Navigating the Economic Landscape of Data Centers

The role of data center infrastructure in enabling a digital ecosystem and its economic implications.

Khazna

Introduction

01

Data centers are at the heart of digital transformation, driving a new services economy...

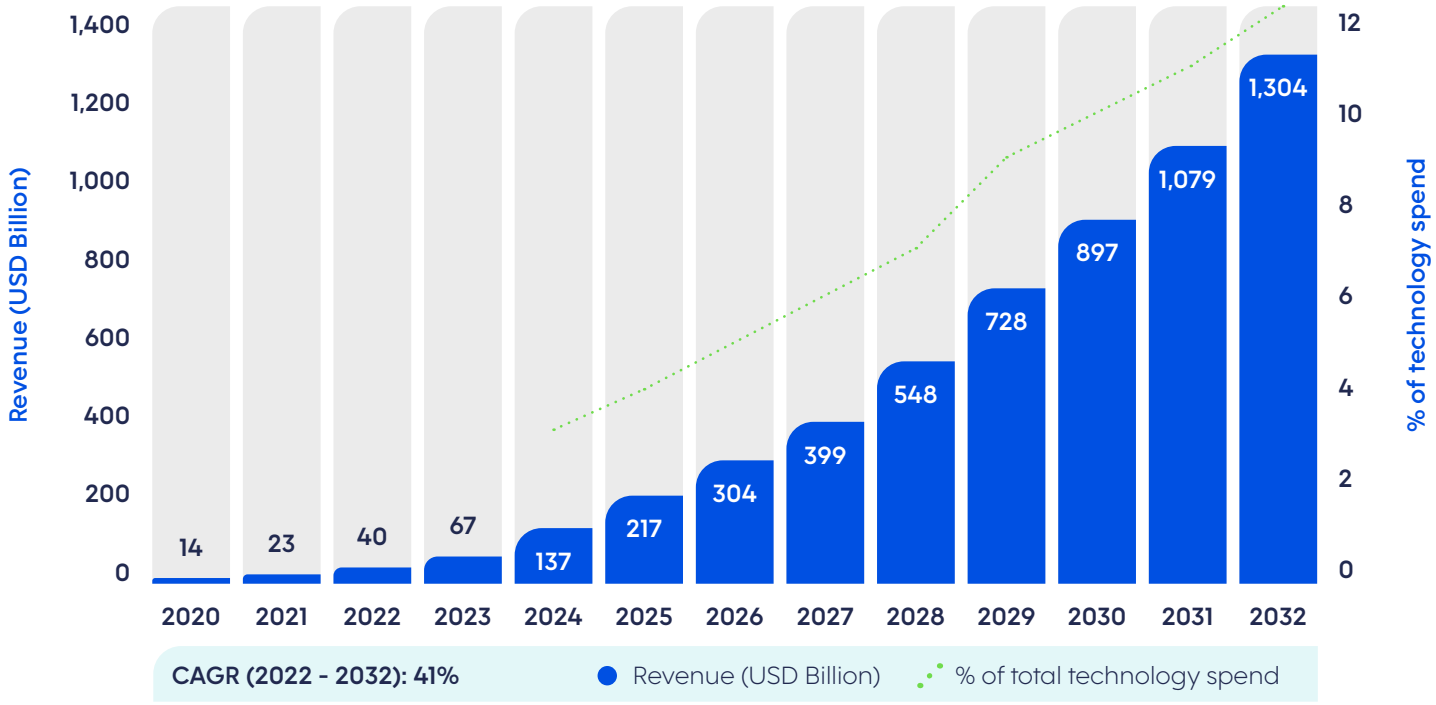
Data centers are the backbone of the digital economy, powering a very energy-intensive Artificial Intelligence (AI) and technology revolution. Running digital apps demands advanced hardware, such as specialised electronic circuits that accelerate graphics and image transferring and AI and machine learning (ML) workloads.

However, conventional data centers are designed with five to 10 kilowatts per rack as an average density, and AI now requires 60 or more kilowatts per rack. AI applications also generate far more data than other types of workloads, and thus require significant amounts of data center capacity. About 20% of global data center capacity is already being used for AI.

The impact of technology and data infrastructure extends beyond mere applications and day-to-day online interactions - it also profoundly influences economic development. In the current economic landscape, technology serves as a catalyst for international trade and business. Although the absolute output of international trade is on the rise, the trade intensity, measured as the percentage of Gross Domestic Product (GDP), is decreasing. Notably, international flows of services are assuming a more significant role in global value chains, emerging as a new driver of globalization alongside digital shifts. The ease facilitated by technological advancements and the digitization in trading services across borders has allowed service providers to access new markets and customers. Looking ahead, forthcoming technological disruptions such as AI and the Internet of Things are poised to further fuel the growth of trade in services.

The global generative AI market alone, with a market size at USD 67 billion today, is projected to grow to USD 1.3 trillion over the next 10 years. This surge in the non-human economy is expected to have an unprecedented impact on services trade, as devices are poised to substitute traditional human activities. Only in the Asia-Pacific (APAC) region, machine-to-machine (M2M) economy is expected to grow 29% annually, driven by global tech giants like Cisco, IBM, Google, Intel, and Huawei.

Figure 1 | Generative AI Market Growth, USD Billion



Source: Bloomberg Intelligence, Mordor Intelligence, World Economic Forum, Jones Lang LaSalle, Whiteshield.

... with rising demand to fuel the underlying technology revolution

At the heart of this digital transformation, robust data centers play a pivotal role. They serve as the backbone of the digital economy, facilitating the seamless flow of data and services across borders. Data centers and data hubs, with their advanced infrastructure and capabilities, are uniquely positioned to meet this demand.

Just to understand the growth prospects, the global data center market size, measured in total revenue worth USD 324 Bn today, is projected to grow at a CAGR of 5.8%, reaching USD 436 Bn by 2028. When examining specific segments, the global colocation data center market is forecasted to experience even higher growth, with a 5-year Compound Annual Growth Rate (CAGR) of 11.3% from 2021 to 2026.

Furthermore, the hyperscale market is anticipated to grow at an even faster rate of approximately 20%.

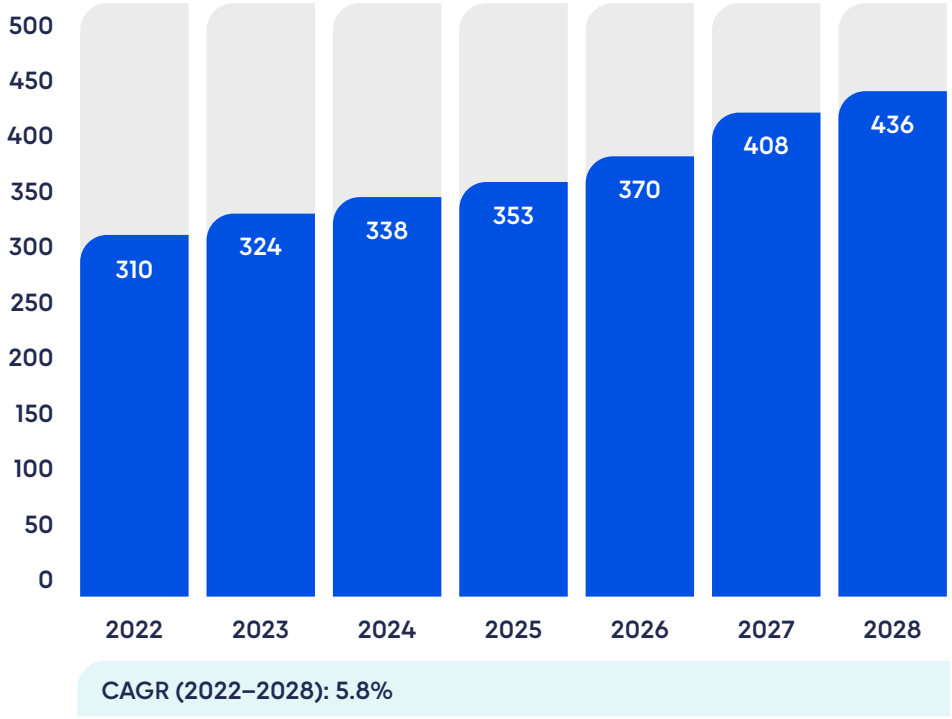
According to data from Synergy Research Group (SRG), more than 900 hyperscale data centers are in operation today, and an additional few hundred are under construction.

Oracle alone, in its Q2 2024 earnings call, stated that company is in the process of expanding 66 of its existing cloud data centers, and building 100 new cloud data centers.

With this level of global expansion, it is expected that an increasing number of labor will be required for the planning, construction, and operation of this data center infrastructure. This growing demand is likely to worsen the existing shortages in staffing.

Data center staff requirements are forecast to grow globally from about 2 million full time employees (FTE) in 2019 to nearly 2.3 million by 2025, suggesting a huge potential for future growth.

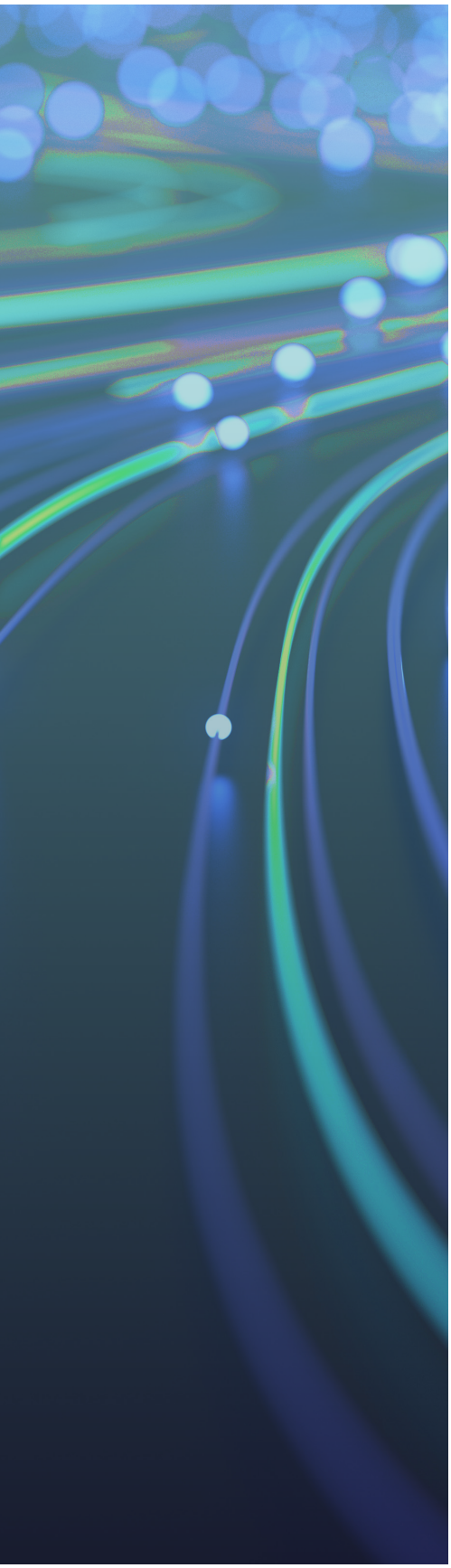
Figure 2 | Global data center market, Revenues, 2022-2028, USD Bn



20%

of total data center storage capacity is being used for AI

Source: Synergy Research Group, Uptime Institute, Oracle, Wall Street Journal, Whiteshield.



Data Hubs are formed by the confluence of an ecosystem of data centers that need to interact seamlessly as part of their service delivery...

What is a Data Hub?

Regional Data Hub facilitates the flow of data across countries. It acts as a backbone for digital services, enabling innovation, fostering the growth of start-up ecosystems, supporting Information and Communications Technology (ICT) services, AI growth, and other digital technologies.

Major Internet Content Providers

Global tech giants (Google, Meta, Amazon, Netflix, etc.)... generate and manage a significant portion of the world's digital content (e.g., Netflix is responsible for 15% of Global Internet Traffic).

Presence in local and regional Data Centers

These companies rely on data centers and hubs to store, process, and distribute this content to users across the region.

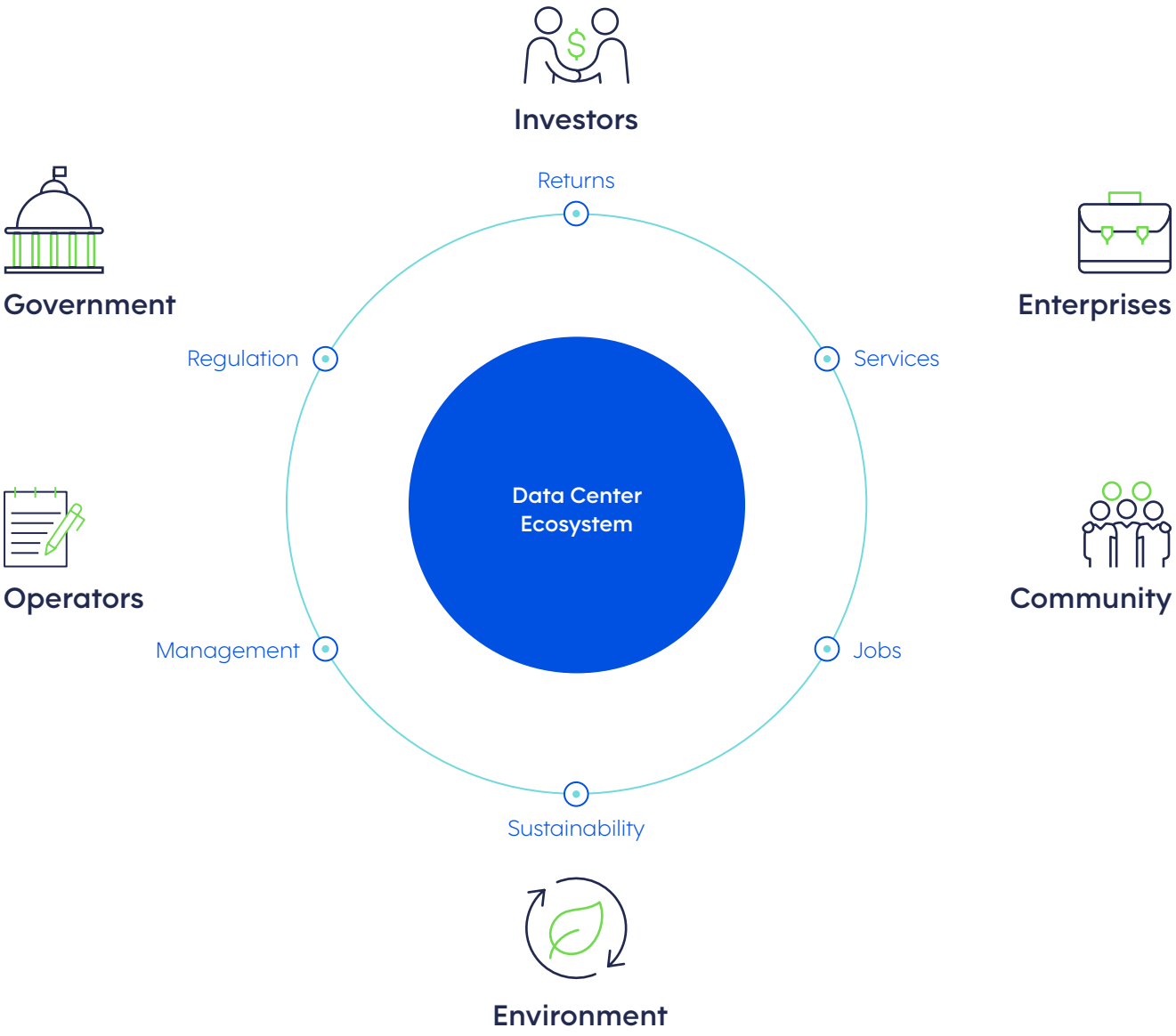
Connecting through a multitude of telecom operators

This exchange is enabled by telecom operators providing the necessary network infrastructure for data exchange, enabling high-speed connectivity and broad network coverage.

Over international and regional cables and through local & regional Internet Exchanges

Data hubs are connected to the global internet infrastructure through local and regional Internet Exchanges.

... with a diverse set of data center ecosystem stakeholders



Equipment

Storage | Servers | Network Infrastructure

Supporting ecosystem

Supply chain | Energy & Utilities | Internet ecosystem

Manufacturing | Technology

Source: Whiteshield

Data centers are the backbone of the digital economy ...

Data centers have become the cornerstone of today's global digital economy, powering diverse industrial activity from retail and manufacturing, to infrastructure and transport sectors. They form the backbone of this flow of information, serving as a vital intersection point for data of individuals, businesses, and economies. Without data centers, businesses would not be able to operate, consumers could not access online markets, and we would all miss out on many technological advancements.

The proliferation of data across our digital world is accelerating at a phenomenal speed, with over 180 zettabytes of data expected to be generated in 2025. The number of internet users has been tripled in the last 10 years, showcasing the exponential growth in the digital landscape (see Figures 3 and 4). Overall, individual data consumption has increased 13-fold, from 2010 to 2022. With digital transformation driving data-heavy applications such as the Internet of Things (IoT) and cloud, the growth of data centers becomes even more significant.

Data centers influence the functioning of many aspects of the business enterprise, including data backup and recovery, networking, website hosting, e-mail management and security, providing support for cloud storage applications, and e-commerce transactions. They ensure that their supply chain is running smoothly by providing steadiness. They also provide access to physical servers and data, rendering data centers a critical asset to the digital economy.

Figure 3 | Volume of data created, captured, copied, and consumed worldwide, (zettabytes)

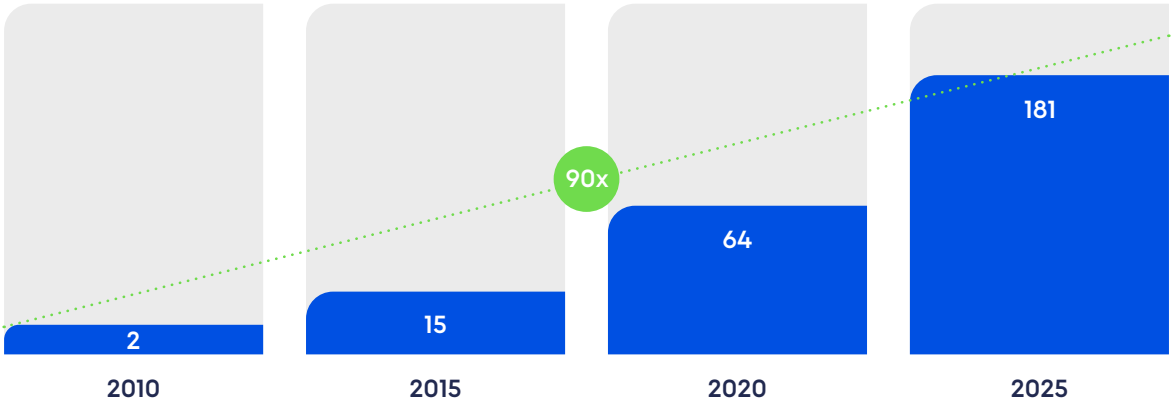
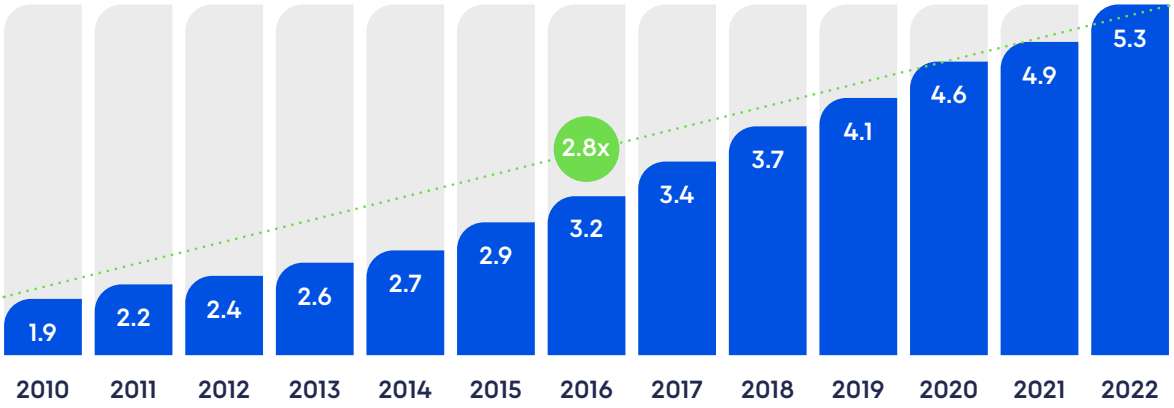


Figure 4 | Number of internet users worldwide, (in billions)



Source: ITU, IDC, Seagate, Whiteshield.

... driving economic growth and employment

Data center infrastructure has a significant impact on economic development by creating jobs and driving entrepreneurship, both during construction and operational phases.

In the United States (US), for example, during the construction of a typical data center with a capital expenditure of USD 215.5 million, 1,688 local workers are employed and an average of USD 243.5 million in output is generated. In addition, the average data center produces USD 9.9 million in tax revenue for state and local governments. Every year after construction, that same data center directly supports 157 local jobs paying USD 7.8 million in wages, injecting USD 32.5 million into the local economy, and generating USD 1.1 million in revenue to state and local governments.

In another example, the data center and cloud industry has become an important part of the Dutch economy, accounting for around 25% of real GDP. The data center and cloud industry attracts around 20% of all foreign direct investment (FDI) in the country, making it the largest sector when it comes to FDI. With a growth rate of around 10% per year, more and more people have a job that is directly or indirectly related to this sector.

The Dutch Central Bureau of Statistics (CBS) estimates that the total Dutch Internet economy has a value of €110 billion and accounts for 333,000 jobs, of which 264,000 in internet-related IT sector. Research by Pb7 Research from 2018 shows that the Dutch data center market accounts for nearly 13,000 jobs and makes an economic contribution of more than a billion euros.

These figures highlight the substantial economic benefits that data centers bring to local economies, not only through direct employment, but also through indirect effects on local businesses and the broader economy.

As such, data centers are not just a critical infrastructure for the digital economy, but also key drivers of economic growth and job creation.

While being built, a typical data center produces **$243.5 million** in output in the US. Every year thereafter it generates **$32.5 million** for the local economy

Dutch Internet economy has a value of **€110 billion** and accounts for **333,000 jobs**, data center market accounts for **13,000 jobs** in the country

Source: U.S. Chamber of Commerce's Chamber Technology Engagement Center, Pb7 Research via The Dutch Data Center Association, JLL.

In the US and Europe, data center infrastructure investments have a significant contribution to economic development

Hyperscale data center investments throughout North America and Europe are exemplified by Big Tech's* approach, showing how the data center industry can drive economic impact.

For example, Google has invested USD 17.5 billion in the construction of 12 North American data center campuses since 2006. Network infrastructure being developed by Google connects its data centers in the US to the entire global data ecosystem.

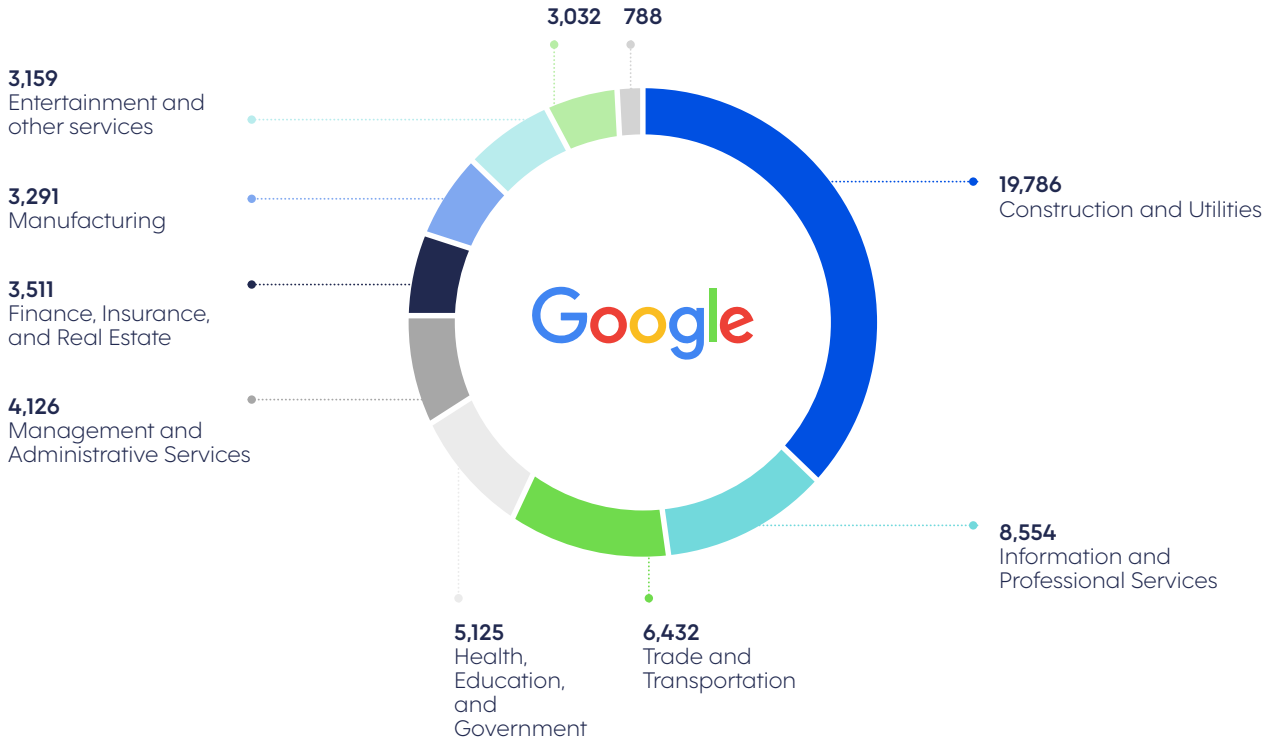
Throughout 2020, Google's operations in data centers, renewable energy, and capital investments collectively supported around 58,000 jobs, produced close to USD 4.0 billion in worker income, and contributed USD 6.4 billion to the GDP, thereby stimulating economic activity across the United States.

The 58,000 jobs include both direct employment, and jobs created indirectly through ripple effects as Google employees and suppliers circulate their earnings within the region. Although most of these jobs are based in the states housing the data centers, nearly 15,000 are based in other parts of the country. This broad dispersion of jobs can largely be credited to the extensive network of individuals and businesses supplying Google with the necessary goods and services to facilitate data center operations, capital projects, and clean energy initiatives.

Employment opportunities facilitated by Google are spread out extensively, with a majority falling under sectors that are not typically linked with data center operations (see Figure 5).

In Europe, for every job supported by data center operations, three more jobs are supported through Google's capital investments and clean energy commitments. In 2020, over 22,211 jobs in the region were supported by Google's operations, clean energy commitments, and capital investment in the data center.

Figure 5 | Distribution of Google's data center-supported jobs by industry in the US



Note: *Including companies such as Google, Amazon, Microsoft, etc.
Source: Oxford Economics

The data center market is evolving rapidly with widespread cloud adoption, fundamentally changing how businesses operate and innovate

Figure 6 | Key trends in the data center market

Sustainability

The operation of data centers requires a huge amount of power supply. Many businesses are setting ambitious sustainability targets of harnessing the potential of digitalization as a driver of sustainability, particularly energy as a resource.

AI

The increasing use of AI is driving significant growth in the data center industry. The mass adoption of cloud computing and AI is leading to exponential growth for the data center industry, with hyperscale and edge computing leading investor demand.

Rise of Hyperscalers

The number of hyperscale data centers continues to increase, with their capacity set to almost triple in the next 6 years, as they take advantage of the ever-growing demand for data storage, management, and processing.

Computing

Driven by the increasing adoption of smart solutions, the demand for edge data centers is projected to grow at a rate of over 15% from 2023 to 2032.

Automation

The pandemic has forced the information technology (IT) sector to provide automated processes and remote management. Among the many methods of IT automation, Artificial Intelligence and robotic process automation is used in data center operations.

6G & Wireless Technologies

The introduction and deployment of 5G wireless technology for mobile networks is expected to bring technical leaps such as the IoT, 5G or 6G, process outsourcing, and data deployment.

The Data center infrastructure market is experiencing significant global growth

The global data center market is experiencing rapid growth, driven by expanding data needs and increased investor interest because of the steady, utility-like cash flows and risk-adjusted yields. As of 2022, the data center market reached a substantial size, totalling USD 313.6 billion, and it is expected to advance at an annual growth rate of 5.8% during 2022–2028, to reach USD 438.6 billion by 2028 (see Figure 8).

Currently, the US, China and Europe dominate the market. The US alone is responsible for 43% of global data center business, generating USD 92 billion in revenue. In terms of power consumption, the US holds a 40% market share at 17GW, set to grow by 9.4% annually until 2030. As of September 2023, there were a reported 5,375 data centers in the US (see Figure 7 and 9).

Figure 7 | Number of data centers worldwide (by country, as of September 2023)

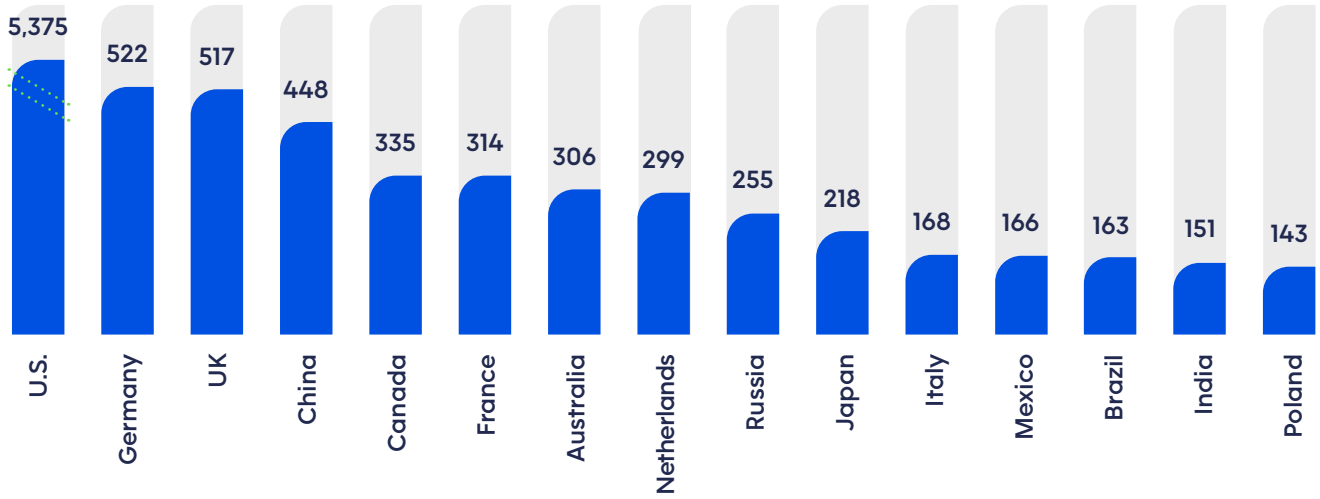


Figure 8 | Global data center market, Revenues, USD Bn

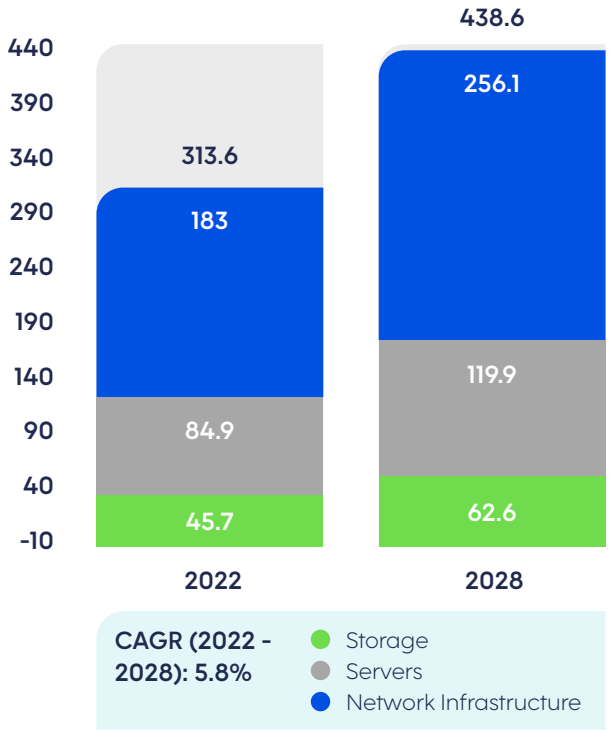
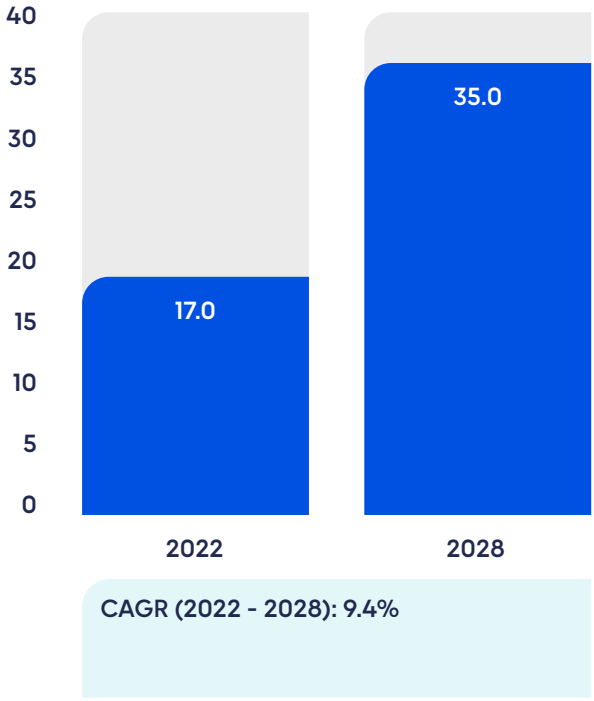


Figure 9 | US data center market, Power Consumption, GW



Source: PS Market Research, SDxCentral, Statista Market Insights.

The FDI in data center is at peak with North America, Middle East and Africa seeing the highest spike

In 2021, FDI into data centers reached a peak of USD 47.6 billion, with Amazon's subsidiary Amazon Web Services (AWS) making multi-billion-dollar investments in a new data center infrastructure region in New Zealand, and a new cloud computing hub in Canada — both of which were aimed at serving domestic markets. FDI into data centers maintained its momentum in 2022, with projects worth USD 44.8 billion announced globally.

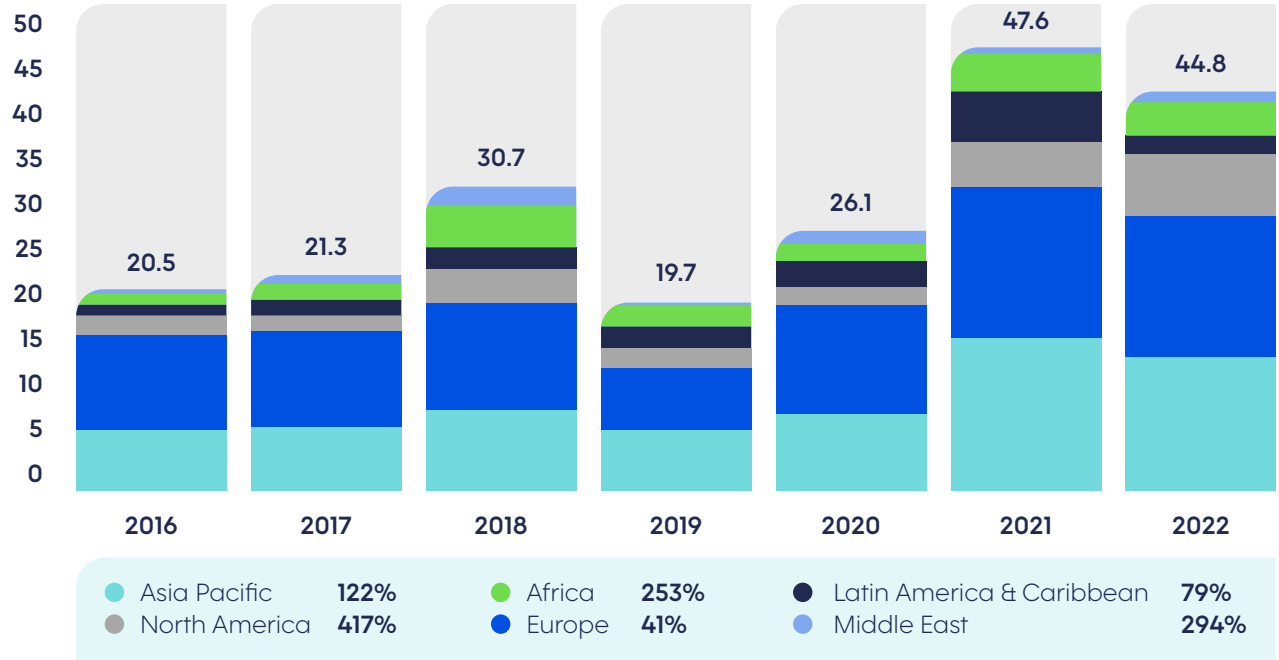
Europe continues to lead in terms of FDI rankings, with a total USD 14.8 billion worth of investments. However, they have the slowest growth rate, compared to other regions.

The APAC market is the second largest region with USD 13.6 billion of FDI inflows. India has received the most foreign investment in data centers since 2019, with 145 FDI projects in cloud and data center infrastructure.

The fastest growing foreign direct investment hot spot is North America. Since 2019, the US has observed 69 FDI projects in cloud and data center infrastructure.

Finally, the Middle East region has shown significant progress in attracting foreign direct investment in the data center infrastructure market - the region has seen a massive, four-fold growth since 2017.

Figure 10 | Foreign direct investment into data centers* by world region, USD Bn, 2016–2022 and Decentral FDI annual growth rate, 2016-2022, %



Note: *Data processing, hosting and related services.
Source: IDC, fDi Markets, Investment Monitor, Whiteshield.

The market is highly consolidated with US, Chinese, and Japanese cloud and DC players driving FDI growth

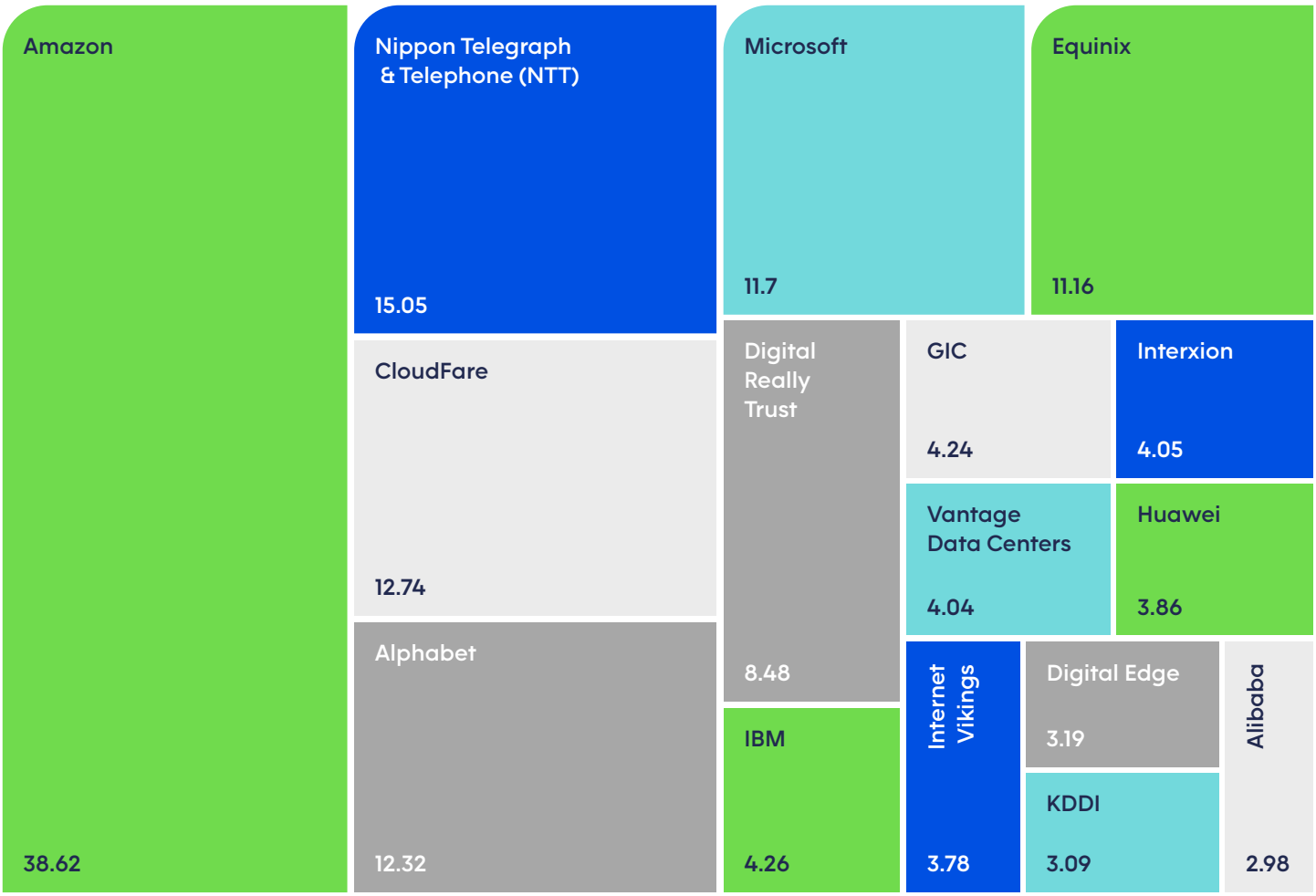
More than a quarter of foreign data center infrastructure investments over the past two decades have been made by just five companies, including US tech giants Amazon, Alphabet, and Microsoft.

Amazon has massively expanded its data center network as the wave of digitalization and demand for cloud computing catalysed by the pandemic continues to grow. More than 75% of its total planned investment over the past two decades was announced between 2020 and 2022.

The company's share of global data center FDI quadrupled from 8.4% to 35% between 2019 and 2022.

Besides AWS, the next five largest investors are Japanese telecom company Nippon Telegraph & Telephone (NTT), the US web infrastructure and security company Cloudflare, Google's parent company Alphabet, fellow tech giant Microsoft and US colocation data center provider Equinix.

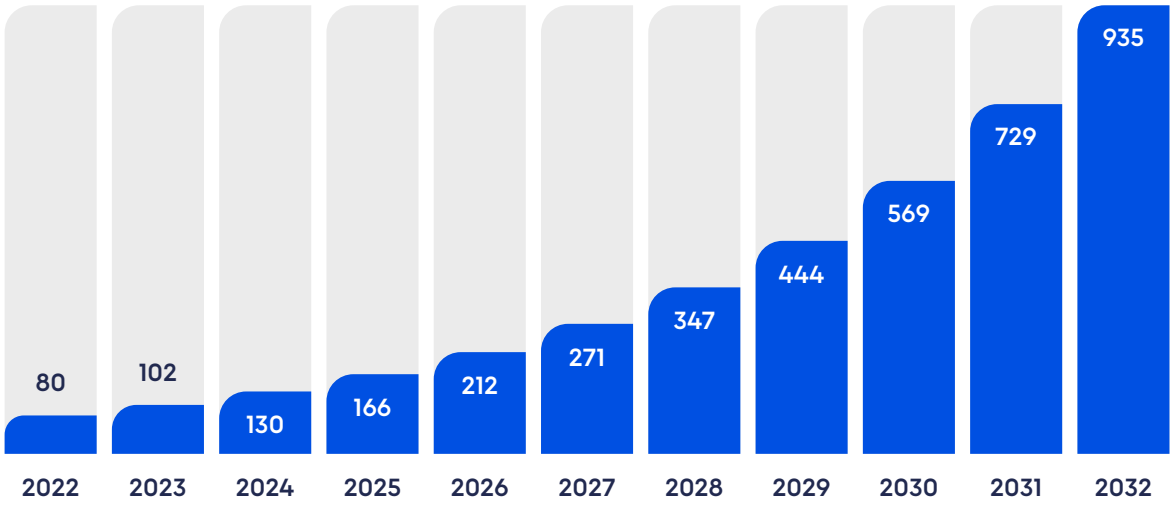
Figure 11 | Top 20 companies by foreign direct investment into data centers*, USD Bn, 2003–2022



Note: *Data processing, hosting and related services.
Source: fDi Markets, Whiteshield.

Hyperscalers make up over half of the global cloud and data center infrastructure market, and are expected to double by 2025

Figure 12 | Hyperscale data centers market size, (Revenues, USD Bn)



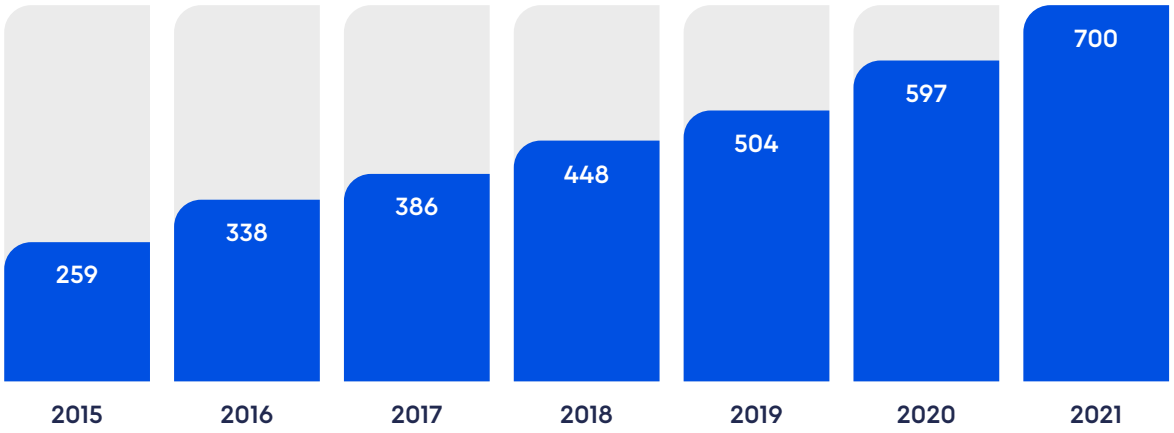
Hyperscale data centers offer a single, broadly scalable computational architecture to serve a technology's digital and cloud infrastructure

Cloud and data center infrastructure market (including servers, storage, and networking equipment) reached $142 billion in 2020, growing by 10.4% Y-Y. Of this amount, $80 billion (56%) was spent by public cloud providers (mostly hyperscale operators), while $62 billion (44%) was spent by non-cloud providers (mostly traditional data centers)

The global hyperscale data center market size is estimated to hit around USD 935.3 billion by 2032, growing at a CAGR of 27.9%

By user type, the cloud providers segment held a market share of around 62% in 2022

Figure 13 | Number of hyperscale data centers worldwide, (2015 to 2021)



Top 5 global data centers

Meta amazon Microsoft Google

Source: Hyperscale Data Center Market Research, 2030.

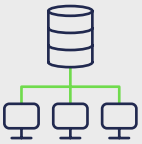
Data center REITs are increasingly establishing themselves as a growing business opportunity within commercial real estate

Data Center Real Estate Investment Trusts (REIT) is a type of real estate investment trust that owns, operates, or invests in data centers.

Key advantages

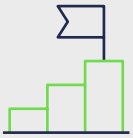
High dividend yield

DC REITs typically have high dividend yields, providing investors with a steady stream of income. This is because they are required to distribute at least 90% of their taxable income as dividends under the current REIT structure.



Exposure to the growing digital infrastructure industry

The demand for digital infrastructure is rapidly growing, and DC REITs provide investors with exposure to this industry. DCs are essential for cloud computing, big data, artificial intelligence, and other applications that require large amounts of data storage.



Limited competition

DC REITs offer attractive returns to investors, as they benefit from the increasing demand for DC space and capacity, the high barriers to entry in the DC industry, and the long-term leases. Some DC REITs have even outperformed the broader REIT sector and the S&P 500 index in last 17 years.

Some examples of data center REITs are:

Keppel DC REIT · EQUINIX · INFRABRIDGE a division of DIGITALBRIDGE · AMERICAN TOWER · DIGITAL REALTY

Source: Nareit Real Estate

The data center industry is energy-intensive, yet significant progress has been made over the years

Global data center energy demand has been growing over the years. The estimated global data center electricity consumption in 2022 was 201 TWh, or around 1-1.3% of global final electricity demand (see Figure 15). This excludes energy used for cryptocurrency mining, which was estimated to be around 110 TWh in 2022, accounting for 0.4% of annual global electricity demand.

Since 2010, data center energy use, excluding crypto, has seen only moderate growth despite the strong demand for data center services. This trend can be attributed to efficiency improvements in IT hardware and cooling, as well as a shift from small, inefficient enterprise data centers to more efficient cloud and hyperscale data centers.

Data centers are finding ways to enhance their energy efficiency. The power usage effectiveness (PUE), which measures the computing equipment's power consumption in relation to the total PUE of a data center, has significantly decreased since 2007 (see Figure 14).

Figure 14 | Data center average annual power usage effectiveness (PUE) worldwide 2007-2018

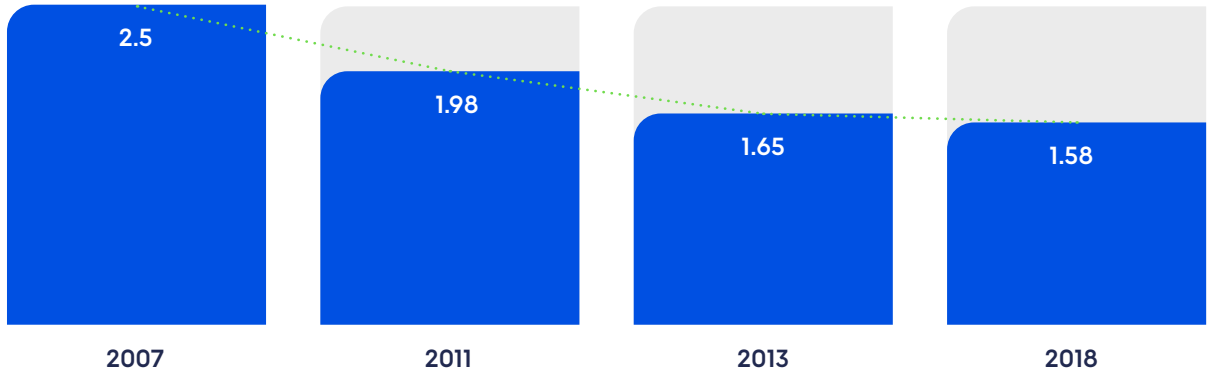
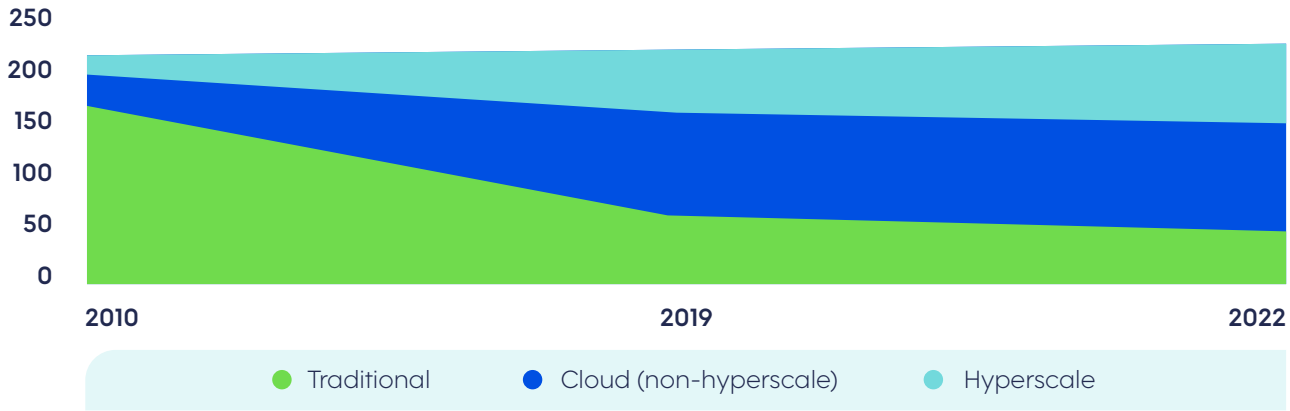


Figure 15 | Global data center energy demand by data center type, 2010-2022, TWh



Source: International Energy Agency, Uptime Institute, Upsite Technologies.

Which is the best country to invest in for a data center?

The Whiteshield Data center Investment Attractiveness framework is designed to assess which countries are best positioned to attract data center investments across three pillars: supply, demand, and policy.

The supply pillar measures feasibility and cost-effectiveness of setting up a data center in a particular location. Factors such as the availability of skilled labor, reliable utilities, robust infrastructure, and suitable land can significantly impact the operational efficiency and profitability of a data center.

The demand pillar assesses the potential market for data center services. High demand indicates a thriving digital economy, which can lead to higher revenues for data center investors and operators. Factors such as market conditions, latency, and coverage can give insights into the potential customer base, their needs, and how well these needs can be met.

Finally, the policy environment can significantly impact the ease of doing business and the risk associated with data center operations. Favourable policies, such as those promoting innovation and protecting data, can attract data center investment. On the other hand, stringent regulations or bureaucratic red tape can pose challenges. Thus, understanding the policy landscape is essential for assessing both the opportunities and risks associated with data center investment in a particular country.

Figure 16 | Data Center Investment Attractiveness – Assessment Framework

Supply	**Labor** Availability of skilled labor force	**Utilities** Reliability of electricity supply, availability of renewable energy sources	**Infrastructure** Cost of construction and availability of technical material	**Land** Availability and cost of suitable land for data center construction
Demand	**Market Size** Size of the local digital market, presence of large IT companies	**Market Growth** Growth rate of the digital sector, projected growth of digital services	**Latency** Average internet speed, latency to major internet hubs and regional eyeballs	**Coverage** Number of internet users at the regional level, internet penetration rate
Policy	**Business Regulation** Ease of doing business, level of bureaucratic red tape	**Innovation Promotion** Government spending on R&D, number of patents filed in IT, presence of tech incubators and accelerators	**Data Protection and Privacy** Existence of data protection laws, privacy laws, and their enforcement	**Sectoral Incentives** Government incentives for data center investment, such as tax breaks, grants, or subsidised loans

Source: Whiteshield

Denmark is the most attractive country for data center operations

Denmark is the leading country in Investment Monitor's first Data center Ranking, with a score of 78.7 (out of 100). The northern European country scored highly in the IT infrastructure, security, innovation, and talent categories.

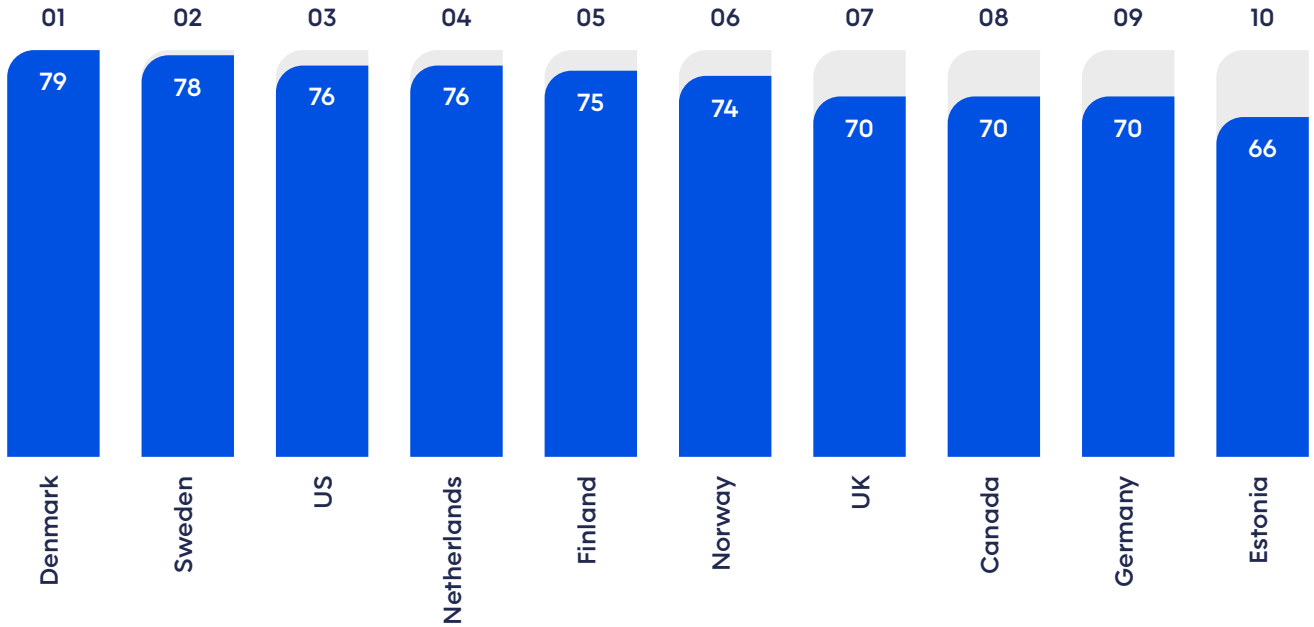
Of all the countries surveyed, it has the fastest internet download speeds at 108 megabits per second (Mbps) and second-fastest upload speeds (66Mbps), as well as the most secure internet servers per million people (277,134 per million). Denmark ranks second globally in the Portulans Institute Network Readiness Index, which ranks the country as having one of the most future-ready societies in the world. Denmark also ranks in the top ten globally for the skill set of its graduates in the World Economic Forum's Global Competitiveness Report.

Sweden comes a close second in the index. Like its neighbour, it ranks strongly in IT infrastructure, innovation, and talent, as well as ranking fourth in the energy category, due to a favorable climate and a widespread focus on renewable energy supply. Other Scandinavian countries also feature in the top ten, with Finland in fifth – scoring highly for support infrastructure, energy, and talent – and Norway in sixth, while nearby Estonia is placed in the tenth position.

The US is in third position and scores well for market conditions and preparedness for cybersecurity attacks. The US and Canada (in eighth) are the only non-European countries in the top ten.

The Netherlands (fourth), the United Kingdom (seventh) and Germany (ninth) completed the top ten.

Figure 17 | Investment Monitor's 2020 Data Center Ranking– Top 10 countries



Source: Investment Monitor's 2020 Data Center Ranking, Whiteshield, Network Readiness Index 2023.

Economic Impact

02

Data center infrastructure stimulates economic growth by creating jobs and driving technological advancement

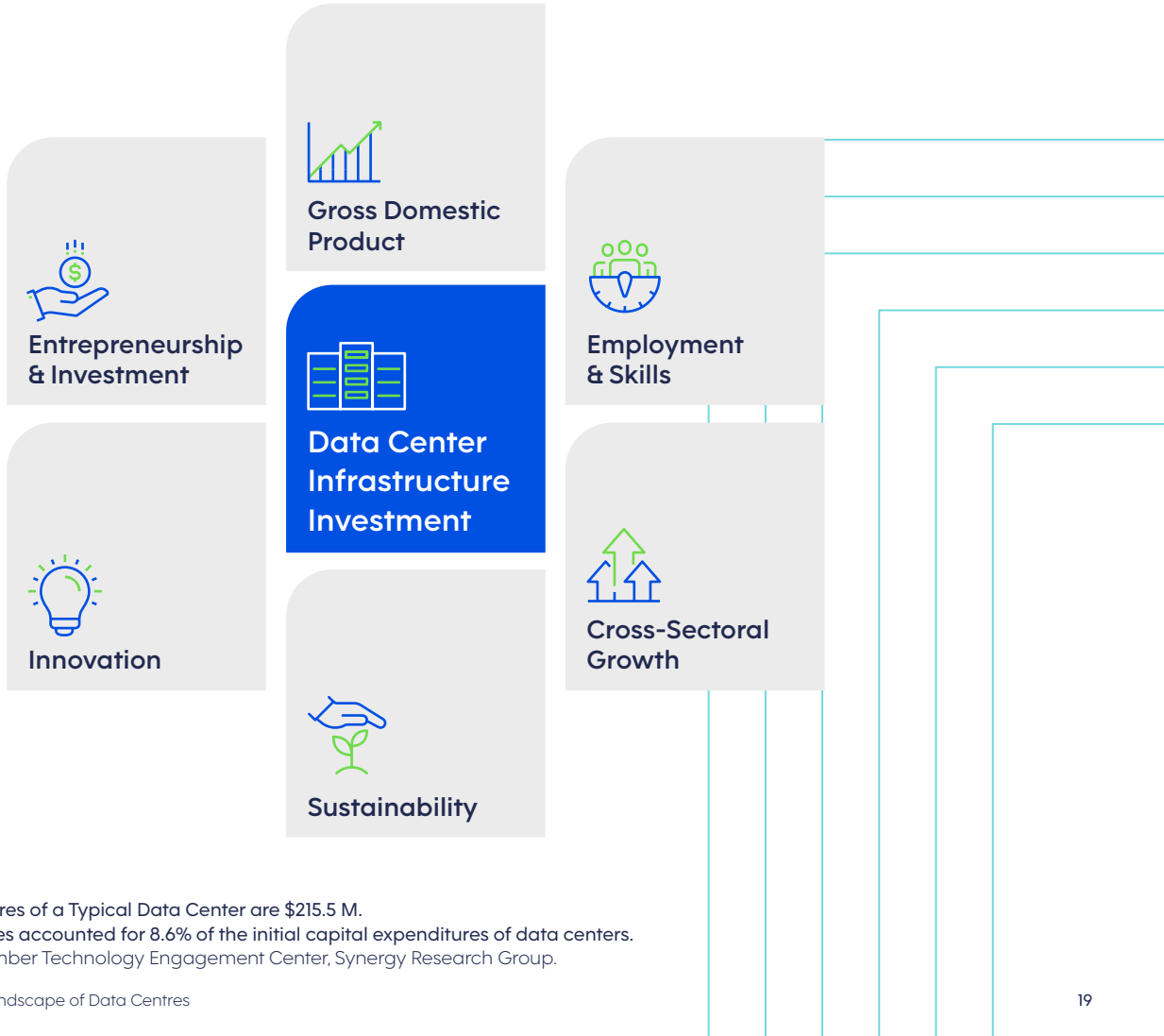
The benefits of data centers go beyond powering cutting-edge innovations. The economic impact, direct and indirect, is substantial.

Investment in the data center infrastructure stimulates economic growth by creating jobs and attracting further investment from businesses that rely on robust digital infrastructure. The number of deals involving data centers has increased steadily over the years, reaching 187 transactions worth of USD 48 billion in 2022. These investments produce significant returns, and create both high tax revenue and new jobs.

During its construction phase, a typical data center engages 1,688 local workers, contributing $77.7 million in wages, fostering $243.5 million in economic output within the local supply chain, and yielding $9.9 million in revenue for state and local governments. Subsequently, on an annual basis, the same data center sustains 157 local jobs, with $7.8 million in wages, infusing $32.5 million into the local economy, and generating $1.1 million in revenue for state and local governments.

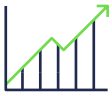
Data centers enhance local public infrastructure, including roads, power lines, water, and sewage systems, both directly and indirectly. They also contribute to the expansion of the skilled workforce, and often serve as magnets for additional data centers or affiliated businesses. Without data centers, we cannot power the innovations to keep our economy moving.

Figure 18 | Data center infrastructure investment: Key benefits



Note: Initial capital expenditures of a Typical Data Center are $215.5 M.
Annual operating expenditures accounted for 8.6% of the initial capital expenditures of data centers.
Source: Whiteshield, U.S. Chamber Technology Engagement Center, Synergy Research Group.

Data center infrastructure stimulates economic growth by creating jobs and driving technological advancement



GDP

Data center infrastructure investment significantly contributes to national economic growth by injecting capital into the economy. The establishment and operation of data centers create a direct positive impact on the GDP. This influence is not confined to the data center industry alone; it permeates various sectors through the multiplier effect, fostering a robust economic environment.

Employment and Skills

Investments in data center infrastructure serve as a pivotal driver of employment and skills development. The construction, operation, and maintenance of data centers necessitate a diverse skill set, generating job opportunities across a spectrum of professions. Furthermore, these investments catalyse skill enhancement initiatives, aligning the workforce with the evolving demands of the digital economy.

Entrepreneurship and Investment

The establishment of data centers fosters a thriving ecosystem for entrepreneurship and investment. The technological demands of data centers spur the emergence of innovative start-ups, creating a dynamic business environment. Simultaneously, these investments attract further capital, both domestically and internationally, solidifying the region's position as a hub for technological advancement.

Cross-Sectoral Growth

Data Center investments drive cross-sectoral growth by acting as a catalyst for technological advancements. Industries such as telecommunications, cloud services, and software development experience heightened demand, driving innovation and collaboration. This interdependence creates a ripple effect, positively influencing the entire supply chain and bolstering overall economic development.

Sustainability

Sustainability is a key facet of data center infrastructure investment. Through rigorous energy-efficient practices and environmentally conscious strategies, data centers can contribute to a greener and more sustainable future. The implementation of renewable energy sources, coupled with innovative cooling technologies, underscores a commitment to minimising the environmental footprint associated with data center operations.

Innovation

Investments in data center infrastructure position regions as hubs for technological innovation. By allocating resources to research and development initiatives, data center investments stimulate continuous advancements in technology. Collaborations between data centers, universities, and research institutions further amplify innovation, creating a fertile ground for cutting-edge breakthroughs and technological leadership.

Source: Whiteshield

Data center investments can contribute between 0.1-0.2% to the real GDP

Whiteshield has conducted a high-level assessment to forecast the direct economic impact of investments in data center infrastructure across a select group of countries. This group comprises the US, Indonesia, Turkiye, the Kingdom of Saudi Arabia (KSA), Ireland, Singapore, the United Arab Emirates (UAE), and Egypt. Collectively, these countries account for one-third of the global data center market, which is worth of USD 101 billion.

The analysis shows that, on average, these investments will contribute to an annual growth rate of 0.1-0.2% in the gross domestic product (GDP) of the selected countries. This signifies a substantial boost to their economies, given the pivotal role of data centers in today's digital age.

Moreover, the forecast shows an increase of 0.03-0.11% in total employment each year in these countries as a result of the data center investments. For a country like Turkiye, for example, this means an additional 5,000 direct jobs will be created in one year. This underscores the significant role of the data center industry in job creation, contributing to economic stability and growth.

It's important to note that these are high-level estimates and actual impacts may vary based on a range of factors. Tables 3-5 illustrate a detailed assessment at the country level.

Figure 19 below also provides insights on how the data center sector can drive job creation, output, and government revenues in Turkiye.

Figure 19 | Estimated impact of data center infrastructure investment – Case of Turkiye

	2023	2024	2025	2026	2027	2028
Jobs (K jobs)	4.7	4.9	5.1	5.4	5.6	**5.9**
GDP (USD Bn)	1.2	1.2	1.2	1.2	1.3	**1.3**
Taxes (USD Mn)	43	44	46	47	48	**50**

Note: Initial capital expenditures of a Typical Data Center are $215.5 M.
Annual operating expenditures accounted for 8.6% of the initial capital expenditures of data centers.
Source: Whiteshield, U.S. Chamber Technology Engagement Center, Synergy Research Group.

Table 1 | Estimated impact of data center infrastructure investment on creation of new jobs in selected countries, number of jobs

	2023	2024	2025	2026	2027	2028
United States	170,977	178,828	187,972	197,583	207,685	218,304
Indonesia	7,135	7,523	7,985	8,476	8,997	9,549
Turkiye	4,719	4,901	5,137	5,385	5,645	5,917
Saudi Arabia	3,242	3,390	3,573	3,765	3,968	4,182
Ireland	2,801	2,948	3,125	3,312	3,511	3,721
Singapore	1,876	1,975	2,094	2,221	2,355	2,498
United Arab Emirates	1,605	1,676	1,765	1,858	1,956	2,060
Egypt	377	399	426	454	485	518

Table 2 | Estimated impact of data center infrastructure investment on GDP, USD Mn

	2023	2024	2025	2026	2027	2028
United States	41,849	43,004	44,218	45,494	46,836	48,246
Indonesia	1,757	1,815	1,876	1,941	2,011	2,084
Turkiye	1,152	1,182	1,214	1,246	1,281	1,317
Saudi Arabia	795	818	842	867	894	923
Ireland	689	711	735	760	786	814
Singapore	462	477	492	509	527	546
United Arab Emirates	393	404	416	428	442	455
Egypt	93	96	100	104	108	112

Source: World Development Indicators, Statista Market Insights, Financial Statements of Key Players, National statistical offices, Whiteshield analysis.

Table 3 | Estimated impact of data center infrastructure investment on tax revenue in selected countries, USD Mn

	2023	2024	2025	2026	2027	2028
United States	1,570	1,617	1,667	1,719	1,773	1,830
Indonesia	66	68	71	73	76	79
Turkiye	43	44	46	47	48	50
Saudi Arabia	30	31	32	33	34	35
Ireland	26	27	28	29	30	31
Singapore	17	18	19	19	20	21
United Arab Emirates	15	15	16	16	17	17
Egypt	3	4	4	4	4	4

Source: World Development Indicators, Statista Market Insights, Financial Statements of Key Players, National statistical offices, Whiteshield analysis.

Data center operations and investments translate to broader economic activity for the country at large

Data centers produce jobs in all three economic impact channels: direct, indirect (supply chain), and induced (spillover).

The broad spillover effects of data center operations and investments translate to economic activity for the region at large. The jobs supported by data center operations are widely distributed, and many are in industries not normally associated with data center operations. As Figure 20 shows, the impact of Google data center operations on jobs was spread across 11 sectors, led by information, communication, and telecom.

In fact, just over 50% of these jobs are in European countries that do not even host a Google data center. We can attribute this wide distribution of jobs to the capital investments made by Google for data center development, and the energy generation capacity needed to support Google's clean energy commitments. These each require large amounts of physical and human capital that is sourced from throughout the continent.

Figure 20 | Sector analysis: data center operations and clean energy - Total jobs supported by Google in Europe

Google

Key sectors impacted	Europe
Information, Communication, Telecom	1,887
Trade and Transportation	1,285
Mining and Manufacturing	977
Professional Services	912
Utilities (Clean Energy)	834
Health	732
Agriculture	677
Leisure (Hotels, Restaurants, Arts)	364
Utilities (Other)	316
Finanace and Real Estate	248
Other	227

Source: Oxford Economics, Whiteshield.

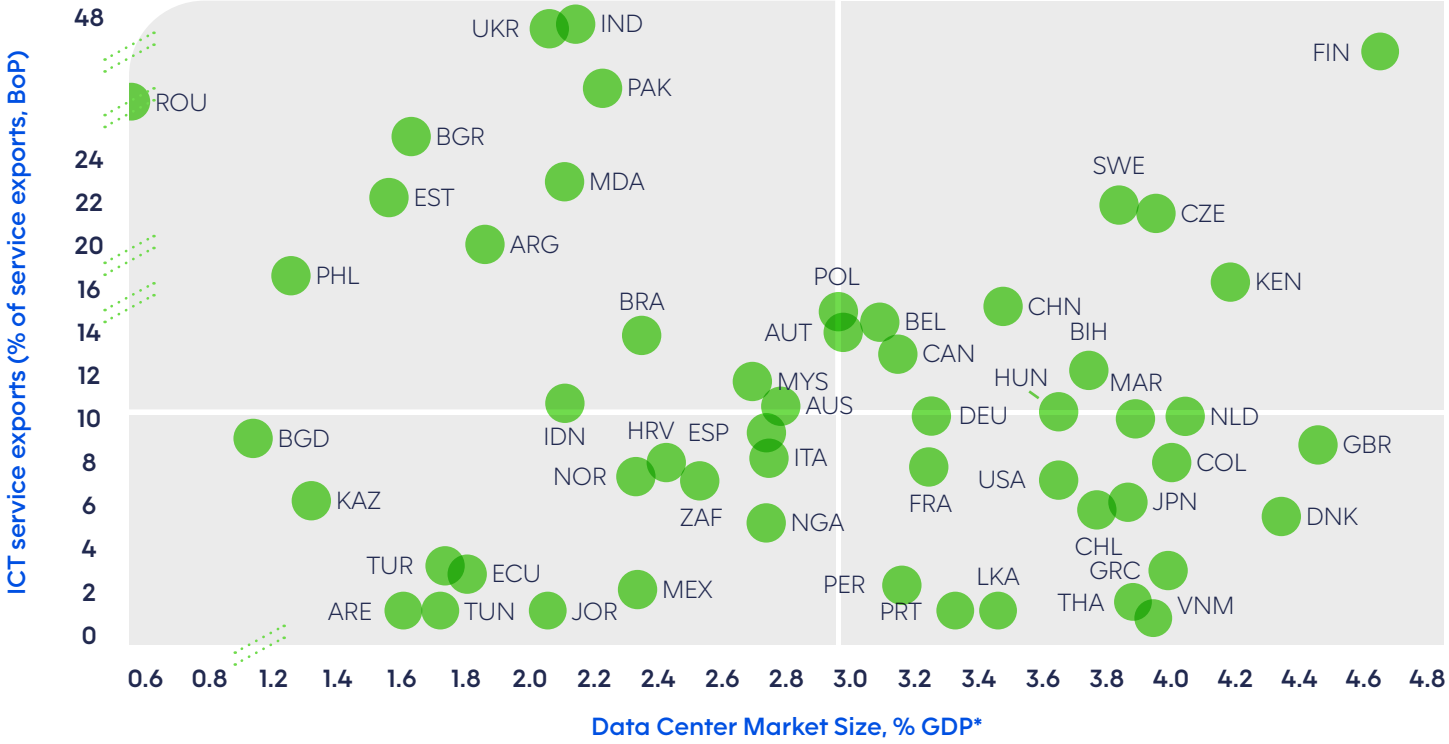
Several European nations are leading in both ICT service exports and data center market size, while others exhibit varying degrees of presence in these domains

Countries with a relatively high data center market are often at the forefront of driving the Information and Communication Technology (ICT) sector. This is primarily because data centers are the backbone of modern digital infrastructure, providing the necessary computing power, storage, and networking capabilities that underpin the digital economy.

Data centers play a crucial role in the ICT sector by hosting cloud services, supporting digital content distribution, and enabling data analytics, among other things. As such, countries with a robust data center market often have a vibrant ICT sector, as the availability of advanced data center infrastructure facilitates the development and deployment of cutting-edge ICT solutions.

Being the world's most attractive data center hot spots, Finland and Sweden have a high share of data center revenue generated as a percentage of gross domestic product, thus driving ICT exports, including data center services abroad (see Figure 21). In general, it is primarily countries in Europe that have managed to excel in the field of ICT services, a success that can be attributed to their substantial market size in the data center industry.

Figure 21 | Prioritisation of countries based on their ICT services exports and data center market size



Note: *DC market size as % of GDP was multiplied by 1000 for ease of illustration.
Source: World Bank, Statista Market Insights, Financial Statements of Key Players, National statistical offices, Whiteshield.

AI & Data Center Infrastructure

03

AI is significantly impacting the global labor market, positively for innovative jobs, negatively for others

Total AI is accelerating - it is valued at USD 422 billion, and will grow further at roughly 40% annually during 2022-2028. By 2030, AI will contribute $15 trillion to the global economy.

However, it is still debated what is the net impact of AI on the labor market. International Labor Organization (ILO) states that AI in general, and generative AI particularly, is likely to augment rather than destroy jobs. It suggests that most jobs and industries are only partly exposed to automation, and are more likely to be complemented rather than substituted by the latest wave of generative AI, such as ChatGPT. The World Economic Forum forecasts that by 2025, AI might displace about 85 million jobs, yet, it is anticipated to generate around 97 million new positions. This overall increase in employment highlights AI's potential to stimulate economic growth and broaden the spectrum of job prospects.

Figure 22 illustrates the anticipated impact of AI on job growth across various occupations. Countries around the world are actively preparing for the impact of AI on the labor market and are adopting various policies to manage this transition.

Singapore sets a prime example in this context. As per LinkedIn's recent Future of Work report, Singaporean workers are leading globally in terms of acquiring AI skills at a rapid pace. This can be attributed to Singapore's labor policy, known as 'SkillsFuture Singapore', which is designed to continually update the workforce's skills to meet future demands.

Figure 22 | Impact of AI and technology on jobs, annual growth rate in number of jobs

Growing Occupation Groups

32%	2514	Applications programers
32%	2529	Database and network professionals not elsewhere classified
27%	2421	Management and organization analysts
25%	2263	Environmental and occupational health and hygiene professionals
22%	3512	Information and communications technology user support technicians

Declining Occupation Groups

-12%	7532	Garment and related patternmakers and cutters
-11%	4110	General office clerks
-11%	7318	Handicraft workers in textile, leather and related materials
-10%	9520	Street vendors (excluding food)
-10%	7114	Concrete placers, concrete finishers, and related workers

AI By 2025, AI is expected to generate a net gain of **12 million jobs**

Source: World Economic Forum, Goldman Sachs, LinkedIn's latest Future of Work report, Whiteshield analysis.

With the AI trend, countries will increasingly depend on strong data center infrastructure, driving up capacity demand

AI applications use a lot of power. This is especially true for deep learning models, which need a lot of computing power to train and run these models. The operation of these applications requires cutting-edge hardware, including Graphics Processing Units (GPUs) - specialised electronic hardware designed to expedite graphics and image rendering - and Tensor Processing Units (TPUs) - hardware tailored to accelerate AI and machine learning workloads.

Conventional data centers are typically engineered with an average density of five to 10 kilowatts per rack. However, the advent of AI introduces a heightened requirement of 60 kilowatts or more per rack. Furthermore, AI applications engender a considerably larger volume of data compared to other workload types, thereby imposing substantial demands on data center capacity.

International Data Corporation estimates that about 20% of total data center capacity is already used for AI.

By 2027, the global electricity consumption attributable to AI is projected to witness a surge ranging from 85.4 to 134.0 terawatt-hours annually, stemming from the deployment of newly manufactured servers. This is equivalent to the yearly electricity consumption levels observed in countries like the Netherlands, Argentina, and Sweden.

As the momentum of AI growth accelerates, traditional data centers may find themselves inadequately equipped to meet the escalating demands. Existing data centers, already operating at near-peak capacities, will encounter challenges in accommodating the transition from AI application testing to comprehensive deployments. In a prominent data center market such as Northern Virginia, covering over 275 facilities, the available power for lease has diminished from 46.6 megawatts to 38.4 megawatts in the past year, according to estimates provided by CBRE Group, a commercial real-estate services firm. Notably, the consumption of tens of thousands of kilowatt-hours by a single AI model over the course of several days underscores the substantial power requirements associated with AI operations.

Note: *Storage capacity.
Source: Data Center Dynamics, International Data Corporation, CBRE Group, Whiteshield.

Countries with resilient digital infrastructure tend to benefit more from AI impact on economy and jobs

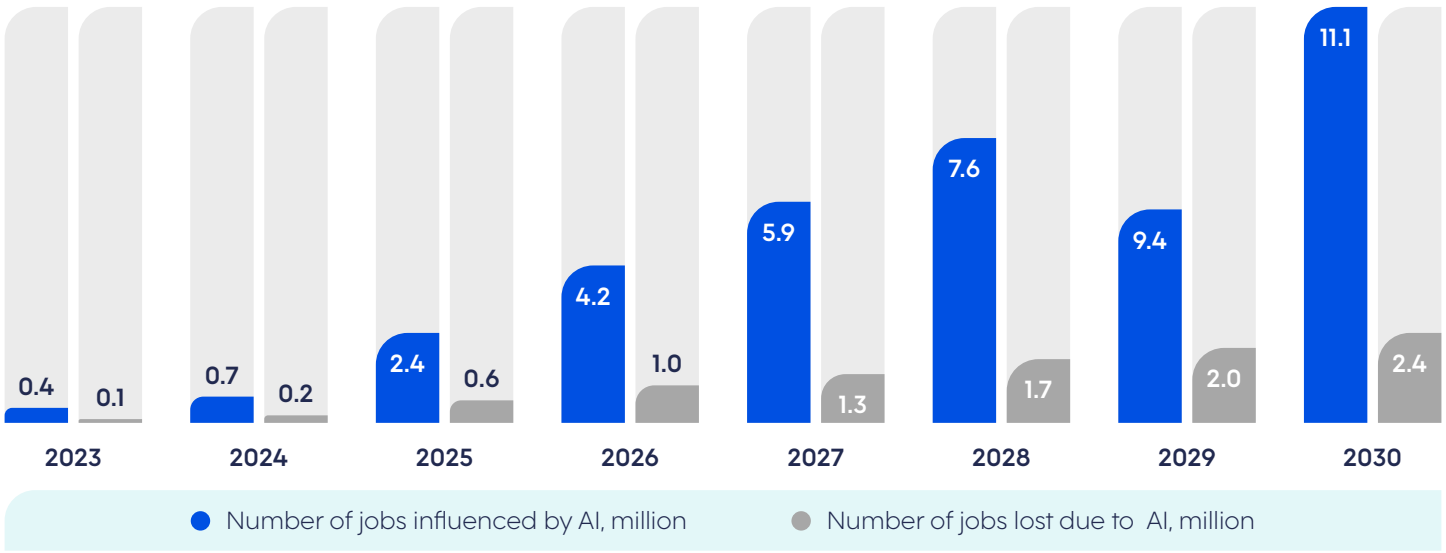
Countries with resilient digital infrastructure are well-positioned to leverage the transformative impact of the AI revolution, fostering robust labor markets that generate benefits rather than succumb to job displacement. Whiteshield analysis underscores a substantial correlation between a country's labor market preparedness for AI and its proficiency in data infrastructure.

The case of the US serves as a compelling illustration, where strategic AI integration is anticipated to result in the creation of 4.8 times more jobs than those that will be potentially lost by 2030. This emphasises the critical role played by advanced digital and data frameworks in not only mitigating employment challenges, but also in propelling economic growth amidst the unfolding AI revolution.

Figure 23 | Correlation between labor market preparedness and digital infrastructure

Corr: 88%

Figure 24 | Projected impact of AI on jobs, US case, million jobs, 2023-2030



Note: Labor market adaptability to AI is measured using Whiteshield's GLRI framework, taking its transformative capability to technology shocks; Data and infrastructure preparedness is derived from Government AI Readiness Index using its Data & Infrastructure Pillar.
Source: Forrester's 2023 Generative AI Jobs Impact Forecast, Oxford Insights, Whiteshield.

However, the rapid development of AI presents risks across the board...

Understanding the spectrum of risks associated with AI is crucial as its applications become more pervasive in our daily lives. To navigate this complex landscape, one approach to categorise these risks is provided by the National Institute of Standards and Technology (NIST), which divides them into three principal areas: Harm to People, Harm to Organizations, and Harm to Ecosystems. This categorisation helps in identifying, assessing, and mitigating the potentially adverse effects of AI technologies.

Harm to People: AI technologies can pose risks to individuals by compromising personal liberties, including privacy breaches and manipulations affecting psychological safety. At a group or community level, AI can enable discrimination or exacerbate inequities, impacting social dynamics and access to resources. Societally, the implications are even broader, potentially jeopardizing democratic processes and the integrity of educational systems through the spread of misinformation, and the undermining of fair access to information.

Harm to Organizations: Operational risks arise when AI systems disrupt an organization's activities, causing inefficiency or downtime. Security breaches and financial losses due to AI vulnerabilities or exploitation can have dire consequences. Moreover, reputational damage can occur when AI applications lead to controversial outcomes or ethical concerns, such as unauthorised use of data or lack of transparency.

Harm to Ecosystems: The interconnected nature of AI can lead to systemic risks, affecting not just individual systems but the broader interlinked network, including the financial and environmental sectors. Ecological concerns are significant, as AI systems may drive resource depletion or contribute to environmental harm, both directly and indirectly.

Figure 25 | Data Security Risks from AI

Harm to People

Individual
Harm to a person's civil liberties, rights, physical or psychological safety, or economic opportunity

Group/Community
Harm to a group such as discrimination against a population sub-group

Societal
Harm to democratic participation or educational access

Harm to Organizations

Operational
Harm to an organization's operations

Security/FInancial
Harm to an organization from security breaches or monetary loss

Reputational
Harm to an organization's reputation

Harm to Ecosystem

Interconnectivity
Harm to interconnected and interdependent elements and resources

Systemic
Harm to the global financial system, supply chain, or interrelated systems

Environmental
Harm to natural resources, the environment, and planet

Examples

- Deepfakes/disinformation
- Misinformation
- Discrimination
- Data Breaches

- Cyber Attacks
- IP Rights Infrigment

- Environmental Impact of Compute Power
- Attacks on Critical Infrastructure

...requiring data security and sovereignty to secure the industry's rapid growth

In a rapidly evolving digital landscape, the role of data centers in national data security and data sovereignty has become increasingly significant. The global cyber security market size was valued at USD 172.3 billion (data security market – 28.8 billion) in 2023, and is projected to reach USD 424.9 billion (data security market – 68.29 billion) in 2030, exhibiting a 13.8% CAGR. This indicates the critical need for secure data storage and management solutions.

Global Data Security Trends: The global data security landscape is witnessing unprecedented challenges and opportunities. As cyber threats become more sophisticated, the importance of secure data centers has never been more critical. Advanced security technologies such as encryption, intrusion detection systems (IDS), and physical security measures are now standard in data centers worldwide.

Data Sovereignty and Compliance: Countries are increasingly enacting data protection regulations such as the European Union's General Data Protection Regulation (GDPR) and the California Consumer Privacy Act (CCPA) in the United States. Data centers play a pivotal role in ensuring that data handling practices comply with these regulations, thereby enhancing data sovereignty. They are designed to provide a secure environment that meets specific legal and regulatory requirements.

Innovations in Data center Security: Innovations in data center technology, such as the use of the AI and ML for security monitoring, are setting new standards for data protection. These technologies enable real-time threat detection and automated responses, enhancing the security posture of data centers and, by extension, the national data they protect.

Figure 26 | Selected cases of data protection approaches

With its strong focus on **data privacy and security,** Germany hosts numerous data centers that adhere to rigorous national and European **data protection** standards. These facilities are vital for Germany's Industrie 4.0, a strategic initiative to digitalize the manufacturing sector, ensuring **secure data flows** and **industrial data sovereignty.**

Positioned as a key **data distribution hub,** the Netherlands' data centers serve not only local companies but also the **broader European market.** The government's Spatial Strategy Data centers 2030 is committed to sustainability and the strategic growth of these centers, which are pivotal to the country's tech employment and digital economy.

Established the world's first '**Data Embassy**' in Luxembourg to **safeguard government-critical data** outside its territorial borders, ensuring digital continuity and security, even in crisis situations.

Implemented strict **data localisation laws**, requiring all personal data collected by companies to be **stored within China** to protect Chinese citizens' personal data.

Source: Whiteshield, Fortune Business Insights, Mordor Intelligence

Country Cases

04

The global market is dominated by US data centers - Northern Virginia alone accounts for more than 5% of total capacity

Figure 27 | Global data center market, top 10 countries in Americas, APAC and EMEA*

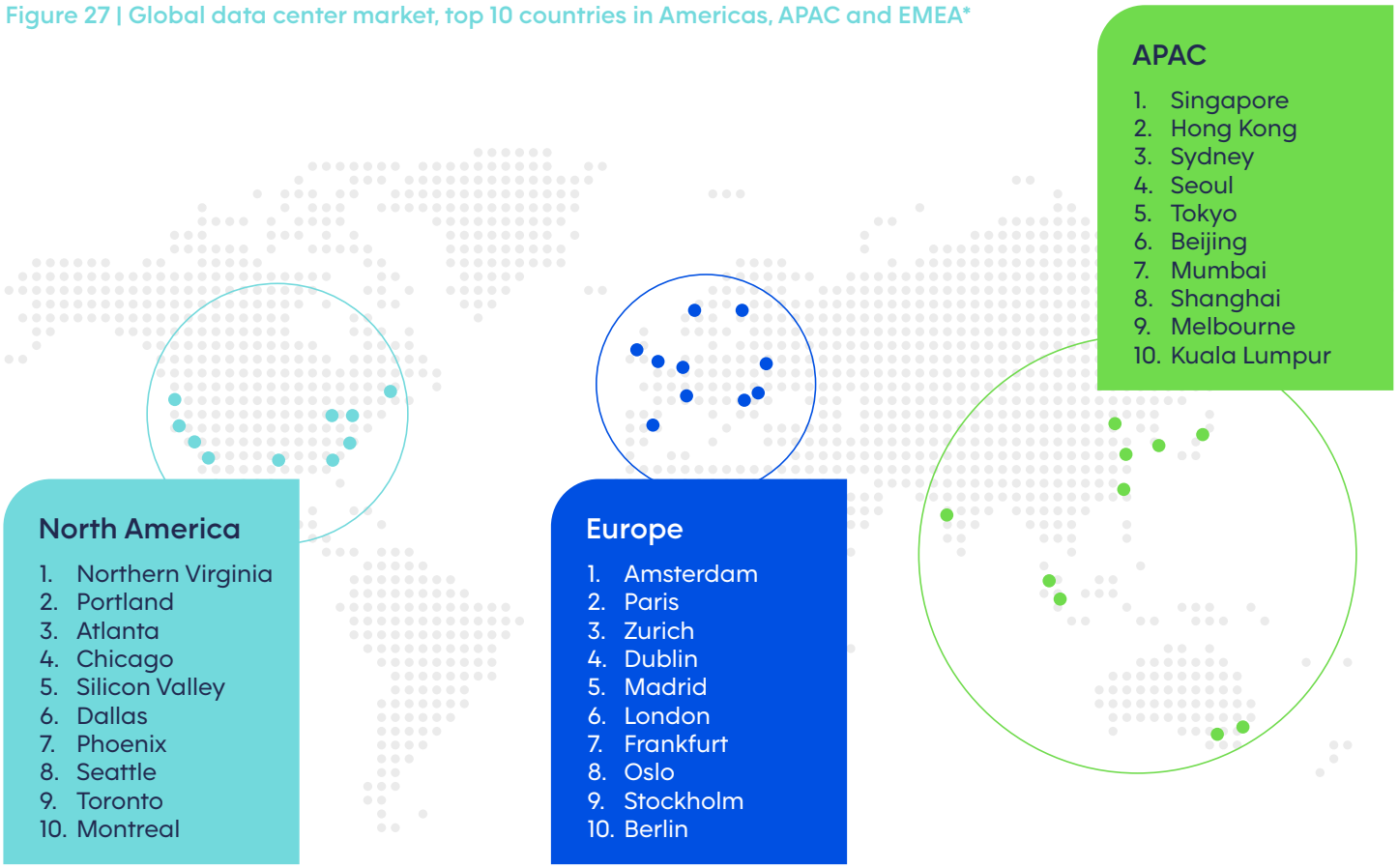
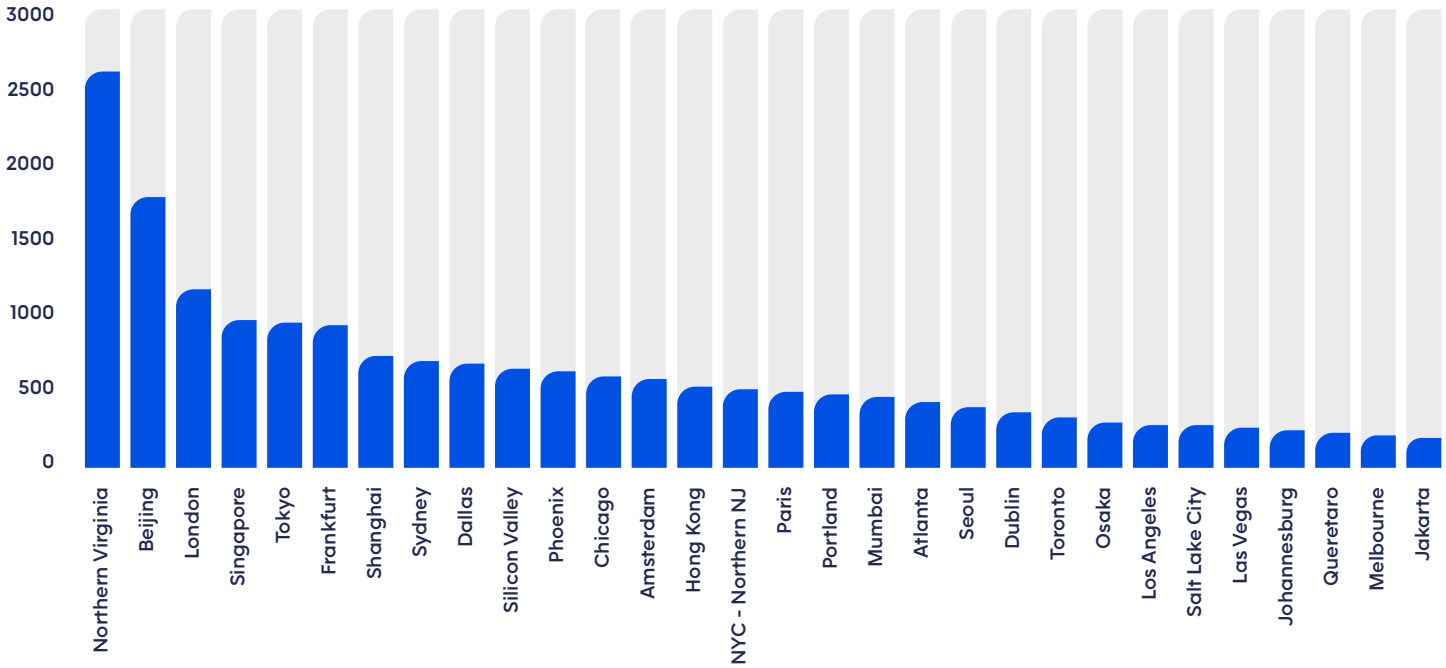


Figure 28 | Top global data center hotspots, total power, MW



Note: *Measured by Cushman & Wakefield Research based on cloud availability, market size and power cost.
Source: Cushman & Wakefield Research, Whiteshield.

Northern Virginia leads the world in the data center market

Key Figures

2.6 GW
Data center capacity

$6.8Bn
Data center investment in 2021

45,460
Jobs supported in 2021

$1Bn
Tax revenue generated in 2021

Key Insights

Ashburn, in Virginia's Loudoun County about 34 miles from Washington D.C., is widely known as the data center capital of the world, through which more than 70% of global internet traffic is routed.

Northern Virginia is the largest market for data center space in the US and is **home to 11.9 million square feet (SF) of commissioned multi-tenant data center space, representing 2,6 gigawatts (GW)** of commissioned power.

Measures and outcomes

The Virginia state government was able to recognise data center potential and played a major role in the development of Data Center Alley. In 2014, the Data Center Zoning Ordinance was approved to allow the construction of new data centers in more districts, as long as they adhere to the design guidelines.

Virginia is one of 31 states that **actively offer incentives to attract data centers** to locate in their states. A sales and use tax exemption is available to data centers that make a minimum new capital investment of $150 million, and that created a minimum of 50 new jobs in a Virginia locality.

There are **more than 250 data centers** located in Northern Virginia, supporting Internet operations for **Amazon, Google, Microsoft, Meta, Apple**, and many others. The amount of data center capacity in Virginia will grow further, with a projected **market size of 10 gigawatts by 2035.**

Data centers **invested $6.8 billion** in Virginia in 2021, **supporting 45,460 jobs** and **paying out USD 3.6 billion in salaries,** as well as **USD 1 billion in tax revenues** for local governments.

Source: Data Center Frontier, Datacenters.com Technology Northern Virginia Technology Council, Loundoun Virginia Economic Development, Dominion Energy, Cushman & Wakefield Research, Whiteshield.

The Netherlands is positioned as a regional data distribution hub

Key Figures

1.3 GW
Data center capacity*

20%
of FDI associated with DC and cloud computing

10,000
Direct and indirect jobs in the data center market

1.6%
Contribution to GDP

Key Insights

The Netherlands has an excellent worldwide position as a data distribution hub, and is an important internet hub, facilitating the exchange of Internet traffic between IP networks.

The data centers located in the Netherlands provide digital services to all types of companies in the country, but also for the rest of Europe. Its **strong data hub** is globally renowned and unique.

80% of Dutch companies with more than 250 employees **use cloud services.**

Measures and outcomes

The country has leveraged its central location as a digital gateway to the rest of Europe. The government's commitment is to facilitate co-location in the Amsterdam metropolitan area for data centers that have hyperconnectivity as a key business requirement.

The Spatial Strategy Data centers 2030 focuses on the rollout of new networks and selective growth of data centers to ensure sustainability. The land where the data center is to be located belongs to the government, and it will only be sold if certain sustainability conditions are met during construction.

Data centers **employ more than 10,000 people** (direct and indirect). But they are also fundamental to the **109,000 jobs in the tech hub** and **2.1 million jobs in the digital economy.**

Global technology companies such as **Netflix, Liberty Global, DAZN, DisneyPlus, Discovery Channel, and BBC** choose Netherlands as a data center location due to its strong digital connections.

Note: *Expected data center capacity in the Netherlands by 2024 from Mordor Intelligence.
Source: Dutch Data Centers, Data Center Forum, Mordor Intelligence, Dutch Data Center Association, Whiteshield.

Ireland's tax policy has led to significant investments in DC market

Key Figures

593MW
Data center capacity in 2022

€7.1Bn
Invested in DC since 2018

5,700
Direct and indirect jobs created data center market since 2018

€2Bn
Of international trade attributed to data centers

Key Insights

Data center presence in Ireland raises Ireland's visibility globally as a technology and innovation economy. This places Ireland on the map as a location of choice for a range of sectors and activities that are increasingly reliant on digital capabilities, including manufacturing, finance, animation, retail, and business services.

Dublin city is **home to the operations of dozens of global companies**, from **Google and Amazon, through to Facebook and TikTok.**

Measures and outcomes

In October 2017, the Government agreed to a strengthened Strategic Policy Framework for the continued development of data centers. Ireland's corporation tax rate, one of the lowest in the EU at around 12.5%, is a significant advantage for data center construction and expansion.

Data center investment has led to significant economic benefits. **€7.13 billion has been invested** through capital and operational expenditure since 2018, and an estimated **3,700 jobs in total** (1,900 construction and 1,800 operations) were created directly, with an **additional 2,000 jobs indirectly.**

According to Enterprise Ireland, **€2 billion ($2 billion) of global Irish sales exports** can be attributed to the data center industry.

Today, the digital industry **employs over 37,000 people** throughout Ireland and **generates €35 billion in exports every year.**

The employment opportunities provided by data centers has seen them **work with Irish educational institutions** to develop courses that enhance the **Government's STEM strategy.**

Source: 2018 Grant Thornton Ireland, Department of Enterprise, Trade and Employment, Enterprise Ireland, Whiteshield.

Methodology

05

Labor Navigator© allows to identify in-demand skills in the labor market ...

Overview

The Whiteshield Labor Navigator© assesses key in-demand skills in the job market by regularly analysing millions of online job postings.

It allows policy makers to observe the evolution of occupations and skills in the labor market, as well as observing the behaviour of the country's top employers. It can be used to shape educational programmes, reduce unemployment, and anticipate future labor market trends.

Use cases

- Strategy design for educational institutions (UAE)
- Skill gap assessment in the labor market (KSA)
- Redaction of the Global Labor Resilience Index

Resolution

- Space: Province-level
- Time: Quarterly
- Players: Company-level

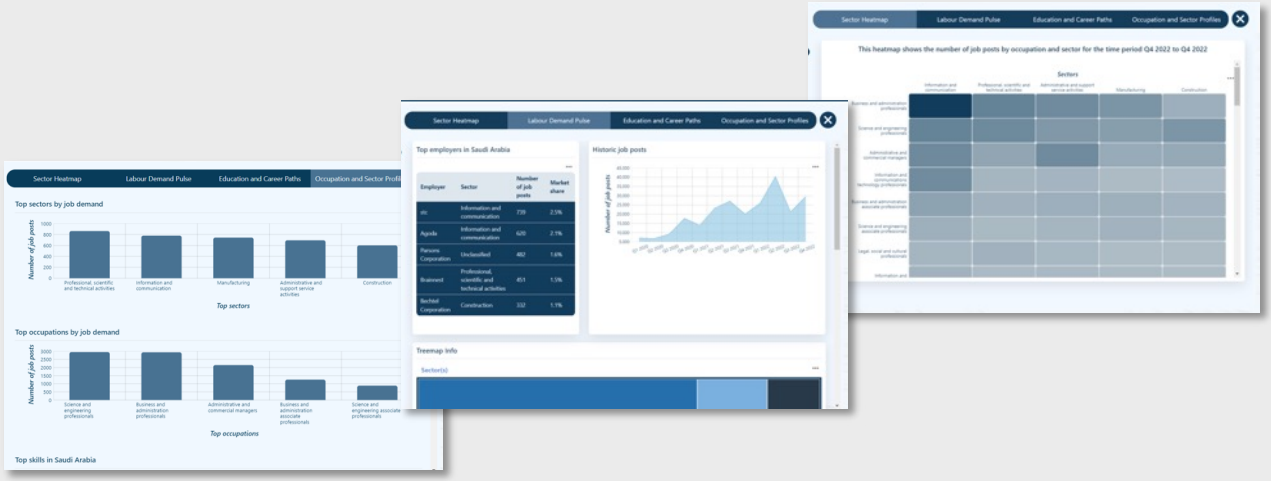
Source data

- Online job postings from various websites

Modelling technique

- Macroeconomic modelling
- Web scraping

Examples



Source: Whiteshield

... and assess AI impact on jobs

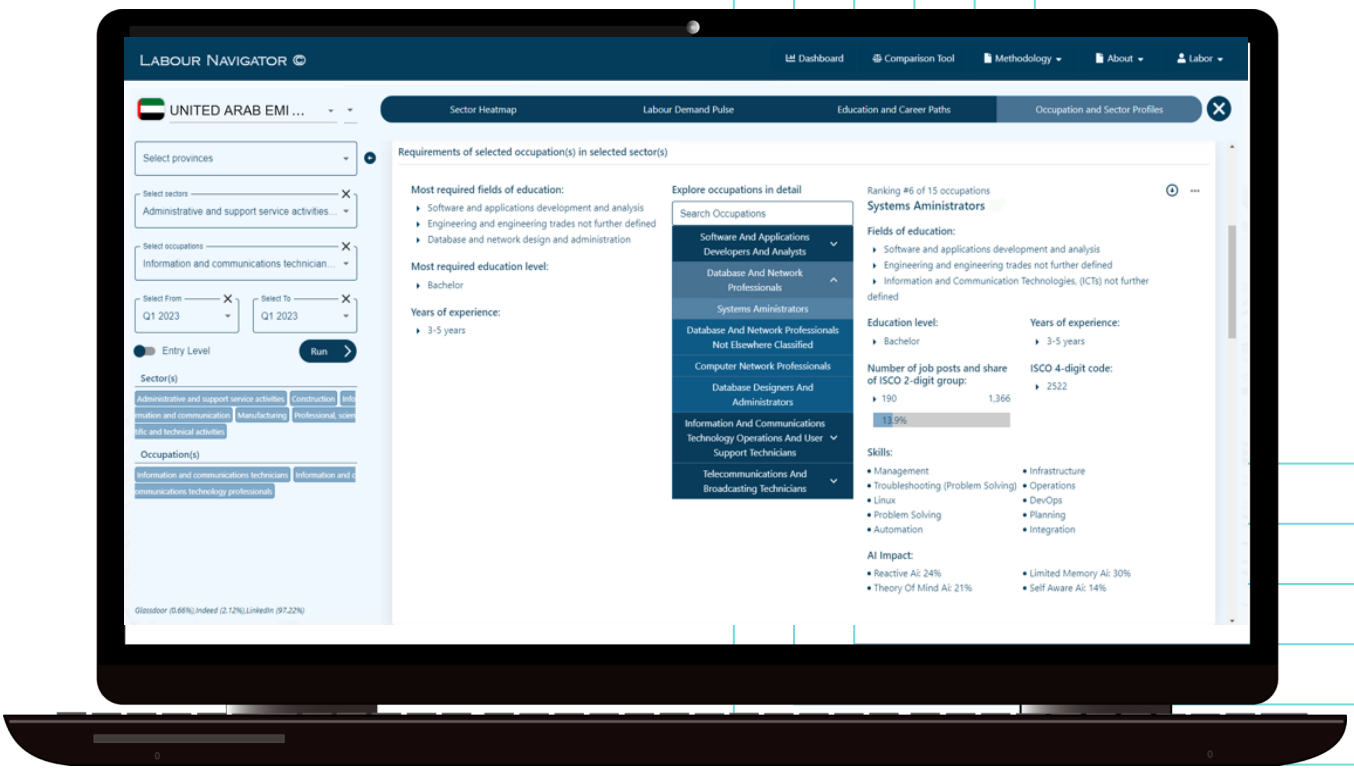
AI Evolutionary Impact Model

Description

At the task level, our advanced AI model evaluates the potential impact of various technologies, including automation and other cutting-edge advancements. It classifies the extent of impact into four distinct levels: Reactive AI, Limited Memory AI, Theory of Mind AI, and Self-Aware AI. This sophisticated model operates in a hierarchical manner, starting from the task level within a specific occupation (ISCO-4) and extending its analysis to encompass broader geographical contexts such as countries and regions.

Technology

Cognitive Intelligence Tools



Source: Whiteshield

Appendix

06

The UAE cloud market is rapidly growing, with the presence of all major global service providers and a relatively concentrated market

Figure 29 | UAE data center locations

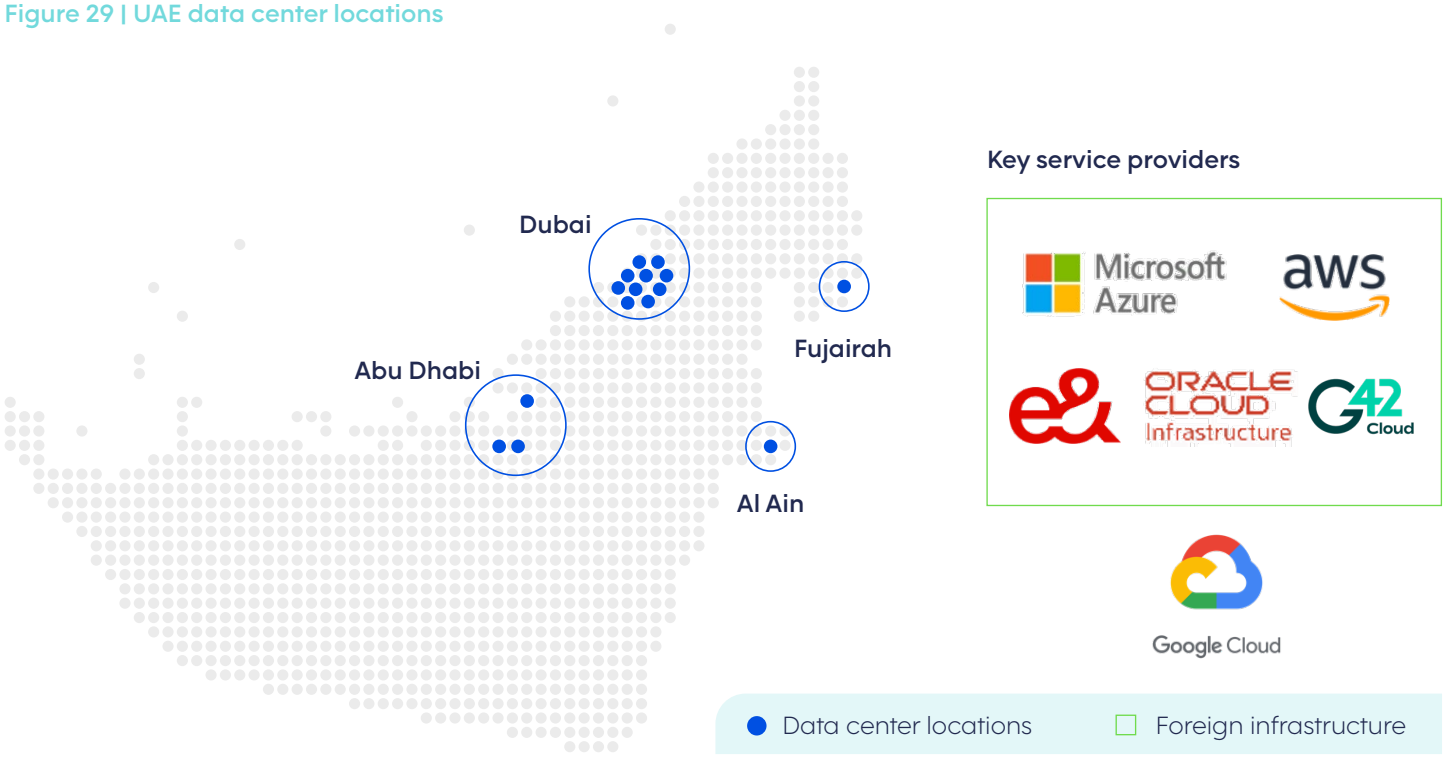
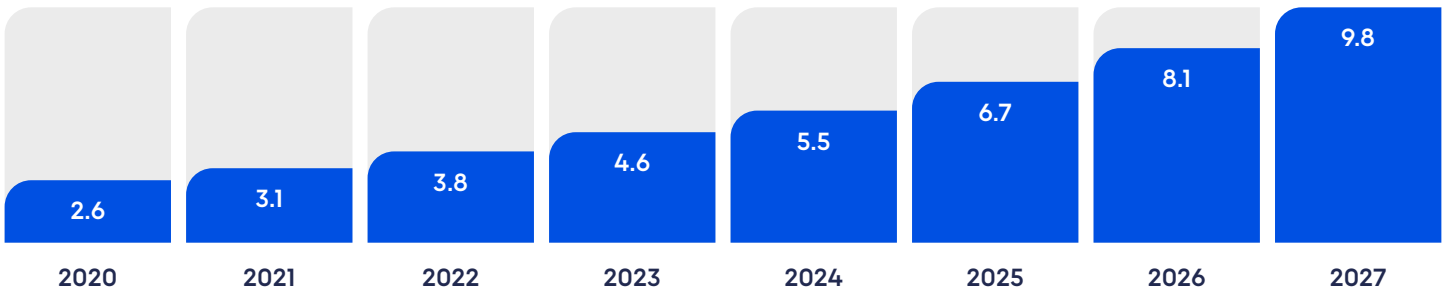


Figure 30 | Key colocation providers by # of DCs operated in the UAE

UAE Cloud market size (USD b, 2020-2027)



Notes: *Others include: Dubai Gold and Commodities Exchange, Comarch, Pacific Controls, eHosting DataFort, Emaar Properties, Moro, Gulf Data Hub.
Source: Cloudscene, Bluewave Consulting, Whiteshield.

Table 4 | Investment Monitor's 2020 Data center Ranking

Rank	Country	Score	Rank	Country	Score
1	Denmark	78.70	29	Kazakhstan	47.80
2	Sweden	78.25	30	Serbia	46.77
3	United States	75.96	31	Ukraine	45.72
4	Netherlands	75.60	32	Greece	45.44
5	Finland	75.39	33	Turkiye	44.65
6	Norway	73.70	34	Thailand	44.41
7	UK	70.03	35	South Africa	43.36
8	Canada	70.03	36	Jordan	43.20
9	Germany	69.91	37	Moldova	43.03
10	Estonia	66.15	38	India	42.67
11	Australia	66.10	39	Indonesia	42.54
12	Japan	63.36	40	Vietnam	42.00
13	Austria	63.36	41	Mexico	41.76
14	Belgium	62.31	42	Argentina	40.69
15	France	61.71	43	Colombia	39.91
16	Spain	60.09	44	Tunisia	39.55
17	Portugal	58.01	45	Brazil	39.29
18	Czechia	57.64	46	Philippines	38.83
19	Hungary	57.10	47	Morocco	38.67
20	UAE	56.81	48	BIH	37.53
21	Italy	56.78	49	Kenya	36.21
22	Malaysia	55.22	50	Sri Lanka	35.68
23	Poland	54.52	51	Ecuador	34.45
24	China	53.76	52	Peru	34.13
25	Bulgaria	52.74	53	Pakistan	27.98
26	Romania	51.19	54	Bangladesh	25.69
27	Chile	50.30	55	Nigeria	22.46
28	Croatia	49.84			

Source: Investment Monitor's 2020 Data Center Ranking.

Table 5 | Top 30 countries by data center market size, revenue in USD billion

	2017	2018	2019	2020	2021	2022	CAGR
United States	76.13	88.51	89.36	89.45	93.40	92.38	3.9%
China	51.78	58.68	57.81	58.80	63.28	62.11	3.7%
Japan	13.96	15.37	15.52	15.69	16.56	16.31	3.2%
Germany	12.08	13.96	13.30	13.45	14.95	14.70	4.0%
UK	10.93	12.61	12.15	12.04	13.56	13.49	4.3%
France	7.51	8.63	8.21	8.20	9.10	8.95	3.6%
India	7.06	7.22	7.30	7.09	7.41	7.17	0.3%
Canada	5.52	6.26	6.16	6.02	6.66	6.64	3.8%
South Korea	5.13	5.75	5.42	5.39	5.92	5.74	2.3%
Italy	4.79	5.39	5.10	5.07	5.61	5.48	2.7%
Brazil	6.15	5.95	5.60	4.31	4.35	4.36	-6.6%
Australia	3.91	4.33	4.09	4.08	4.74	4.63	3.4%
Netherlands	3.18	3.74	3.59	3.67	4.03	3.96	4.5%
Spain	3.29	3.69	3.53	3.48	3.90	3.81	3.0%
Russia	5.70	5.77	5.68	5.06	5.46	4.02	-6.7%
Switzerland	2.21	2.54	2.49	2.61	2.84	2.84	5.1%
Mexico	3.25	3.52	3.55	3.14	3.39	3.27	0.1%
Indonesia	2.50	2.62	2.69	2.60	2.78	2.72	1.7%
Sweden	1.85	2.08	1.93	1.99	2.27	2.24	3.9%
Poland	1.79	2.04	1.97	1.96	2.07	2.04	2.6%
Thailand	1.62	1.85	1.94	1.88	2.02	1.97	4.0%
Denmark	1.41	1.63	1.56	1.59	1.75	1.70	3.8%
Belgium	1.48	1.70	1.63	1.63	1.80	1.77	3.6%
Vietnam	1.48	1.61	1.64	1.67	1.70	1.65	2.2%
Nigeria	1.00	1.20	1.20	1.15	1.25	1.29	5.2%
Israel	1.23	1.36	1.40	1.45	1.58	1.54	4.6%
Turkiye	2.60	2.16	1.91	1.62	1.63	1.53	-10.1%
Austria	1.18	1.35	1.29	1.29	1.43	1.40	3.5%
Colombia	1.49	1.64	1.51	1.32	1.39	1.35	-2.0%
Saudia Arabia	1.23	1.37	1.37	1.31	1.41	1.35	1.9%
UAE*	**0.75**	**0.85**	**0.83**	**0.78**	**0.84**	**0.8**	**1.07%**

Note: *UAE is not part of the global top 30. It is represented in this table for reference.
Source: Statista, Whiteshield.

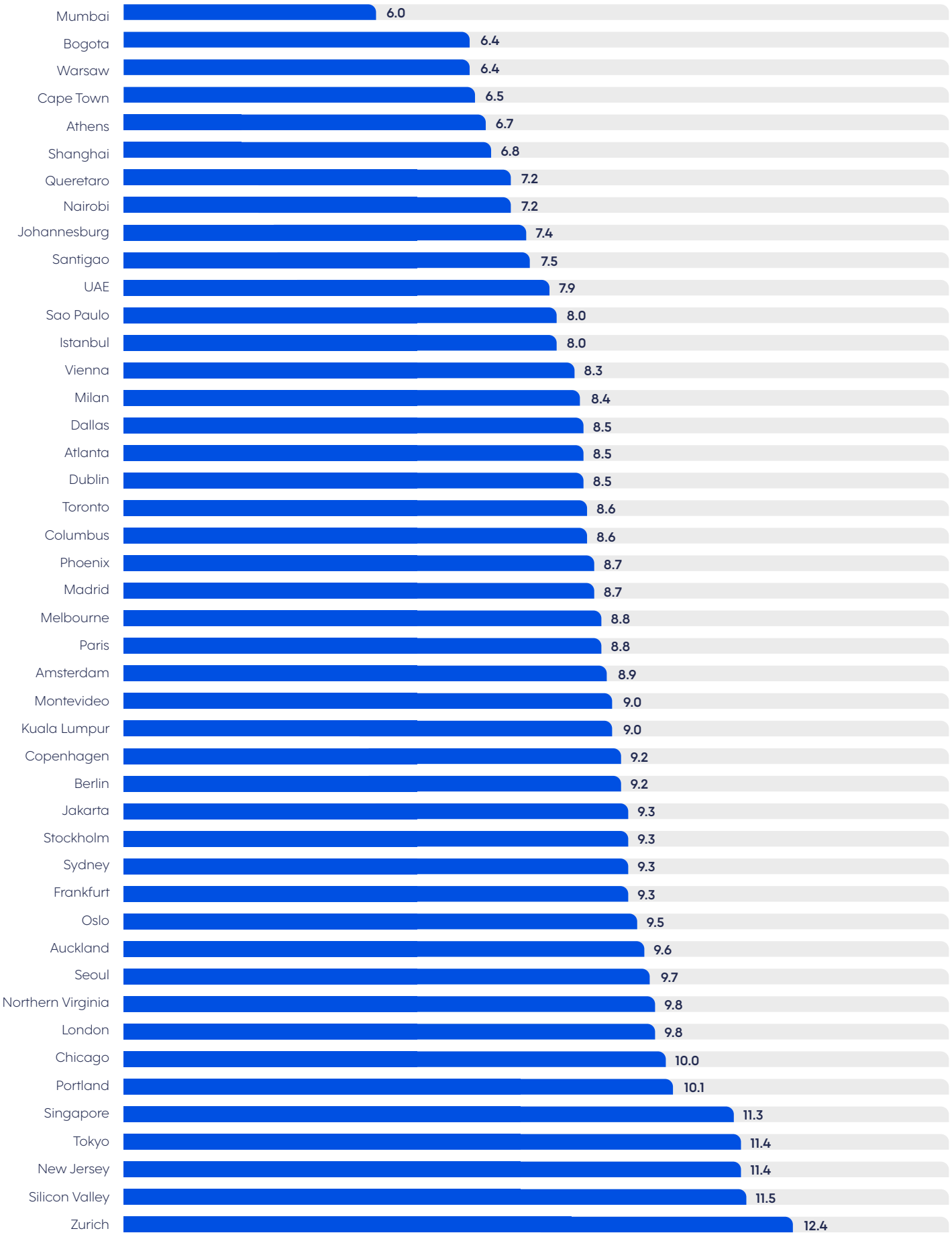
AI innovation is expected to displace some of the occupations in the future

Table 6 | AI impact on jobs displacement measured at a scale of 0-100, UAE case

ISO Code	Occupations	AI job cannibalisation	Share of jobs*
9112	Cleaners and Helpers in Offices, Hotels and Other Establishments	30.6	0.4%
1113	Traditional Chiefs and Heads of Villages	29.3	0.0%
7133	Building Structure Cleaners	28.1	0.0%
8157	Laundry Machine Operators	23.1	0.1%
7213	Sheet Metal Workers	22.9	0.0%
2522	Systems Administrators	22.3	1.1%
3339	Business Services Agents Not Elsewhere Classified	22.0	0.5%
7115	Carpenters and Joiners	22.0	0.2%
2656	Announcers on Radio, Television and Other Media	22.0	0.0%
7318	Handicraft Workers in Textile, Leather and Related Materials	22.0	0.0%
1111	Legislators	21.9	0.1%
9121	Hand Launderers and Pressers	21.9	0.0%
9129	Other Cleaning Workers	21.7	0.0%
9123	Window Cleaners	21.7	0.0%
9122	Vehicle Cleaners	21.7	0.0%
7531	Tailors, Dressmakers, Furriers and Hatters	21.5	0.0%
7211	Metal Moulders and Coremakers	21.1	0.0%
1341	Childcare Service Managers	20.8	0.0%
7536	Shoemakers and Related Workers	20.6	0.0%
5151	Cleaning and Housekeeping Supervisors in Offices, Hotels and Other Establishments	20.3	0.5%
9311	Mining and Quarrying Laborers	20.0	0.0%
1311	Agricultural and Forestry Production Managers	20.0	0.0%
4211	Bank Tellers and Related Clerks	20.0	0.0%
1420	Retail and Wholesale Trade Managers	19.9	0.6%
1221	Sales and Marketing Managers	19.8	6.8%
9613	Sweepers and Related Laborers	19.7	0.0%
7516	Tobacco Preparers and Tobacco Products Makers	19.5	0.0%
5152	Domestic Housekeepers	19.3	0.1%
1219	Business Services and Administration Managers Not Elsewhere Classified	19.0	1.3%
3214	Medical and Dental Prosthetic Technicians	19.0	0.0%

Note: *Share of jobs out of 781,716 job posts reviewed via Labor Navigator.
Source: Whiteshield Labor Navigator insights.

Figure 31 | Data center markets worldwide ranked by cost of construction in 2022 (in U.S. dollars per watt)



Note: Cost data was captured from more than 200 live or recent projects in more than 20 countries. Cost data was captured under the following key capital cost headings: shell & core, architectural fit-out and finishes, mechanical and electrical fit-out, general contractor preliminaries, general contractor margin, general contractor contingency, mechanical and electrical equipment.
Source: Turner & Townsend, Whiteshield.

Whiteshield
Public Policy & Strategy Advisory

Head-Office & Europe Office: 106a St. Georges Square, London, SW1V 3QY, United Kingdom
Phone/Fax: (+44) 7471018144

For inquiries, please contact:
Johan.Nilerud@khazna.ae
Philippe.Nahas@whiteshield.com

Disclaimer
The analysis and drafting of this report was conducted by Whiteshield based on a methodology integrating statistics from international organizations and interviews with industry experts.

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