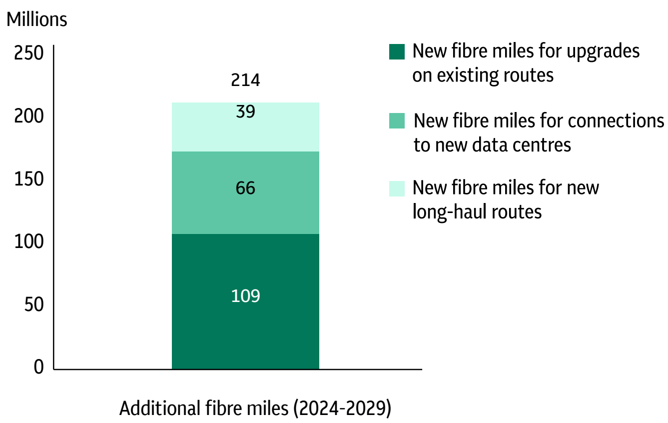


Figure 10:
...driven by upgrades on existing routes, connections to new data centres and new long-haul routes



Source: Fiber Broadband Association, “The Underappreciated Need to Enable AI and Data Center Growth: Increased and More Strategic Fiber Interconnections” (July 2025).

6. Fiber Broadband Association, “The Underappreciated Need to Enable AI and Data Center Growth: Increased and More Strategic Fiber Interconnections”, (July 2025).

Telecom towers: Overall positive impact but may not be immediate

AI is accelerating growth in latency sensitive usage from applications such as real time AI assistants, video creation and edge inference. This strengthens the case for network densification and incremental demand for new sites and small cell infrastructure in dense urban areas. TowerCos may see an expanded addressable market beyond traditional macro towers, more amendments per site, and additional power and fibre upgrades. Overall, AI reinforces the long term volume growth and tenancy driven economics that underpin the TowerCo model. That said, AI-driven network optimisation may enable mobile network operators (MNOs) to extract more capacity from existing assets, potentially delaying the need for incremental tower infrastructure in the near term.

Electricity distribution and transmission: Load growth picking up after years of stagnation

After 20 years of largely flat demand (as improvements in energy efficiency offset GDP-driven growth in power demand), the US and European load growth is projected to accelerate to around 2.0% CAGR through 2035 (Figures 11 and 12).[7] Data centres, industrial electrification and electric vehicles (EVs) are driving the need for the expansion of the transmission and distribution networks globally.

Figure 11:
Final electricity consumption growth in the US is accelerating...

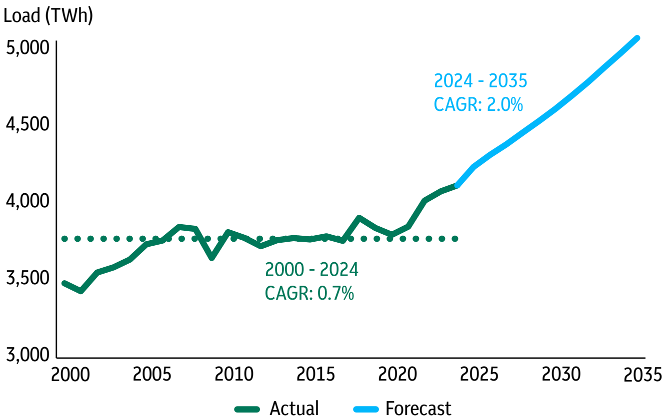
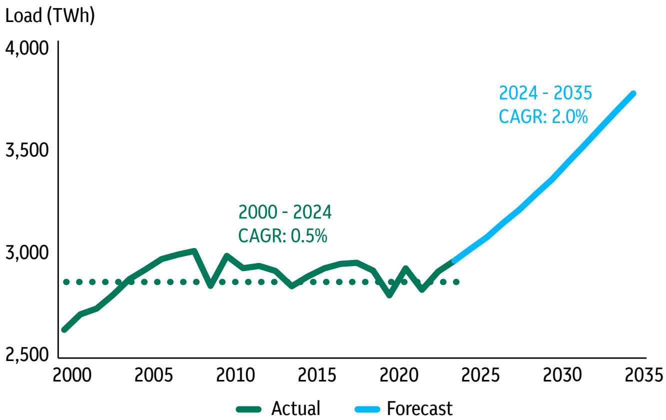


Figure 12:
...with Europe experiencing the same dynamic



Source: BloombergNEF database (April 2026).

7. BloombergNEF database (April 2026). Refers to final electricity consumption growth.

In 2025, the US saw the largest amount of grid investment globally at $US115 billion, representing almost a quarter of the total global spend (Figure 13). Total US grid capex is projected at $US1.0 trillion between 2026 and 2035 across distribution and transmission, with the investment required in grid distribution ($US652 billion) almost double that in grid transmission ($US393 billion). In Europe, grid capex is estimated at $US1.2 trillion over the next ten years, with $US601 billion required in grid transmission and $US560 billion in distribution (Figure 14).[8]

Figure 13:
Total US grid capex requirements between 2026 and 2035 total $US1.0 trillion...

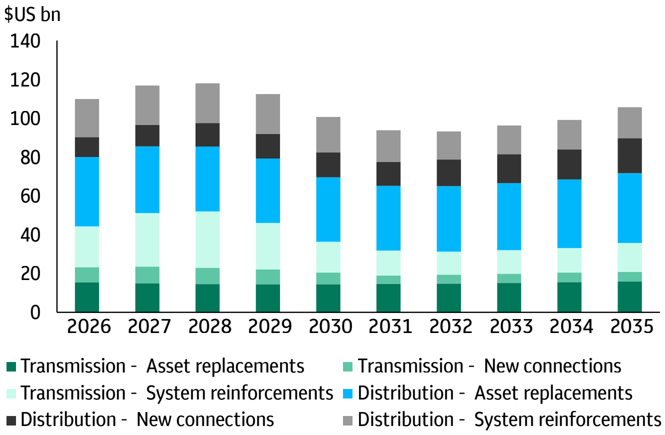
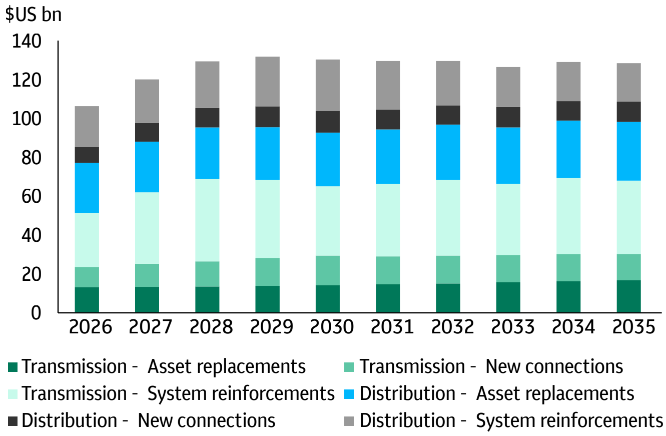


Figure 14:
...similarly, European grid requires $US1.2 trillion over the same period



Source: BloombergNEF, "New Energy Outlook 2025: Grids" (August 2025).

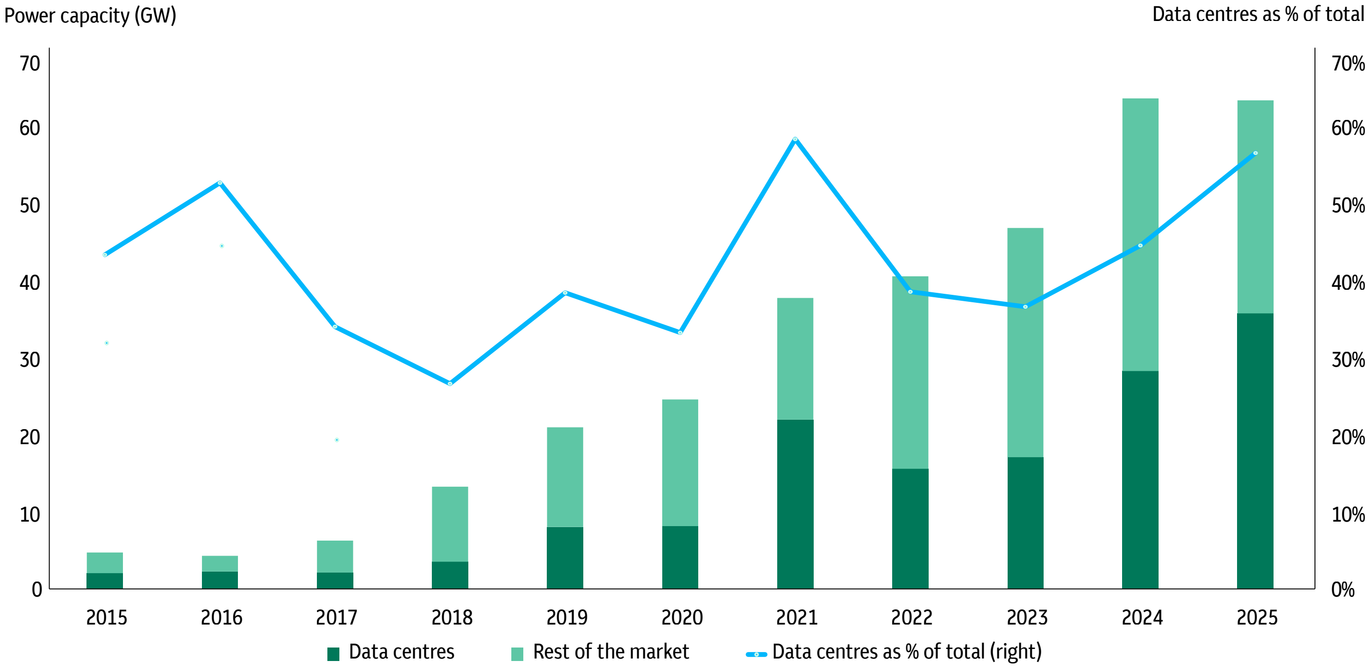
A key challenge is the scale and concentration of load: data centres tend to cluster geographically, creating step changes in local demand and infrastructure requirements. This raises concerns around grid stress without appropriate mechanisms to manage these challenges. In the US, interconnection timelines have stretched from under two years in 2008 to 4-5 years on average in 2025.[9] The risk is that grid build-out cannot keep pace with demand, resulting in capacity shortfalls, reliability events and upward pressure on wholesale power prices.

8. BloombergNEF, "New Energy Outlook 2025: Grids", (August 2025)
9. "Queued Up: Characteristics of Power Plants Seeking Transmission Interconnection" Berkeley Lab, Energy Markets & Planning, (2025).

Renewables: Beneficiary of growing power demand, supporting stronger PPAs volumes and pricing

Rapid hyperscaler data centre build-out is creating a large and durable new pool of electricity demand, supporting stronger PPA pricing. In the US (home to over half of global data centre capacity) power demand from data centres is projected to increase from 176 to 429 terawatt-hours (TWh) between 2025 and 2034,[10] creating strong pricing tailwinds for renewables developers. Reflecting this shift, the top 10 largest data centre developers accounted for 56% of clean power procurement by corporations in the Americas region via PPAs in 2025 (Figure 15).

Figure 15:
Clean power purchase agreements signed by 10 largest data centre operators vs rest of the market



Source: Macquarie Asset Management analysis based on Bloomberg NEF database (April 2026).

More volatile electricity prices are also lifting PPA demand from a wider set of industrial and commercial offtakers that increasingly seek long-term contracts to hedge power price risk. As a result, renewables development platforms benefit from both deeper hyperscaler demand and a growing corporate offtake market. This supports higher contracted volumes, improved risk diversification and stronger long-term cash flow visibility across portfolios.

Rising and more volatile electricity prices are accelerating demand for energy cost management solutions, particularly behind-the-meter generation and storage. In Europe, nearly 12 gigawatts (GW) / 23 gigawatt-hours (GWh) of battery energy storage system (BESS) capacity was contracted under flexibility purchase agreements (FPAs) and optimisation deals in 2025 – tripling the volume recorded in 2024. FPAs have emerged as the backbone of BESS bankability in 2025, unlocking capital and enabling rapid scale-up beyond Great Britain into Germany, Italy, and the Netherlands.[11]

In terms of challenges, AI-related power demand is also pulling significant new renewable capacity into interconnection queues, creating congestion and development delays. Over 3,000 GW of renewable projects are estimated to be stuck in interconnection queues worldwide. For platforms with large development portfolios, securing and maintaining strong queue positions is therefore an increasingly important source of competitive advantage, and a key risk to monitor in business plan assumptions.

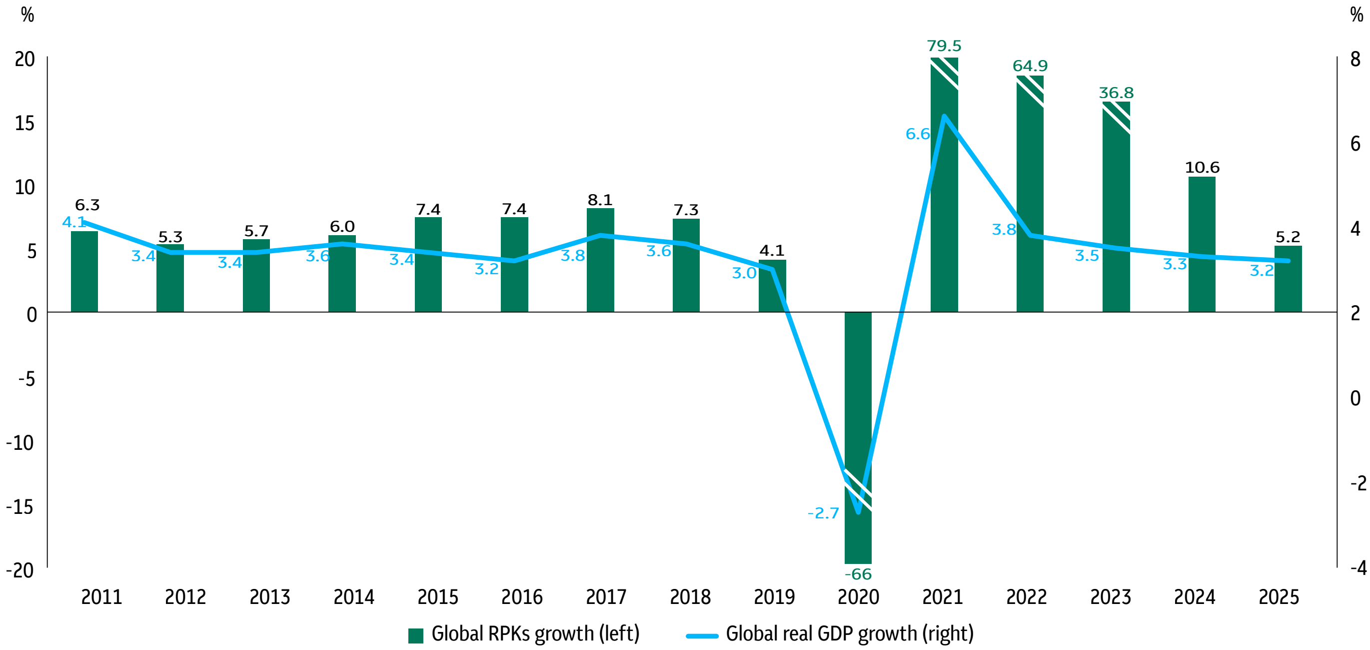
10. BloombergNEF, "New Data Center Hotspots Are Emerging: Four Things to Know" (March 2026).
11. Pexapark, "Price volatility accelerates race to value across clean energy markets – Pexapark Market Outlook 2026" (January 2026).

Airports: AI impact is likely positive due to GDP-growth linkage

AI has the potential to support passenger growth and aeronautical revenues by enhancing capacity and utilisation. AI-enabled airport operations such as predictive security screening, dynamic gate allocation and streamlined turnaround management can increase throughput (passengers processed per hour). This allows airlines to add frequencies and maximise use of existing infrastructure.

Airport revenues are typically linked to GDP growth, particularly for non-regulated airports and those with significant non-aeronautical exposure. Historically, global air travel demand has consistently outpaced economic growth, with a GDP multiplier of around 1.8x over 2011–2019 (Figure 16), reflecting the sector's strong underlying fundamentals. To the extent that AI drives higher productivity and stronger economic growth, the airport sector is well positioned to benefit.

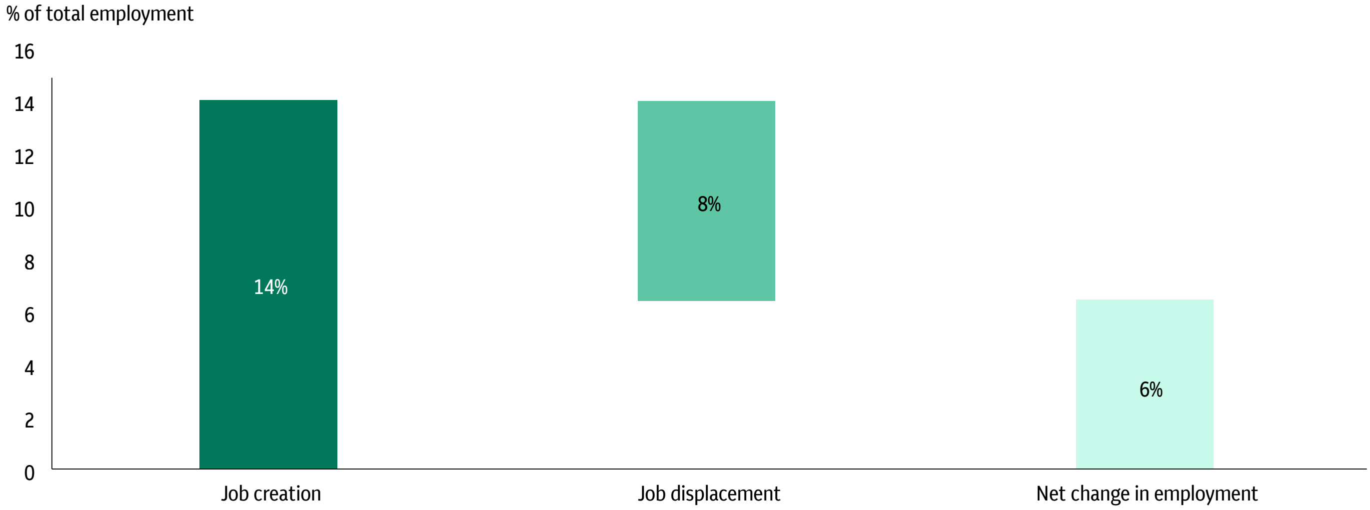
Figure 16:
Global air travel growth has consistently outpaced economic growth, with GDP multiplier around 1.8x



Sources: IATA, IMF, Macquarie Asset Management analysis (January 2026). Revenue Passenger Kilometres (RPK) measures air traffic demand by multiplying the total number of paying passengers by the total distance flown in kilometres.

We view the net effect of AI's impact on employment as more likely to be positive despite sentiment around it often negative (with fears of AI impacting middle-income consumption patterns). Historically, major technological shifts such as electrification and the rise of information technology have displaced certain tasks but also generated new roles and industries, ultimately expanding overall employment. Recent estimates suggest that between 2025 and 2030, new job creation could reach about 14% of current employment, outweighing displacement of around 8%, and resulting in a net increase of 6-7% (Figure 17).[12]

Figure 17:
Net growth of employment is likely to be positive between 2025 and 2030 despite job displacements



Source: World Economic Forum, "Future of jobs report" (January 2025).

We expect stronger growth in leisure travel to more than offset any moderation in the growth of business travel stemming from the changing job mix. Reduced working hours and increased workplace automation could expand discretionary leisure time, extending a structural shift observed since COVID-19. Over the longer term, AI may also unlock new revenue pools through developments such as urban air mobility, potentially expanding the addressable market for airports beyond traditional commercial aviation.

12. World Economic Forum, "Future of jobs report", (January 2025).

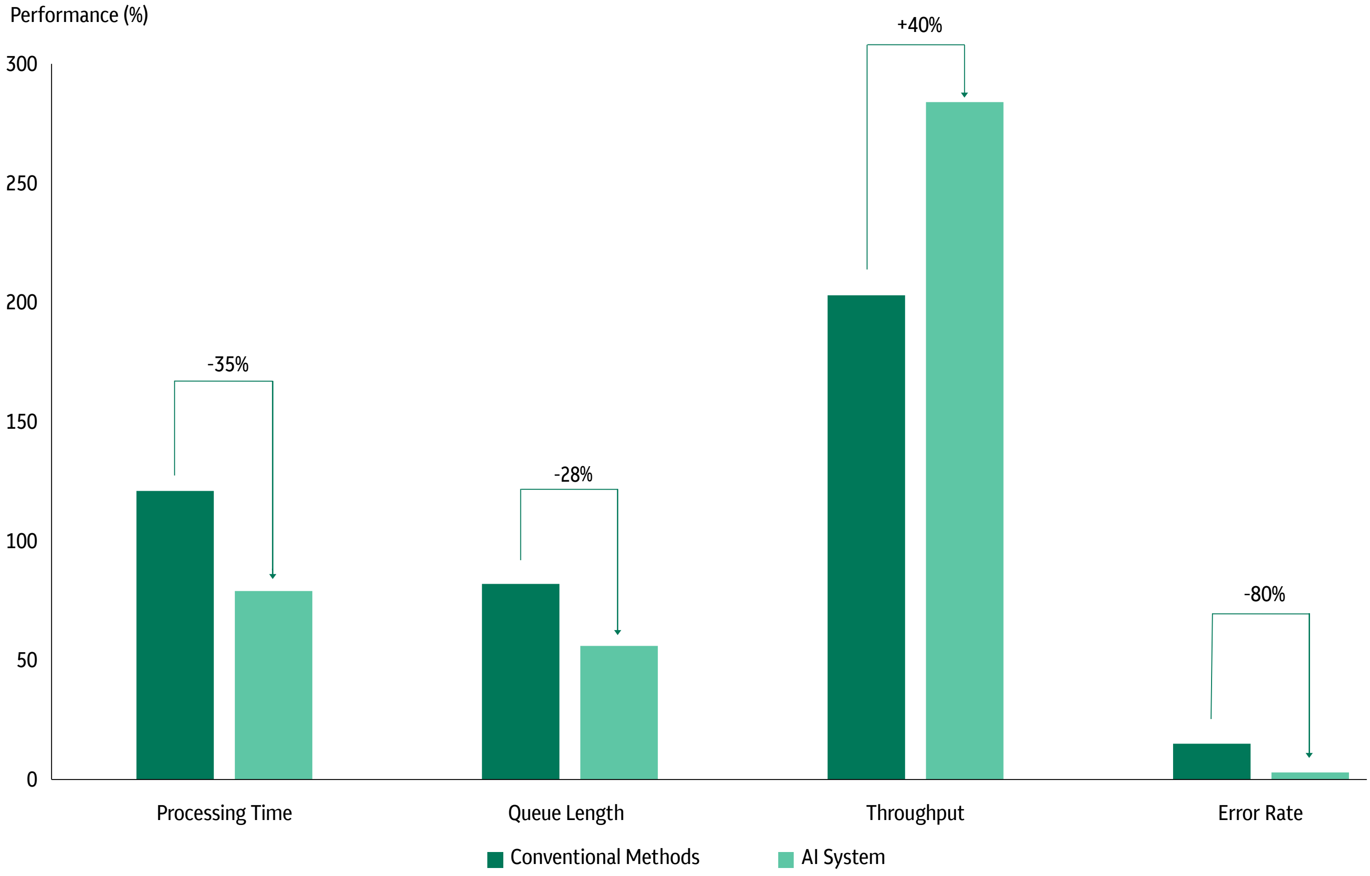
Container ports: AI can improve throughput, but long-term growth in import volumes may slow in developed markets

Route planning and freight booking can more effectively align demand with available capacity and preferable transit lanes, improving network utilisation. By lowering the cost per shipment, these efficiencies, if passed through to customers, can stimulate higher freight volumes. AI-driven berth, yard and equipment management may potentially increase container throughput. AI and robotics may reduce domestic manufacturing costs of low value goods, which could affect import volumes in developed economies. That said, it is likely to take time as the technology and equipment required to manufacture domestically would need to be sufficiently cost-effective to compete with offshore manufacturing. In the US, domestic manufacturing innovation will likely prioritise higher value goods, which have less impact on container import volumes.

Toll roads: Overall positive AI impact due to improved throughput but urban toll roads with commuter traffic exposure could be affected

AI-driven toll management techniques reduce processing times by approximately 35%, decrease queue lengths by 28%, and increase throughput by 40% compared to traditional toll processing systems (Figure 18).[13] In the longer term, AI-enabled autonomy could increase vehicle miles travelled by unlocking new demand from previously underserved user groups, including the elderly, disabled and non-drivers.

Figure 18:
AI-driven toll management may increase throughput by 40%



Source: MDPI, Satendra Chandra Pandey, and Vasanthi Kumari, "Adaptive AI-Driven Toll Management: Enhancing Traffic Flow and Sustainability through Real-Time Prediction, Allocation, and Task Optimization" (November 2024).

Conversely, AI-enabled remote and flexible working may reduce commuting frequency, disproportionately affecting urban toll roads with high exposure to daily commuter traffic. The impact on non-commuter traffic is likely to be more limited. Toll roads with greater exposure to freight, logistics, leisure travel and suburban growth corridors should remain relatively resilient, supported by population growth and e-commerce trends.

13. Satendra Chandra Pandey, and Vasanthi Kumari, "Adaptive AI-Driven Toll Management: Enhancing Traffic Flow and Sustainability through Real-Time Prediction, Allocation, and Task Optimization", MDPI, (November 2024).

Hospitals: AI drives earlier diagnosis and expands treated patient volumes

AI tends to increase diagnosis rates, improve referral accuracy and bring patients into the system earlier. This supports volumes for imaging, surgery, oncology, cardiology and specialist interventions, where private hospitals are most active. In radiology and pathology, for example, AI improved accuracy and reduced diagnostic time by approximately 90%.[14] AI-enabled screening, imaging analysis and clinical decision support can also expand the treated population, particularly for under-diagnosed conditions (e.g. early-stage cancers, neurological and cardiovascular disease).

Waste management: Mixed, with significant positive impact on MRFs and negative for waste-to-energy facilities

The waste management industry operates across three principal stages of the value chain. Collection encompasses the physical gathering and transportation of waste from residential, commercial, and industrial premises to consolidation points. Processing covers transfer stations, where waste is consolidated and redirected, and material recovery facilities (MRFs), where recyclable materials are sorted and prepared for commodity markets. Disposal is the terminal stage, comprising landfill, waste-to-energy (WTE) plants, and composting operations. Overall, we believe that AI has a net positive impact on the waste management industry, however, the impact on demand revenues could differ significantly by activity (Figure 19).

Figure 19:
Summary of AI impact on waste management

Collection	AI application in collection is already well-penetrated in the US, with other regions catching up gradually. Dynamic route optimisation, driven by fill-level sensors and real-time traffic data, has materially compressed fuel and labour cost per stop. Computer vision mounted on collection vehicles enables contamination detection at the curb prior to pick up, reducing downstream processing costs.
Processing and Material Recovery Facilities (MRFs)	The MRF stage represents the most significant opportunity for AI-driven value creation. AI-powered robotic sorting systems, using computer vision to identify materials by type, colour, and composition at speeds and accuracy rates that far exceed manual labour, are still in relatively early deployment across the industry. The impact is structural and double-sided: operating cost per ton is likely to fall as throughput increases, while the quality and purity of output may improve.
Disposal	AI presents a more structurally negative outlook for disposal volumes. AI enabled sorting, robotics, and material identification may increase recycling rates and material recovery, diverting waste away from landfills and waste to energy facilities, exerting downward pressure on tonnage-based revenues.

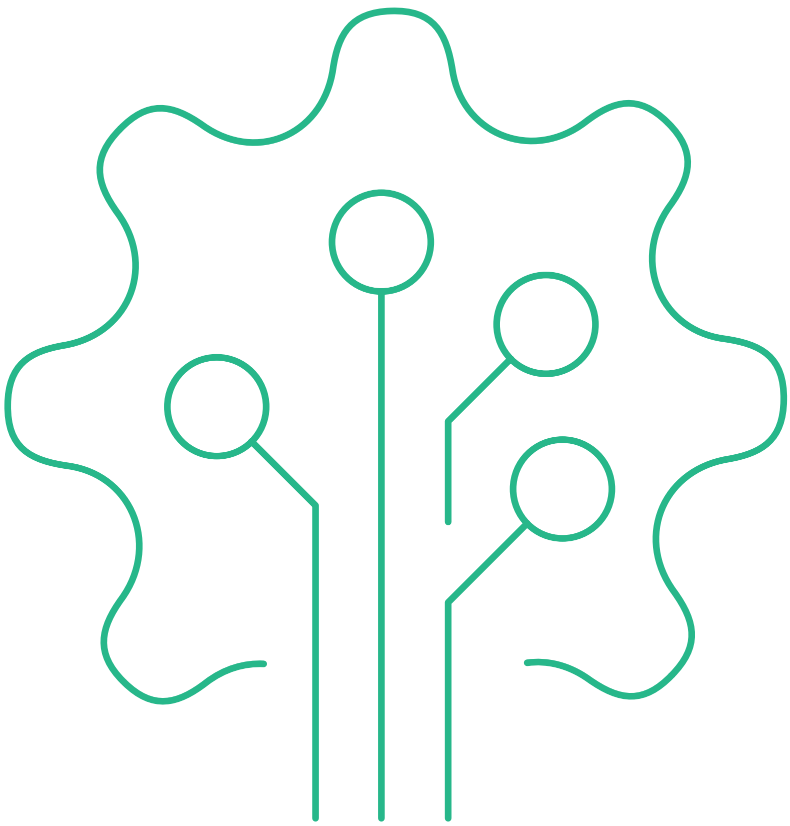
Source: Macquarie Asset Management (May 2026).

Car parks: Core demand intact, long term disruption risk is location-specific

Core demand drivers such as car ownership growth are likely to remain largely intact. However, AI could reshape usage patterns and monetisation. Remote and flexible working may reduce commuting-related parking demand over time, with the impact felt primarily in office-centric assets rather than airports and retail. Over a longer horizon, AI enabled mobility (ride hailing optimisation and autonomous vehicles) may reduce the time vehicles spend parked, though it is unlikely to entirely eliminate the need for parking (and charging in case of EVs). Overall, we see long term demand risk for car parks, but the magnitude is likely to be highly location-specific.

14. Jeong J, Kim S, Pan L, Hwang D, Kim D, Choi J, Kwon Y, Yi P, Jeong J, Yoo SJ. “Reducing the workload of medical diagnosis through artificial intelligence: A narrative review”, US National Library of Medicine (February 2025).

Impact of AI on operational efficiency



Across many infrastructure sectors, AI has the potential to reduce operating costs and capital intensity by enabling predictive maintenance, enhancing labour productivity, and streamlining operations.

In this section, we summarise the empirical evidence on AI-enabled tools that drive opex efficiencies. Our findings suggest that the adoption of AI across infrastructure operations can deliver cost savings, typically in the range of 5–30% of opex.

We have identified five common ways that AI-enabled tools can help improve operational efficiency across infrastructure sectors:

- **Predictive maintenance:** AI models use sensor and historical asset data to anticipate failures before they occur, reducing unplanned downtime, lowering maintenance costs, and extending asset life.
- **Anomaly detection:** Real-time monitoring and machine learning enable early identification of faults, leaks, or performance deviations, improving reliability and preventing costly outages or safety incidents.
- **Network and capacity optimisation:** AI optimises load balancing, traffic flows, and capacity utilisation across networks (e.g. power grids, transport systems), increasing throughput.
- **Process automation and labour productivity:** AI automates routine operational tasks (e.g. inspections, reporting, dispatching), reducing labour intensity, improving consistency, and lowering operating expenses.
- **Forecasting and decision optimisation:** Advanced analytics improve demand forecasting, asset scheduling, and resource allocation, enabling more efficient operations, better pricing decisions, and reduced waste across systems.

Key evidence from AI-enabled tools and applications are summarised in Figure 20, below.

Figure 20:
Summary of the AI impact on operational efficiency by sector

Data centres	• AI solutions are demonstrating remarkable capabilities in predictive maintenance, where they can reduce unplanned downtime by up to 45%.[15] • AI-driven cooling systems have demonstrated the ability to reduce energy consumption by 20-35% compared to conventional approaches.[16] • The implementation of predictive systems has reduced thermal-related incidents by 72-86% while simultaneously decreasing cooling energy consumption by 27-38% compared to traditional threshold-based approaches.[17]
Fibre networks	• Operators deploying AI-based planning engines are reporting 10-20% lower greenfield rollout capex.[18]
Telecom towers	• Through AI-powered network management, site visits could be reduced by up to 15%.[19]
Utilities	• Applying AI in the electricity distribution network can provide an effective and sustainable solution to reduce power loss and operational costs, as well as support the use of renewable energy. Research found a 15% increase in energy efficiency, a reduction in response time by 85%, and a 10% increase in maximum load capacity. Additionally, operational costs of the network decreased by 12% due to automation generated by AI.[20] • AI-based fault detection models achieve an average accuracy of 85% to 95%, reducing false alarms by 50% and minimising power restoration times by up to 60%. • The integration of IoT sensors with real-time analytics has improved anomaly detection rates by 28%, while digital twin technology has enhanced predictive maintenance efficiency, reducing unplanned outages by 35%.[21]
Renewables	• Solar energy efficiency increased from 2.5% in 2020 to 4.5% in 2023, demonstrating steady progress driven by advancements in photovoltaic materials and AI-driven improvements. • Similarly, wind energy efficiency rose from 2% in 2020 to 3.7% in 2023, with AI-powered tools such as Deep Learning improving turbine performance and fault detection.[22] • Machine learning-based forecasting models achieved up to a 15–30% increase in accuracy compared to traditional methods, especially in predicting solar irradiance and wind speed fluctuations. • Energy providers reported a reduction in operational costs by 10–20% due to better energy dispatching and predictive maintenance.[23]
Airports	• Airports using AI for predictive maintenance may reduce system downtime by up to 40%. • Airports using AI for energy monitoring have achieved energy savings of up to 20% annually.[24]
Toll roads	• AI-driven toll management techniques tend to reduce processing times by approximately 35%, decrease queue lengths by 28% compared to traditional toll processing systems.[25]
Ports	• Research shows that AI-based predictive maintenance systems help reduce failures and downtime by up to 30%.[26] • AI-driven automation of cranes and robotics help improve operational productivity by up to 15-20% through the increase in twenty-foot equivalent unit (TEU)/hour and reduction of manual labour.[27]

15. DataBank, "How AI-driven data centres are boosting technological efficiency and innovation", 2024.
16. Pratikkumar Dilipkumar Patel, "Artificial Intelligence in Datacenters: Optimizing Performance, Power, and Thermal Management" Journal of Computer Science and Technology Studies, (April 2025).
17. Pratikkumar Dilipkumar Patel, "Artificial Intelligence in Datacenters: Optimizing Performance, Power, and Thermal Management" Journal of Computer Science and Technology Studies, (April 2025).
18. McKinsey & Company, "Issue Brief: AI-driven telecom networks" (February 2026).
19. Ericsson, "Can AI bring down network energy costs?" (February 2020).
20. "Applying Artificial Intelligence Algorithms for Optimizing the Electricity Distribution Network" Journal of Embedded Systems Security and Intelligent Systems, (November 2024).
21. "AI-Driven fault detection and preventive maintenance in electrical power systems: A systematic review of data-driven approaches, digital twins, and self-healing", American Journal of Advanced Technology and Engineering Solutions, (April 2025).
22. Sameer Algburi et al, "The role of artificial intelligence in accelerating renewable energy adoption for global energy transformation", Unconventional Resources, Volume 8, 2025, 100229, ISSN 2666-5190, (October 2025)
23. Mayowa Emmanuel, Emmanuel Ok, Yusuf Adebayo, "Artificial Intelligence in Renewable Energy Optimization", (November 2025).
24. Mahima Tanwar Khushi (Mrs.), "Role of Automation & AI in Improving Airport operations", International Journal of Research Publication and Reviews, ISSN 2582-7421, (June 2025)
25. Satendra Chandra Pandey, and Vasanthi Kumari, "Adaptive AI-Driven Toll Management: Enhancing Traffic Flow and Sustainability through Real-Time Prediction, Allocation, and Task Optimization", MDPI, (November 2024).
26. The Role of Artificial Intelligence in Optimizing Operational Processes and Managing Port Logistics, The American Journal of Applied Sciences, (December 2025).
27. The Role of Artificial Intelligence in Optimizing Operational Processes and Managing Port Logistics, The American Journal of Applied Sciences, (December 2025).

Waste management	• AI-driven systems have achieved a reduction of up to 36.8% in transportation distances, 13.6% in cost savings, and 28.2% in time savings. [28] • AI models, such as those utilising deep learning and computer vision, can accurately identify and classify waste materials, have reached accuracies of 94.5% and 99.2%, respectively.[29]
Healthcare	• Real-world evidence shows that a natural language processing (NLP) system was able to automatically extract clinical data from unstructured medical records. This reduced the time taken for documentation by 30%.[30]
Car parks	• Studies show that the artificial intelligence of things (AIoT)-based system demonstrated clear advantages in multiple operational dimensions. Average vehicle wait time saw a 57% reduction. Space utilisation was increased by 64.7%.[31]

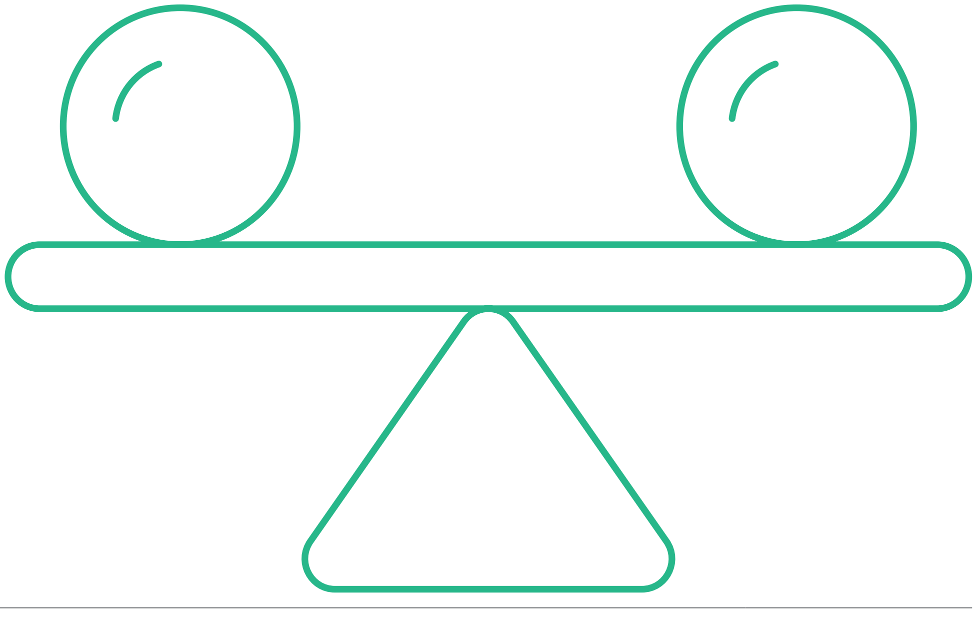
Source: Macquarie Asset Management (May 2026).

Additional considerations for infrastructure investors:

- **Operational risk and oversight:** Increased automation may introduce new operational risks, requiring a careful balance between system autonomy and human oversight, particularly for safety-critical activities.
- **Cybersecurity:** Greater automation and AI-driven decision-making are likely to elevate cybersecurity risks, increasing reliance on robust governance, monitoring, and control frameworks across infrastructure assets.
- **Competition and asset differentiation:** AI-driven efficiency gains may widen the performance gap between assets, enhancing the competitiveness of digitally advanced platforms while rendering older, less digitised assets less attractive over time.

28. Fang, B.; Yu, J.; Chen, Z.; Osman, A.I.; Farghali, M.; Ihara, I.; Hamza, E.H.; Rooney, D.W.; Yap, P.S. “Artificial intelligence for waste management in smart cities: A review”, Environ. Chem. Lett. 2023
29. Rajalakshmi, J.; Sumangali, K., Artificial Intelligence with Earthworm Optimization Assisted Waste Management System for Smart Cities. Glob. NEST J.2023.
30. Y. Park, "AI and predictive analytics in hospitals," Journal of Medical AI, vol. 25, pp. 89-102, 2022.
31. MYU Tokyo, *Implementation of an AIoT-based Smart Parking System for Urban Mobility and Sustainable Infrastructure Management”, Sensors and Materials, Vol. 37, No. 9 (2025) pp. 4267–4283, (September 2025).

Structural shift vs speculative bubble



In this section, we seek to address whether AI-related infrastructure is exhibiting bubble-like characteristics and not the broader question of whether AI as a whole is in a bubble.

At a fundamental level, AI investment can be segmented into three primary categories: hardware (compute), data centre and power infrastructure, and software (Figure 21). Within this framework, the central question for infrastructure investors is whether the current investment cycle in data centres and associated power infrastructure reflects sustainable, demand-driven growth, or elements of overcapacity and speculative excess.

Figure 21:
Examples of technology investments in AI by category

Compute and hardware	Data centre and power infrastructure	Software
• Semiconductors • Servers and high-performance compute • Networking equipment	• Hyperscale data centres (training) • Edge data centres (inference) • Power infrastructure (grids, renewables, storage)	• AI model providers • AI development platforms

Source: Macquarie Asset Management (May 2026). For illustrative purposes only.

The defining characteristic of historical technology bubbles (e.g. the dotcom fibre overbuild) was infrastructure built speculatively ahead of demand that had not yet materialised. This is currently not the case in today's AI-driven infrastructure cycle however, as demand for data centres and other AI-related infrastructure is outstripping supply. The overall vacancy rate across primary North American markets fell to a record low of 1.4% at year-end 2025.[32] Interestingly, 92% of capacity currently under construction is pre-committed, either through binding lease agreements or owner-occupied development, and these dynamics point to vacancy remaining in the low single digits through 2030 (Figure 22). Similarly, in Europe, vacancy rates are also at record lows across the FLAP-D markets. Taken together, near-full occupancy alongside record construction is the signal of deep, durable structural demand, in our view (Figure 23).

Figure 22:
North America data centre vacancy rates are at historical lows...

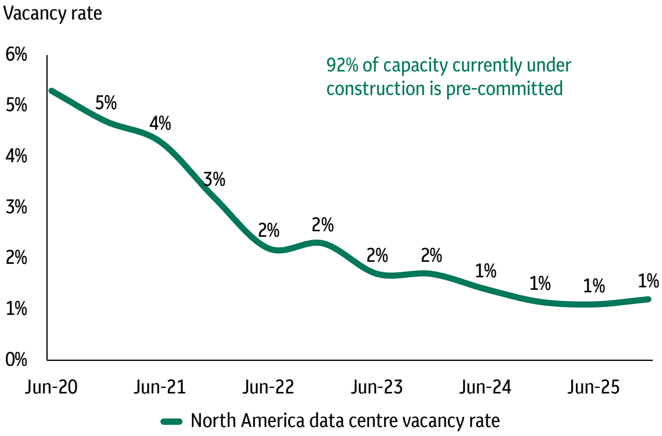
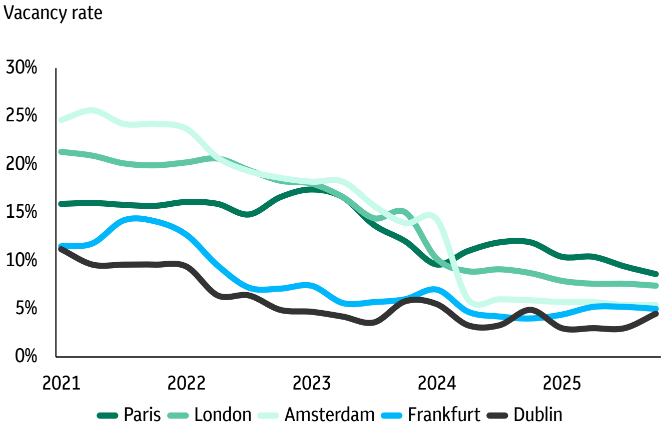


Figure 23:
... and Europe is experiencing a similar dynamic



Source: JLL, North America Data Center Report Year-end 2025 (February 2026).

32. JLL, North America Data Center Report Year-end 2025 (February 2026).

Data centres' core customers are hyperscalers, and unlike the dot-com era (when many companies relied heavily on external financing to fund speculative expansion), leading platforms[33] are currently largely funding growth through internally generated cash flows. According to S&P Global Ratings calculation, the average leverage ratio debt/earnings before interest, taxes, depreciation and amortisation (EBITDA) across five major hyperscalers (Alphabet, Amazon, Meta, Microsoft and Oracle) is currently at 0.9x (Figure 24).[34] So far, there are limited signs of balance sheet stress: leverage ratios remain broadly stable, capital discipline has been maintained, and capex-to-revenue ratios to gradually decline to ca. 34% by 2029 (Figure 25).

That said, we would like to note that there has also been an increase in off-balance sheet arrangements that use limited purpose joint-ventures and special purpose vehicles. Going forward, this may reduce transparency and make it increasingly difficult to assess true risk exposure and the debt leverage of AI participants.[35]

Figure 24:
Leverage levels of key hyperscalers are uncharacteristic of a typical bubble

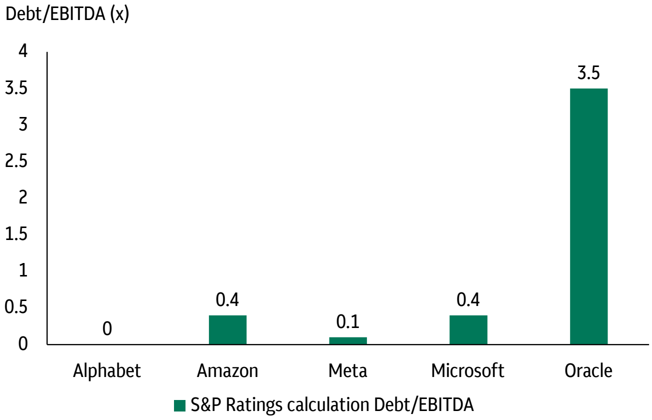
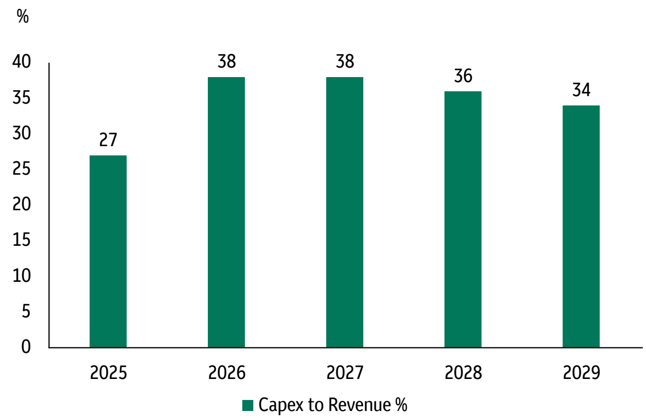


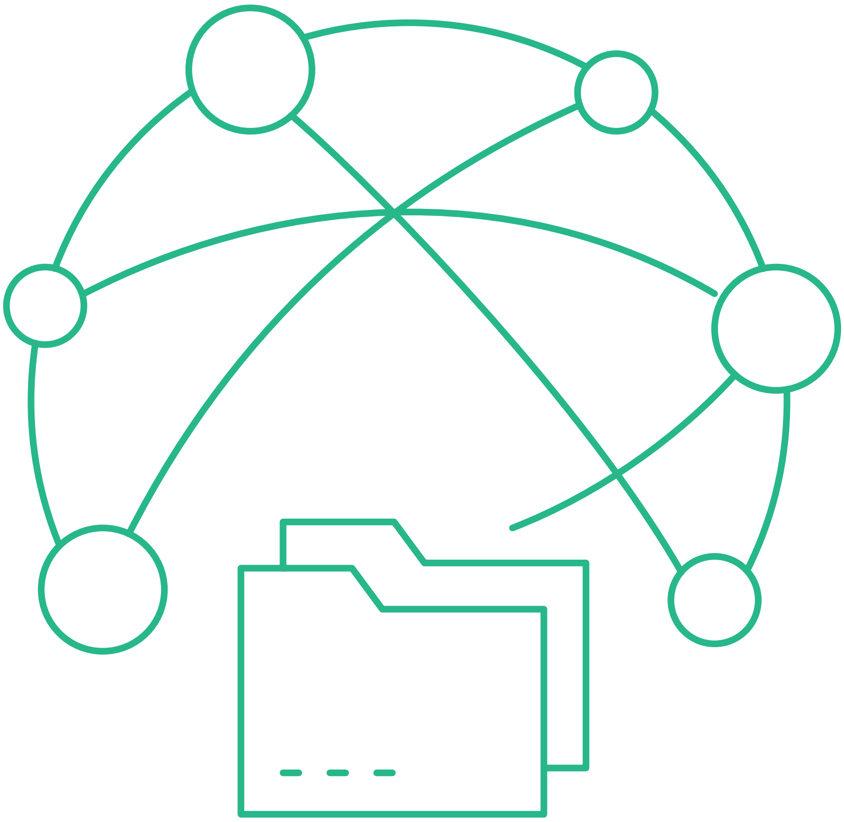
Figure 25:
Capex spending by five hyperscalers (% of revenue)



Source: S&P Global Ratings (March 2026), Annual data as of 31 December 2025, except for Microsoft and Oracle, which are LTM 31 December 2025 and 28 February 2026. Capex of all companies includes finance leases.

33. Except Oracle, according to S&P Global Ratings (March 2026).
34. S&P Global Ratings (March 2026), Annual data as of 31 December 2025, except for Microsoft and Oracle that are LTM 31 December 2025 and 28 February 2026.
35. S&P Global Ratings, "Where Are AI Investment Risks Hiding?" (January 2026).

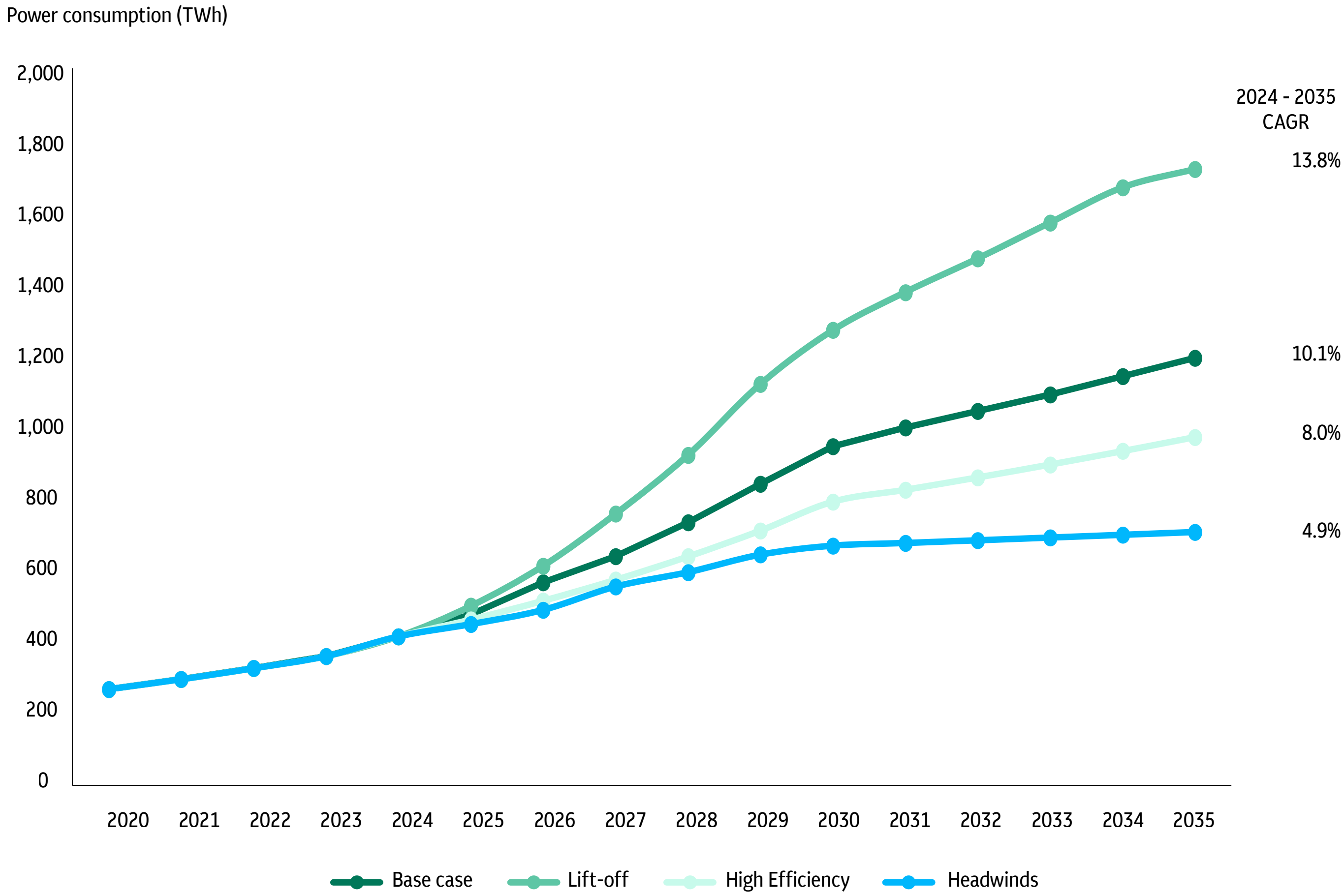
What if AI-driven growth does not live up to expectations?



If AI-driven growth were to slow relative to expectations, data centre power demand would likely moderate, but not reverse, given the structural nature of the underlying demand drivers.

In the International Energy Agency (IEA)'s "Energy & AI" report, the stress case scenarios of data centre power demand growth shows that both the High Efficiency and Headwinds scenarios point to continued growth in data centre power demand at a CAGR of 8.0% and 4.9% respectively to 2035 (Figure 26). While these scenarios are below the 10.1% CAGR expected in the IEA's base case, across both stress scenarios power demand from data centres continues to grow in absolute terms, reinforcing the view that downside risks are more likely to delay and smooth the growth curve rather than reverse it, with structural demand drivers remaining intact.

Figure 26:
Data centre power demand growth by scenario



Source: IEA, "Energy & AI" report (April 2025). Base Case: the total installed capacity of data centres more than doubles from around 100 GW today to around 225 GW in 2030. The global weighted average PUE is projected to improve, decreasing from 1.41 to 1.29 on average. Lift-Off: trajectory sees global electricity demand from data centres in 2035 that is around 45% higher than in the Base Case, exceeding the 1 700 TWh mark and reaching 4.4% of global electricity demand. High Efficiency: AI and digital services demand follows the same trajectory as in the Base Case. However, there is a reduction in the aggregated PUE, which falls to around 1.13 by 2035. Headwinds: In this case, service demand does not grow as fast as in other scenarios, and AI sees a slower uptake. Difficulties in monetisation lead to a pullback in investment. This case also assumes stronger local constraints.

Under the assumption that the AI-driven growth slows down, we believe that the implications for data centre infrastructure are materially different from those for AI software companies or chip manufacturers. In our view, there are five reasons why data centre demand is likely to be relatively resilient even if AI-driven growth slows down:

1. **Long-term contracted revenues:** Most data centre revenues are under multi-year (10–15 years) contracts with hyperscalers and large enterprises. These contracts typically include minimum capacity commitments, take-or-pay clauses, and inflation escalators, limiting downside risk.
2. **AI is not the only demand driver:** Cloud migration, IT outsourcing, e-commerce, fintech, and digital government will continue to drive data centre demand. Even if the expected AI spend slows down, cloud workloads and traditional compute remain largely intact.
3. **AI capex is front loaded:** The economics of AI require up front investment to build baseline capability. If AI expectations reset, the main impact is slower additional capacity growth, not revenue collapse.
4. **Hyperscaler credit quality:** The dominant customers are investment grade hyperscalers with strong balance sheets, limiting counterparty risk.
5. **Digital demand tends to be non-cyclical:** Data consumption tends to grow with population growth, bandwidth expansions, and growth in use cases, not economic cycles. History shows cloud and data traffic growth persisted through prior corrections.

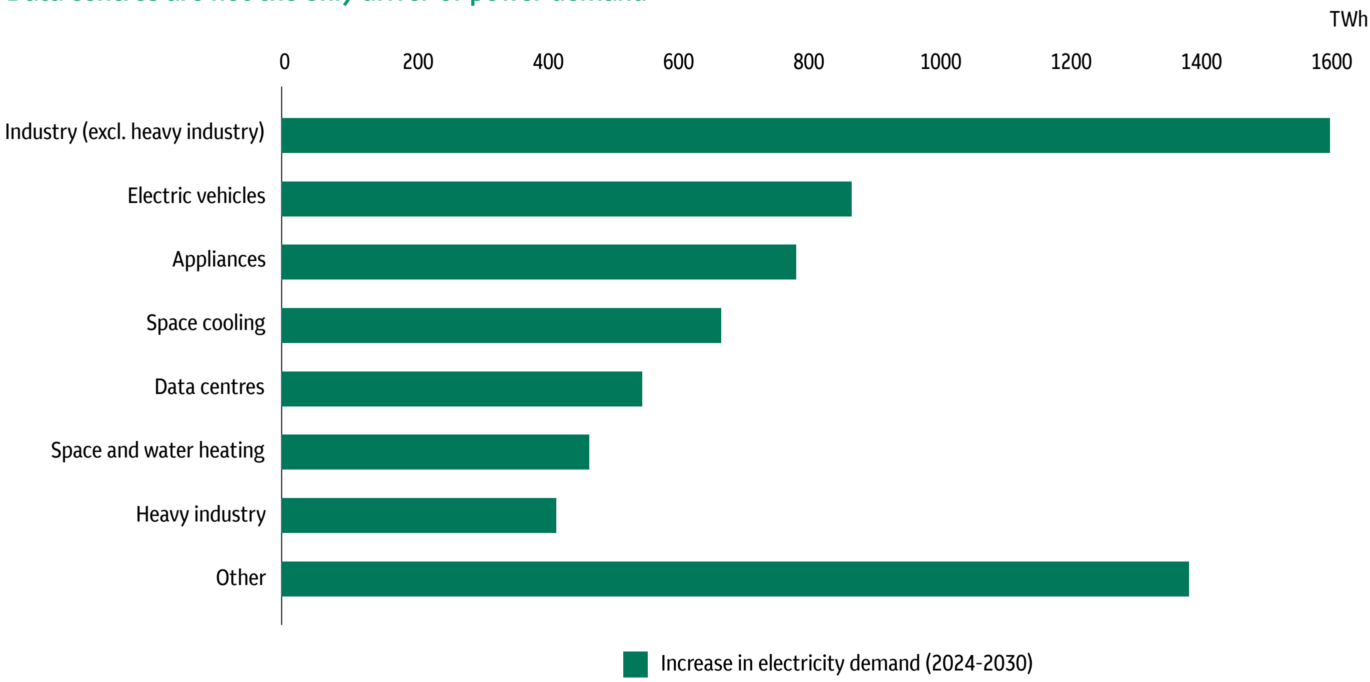
That said, investments where returns are heavily predicated on contract renewals may carry elevated risk. The assumption of renewals has long underpinned the hyperscale cloud data centre model; however, AI-related demand may not be supported by the same structural drivers that have historically sustained the cloud market, making renewal risk more pronounced for certain assets.

In a scenario where AI-driven growth moderates, we could see downward pressure on valuations, particularly for AI-oriented data centres, while traditional cloud data centres are likely to demonstrate greater resilience given their more established and diversified demand base.

The case for utilities likely remains intact even if AI-driven growth slows down

It is important to note that even as data centre capacity expands rapidly, its share in overall power demand growth remains relatively small compared to other drivers. According to the IEA, global electricity demand is forecast to increase due to rising consumption from industry, electric vehicles, appliances, space cooling and data centres, with data centre electricity demand growth accounting for less than 10% of global electricity demand growth between 2024 and 2030 (Figure 27).[36]

Figure 27:
Data centres are not the only driver of power demand

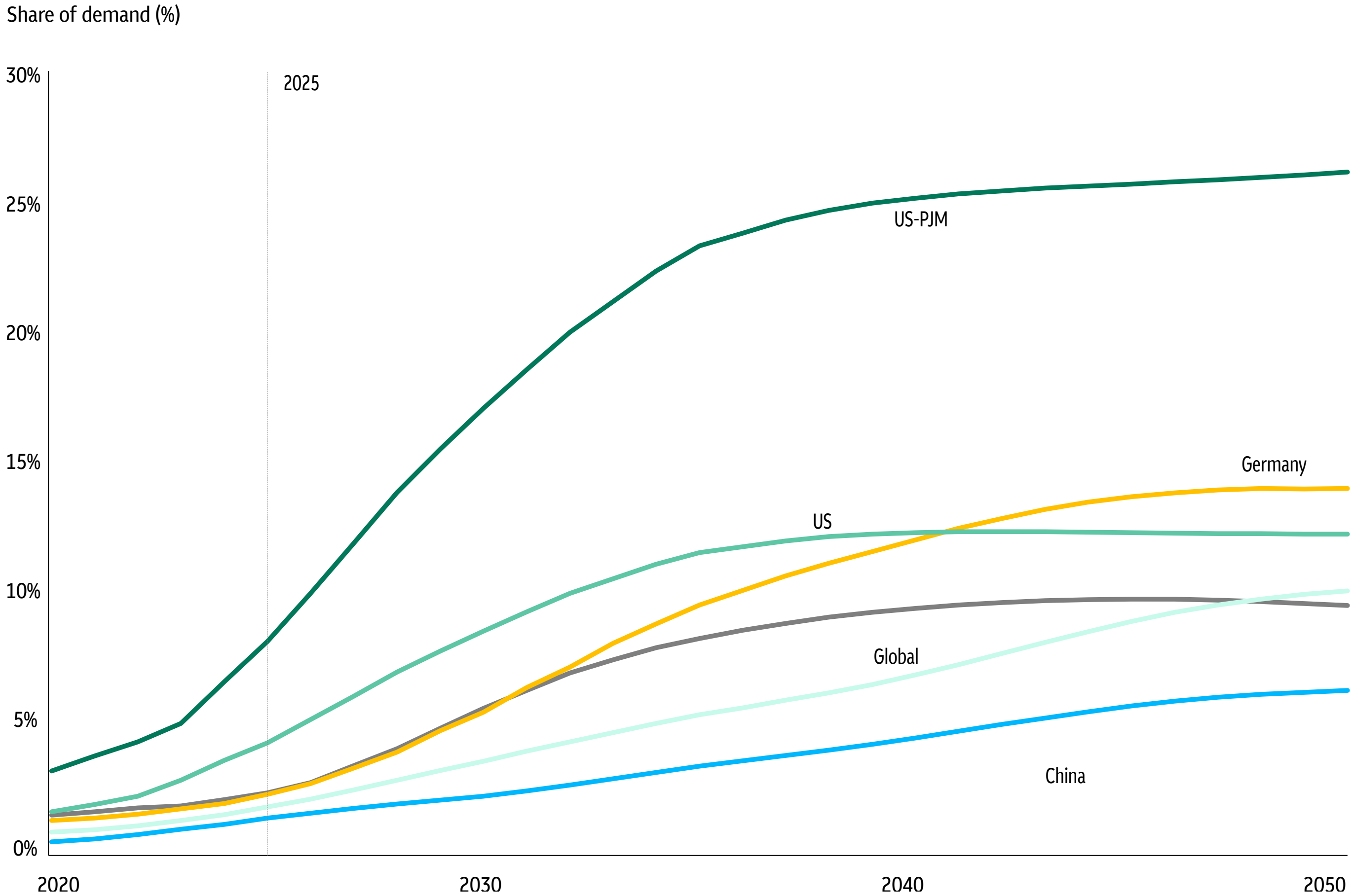


Source: IEA, "Energy & AI" report (April 2025).

36. IEA, "Energy & AI" report, (April 2025).

According to Bloomberg New Energy Finance (BloombergNEF), data centres' share of global electricity demand is projected to increase from around 2.2% in 2026 to 10.1% by 2050 (Figure 28). In the US, the share is expected to rise from approximately 5% to 12% over the same period, slightly above the global average. However, the impact is likely to be uneven across regions because data centre capacity is highly clustered. Certain power markets will experience significantly higher concentrations of demand. For example, in PJM Interconnection[37], data centres' share of electricity consumption could increase from around 10% to 26% by 2050.[38]

Figure 28:
Data centres' share in total global power demand is expected to account for 10.1% in 2050



Source: BloombergNEF, "New energy outlook 2026" (May 2026).

As a result, even in a scenario where data centre power demand growth disappoints relative to current projections, the case for a sustained utility capex super-cycle is likely to remain intact, because data centres represent only one of a number of power demand drivers. Other key drivers, such as industry output growth and electrification, constitute a far larger share of power demand growth.

37. PJM is the largest wholesale power market and transmission planning region in the US.
38. BloombergNEF, "New energy outlook 2026" (May 2026).

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Infrastructure companies may be subject to a variety of factors that may adversely affect their business or operations, including high interest costs, high leverage, economic slowdowns, surplus capacity, increased competition, commodity prices, regulatory and political developments, difficulty raising capital, and terrorist acts or political actions, and general changes in market sentiment.

The global financial crisis (GFC) refers to the period of extreme stress in global financial markets and banking systems between mid-2007 and early 2009.

Inflation is the rate at which the general level of prices for goods and services is rising, and, subsequently, purchasing power is falling. Central banks attempt to stop severe inflation, along with severe deflation, in an attempt to keep the excessive growth of prices to a minimum.

Stagflation occurs when persistent high inflation is combined with high unemployment and stagnant demand in a country's economy.

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The **Cambridge Associates Infrastructure Index** represents a horizon calculation based on data compiled from 232 infrastructure funds, including fully liquidated partnerships, formed between 1994 and 2024. The Developed Markets sub-index comprises 199 funds; the Emerging Markets sub-index comprises 27 funds.

The **US Consumer Price Index (CPI)** is a measure of the average change over time in the prices paid by urban consumers for a market basket of consumer goods and services.

The **INREV Global Real Estate Fund Index (GREFI)** measures net asset value weighted performance of non-listed real estate funds on a quarterly basis.

The **MSCI World Index** represents large- and mid-cap stocks across 23 developed market countries worldwide. The index covers approximately 85% of the free float-adjusted market capitalization in each country.

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