

Market trends report

Supercomputing Market Trends

MARKET INTELLIGENCE REPORT

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KEY TAKE AWAYS

- The aim of this report is to provide an overview of **current and forecasted supercomputing market trends** to better understand the technological and service evolutions to come, who the current technology provision key players on the market are and how Europe, and more specifically Luxembourg, are positioning themselves compared to other international contenders.
- The supercomputing market reached a total revenue of \$34,8 bn in 2021. It was dominated by **United States and China based** technologies, solutions and services providers. **Government, research, computer-aided engineering, defence and biosciences** applications generated most revenue that year. Key players noticeably include companies such as **Lenovo, HPE, Dell Technologies** and **NVIDIA**.
- **Europe currently owns 24.2% of supercomputer system shares** (active machines) available globally. Europe's shares are spread across 16 countries among which can be cited Germany, France, the United Kingdom and the Netherlands. Luxembourg owns 0.4% of the world's supercomputer system shares and ranks 25th out of 34 referenced countries ([Source](#)).
- Although Europe plans for the acquisition of two Exascale supercomputing systems by 2023 and of a hybrid combination of high performance computing (HPC) and quantum computing infrastructure by 2027, it **lacks European solutions providers** able to compete with United States providers such as Google and Amazon Web Services.
- Analyses of supercomputing market forecasts tend to highlight four major trends shaping the future:
 - a slow shift in supercomputing deployment schemes towards a **hybrid deployment model**;
 - the development of **high performance computing as a service** (HPCaaS¹);
 - an **increasing use of artificial intelligence (AI) powered applications** in combination with supercomputing; and
 - a **ramping up of supercomputing in the healthcare sector**, which is predicted to generate the most revenue as an application sector in the coming years.
- The major benefits of supercomputing for small and medium-sized enterprises (SMEs) are time and cost savings. However, security concerns, a lack of awareness and the scarcity of highly skilled personnel current hamper the adoption of supercomputing among SMEs.

¹ All HPC resources (e.g., compute instances, storage, applications software) provisioned to users on a dynamic, pay-as-you-go basis, regardless of where the resources are hosted.

INTRODUCTION

Aims and objective

This document was commissioned by [Supercomputing Luxembourg](#), Luxembourg's High Performance Computing National Competence Centre, in the context of the EuroCC project. The [EuroCC project](#), supported by European Union's Horizon 2020 programme, aims at establishing a single National Competence Centre in the area of high performance computing (HPC) in each of the 33 countries¹ taking part in this undertaking. The project covers all EU member states and aims at displaying a comprehensive and transparent map of supercomputing competences and institutions.

MeluXina, the Luxembourg supercomputer, is known for its low environmental impact and currently considered the 57th most powerful supercomputer worldwide according to the Top500 List ([source](#)). LuxProvide S.A., the company managing MeluXina, is currently working on a range of services to bring supercomputing calculation power to small and medium-sized enterprises (SMEs) among others. The aim of this report is to give an overview of the current and forecasted supercomputing market trends to better understand the technological and services evolutions to come, who the current technology provision key players are and how Europe, and more specifically Luxembourg, are positioning themselves compared to other international contenders.

¹ Countries outside of the EU are also included.



Defining supercomputing

Supercomputing, commonly known as **high performance computing (HPC)**, is defined as “*the ability to carry out large scale computations to solve complex problems that either need to process a lot of data, or to have a lot of computing power at their disposal*” (Quantonation; 2020). As shown in figure 1, a supercomputing infrastructure is composed of thousands of processors working in parallel, in clusters of servers, forming nodes to analyse billions of data and perform calculations thousands of times faster than an ordinary computer.

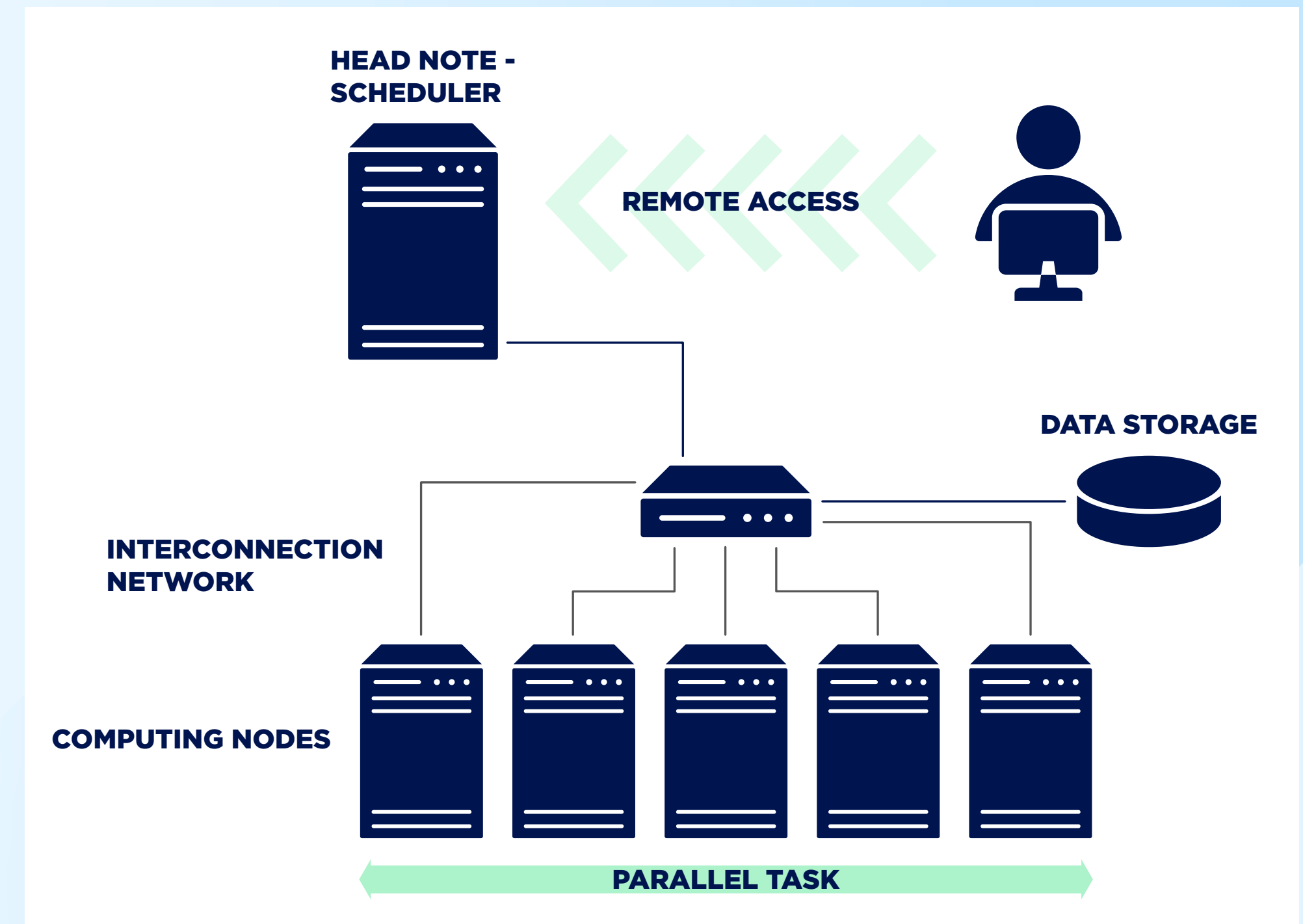


Figure 1 - Supercomputing Basic deployment Scheme (Riga Tech University)

Supercomputing provides enhanced calculation, networking and storage capacities. Supercomputer calculation power is currently available via two types of deployments: either locally via on-premises nodes of servers or via cloud infrastructure.

This technology makes it possible to address major challenges within our societies concerning citizens, researchers, scientists and businesses in various industries.

Market trends analysis

This market trends report focuses on the market situation as it was in 2021 and the supercomputing market forecasts for the next 5 to 10 years. It analyses the growth of market segments by components, by form of deployment, by application dynamics and by geographical location.



Figure 2 - Supercomputing major benefits - Source: [EuroHPC: the Joint Undertaking Factsheet](#) July 2019

MARKET OVERVIEW

This section gives a general overview of the key figures and players of the global supercomputing market. This analysis is based on open data gathered over the last two years from various sources.

2021 key figures

According to a survey compiled by the [Hyperion Research Centre](#) in 2022, the **global supercomputing market** reached a total revenue of \$34,8 bn in 2021 and was expected to reach \$36 bn in 2022.

The supercomputing market is segmented in two major segments: solutions and services. The first one, solutions, is subsegmented into servers¹, storage, cloud networking and applications (software). The second one, services, includes repair services and middleware.

As shown in figure 3, the servers and storage segments were the largest ones in the market in 2021 in terms of revenue generation due to the increasing number of data centres and of midsize enterprises and organisations offering colocation infrastructure to meet the demand for public cloud services (Source: [Emergen Research](#)).

In terms of **deployment**, the on-premises segment represented 85.7% of the market with revenues reaching \$29.7 bn in 2021. This dominance is mainly due to the reluctance of government-led entities as well as of corporations to host sensitive data externally. Cloud deployment generated 14.7% of revenues, which corresponds to \$5.1 bn (Source: [Emergen Research](#)).

¹ A server is a physical and virtual centralised database used to store and share information across multiple computers connected across a network.

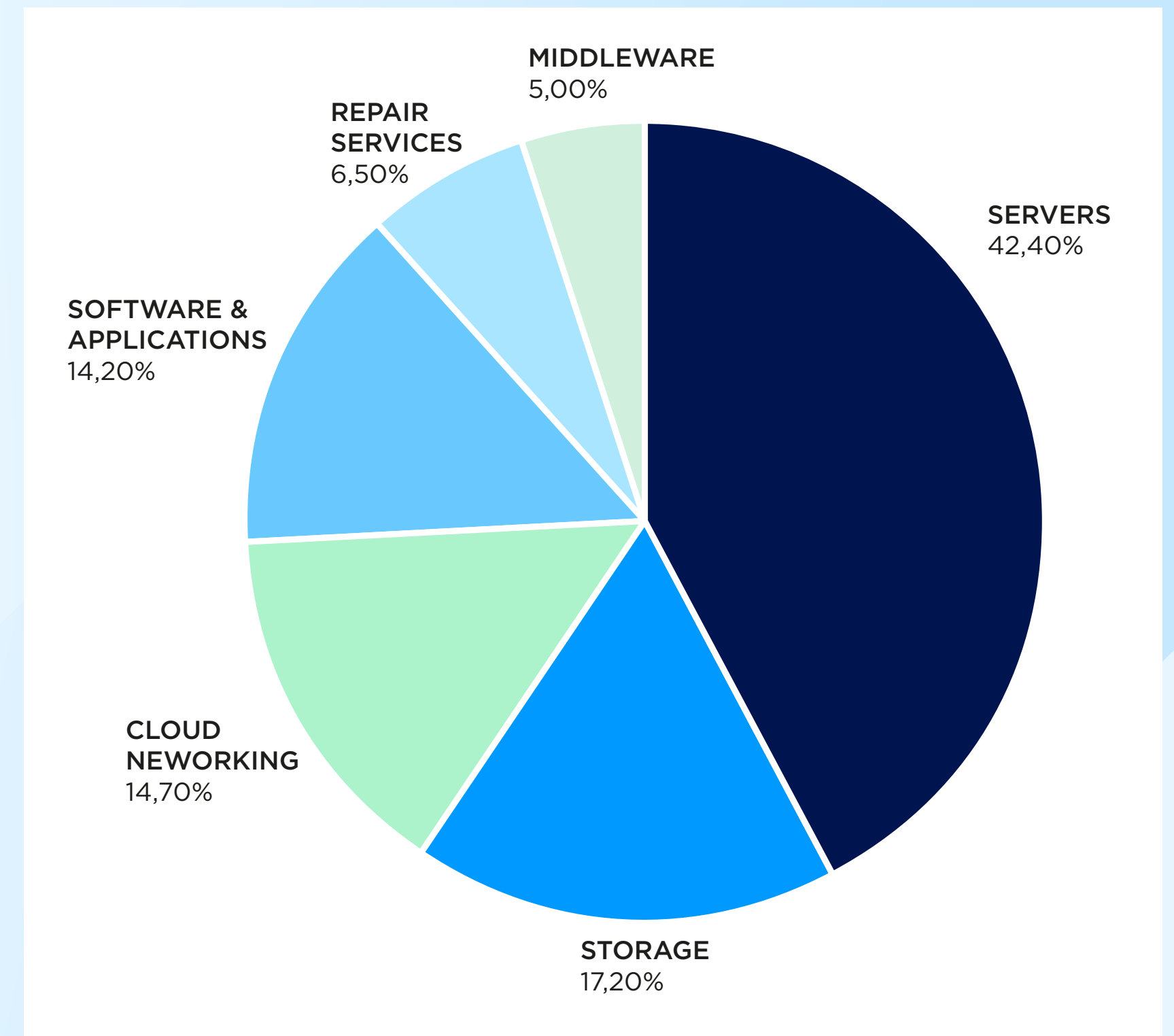


Figure 3 - 2021 Overall Supercomputing Market – Source: [Hyperion Research 2022](#)

United States and Asia market domination

When looking at who holds the more supercomputing power, or system shares, the **Top500 classification** – a cooperative university project between German and US-based researchers which ranks the top 500 supercomputers worldwide – states that supercomputing technology is spread across 34 countries from Northern America to Asia, including Europe and Middle East.

As shown in figure 4, 57.8% of system shares worldwide is owned by **China** and the **United States**, closely followed by **Germany** and **Japan**.

This ranking of supercomputing technology holders is corroborated by a 2021 report from the Insitut Français des Relations Internationales (IFRI) that concludes that China and the United States own more than 50% of supercomputing system shares worldwide ([PANNIER, Alice, 2021](#)).

This Asian/US proficiency in supercomputing technology is further highlighted when looking at the top supercomputing vendors globally.

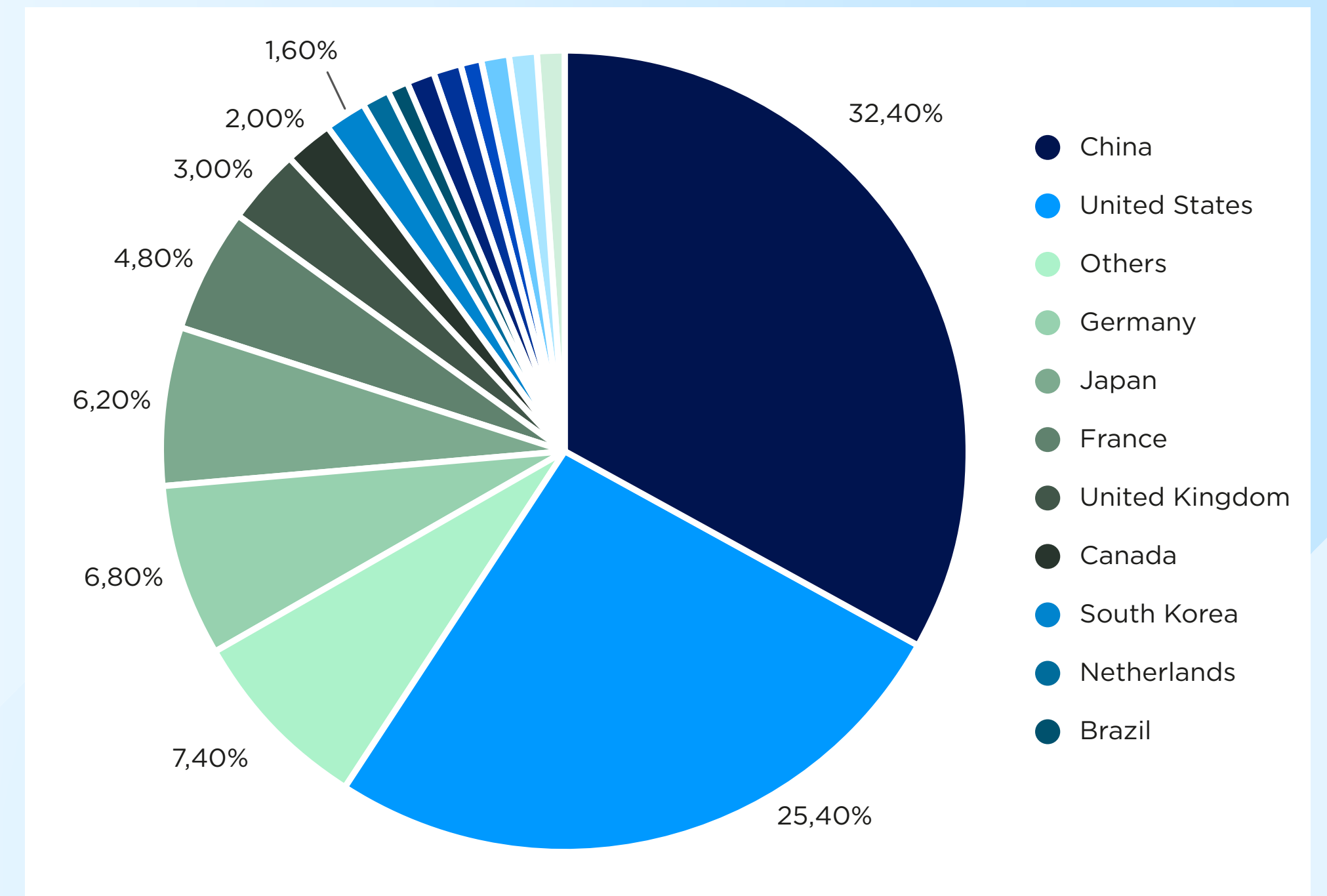


Figure 4 - Distribution of supercomputers in the Top500 list by Country - November 2022

According to Hyperion Research, as shown in figure 5, four US-based companies - HPE, Dell Technologies, IBM and Penguin - owned 61.5% of on-premises supercomputing market shares calculated by revenue in 2022. Three Chinese companies, Lenovo, Inspur and Sugon, owned 18.3% of shares.

In addition, a 2021 study released by [Emergen Research](#) states that 90% of the top 10 supercomputing solution providers¹ by revenue are United States-based. Providers such as IBM, Amazon Web Services Inc, DataDirect Networks, Rescale, Advanced HPC and Penguin Computing can be cited as examples.

Although Chinese companies have less market shares in terms of on-premises supercomputing revenue, the Top500 list June 2023 data states that Lenovo (CN) owns 34% of the total vendors system shares (active supercomputers) globally while HPE (US) owns 20% of system shares ([Source](#)).

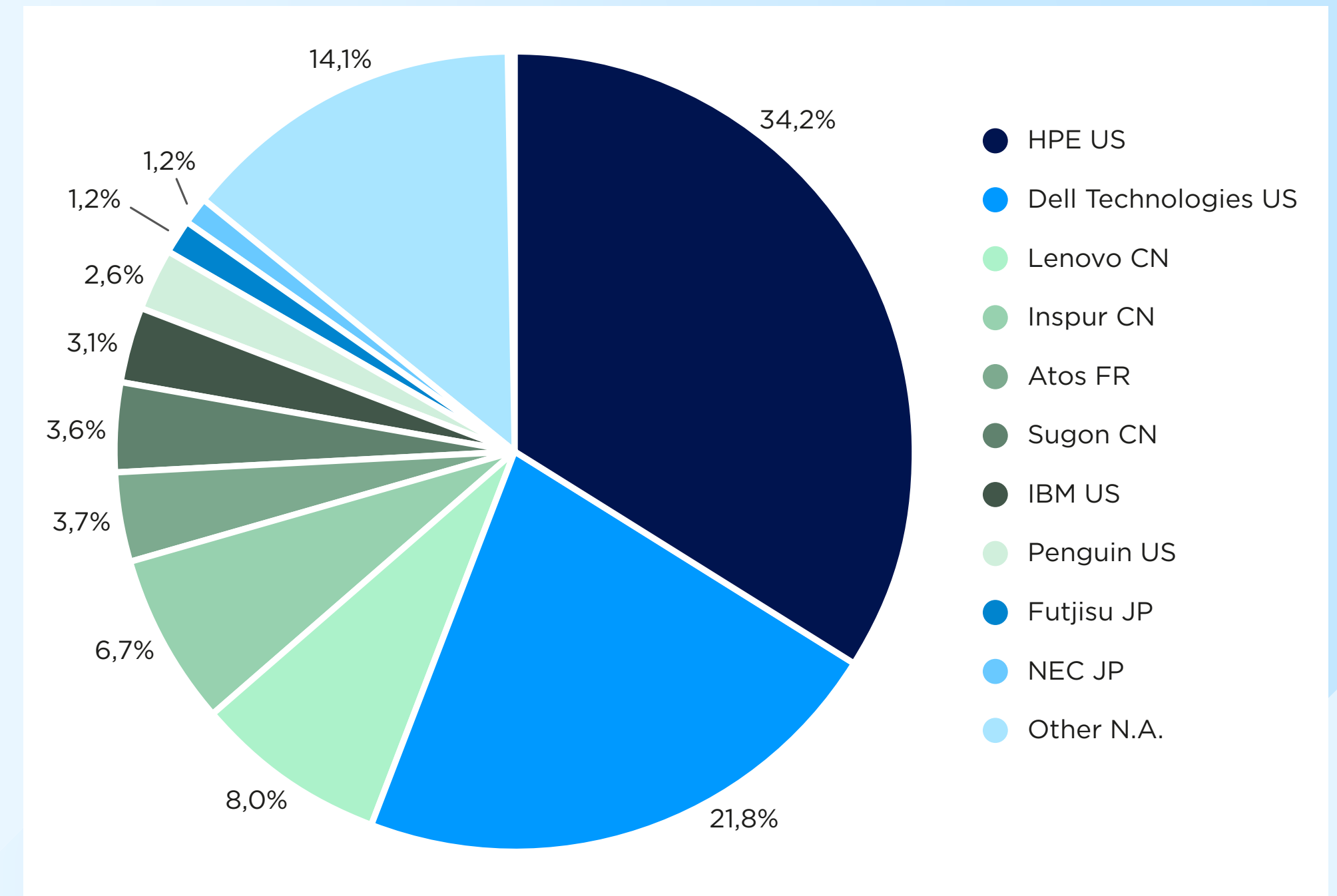


Figure 5 - Top Supercomputing Vendors by Revenue - Hyperion Research November 2022

¹ Companies providing ready to use digital HPC powered solutions and applications.

Europe's growing ambitions

Although Europe has less supercomputing power, technology and solutions providers and consequently less market shares (only 8.6% for French tech provider Atos) than its Northern American and Asian counterparts, the region has nonetheless growing ambitions regarding supercomputing potential and capabilities.

In 2019, the European Commission launched EuroHPC JU, the Joint Undertaking on High Performance Computing, with the objective of promoting green and sustainable technologies as part of the EU's goals of carbon neutrality laid out in the European Green Deal and, more specifically, of acquiring and deploying of a world-class pan-European supercomputing infrastructure in the EU. Future plans call for the integration and deployment of the first hybrid HPC/quantum infrastructure in Europe by 2027 ([Source](#)).

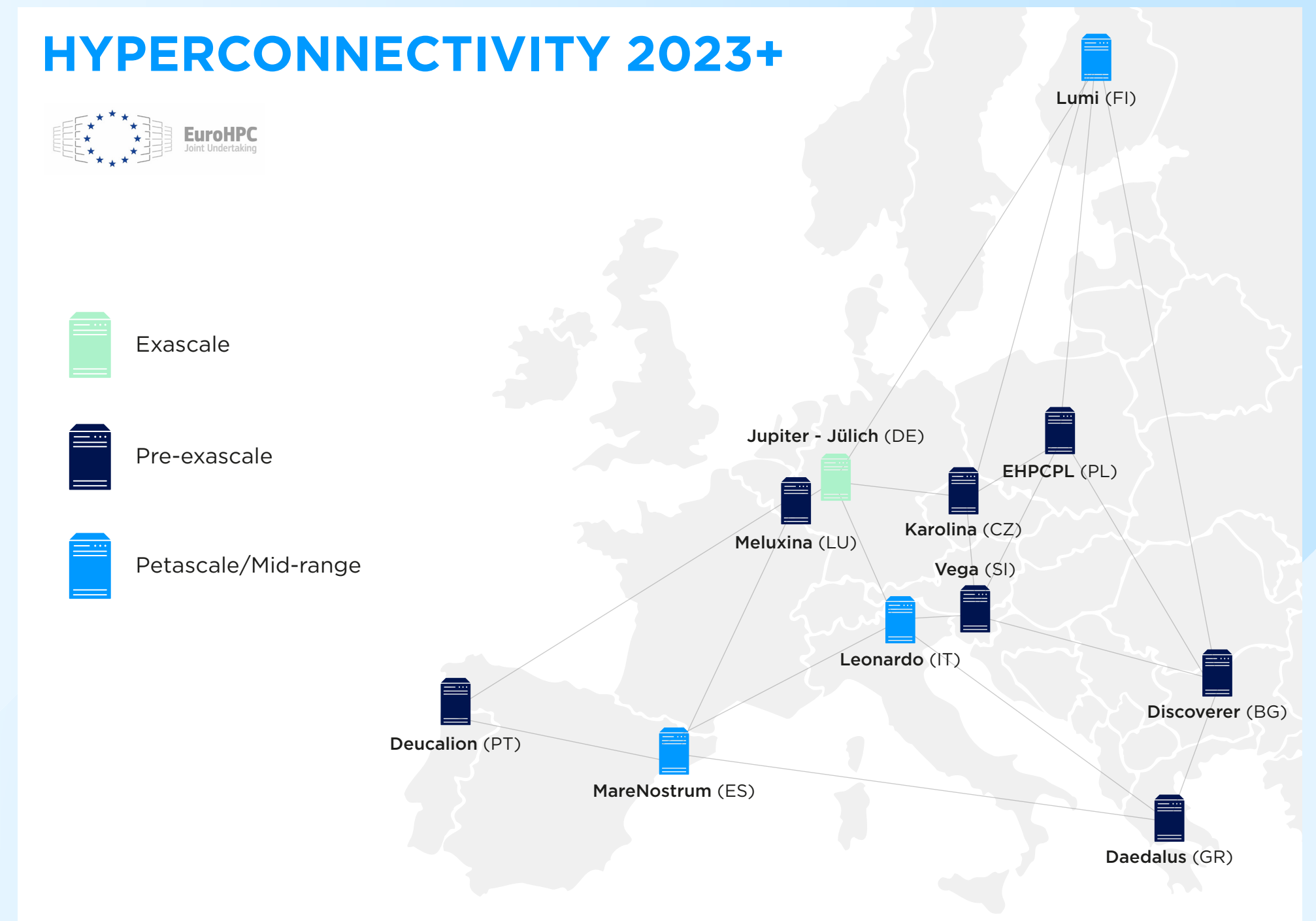


Figure 6 - Europe Supercomputing Network by 2023 ([Opportunities on EuroHPC JU systems for SMEs](#))

Europe currently owns a total of 24,2% of supercomputer system shares globally, spread across 16 countries known as “second tiers powers”, among which can be cited Germany, France, the United Kingdom and the Netherlands ([Source](#)).

Luxembourg ranks 25th among the 34 referenced countries, owning 0.4% of supercomputer system shares worldwide ([Source](#)). The country’s supercomputer MeluXina ranks 57th in terms of pure core computer power out of 500 ranked machines ([Source](#)).

In terms of supercomputing technologies and solutions providers, French company ATOS is the only European company cited globally by Hyperion Research studies and the Top500 List. It owns 8.6% of market vendors system shares globally and 9.2% of vendors global performance shares ([Source](#)).

Although the European Union plans to acquire and deploy two Exascale supercomputers on its territory by 2024 as well as to integrate and deploy the first hybrid HPC/quantum infrastructure in Europe by 2027, Mariya Gabriel, European Commissioner for Digital Economy and Society, identified **a funding gap in European supercomputing capacities of €500-€750 million per year** compared to the US, China or Japan. Despite already hosting supercomputing infrastructures locally (e.g. in Luxembourg, Germany, France, the United Kingdom, Italy and the Netherlands), Europe seems to lack cloud-based supercomputing solutions and providers able to compete with AWS and Google ([PANNIER, Alice, 2021](#)).

2021 top supercomputing application sectors

13 supercomputer-related application sectors were identified by Hyperion Research as generating revenue. As shown in figure 7, the top 5 supercomputing application sectors by revenue in 2021 included government labs (\$2,866 bn), university / academics (\$2,637 bn), computer aided engineering (\$1,767 bn), defence (\$1,552 bn) and bio sciences (\$1,455 bn).

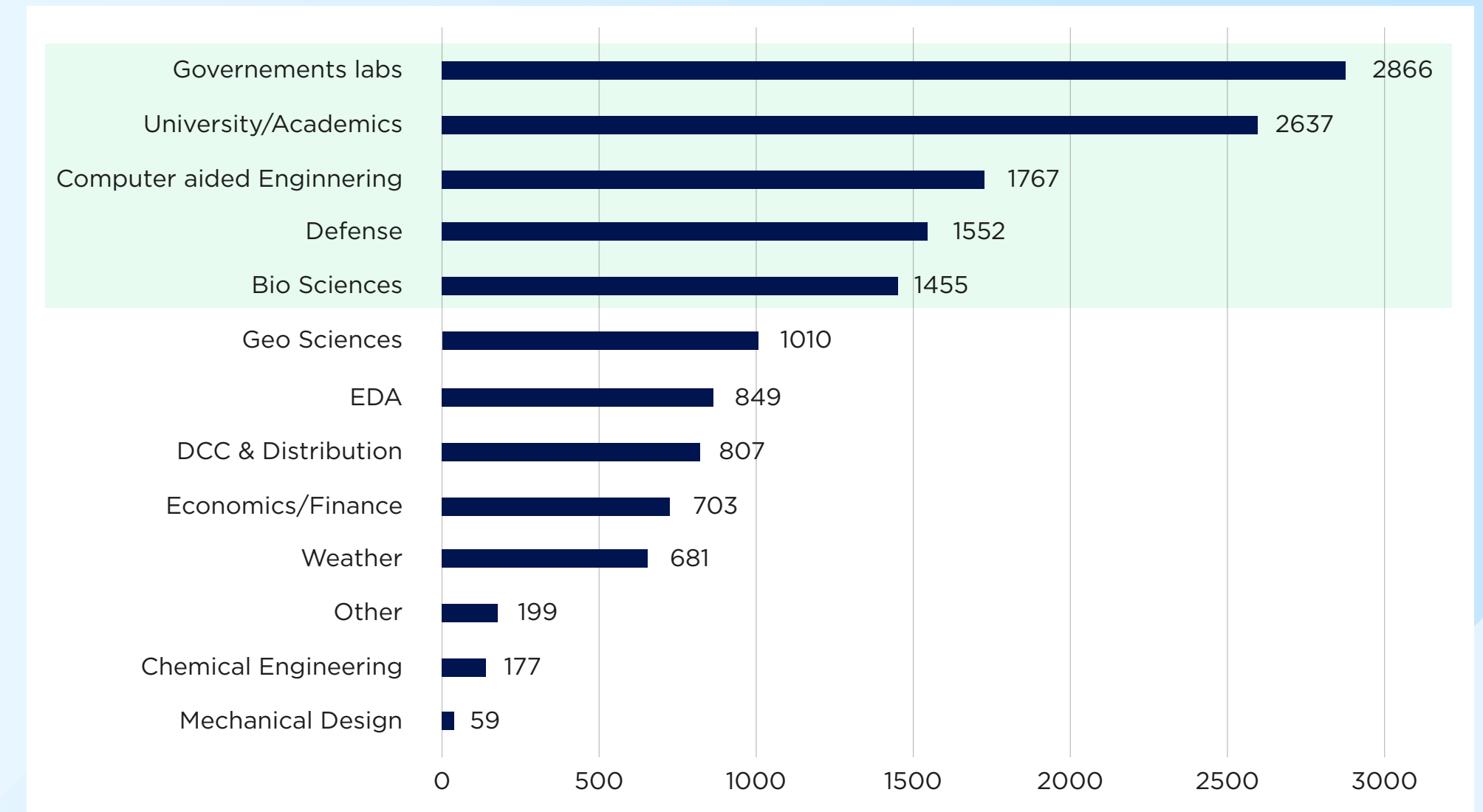


Figure 7 - 2021 Supercomputing systems revenue by Application (Million USD)
Source: Hyperion Research November 2022

MARKET FORECASTS

According to the latest figures available, the supercomputing market should reach \$50.3 bn in revenue globally by 2028. Note that forecasted market revenue may differ from one study to another depending on factors studied. However, the HPC market should continue to grow at an expected compound annual growth rate (CAGR) of 6.3% until 2028 ([Global Newswire / Vantage Market Research - 2022](#)).

Analyses of supercomputing market forecasts tend to highlight four major trends shaping the future including a slow shift in supercomputing deployment scheme towards a hybrid deployment model, the development of supercomputing as a service, an increasing use of AI-powered applications in combination with supercomputing and a ramping up of supercomputing use in the healthcare sector, which is predicted to generate the most revenue as application sector in the coming years.

Trend 1: A growing supercomputing market relying on a hybrid deployment model

As shown in figure 8, the on-premises supercomputing server market is expected to **grow with 7-8% per year**, while supercomputing in the cloud is expected to grow by **17,6% in the next 5 years**. Cloud deployment will exceed \$11 bn in revenue in 2026 according to [Hyperion Research](#).

A 2022 Gartner study (Source: [Rethink Supercomputing for a Digital Era, Gartner, June 2022](#)) states that although the current supercomputing operating models are relatively static in their deployment scheme, on-premises deployment will continue to generate most revenues in the global market. However, this market is slowly shifting towards a “hybrid deployment model” combining both on-premises infrastructures and cloud-based supercomputing applications in order to reduce operational expenses and increase the agility and flexibility provided by cloud infrastructures ([Source](#)). Note that on-premises deployment continues to generate the highest revenue contribution due to the fact that government-led institutions and major corporations are concerned about retaining sensitive data in-house due to security concerns and operational processes ([Source](#)).

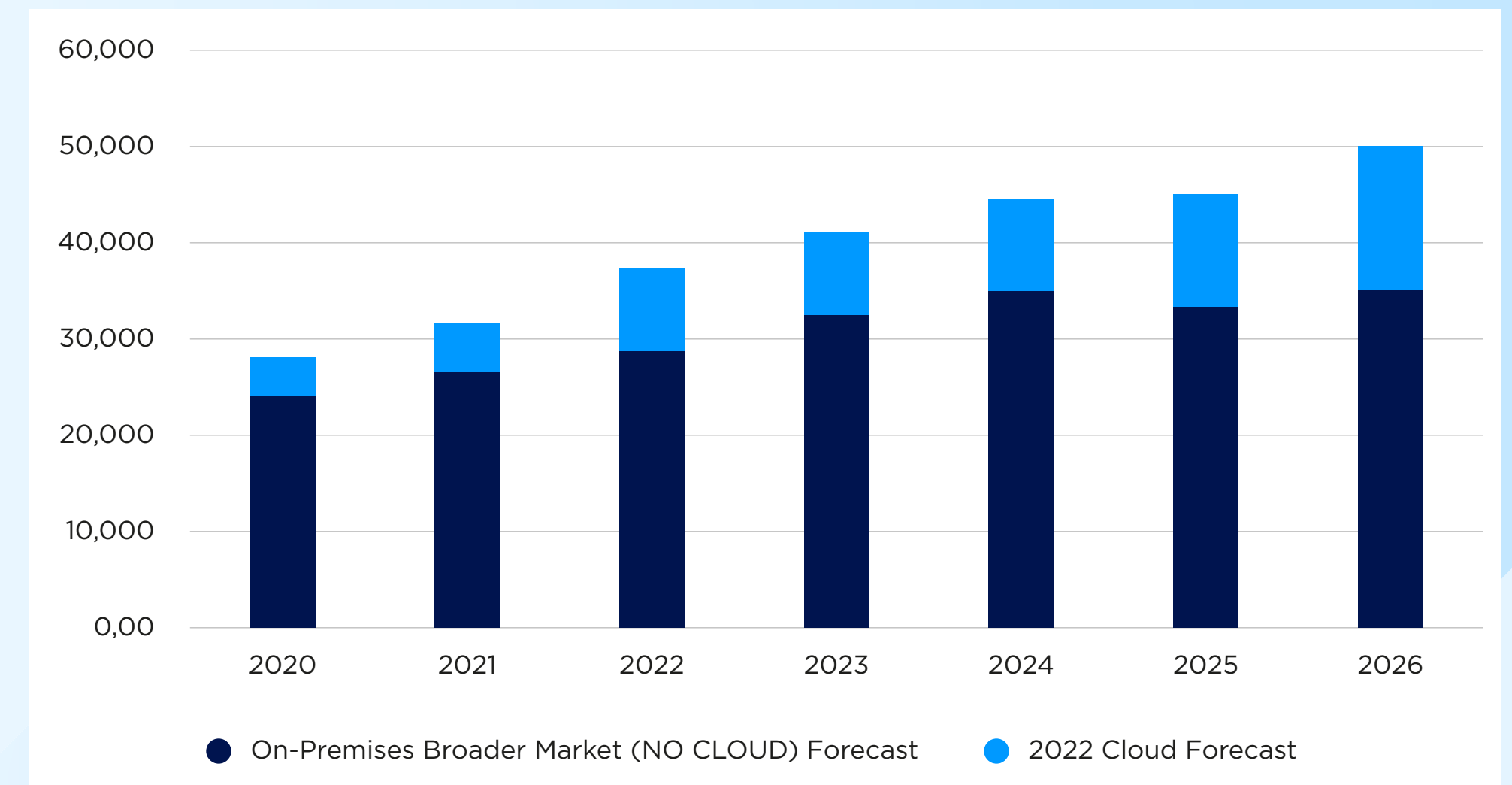


Figure 8 - Supercomputing Market Analysis by Deployment Segment
Source: [Hyperion Research 2022](#)

Trend 2: Development of supercomputing as a service

When taking a closer look at supercomputing market dynamics in terms of technology deployment and services development, the following conclusions can be drawn:

Cloud service providers¹ (CSPs) have begun to offer **turn-key supercomputing solutions** geared to the specific requirements of companies, developing the market segment identified as **“HPC as a Service” (HPCaaS)**². This trend is driven by an increasing demand from customers needing to address **data-intensive workloads** generated in our increasingly data-driven society. According to Gartner, *“pioneering enterprises are devising digital-native supercomputing strategies and leveraging supercomputing to catalyse digital transformation and new value creation”* ([Gartner, June 2022](#)). However, migrating workloads to cloud platforms requires a **new set of skills** for centre managers and researchers.

According to [Databridge Market Research](#), the HPCaaS market segment is expected to reach \$20.62 bn by 2029.

¹ E.g. HPE, IBM, Pinguin, Oracle, Azure, Amazon Web Services

² All HPC resources (e.g. compute instances, storage, applications software) provided to users on a dynamic, pay-as-you-go basis, regardless of where the resources are hosted.

Trend 3: An increasing use of artificial intelligence powered and accelerated applications

According to the [Hyperion Research 2022](#) market study, the development of supercomputing as a service has initiated an increased use of **accelerated and artificial intelligence (AI) powered applications** in combination with **edge computing** technologies¹.

The increasing use of AI is driven by the diversity of workloads, applications development and system designs which have shifted to incorporate AI-favourable features. The incorporation of **AI models and platforms** within traditional workloads allows for better **data preparation, cleansing and simulations** ([Gartner, June 2022](#)).

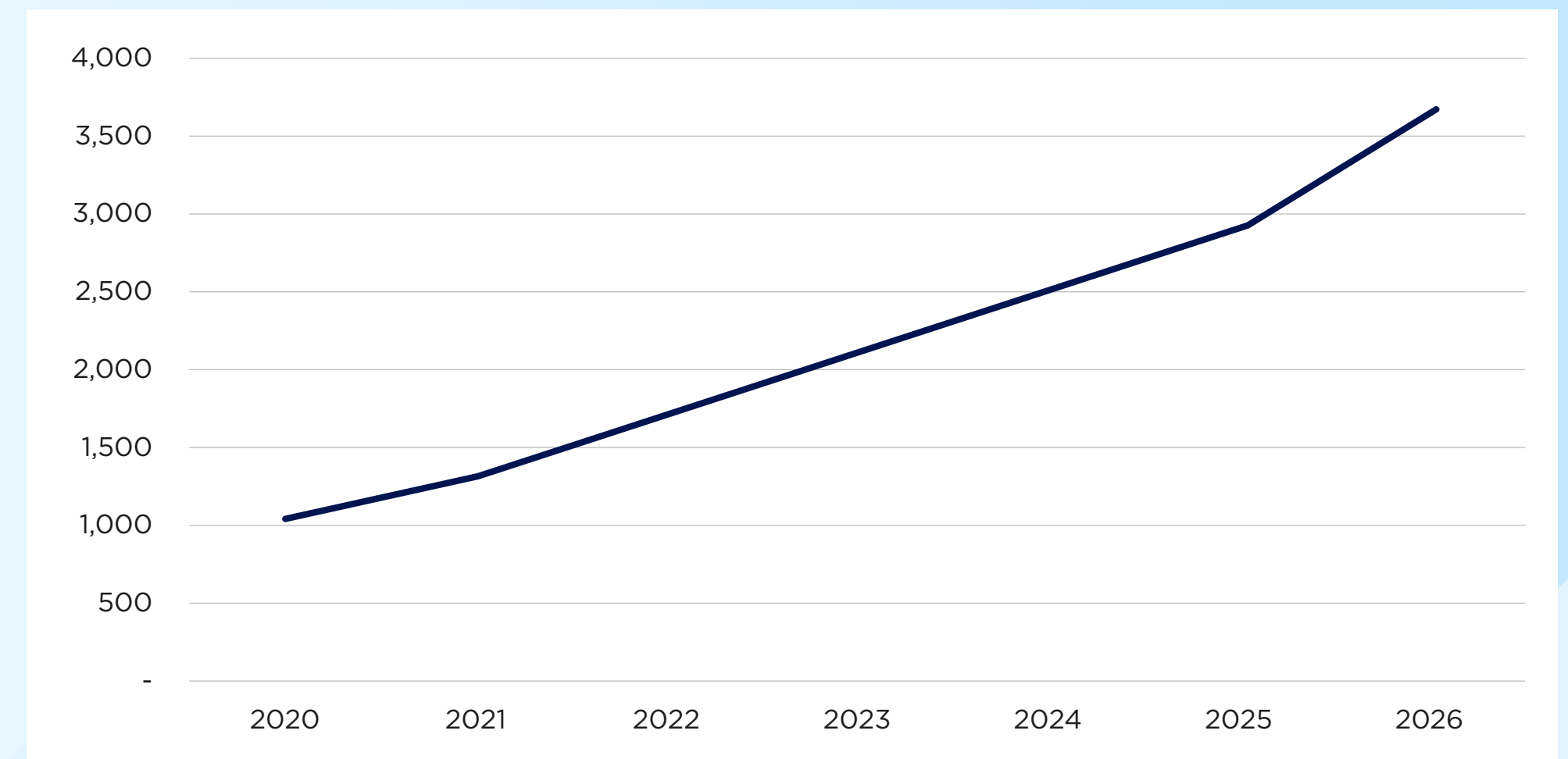


Figure 9 - AI HPC enabled servers' revenue forecasts. Source: [Hyperion Research 2022](#)

¹ Edge computing is a distributed information technology (IT) architecture in which client data is processed at the periphery of the network, as close to the originating source as possible.

Trend 4: Healthcare top application sector by 2030

According to [Emergen Search](#), and as shown in figure 10, **healthcare**, **government & defense** and **manufacturing** are expected to be the top 3 application sectors by revenue by 2030.

Healthcare-related applications are expected to generate most revenues due to the increasing use of supercomputers for **data management** and **simulation**. Concerned subsectors noticeably include **life sciences** and **genomics research**.

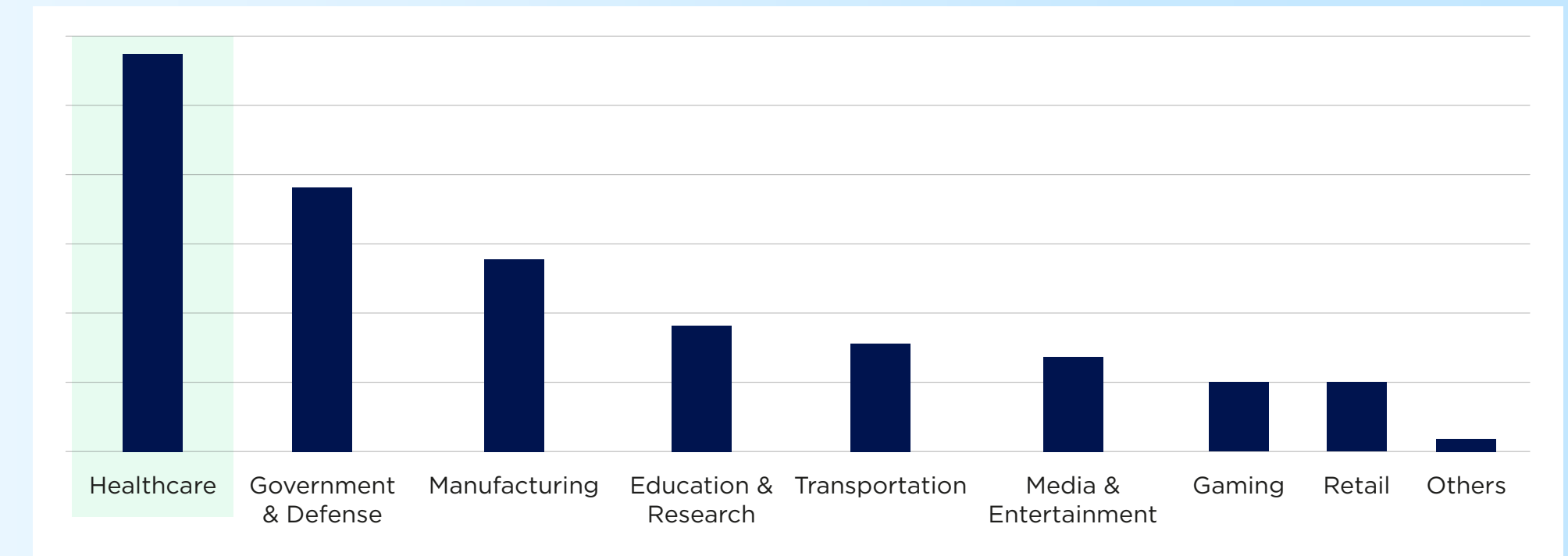


Figure 10 - Supercomputing market Application Dynamics by 2030 - Source: [Emergen Search.com](#)

CONCLUSION

The demand for supercomputing (HPC) systems is increasing rapidly due to their speed, reliability and accuracy for **extensive data processing**. This demand is being driven by several factors including the explosion of data workloads to be exploited by companies, the necessity for quick and efficient analytics capabilities and the combined implementation of several other key technologies such as **artificial intelligence, data analytics** and **edge computing** in sectors such as healthcare (e.g. genomics) ([Global Newswire / Vantage Market Research - 2022](#)).

However, some hurdles to the supercomputing expansion remain to be addressed. Supercomputing systems and applications do not work on live data feeds as they need to be pre-loaded with data to run operations and calculations before results can be exploited. The heterogeneity and complexity of supercomputing systems have pushed end-users to raise concerns about data security and extensive vulnerabilities of such systems from a cyber-security perspective. The migration of supercomputing workloads to the cloud also requires a new set of expertise, specifically for **cloud services providers**, an issue of growing concern due to the **scarcity of highly skilled personnel** and the difficulty of replacing an aging workforce. SMEs are also slow to adopt supercomputing applications due to their lack of awareness about benefits such as time and cost savings (Source: [Challenging Barriers to High Performance Computing in the Cloud](#)).

In response to those challenges, the European Commission, via the European High Performance Computing Joint Undertaking (EuroHPC JU), has launched several joint initiatives at the regional level to facilitate supercomputing adoption and strengthen European capabilities on the matter. Luxembourg's supercomputer MeluXina based on BullSequana XH2000 technology developed by French company Atos ([Source](#)). LuxProvide S.A., the company running MeluXina, is currently working on a range of services to bring supercomputing calculation power to small and medium-sized enterprises.

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