



PERSPECTIVES Viewpoint Alternative Investment

Infrastructure: Scaling for a future-proof world

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Key takeaways

- As a long-lived, physical asset with some features of a public good, infrastructure is structurally important for an economy, contributing to its productivity, energy supply, resilience, and citizens' quality of life.
- Rapidly rising electricity demand due to unprecedented AI data centre build-ups in recent years has exposed the need for grid expansion, storage, cooling and asset repurposing.
- Infrastructure demand is likely to remain resilient amid elevated energy prices and increased geopolitical instability, driven by higher fiscal spending, a recent shift in strategic priorities, and structural investment needs.
- Infrastructure requires three main types of raw materials: core construction materials, battery metals, and rare earths. Each group shows unique supply and demand characteristics. Infrastructure investments have gained traction in both public and private markets in recent years as the global gap for infrastructure financing has widened, and the need for infrastructure investment has increased.

Introduction

Infrastructure refers to the essential physical assets and systems that support economic activity and societal functioning. As a real asset, it is characterized by tangible, long-lived capital structures that provide foundational services, often with strong public good characteristics such as accessibility, reliability, and broad social benefit. Infrastructure underpins energy supply, mobility, and basic services, making it central to both economic productivity and quality of life.

Infrastructure assets typically follow a three-stage lifecycle – build, operate, and transfer – spanning in many cases a full economic life of roughly 20-30 years or longer.

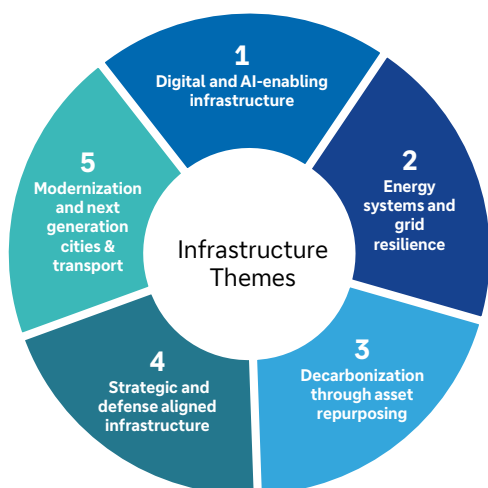
The asset class spans several core categories. **Energy infrastructure** includes power generation, transmission and distribution networks, pipelines, and storage systems. This segment reflects the growing importance of reliable energy supply, with demand increasingly shaped by structural drivers such as electrification and the expansion of digital activity. **Transport infrastructure** – such as roads, rail networks, airports, and ports – facilitates the movement of goods and people and is closely linked to economic activity levels and trade flows. **Social infrastructure** encompasses assets such as hospitals, schools, water systems, and waste management facilities, typically providing essential services with low sensitivity to economic cycles. **Digital infrastructure** has grown in recent years and is often clustered together with Energy infrastructure due to its increasingly important energy requirements.

Infrastructure can also be distinguished by its stage of development. **Greenfield assets** involve the construction of new infrastructure, often aligned with expansion needs in areas such as energy systems and digital networks, and are characterized by longer development timelines before becoming fully operational. In contrast, **brownfield assets** are already built and in use, with established performance profiles and a primary focus on ongoing operation, maintenance, and service delivery. The main risks to infrastructure investment entail potential building and operating costs which are higher than expected and delays as well as other factors making profitability uncertain, for example usage level.



Infrastructure: Five themes and areas

Infrastructure has moved increasingly into public and private focus in recent years. This has been driven not only by the need to modernize aging assets, but also by its role in enabling new, more efficient solutions to meet rising global energy demand – particularly in support of the expanding artificial intelligence (AI) ecosystem. Against this backdrop, several key themes and associated trends are likely to shape the infrastructure landscape over the coming years.



Theme 1: Digital and AI-enabling infrastructure

Rapid expansion in AI adoption has exposed physical bottlenecks in existing infrastructure, particularly around power and thermal capacity, and these could get more acute: global data centre electricity demand is expected to double by 2030¹. Building these assets remains capital-intensive and slow; supply is constrained by permissioning, grid access, and equipment bottlenecks.

As computing power increases, demand grows not just for compute and storage, but also for the broader infrastructure that supports it. This includes cabling, power equipment and physical infrastructure, with the data centre cables market alone reaching USD20bn in 2025². At the same time, capacity growth remains constrained, with vacancy rates – defined as the share of total data centre capacity that is unleashed or unoccupied at a given point in time, and therefore a key indicator of available supply in key markets as low as 1.4% and permissioning and power delays slowing new buildouts.

Cumulative AI-related data centre investment has been forecast to reach around USD3tn by 2030³ with some estimates pointing to an even larger USD7tn global buildout across the value chain.

Cooling and thermal infrastructure: Higher-density AI workloads have increased reliance on advanced cooling solutions, particularly liquid-based systems as traditional air cooling becomes insufficient. Capital has flowed rapidly into this segment, with the AI data centre liquid cooling market reaching USD3.7bn in 2026⁴ and expected to scale materially over the next decade. This reflects the structural shift toward liquid cooling as a core requirement for next generation of AI infrastructure rather than a discretionary upgrade.

Rising water demand from AI and other water-intensive technologies, combined with aging infrastructure and growing scarcity-related pushback, could make water infrastructure itself an increasingly important and underappreciated investment theme.

Theme 2: Energy systems and grid resilience

Rising electricity demand is putting pressure on power systems. The trend is structural, not cyclical, reflecting both electrification and digitalization. Data centres are a key driver, with electricity demand from them rising by 16% in 2025 and expected to double by 2030, accounting for 55% of forecast load growth in some utility projections⁵. This has increased focus on grid resilience, network expansion, and storage, with development constrained by permitting delays, interconnection bottlenecks, and supply chain pressures for critical equipment.

Resilient energy infrastructure: Infrastructure is increasingly designed to support distributed activity, i.e. multiple smaller-scale sources of supply, often based on renewable energy sources. This entails a need for storage capacity to balance intermittency and peak loads. Deployment of such storage is accelerating, with the US expected to add 111 GWh of grid scale storage over a three-year period⁶. New technologies such as sodium-ion batteries are beginning to scale, with deployments now moving from pilot to planned multi-GWh projects. The abundance of sodium relative to lithium offers the potential for more cost-effective, resilient storage solutions (with fewer supply chain concerns), supporting broader grid stability.

Theme 3: Decarbonization through asset repurposing

Reducing dependency on fossil fuels and decarbonizing does not only create demand for new assets but also drives the reuse of existing industrial infrastructure. Repurposing so-called brownfield facilities can shorten development timelines and help to reduce capital-intensity of the infrastructure project, especially when combined with policy support and long-term offtake agreements, as in the example of Sustainable Aviation Fuel.

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Sustainable Aviation Fuel (SAF) via industrial asset repurposing: Global SAF production reached 2 million tons in 2025, double the 2024 level, but still equivalent to less than 1% of total jet fuel consumption. Mandated SAF demand alone is estimated at around 4.5 million tons by 2030, while voluntary airline commitments aim to raise potential demand to 16 million tons by 2030, indicating a persistent supply gap. Brownfield facilities, including paper mills and other biomass adjacent plants, are being evaluated for conversion to SAF production due to existing grid access, water rights, logistics, and permitting, reducing upfront capital needs. SAF projects are typically supported by long-term airline offtake agreements.

Theme 4: Strategic and defence-aligned infrastructure

Changing geopolitical priorities are increasing demand for infrastructure that delivers both strategic autonomy and economic value. Part of the backdrop is a sustained re-armament cycle, with global military expenditure reaching USD2.9tn in 2025⁷ and expected to continue to rise as a share of GDP. NATO members, with the sole exception of Spain, have for example committed to raise their defence spending to 5% of GDP by 2035, 1.5% of which should be spent on critical defence-related infrastructure.

Defence-adjacent and dual-use infrastructure: As a complement to traditional defence-related infrastructure, dual-use infrastructure spans physical and digital systems that serve both civilian and military functions. This includes aerospace and satellite infrastructure where commercial constellations are increasingly integrated into defence operations, as well as cybersecurity systems that protect critical networks, satellites, and national infrastructure. These areas are becoming core defence layers, alongside traditional land, sea, and air military capabilities. Investment is also extending into related industrial capacity, logistics networks, and mission-critical data platforms, including Geospatial Information Systems (GIS) used for mapping, surveillance, and real-time decision making across both civilian and defence applications.

Private capital is playing a growing role alongside governments, with over USD400bn invested into defence and dual-use sectors in recent years⁸ and defence technology funding reaching around USD25bn⁹ in 2025. Within this, aerospace and space infrastructure represent the largest dual-use layer globally with the broader sector exceeding USD1.5tn, while cybersecurity is one of the fastest-growing segments, supported by structural demand tied to digitalization and hybrid warfare.

The investment case is increasingly driven by long-term government demand rather than cyclical spending. Assets are typically supported by multi-year contracts, with returns linked to capacity build-out, supply chain resilience, and domestic production, rather than discretionary growth.

Theme 5: Modernisation and next generation cities and transportation systems

The modernisation of existing infrastructure is emerging as a central investment theme, driven by the convergence of urbanisation, climate change, and technological disruption. Rather than focusing solely on new (greenfield) developments, the revitalisation and optimisation of existing (brownfield) assets has become increasingly critical. These assets – ranging from transport networks and utilities to buildings and digital systems – form the backbone of cities and metropolitan areas and are undergoing profound transformation.

Urbanisation remains one of the most powerful structural forces shaping infrastructure demand. Today's cities already host most of the global population, and this share is expected to increase significantly in the coming decades. Rapid population inflows intensify demand for housing, mobility, energy, water, and digital connectivity, placing considerable strain on ageing infrastructure systems. Legacy systems in many developed markets were not designed to accommodate current levels of urban density or the evolving needs of increasingly digital and service-oriented economies. As a result, modernisation efforts increasingly focus on expanding capacity (e.g. public transport, electricity grids), improving efficiency (e.g. smart traffic systems, digital grids), and enhancing integration across infrastructure networks (e.g. energy-mobility-data convergence). Climate change is accelerating the need to modernize infrastructure. Urban infrastructure is a major contributor to greenhouse gas emissions, particularly through buildings, transport and energy systems. At the same time, it is increasingly exposed to physical climate risks such as extreme weather events, flooding, and heat stress. Cities are increasingly evolving into "integrated infrastructure ecosystems," where digital technologies play a key role in optimizing performance and enabling new service models. The concept of the smart city reflects this transformation, combining physical infrastructure with digital layers such as sensors, data platforms and automation tools. Risks inherent in modernising existing infrastructure include execution and costs, changing regulation and policy support, as well as limited predictability of demand and usage levels.

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Transport is shifting toward automation in controlled, high-use environments, where adoption is already visible. In autonomous freight, deployment is moving from pilot to commercial scale, with driverless operations in the US – notably along Texas logistics corridors – already exceeding 100,000 miles on public roads and logistics corridors extending 600 miles across key regions.

Autonomous logistics: In industrial settings, adoption is further along. Autonomous systems are now deployed at scale in mining, with fleets numbering over 1,000 autonomous heavy vehicles and moving approximately 11bn tons of material, demonstrating measurable gains in productivity and safety. Across logistics networks, automation is increasingly used to improve throughput and reliability, with deployments handling hundreds of thousands of miles and cargo movements across ports, rail, and warehouse environments.¹⁰

Robotaxis: Autonomous ride-hailing services are now operating at around 400,000 rides per week in leading markets, up from 250,000 earlier in 2025, with comparable levels of activity in parts of Asia. Cumulatively, deployments have already reached tens of millions of trips and hundreds of millions of kilometres driven, indicating rapid scaling of real-world use.

Fleet electrification and corridor readiness: Supporting infrastructure is evolving alongside adoption. Regulatory frameworks now require dense charging networks along major transport corridors from 2025, while public funding programmes are directing USD5bn toward nationwide charging deployment, supporting the rollout of electric and autonomous fleets.

Macroeconomic impact and expectations

While infrastructure is often seen as relatively resilient to macroeconomic fluctuations, due to its essential nature and long-term cash flows, macroeconomic conditions remain important. These can influence some demand dynamics, project financing costs (e.g. through interest rates and inflation) as well as available policy support for new projects.

Global growth momentum has weakened in recent months as higher energy prices, driven by supply disruptions due to the Iran conflict, weigh on economic activity. The impact of this is particularly pronounced in economies reliant on imported oil and gas imported from the region. Inflation, which had been declining from its 2022 peak, is rising again as energy costs feed through to the real economy, prompting central banks to reassess their policy paths and markets to expect a tighter monetary stance.

The US economy remains comparatively resilient. Real GDP grew at an annualized rate of 2.0% in Q1 2026, supported by strong fiscal spending and private investment, especially in AI-related infrastructure. These two pillars continue to underpin the US growth outlook despite rising price pressures, with headline consumer price inflation expected to average 3.2% in 2026 before easing to 2.3% in 2027. GDP growth is still expected to remain solid at 2.0% in 2026 and 2027. The Federal Reserve is likely to tighten gradually, with rates reaching 3.0-3.25% by mid-2027.

In the Eurozone, momentum remains subdued, GDP growth slowed to 0.1% quarter- on-quarter in Q1 2026 as higher energy prices weighed on activity and private consumption stagnated. Fiscal measures aimed at cushioning the shock have so far proved insufficient to offset these pressures, while weak private sector dynamics continue to limit the growth impulse. Against this backdrop, Eurozone GDP is now expected to grow by 0.9% in 2026 and 1.3% in 2027, with inflation picking up to 3.1% in 2026, well above the European Central Bank's (ECB) target of 2%, before easing to 2.5% in 2027. The ECB is expected to have lifted the deposit rate to 2.5% by the end of June 2027.

In Japan, accommodative conditions and government spending continue to support activity, although rising energy costs are weighing on the domestic economy. Japanese GDP is expected to grow by 0.7% in 2026 and 0.9% in 2027, while inflation rises to 2.3% and 2.4%, respectively.

In China, targeted policy support, particularly in infrastructure, technology and the green transition, along with easing deflationary pressures are expected to play a key role in sustaining growth despite weak domestic demand. GDP growth is expected at 4.7% in 2026 and 4.4% in 2027, while inflation remains subdued at 0.8% in 2026 and 1.0% in 2027.

Key raw material needs

Key raw materials needed to enable the global infrastructure buildup can be roughly divided into three groups: core construction materials, battery metals, and rare earths.

Construction cycles and public infrastructure spending are the key drivers for core construction materials (such as steel, cement, aluminium, copper and zinc), which are used for high volume construction of traditional infrastructure. Governments' plans to ramp up infrastructure spending suggest that the demand for these materials may rise in the future.

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In addition, recent structural demand trends in advanced infrastructure and energy transition, mainly expansion of digital infrastructure and electrification, have driven demand for battery metals such as copper, nickel, lithium, cobalt, graphite and silver. Demand for battery metals is likely to grow even faster than that for traditional materials.

Rare earths have moved into sharper focus recently as they are essential to many components of advanced infrastructure as well as energy systems. While the rarity of many of these rare earths can be overstated, there is a critical bottleneck in the concentration of refining capacity, with a heavy dependence on a limited number of countries. The market for several base metals, especially copper, is currently moving towards structural tightness, caused by limited production growth and operational disruptions. The steel market, on the other hand, is oversupplied due to global excess production capacity. For battery metals, supply has expanded faster than demand, pushing prices lower. However, there is a medium-term risk of demand/supply deficits if demand accelerates. The most marked structural deficits are likely to be in copper and rare earth elements, and (over the long term) in lithium and graphite. Trade restrictions and other forms of supply chain disruption could tighten markets further.

The growing capability of circular economy could help combat supply shortages by recovering resources from extractive waste. A variety of resources can already be recycled without substantial loss of quality. Governments and private companies are increasingly

collaborating to improve circularity of resources. Besides, shortages will encourage a focus on resilience, including near- and friend-shoring as part of supply chain diversification. Research and development into new materials capable of being effective substitutes is also of key importance.

There are of course downside risks for prices too. On the demand side, a global growth slowdown or recession could hit construction materials first. On the supply side, new mining capacity or recycling improvements could limit price upside.

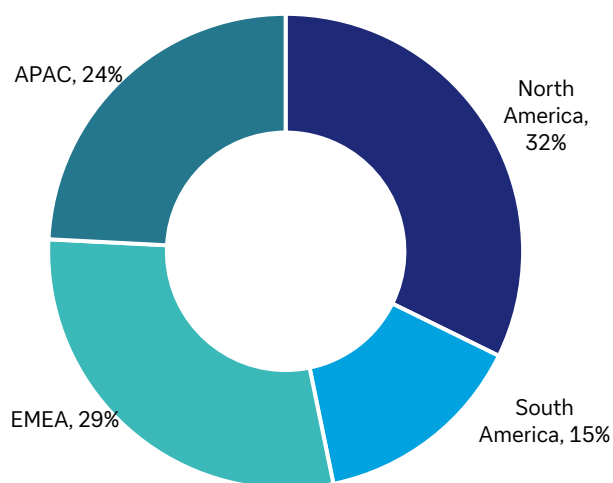
Private infrastructure investments

Global infrastructure investment requirements are estimated to exceed USD100tn over the period through 2040¹¹. However, annual global spending remains well below that level. Given the limits on public financing of infrastructure projects, private infrastructure investments have become increasingly important.

Private financing has historically been equity-led, with debt playing a small but growing role as capital markets deepen. Global private infrastructure equity investment AuM was at USD1.6tn by end of 2025 while private debt AuM was at around USD0.2tn, respectively.¹² In 2025, investors committed a record fundraising amount of USD289bn to new private infrastructure equity investments. The sector could reach nearly USD3tn AuM by 2030¹³. Regionally, the US remains the leading destination for infrastructure projects with energy the largest sector by far.

Figure 1: Infrastructure projects: division by region

New infrastructure projects by region between January-April 2026,



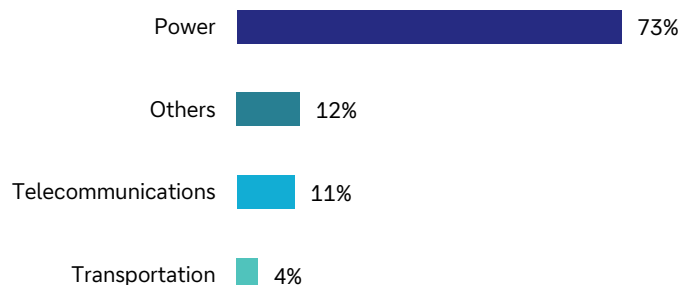
Source: LSEG Workspace, Deutsche Bank AG. Data as of May 4, 2026.

Figure 2: Infrastructure projects: division by sector

Global new infrastructure projects by sector between January-April 2026, %-share

Power leads the portfolio

73%



NOTE: "Power" includes energy generation and storage, renewables, utilities, "Others" includes oil and gas, petrochemicals, industry, water & waste management.

Source: LSEG Workspace, Deutsche Bank AG. Data as of May 4, 2026.

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The average holding period of private infrastructure investments ranges from five to twelve years depending on development stage, risk profile and strategy. Structurally, build-operate-transfer models are shifting toward more flexible hybrid arrangements against a background of rising investment complexity and strong private capital inflows. Lately, investors appear to be preferring projects where they can build scalable platforms rather than single assets.

Investing into infrastructure has typically been positioned to generate stable cash yield, offer partial inflation protection and reduce portfolio drawdowns, as the asset class (overall) presents historically lower volatility than private equity within Alternatives. Continued institutional and wealth inflows are expected as investors seek such perceived stable income, lower inflation sensitivity, and diversification benefits.

However, private infrastructure equity strategies do span a clear risk-return continuum, as summarised in the following three-way division.

Core infrastructure targets high-quality, operational assets with contract-backed cash flows and limited complexity. Returns are primarily income-driven, with minimal reliance on asset transformation. Core is therefore positioned as a bond-like real asset, although prudent leverage is critical to preserving these defensive characteristics.

Core+ infrastructure balances stability and growth, investing in operational assets while allowing incremental value creation through capex, operational improvements, or contract repricing. Compared with core, execution and financial risk are modestly higher, but cashflow visibility remains meaningful, making Core+ an increasingly-used return enhancement strategy amid increased competition for pure core assets.

Opportunistic infrastructure represents the highest risk segment, encompassing greenfield development and complex transformations. Cash flows are typically back-ended, and outcomes depend heavily on timing of execution and financing conditions. Return dispersion is wide, with managers typically targeting mid-teens to high-teens gross returns, and downside risk is material. As a result, opportunistic strategies are generally positioned as satellite allocations rather than portfolio anchors.

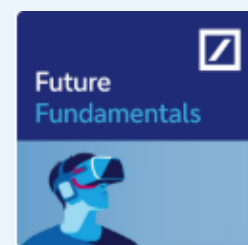
Infrastructure secondaries: Longer asset holding periods and uneven exit conditions given recent geopolitical situations, have accelerated activity in infrastructure secondaries where infrastructure assets or portfolios are sold to another institutional investor. Industry data indicates transaction volumes of approximately USD20bn for secondaries in 2025¹⁴, the highest level on record, providing access to mature, cash generative assets while offering some flexibility to existing investors.

Conclusion

Higher demand for infrastructure, driven by structural factors, is making it a focus of governments and markets worldwide. It stands at the intersection of multiple trends, concerns and technologies. Infrastructure, for example, may help both drive productivity growth and bolster economic security and resilience, although it is not immune from supply chain issues. Its capabilities will be further boosted by digitalization and adoption of artificial intelligence. We expect infrastructure investment to continue to grow.

However, while government spending plans may prioritise infrastructure investment, challenging macroeconomic conditions may further constrain public investment capabilities. This may further enhance the need for private market investment in infrastructure, as well as strategic long-term allocation within diversified portfolios. Multiple private infrastructure strategies exist, offering different ways to invest in this exciting area.

Refer to our [PERSPECTIVES Future Fundamentals Podcast: Sustainable cities](#), where the Private Bank's CIO for Sustainability & Global Head of CIO Office, **Markus Müller** and **Dr. Philipp Rode** of the London School of Economics (LSE) explore how cities can adapt to mounting social, economic and environmental pressures in an increasingly urbanised world.



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Glossary

Consumer price index (CPI) is based on the price of a basket of products and services representing the typical consumption of a private household.

Core infrastructure targets high-quality operating assets with stable, contract-backed cash flows and limited complexity.

Core+ infrastructure combines stable operating assets with incremental value creation through capex, operational improvements, or contract repricing.

Decarbonization can refer to the reduction of carbon emissions from individual industries or overall economic activity, or the removal of carbon emissions from the atmosphere.

Digital infrastructure refers to systems supporting digital services, data centres and connectivity.

Diversification refers to the dispersal of investments across asset types, geographies and so on with the aim of reducing risk or boosting risk-adjusted returns.

European Central Bank (ECB) is the central bank for the Eurozone.

Eurozone is formed of 19 European Union member states that have adopted the euro as their common currency and sole legal tender.

Federal Reserve (Fed) is the central bank of the United States.

Geospatial Information Systems (GIS) are systems for mapping and analysing location-based data.

Greenfield assets involve the construction of new infrastructure where no facility is operating.

Gross domestic product (GDP) is the monetary value of all the finished goods and services produced within a country's borders in a specific time period.

NATO stands for the North Atlantic Treaty Organisation.

Private debt is lending by non-bank investors, outside of the traditional banking system or public bond markets.

Private equity refers to funds or individuals investing directly in private, non-listed companies.

Renewable energy is energy generated from naturally replenished sources.

Sustainable Aviation Fuel (SAF) is lower-carbon jet fuel produced from non-fossil feedstocks.

Trillion (tn) denotes one million million.

USD is the currency code for the US Dollar



Appendix

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