AQUILA GROUP

Aquila Group Insights 2025

ARTIFICIAL INTELLIGENCE AND INFRASTRUCTURE

Part 2: Watt up! Renewable energy driving the AI revolution

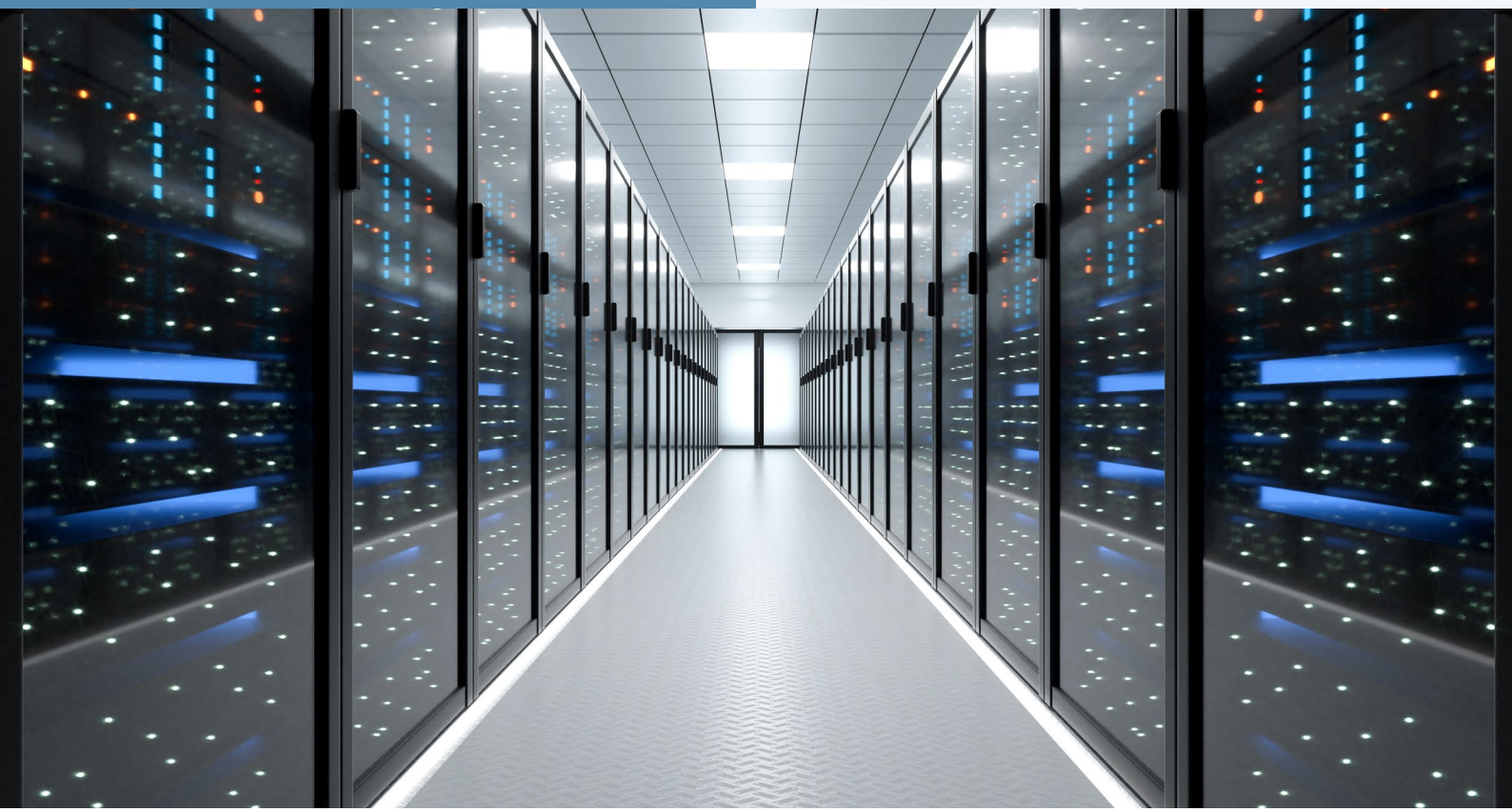
CONTENTS

1. INTRODUCTION

The first part of our series examined the key role of data centres as the backbone of digital transformation. We demonstrated how the increasing volume of data and the rapid rise in Artificial Intelligence (AI) usage drive the demand for high-performance digital infrastructure and create investment opportunities in this sector.

However, one of the most pressing challenges has so far remained in the background: massive energy consumption. AI applications and data centres consume enormous amounts of electricity – both for processing vast amounts of data and for operating and cooling the hardware. As a result, energy supply becomes a key factor in the scalability and economic viability of the digital revolution.

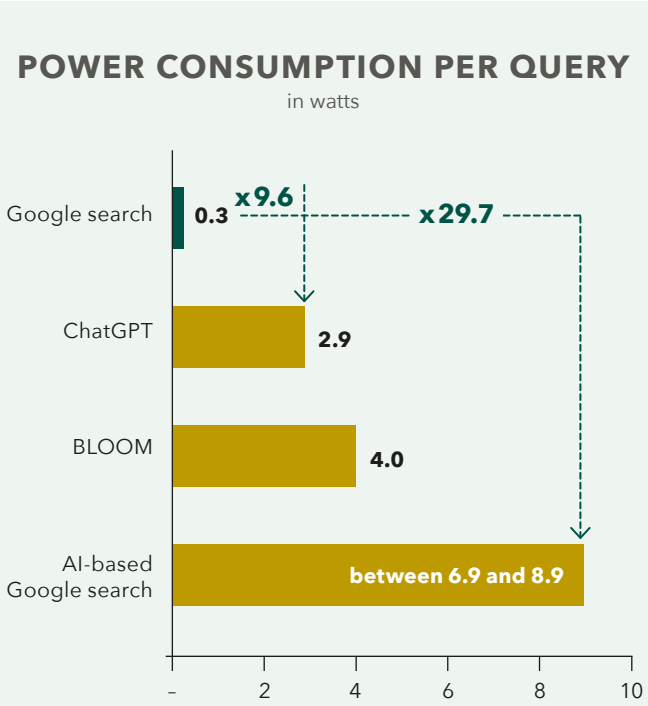
In this second paper in our series, we address precisely this topic: How does AI impact global energy demand? What role do renewable energies play? And what approaches exist to meet rising power consumption efficiently and sustainably?

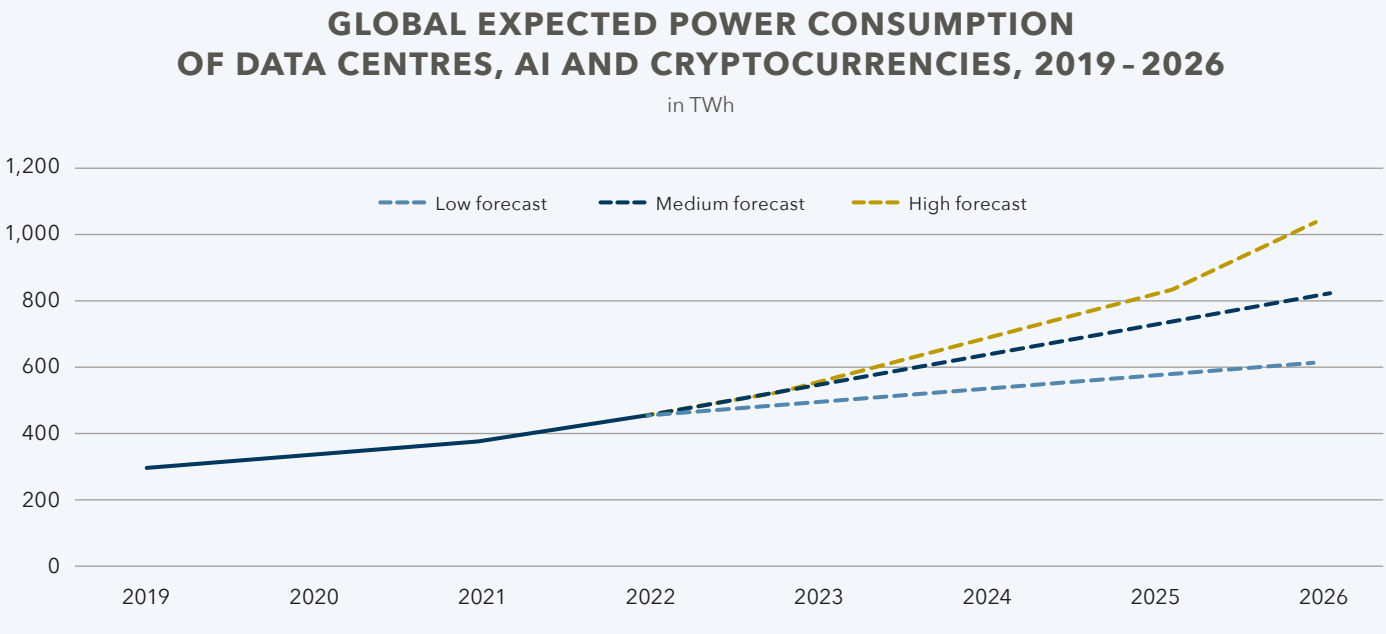


2. Power demand of artificial intelligence

AI systems rely on data-intensive processes. Training neural networks, particularly those with billions of parameters such as language models, involves processing vast amounts of data. These operations require high-performance servers operating around the clock in data centres. The power consumption of AI-optimised data centres is significantly higher than that of conventional data centres. For example, a single ChatGPT request consumes 2.9 watts – nearly ten times the energy of a Google search, which requires only 0.3 watts. Other AI-powered chatbots have even higher energy demands. If Google were to integrate its proprietary AI into its traditional search model, power consumption per search would range between 6.4 and 9 watts.[1]

For years, data centres maintained a steady power demand even as workloads increased. However, since the introduction of AI-driven services like ChatGPT, Perplexity and Gemini, power consumption has surged and doubled within a few years. Given the dynamic developments and significant investments in AI, we expect this trend to continue. The International Energy Agency (IEA) predicts that global power consumption by data centres could double again by 2026, exceeding 1,000 terawatt-hours – equivalent to the total electricity consumption of Japan[2] in one year.



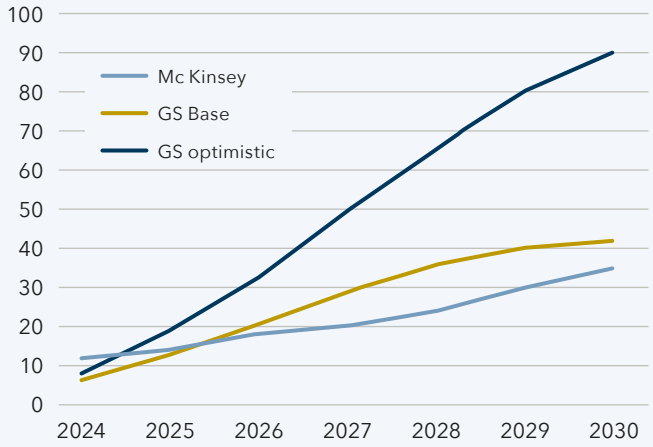


1 Source: Alex de Vries, January 2024
2 Global data center electricity use to double by 2026 - IEA report - DCD (datacenterdynamics.com)

The U.S. market is already more advanced than Europe. However, numerous data centres are also planned in Europe, set to be built over the coming decade. Against this backdrop, McKinsey expects additional power demand from data centres in Europe to reach 35 gigawatts by 2030, while Goldman Sachs projects 42 gigawatts in its base case scenario and as much as 90 gigawatts in its bull case scenario. According to our information, the current volume of applications for data centres in Europe even exceeds 160 GW.

GROWTH OF DATA CENTRES IN EUROPE

in GW



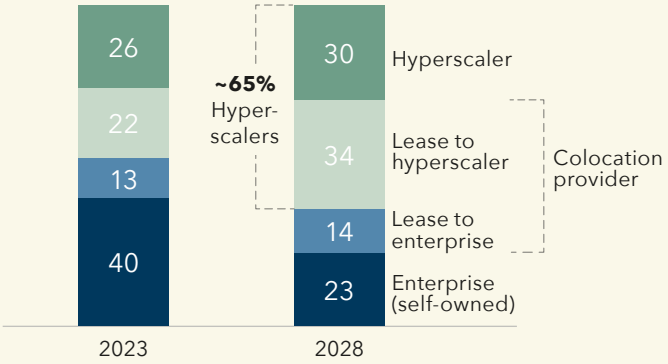
Estimates for the expansion of AI and the associated power consumption still vary significantly. This is partly due to the fact that, on the one hand, the computer chips used for AI applications are becoming increasingly powerful, while on the other hand, these high-performance chips consume more electricity. It is expected that more energy-efficient solutions will be developed in the coming years, preventing power demand from rising exponentially. However, overall, it seems clear that forecasts for electricity consumption will mostly need to be revised upwards.

Although advancements in the energy efficiency of AI systems might initially suggest a reduction in overall demand, the Jevons paradox illustrates that efficiency improvements often lead to increased usage and, consequently, higher resource consumption. For AI, this means that enhanced energy efficiency will further drive its adoption and application, ultimately increasing the demand for computing power and energy. Investors should view this dynamic as an opportunity: efficiency gains will accelerate the growth of AI technologies and create new investment opportunities – both in the data centre sector and in the energy industry.

3. Hyperscalers: the dominant energy consumers

Hyperscalers such as Amazon Web Services (AWS), Microsoft Azure and Google Cloud operate extensive, globally distributed data centre networks. These companies offer services such as Infrastructure as a Service (IaaS) and Platform as a Service (PaaS), processing massive amounts of data and using large-scale storage. McKinsey forecasts that hyperscalers will account for between 65% and 70% of Europe's data centre electricity consumption by 2028. In comparison, colocation providers and enterprise-owned data centres are likely to account for a considerably smaller share. The energy demand of hyperscale data centres is growing rapidly and represents a major portion of global electricity consumption. The annual energy consumption of an average hyperscale data centre ranges between 20 and 50 megawatts – enough to power tens of thousands of households .

DATA CENTRE DEMAND BY OWNERSHIP, EUROPE IN %, 2023–2028



Note: Figures may not sum to 100%, because of rounding.
Source: McKinsey & Company

To meet the rising demand for electricity without driving up CO_2 emissions, the use of renewable energy is considered the best solution. Hyperscalers are therefore increasingly aiming to source 100% of their data centre energy needs from renewable sources by 2030.[3] This is a crucial step in minimising the negative environmental impact of growing power consumption. Amazon has already become the world's largest buyer of power purchase agreements (PPAs) for clean energy.[4] In addition, the company has made significant investments in photovoltaic and wind power projects. Microsoft and Google are also committed to clean energy and aim to make their operations carbon-neutral by 2030.

3 https://www.cnbc.com/2022/04/13/google-data-center-goal-100percent-green-energy-by-2030.html" Google data center goal: 100% green energy by 2030 (cnbc.com)Google data center goal: 100% green energy by 2030 (cnbc.com) „https://www.cnbc.com/2024/05/01/microsoft-brookfield-to-develop-more-than-10point5-gigawatts-of-renewable-energy.html" Microsoft, Brookfield to develop more than 10.5 gigawatts of renewable energy (cnbc.com)
4 Kyle Harrison, "Amazon is top green energy buyer in a market dominated by US," BloombergNEF, February 26, 2024

4. Implications for renewable energy

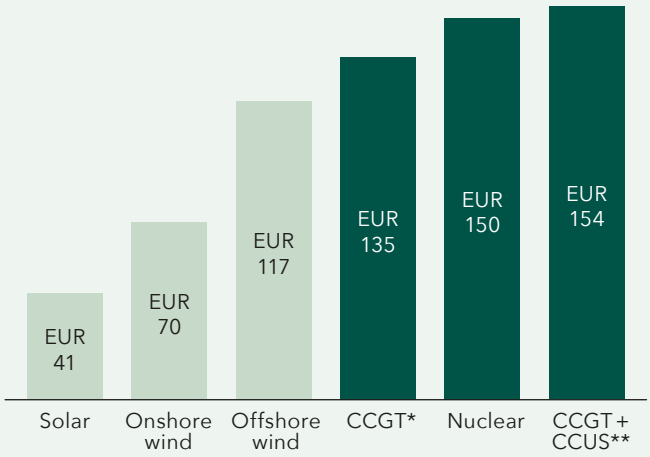
The exponential rise in power demand, particularly due to the rapid expansion of digital infrastructure such as data centres, presents major challenges for the global energy market. At the same time, this trend offers significant investment opportunities, particularly in renewable energy and Battery Energy Storage Systems (BESS). These technologies are essential not only for sustainable power supply but also as highly lucrative investment opportunities that combine long-term and predictable returns with societal benefits.

Renewable energy has become a competitive alternative to fossil fuels in recent years. With continuously decreasing Levelised Costs of Electricity (LCOE), photovoltaic and wind power offer both ecological and economic benefits. This development is crucial to meeting the increasing electricity demand of data centres, which is expected to grow by more than 20% annually until 2030.

While renewables lay the foundation for sustainable energy supply, battery storage systems play a crucial role in stabilising the power grid. BESS solutions facilitate the integration of wind and solar energy. Additionally, they balance fluctuations in energy production, store surplus renewable energy during low-demand periods, and release it when demand and electricity prices are higher. This not only not only enables more cost-effective operation of data centres but also opens up substantial opportunities for investors. According to BloombergNEF, the global battery storage market is expected to reach over 1,000 gigawatt-hours by 2030 – representing growth of more than 300% compared to 2022. Additionally, the costs of battery storage are continuously decreasing, further enhancing the economic viability of combining clean energy with battery storage.

OVERVIEW OF COSTS FOR ENERGY GENERATION

per MWh

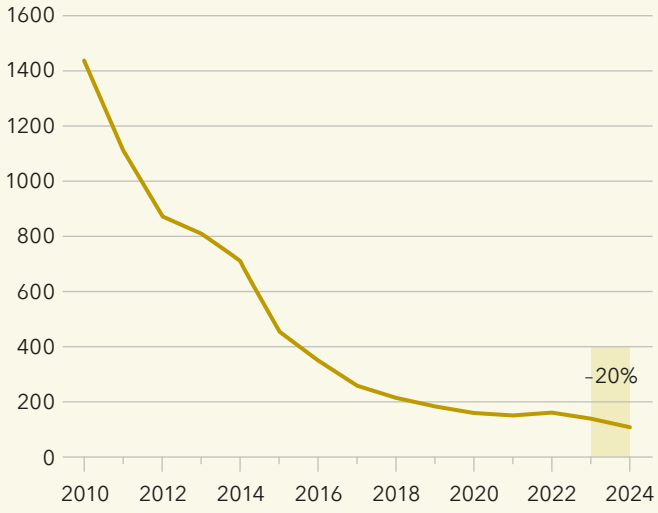


* Combined-cycle gas turbine
** Combined-cycle gas turbine (CCGT) + Carbon capture, utilisation and storage

Source: own presentation, Aquila Capital Holding GmbH

LITHIUM-ION BATTERY PRICE SURVEY RESULTS: VOLUME-WEIGHTED AVERAGE PACK PRICES, ALL SECTORS

Real 2024 USD/kWh



Note: Historical data has been adjusted to real 2024 dollars.
Source: BloombergNEF

Renewable energy and battery storage solutions are not only a response to the growing power demand from data centres but also key building blocks for a sustainable and resilient energy system. The combination of these technologies presents significant investment opportunities, offering both economic and environmental benefits.

For investors seeking future-oriented and high-growth investment opportunities, renewable energy and battery storage are highly interesting sectors. They not only contribute to the energy transition but also play an active role in shaping the future of the global energy market.

5. Investments in the power grid required

The rising power demand driven by the expansion of data centres, especially AI-driven applications, poses significant challenges for Europe's power grid. Data centres operate 24/7, requiring a constant and high energy supply. Wind and solar energy offer promising solutions, as they contribute sustainably to meeting demand. However, they are weather-dependent and do not always generate the required electricity levels. Advanced and flexible solutions are being integrated into the grid to address these challenges. Large-scale battery storage systems can compensate for many of these fluctuations by storing electricity for extended periods and supplying data centres when needed. In some cases, gas turbines may also serve as a backup solution during peak demand or insufficient renewable generation.

Regardless of renewable energy, Europe's power grids are, on average, over 40 years old and have been underinvested for a long time. To meet growing demands, an estimated EUR 800 billion[5] investment in modernising and expanding transmission and distribution networks is required.

The combination of modernised grids, renewable energy and battery storage offers a sustainable solution to the rising power demand from data centres. However, coordinated efforts from both policymakers and the private sector are required to bring this vision to life.

6. Conclusion

The ever-growing demand for computing power, particularly driven by Artificial Intelligence, poses a major challenge for energy supply. Data centres consume vast amounts of electricity. To meet this increasing demand while protecting the environment, renewable energy and battery storage offer a promising solution. These technologies are not only ecologically sound but also economically superior. Investors can benefit from this trend by investing in companies focused on expanding renewable energy and battery storage infrastructure. The combination of modernised power grids, renewable energy and battery storage enables a sustainable and secure energy supply for the growing digital economy. Political frameworks and technological advancements will further accelerate this development.

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A quantitative economist, Moritz Paysen began his career as a proprietary trader in foreign currency derivatives at the private and investment bank M.M.Warburg, before moving to the private and investment bank Berenberg, where he worked both as a trader and advisor in the FX & Rates segment. Moritz Paysen has been Head of Corporate Hedging at Aquila Group since January 2023 and is responsible for hedging the company's currency and interest rate risks. He has extensive knowledge of macroeconomics, currencies, interest rates and financial markets.

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