AQUILA CAPITAL

Aquila Group Insights 2025

ELECTRIFICATION, AI AND THE FUTURE OF ENERGY

Investment opportunities in a dynamic market

CONTENT

1. **INTRODUCTION** 2
2. **GROWING ELECTRICITY DEMAND IN EUROPE** 3
2.1 THE ELECTRIFICATION TREND 3
2.2 DATA CENTRES AND ARTIFICIAL INTELLIGENCE 3
3. **CHALLENGES ON THE SUPPLY SIDE** 4
4. **THE GROWING PPA MARKET** 6
5. **BATTERY STORAGE AS A CENTRAL PILLAR** 7
6. **OPPORTUNITIES FOR INVESTMENT IN RENEWABLE ENERGY** 8
7. **CONCLUSION** 9

1. Introduction

The European electricity market is undergoing a substantial transformation. After years of stagnation, a clear increase in electricity demand is now emerging – driven by electrification and new consumers such as data centres. As a result, the market faces major challenges in ensuring sufficient generation capacity.

Recent studies forecast that total electricity consumption in Europe will increase by 40 to 50% by 2033, driven by accelerated electrification across sectors such as transport, industry, heating and data centres[1,2].

Demand from data centres in Europe alone is expected to rise from ten GW in 2023 to around 35 GW[3] by 2030, representing annual growth of approximately 20%.[4] As a result, electricity consumption by European data centres could nearly triple from the current level of around 62 TWh to more than 150 TWh by the end of the decade.

At the same time, this growing demand is facing a limited supply of renewable energy. Recently published studies also suggest that supply will not keep pace with rising demand until 2031, potentially leading to shortfalls during peak periods.

These developments pose major challenges for the European electricity market. At the same time, they present opportunities for investments in renewable energy, grid infrastructure and new demand-side management technologies. We are seeing policymakers now actively addressing these issues and increasingly rallying behind European initiatives such as the "Draghi Plan", which could mark a long-overdue shift in the EU's economic policy. In addition, both the EU Commission's "Affordable Energy Act" and national initiatives such as Germany's planned investment package are reinforcing energy policy efforts through targeted investments aimed at ensuring stable energy prices, supply security and the expansion of the grid.

1 For data centre estimates, we draw on figures from Aurora ER, Baringa, Wood Mackenzie, Goldman Sachs, McKinsey and our own calculations.
2 World Energy Outlook 2024 – Analysis – IEA
3 Data centre demand is often measured in gigawatts (GW), as this unit accurately reflects the energy requirements of such infrastructure.
4 McKinsey

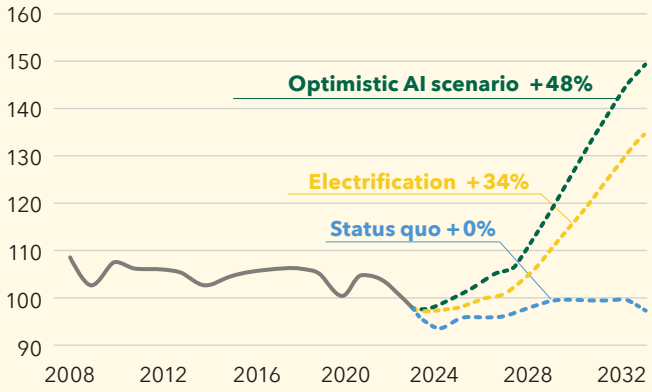
2. Growing electricity demand in Europe

2.1 The electrification trend

In recent years, the global trend towards electrification has continued to accelerate – driven by the urgent need to decarbonise economies and combat climate change. The war in Europe has further contributed to raising the relevance of electrification in both security and economic policy. Electrification in the areas of heating, transport and industry, the use of green hydrogen, as well as the growing importance of data centres, are considered the main drivers of future growth. While market estimates for the increase in electrification (excluding data centres) vary slightly, they consistently point to strong growth in the coming years. Forecasts indicate that electricity demand will rise by around 34% over the next ten years.[5]

ELECTRICITY DEMAND SCENARIOS

EU27, re-indexed, 2023 = 100



Source: Aurora ER, Baringa, Wood Mackenzie, Goldman Sachs, McKinsey, Aquila Capital

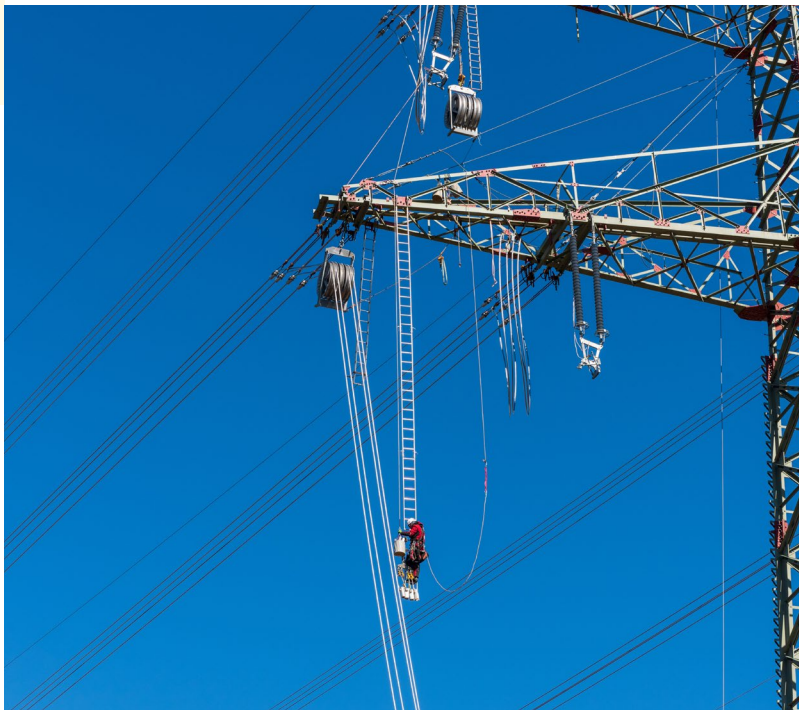
This development is being driven by the planned installation of heat pumps in Europe, which could increase electricity consumption by up to 10%. Through the REPowerEU initiative, the EU also aims to bring a large number of electric vehicles onto European roads and to expand the necessary charging infrastructure accordingly.[6] In energy-intensive industries such as steel and chemicals, increasing electrification is also being pursued and could raise current electricity demand by an additional 10% by 2033.[7]

Despite current challenges and criticism surrounding the implementation of individual measures, the global trend towards electrification is entering a long-term growth phase. Heat pumps are already reducing energy consumption today and are particularly cost-efficient when combined with renewable energy sources. Although electric vehicles and charging infrastructure face a longer rollout timeline, they benefit from steadily improving technologies that offer greater range. In energy-intensive industries such as steel and chemicals, electrification is not only a means of decarbonisation but also a strategic decision to remain competitive.[8]

2.2 Data centres and artificial intelligence (AI)

A new and, until recently, largely unexamined but highly significant factor driving rising electricity demand is the rapidly increasing energy consumption of data centres due to the growing importance of artificial intelligence (AI). A single query to an AI model such as ChatGPT consumes nearly ten times more electricity than a conventional Google search. The rising demand for data-intensive AI applications, along with the training of large-scale AI models, is causing a dramatic surge in energy consumption.

In parallel, specialised AI technologies such as DeepSeek are further fuelling demand for data centres. DeepSeek provides optimised infrastructure for AI models, enabling even more powerful processing of large data volumes. While the higher efficiency of such systems reduces energy consumption per computing operation, it is also expected to drive broader adoption of AI across industries – leading to a continued rise in overall demand for computing capacity. We therefore anticipate that the growth of data centres and their energy consumption will accelerate beyond current forecasts.



5 For electrification estimates excluding data centres, we draw on data from Aurora ER, Baringa, Wood Mackenzie, Goldman Sachs, McKinsey and our own calculations.

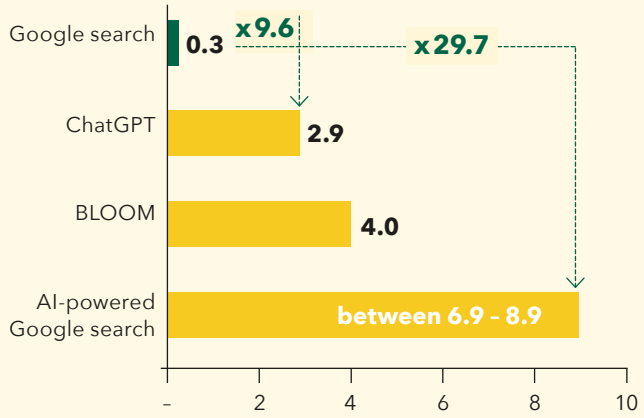
6 Fit for the future, not Fit-for-55 | Ember

7 Goldman Sachs

8 A study by the Potsdam Institute for Climate Impact Research estimates that it is possible to electrify 78% of industrial energy demand in the EU using already available technologies. https://www.europarl.europa.eu/RegData/etudes/ATAG/2024/762859/EPRS_ATA(2024)762859_EN.pdf

ELECTRICITY CONSUMPTION PER QUERY

in watts

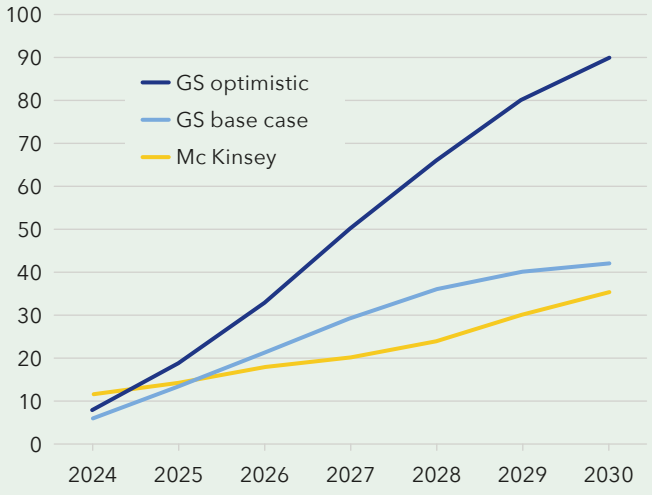


A query to ChatGPT consumes 2.9 watts, almost 10 times as much electricity as a Google query, which uses 0.3 watts. Other providers of AI-powered chatbots have even higher energy consumption. If Google were to integrate its own AI (Gemini) into its traditional search, the power consumption per search would be between 6.9 and 8.9 watts.

Source: Alex de Vries, January 2024

When the necessary expansion of data centres for AI is incorporated into the calculations, electricity demand is expected to grow even more strongly – by up to 48% in the optimistic scenario.

DATA CENTRE GROWTH IN EUROPE IN GW



Source: Global Energy Perspective 2024; McKinsey analysis

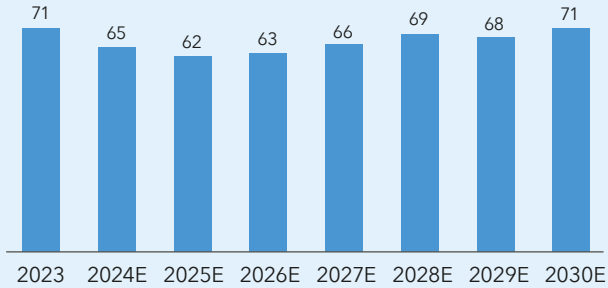
3. Challenges on the supply side

The significant increase in demand expected by 2033 calls for a consistent expansion of renewable energy sources such as wind, solar PV and hydropower. In addition, investments in grid capacity – for example through smart grids and energy storage solutions – are essential to ensure the stability and efficiency of electricity supply. However, recent studies indicate that electricity supply is growing too slowly to keep pace with rising demand.

An interesting economic effect in this context is the Jevons Paradox: improvements in energy efficiency often do not lead to lower overall consumption, but instead promote increased usage, as falling costs enable new applications. This dynamic is particularly evident in data centres – more efficient AI chips and improved software algorithms reduce energy consumption per computing operation, but make AI even more economically attractive, thereby increasing overall demand. According to Goldman Sachs, annual capacity additions are expected to reach around 70 GW (including the UK), which could result in Europe's reserve capacity falling to a low single-digit percentage by the end of the decade (see figures below and on the next page).

GROWTH IN RENEWABLE CAPACITY IN EUROPE

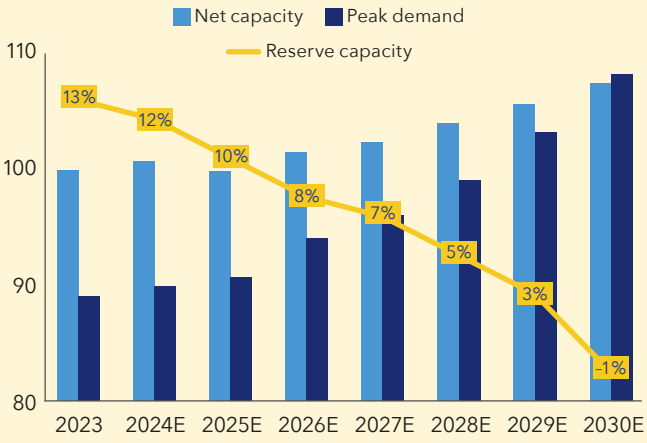
Annual increase in GW



Source: Goldman Sachs

NET POWER GENERATION CAPACITY IN THE EU

Indexed values (base 100 = net capacity in 2023)



Source: Goldman Sachs

A shrinking reserve margin can cause significant harm to both the economy and energy security.

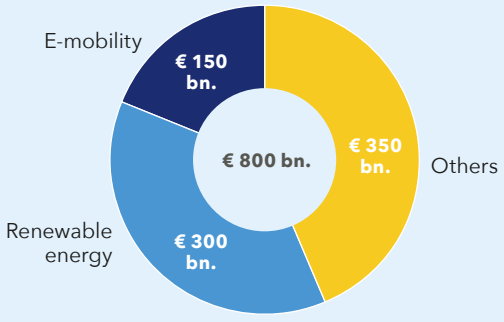
- If a power grid is less able to respond flexibly to fluctuations in supply and demand, the risk of blackouts increases. This can lead to production stoppages in factories or to the postponement of operations in hospitals, for example.[9]
- Electricity prices and price volatility would rise, as tighter reserves intensify competition for available resources. Prices would spike particularly during peak demand periods.[10]
- An inflexible grid would result in reduced investment in the maintenance and expansion of grid infrastructure. Over time, this would further deteriorate grid quality and jeopardise supply security.
- Battery storage systems are becoming an essential solution to manage bottlenecks and improve flexibility, as they can absorb surplus capacity from the grid and help stabilise supply during peak demand.

This development poses a serious challenge for the continent. An unreliable power grid would significantly reduce investment in Europe as a business location – particularly in energy-intensive industries such as chemicals, steel and automotive. In addition, a shrinking reserve margin would lead to rising production costs and place a burden on households through higher and more volatile electricity prices. Moreover, insufficient power supply threatens to slow technological progress in digitalisation and severely undermines Europe's capacity for innovation. The energy transition would lose momentum, and climate targets could be missed.

The Draghi Plan[11], which has received strong support within the European Commission, recognises this challenge and aims to significantly strengthen Europe's energy infrastructure in order to drive forward the energy transition. Key measures include annual investments of EUR 800 billion, with EUR 450 billion allocated to renewable energy, grid modernisation and e-mobility.[12] The goal of the Draghi Plan is to enhance – or restore – Europe's competitiveness. The focus on energy infrastructure highlights the extraordinary economic leverage that a reliable and cost-effective energy supply could offer the continent. In addition to the Draghi Plan, the Affordable Energy Act and Germany's planned government support package play a crucial role in accelerating the expansion of renewable energy and ensuring security of supply through targeted funding measures.

INVESTMENTS UNDER THE DRAGHI PLAN

(IN EUR BN)



Source: EU Commission

9 A well-known example of this is the so-called scheduled blackouts in South Africa, where planned power outages occur due to insufficient grid capacity.

10 An extreme example of sudden price spikes can be seen in Australia, where electricity prices temporarily exceeded EUR 30,000/MWh during peak demand periods in June 2022.

11 https://commission.europa.eu/topics/strengthening-european-competitiveness/eu-competitiveness-looking-ahead_en

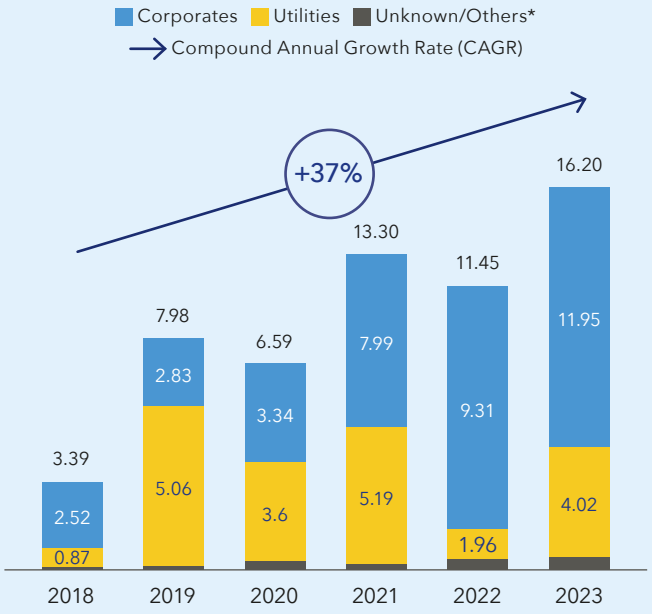
12 The remaining EUR 350 billion in "other" investments is intended to support strategically important areas to boost Europe's competitiveness – such as digital infrastructure, technological innovation, R&D and potentially the defence industry.

4. The growing PPA market

The market for Power Purchase Agreements (PPAs)[13] continues its strong growth, with an average annual rate of 37% between 2018 and 2023 in Europe. In 2023, 272 PPAs were signed – a 62% increase in the number of agreements, indicating a rise in lower-volume contracts.

This reflects a trend of increasing participation by small and medium-sized enterprises in the PPA market. 80% of all PPAs were concluded with corporate offtakers, accounting for 73% of the total transaction volume.

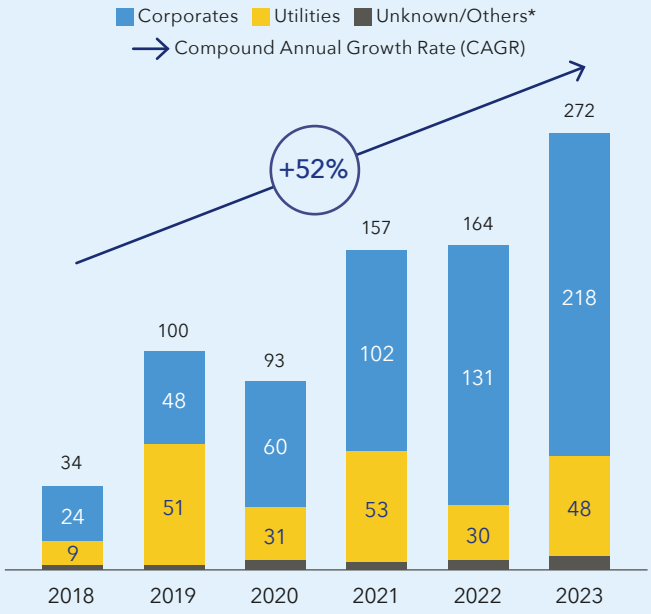
PPA DEAL FLOW BY ANNOUNCED CONTRACTED CAPACITY, 2018 – 2023 (GW)



„"Unknown/Others" primarily refers to electrolysis developers

Source: PexaQuote, PPA Tracker

PPA DEAL FLOW BY NUMBER OF CONTRACTS, 2018 – 2023 (#CONTRACTS)



"Unknown/Others" primarily refers to electrolysis developers

Source: PexaQuote, PPA Tracker

Hedging against price volatility is the main reason many companies choose to enter into a PPA. Increasing electrification and the structural challenges facing the power grid are likely to drive greater volatility in electricity markets, which in turn boosts demand for PPAs. In addition, the price of a green PPA is generally lower than purchasing electricity directly on the market.

- This is partly due to the fact that the levelised cost of renewable energy is almost always lower than that of conventional sources such as coal or gas.
- Furthermore, PPAs enable companies to negotiate directly with renewable energy project developers or operators, thereby avoiding supplier mark-ups charged by utilities.[14]
- A PPA improves a company's carbon footprint by sourcing green electricity and reinforces its commitment to sustainability.

On the side of renewable energy developers, PPAs enhance the financial attractiveness of their projects.

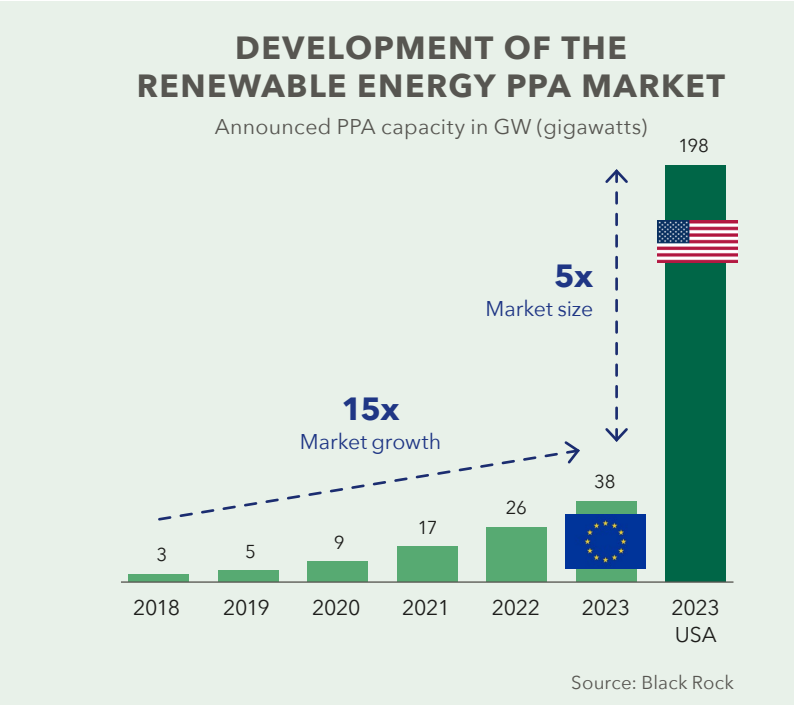
- By entering into direct agreements with corporate offtakers, developers can often secure better prices than through traditional PPAs with utility companies.
- Long-term price agreements ensure stable and predictable cash flows. This reduces the investment risk in renewable energy, as a fixed income base improves both the financing conditions and profitability of projects.

13 Power Purchase Agreements (PPAs) are long-term electricity supply contracts between power producers and offtakers.

14 In the case of on-site PPAs (direct agreements between companies and facilities located on-site), companies can reduce or bypass grid fees and other charges, further lowering electricity costs.

As a result, an increasing number of companies and developers are entering into direct PPAs to secure better pricing for both parties. In 2023, 56% of PPA volume in Europe was concluded between corporates and non-utility counterparties[15,16].

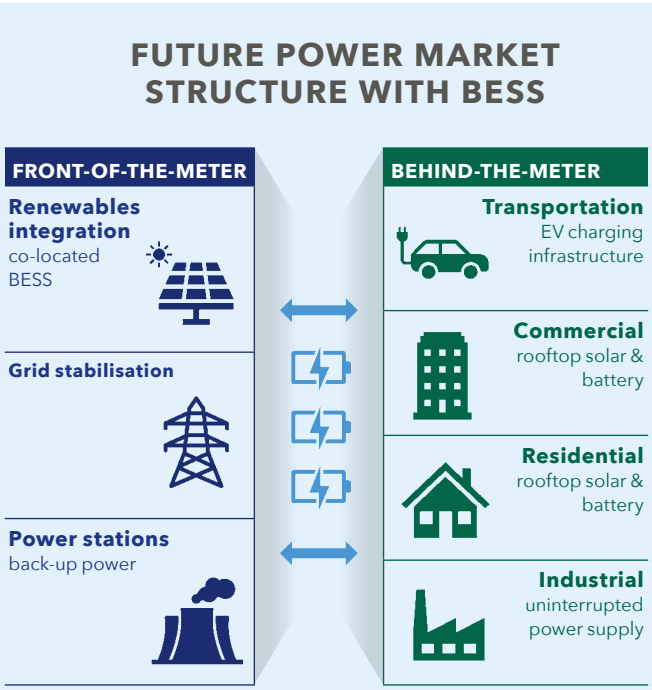
In the United States, the PPA market is already at a more advanced stage and is roughly five times the size of the European market. While the growth of the PPA market in the US has led to higher PPA prices, PPAs from renewable energy sources still represent the most cost-effective form of electricity generation.



A growing PPA market offers tremendous opportunities for the expansion of renewable energy in Europe. The significant price gap between fossil fuels and renewables creates even greater potential for companies and developers in Europe than in the US. The expansion of the PPA market presents substantial economic opportunities, as it not only accelerates the deployment of renewable energy, but also has the potential to sustainably enhance Europe's competitiveness as a business location.

5. Battery storage as a central pillar

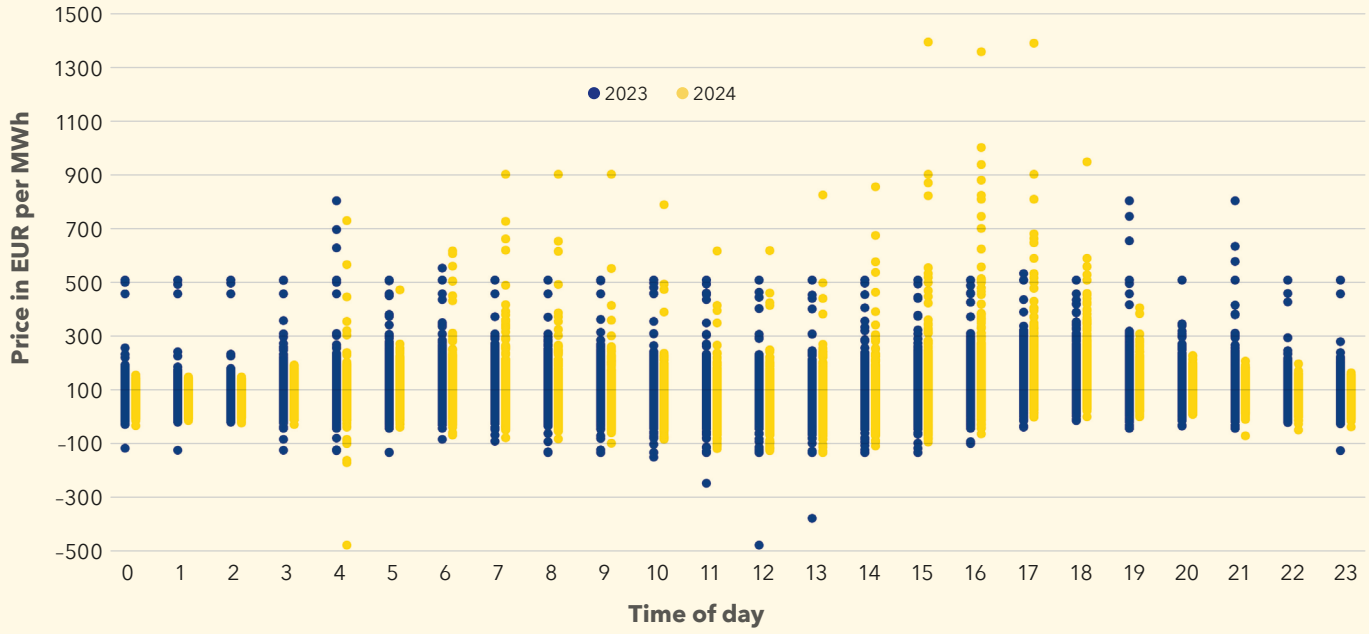
As clean energy sources become increasingly diversified, battery storage systems (BESS) play a central role in the future of the energy system. They are therefore crucial to the growth of renewable energy, grid expansion and the stability of electricity markets. As illustrated in the diagram, BESS impacts many core aspects of electricity infrastructure. First, BESS supports the integration and expansion of renewables by compensating for weather-related fluctuations in production – storing excess electricity and feeding it back into the grid when needed. Second, BESS enhances grid stability and flexibility through its responsiveness, helping to manage frequency deviations and peak loads. This improves grid quality and can either support the expansion of grid capacity or serve as a more cost-effective alternative in cases where traditional grid development is too expensive.



Given the wide range of applications and the growing importance of battery storage systems, attractive investment opportunities are emerging. The increasing demand for stable, flexible storage solutions within the energy infrastructure makes BESS a future-proof investment. In addition to its role in grid stabilisation, BESS also benefits from arbitrage opportunities – storing electricity when prices are low and selling it during periods of high demand. Additional revenue streams include capacity markets and demand response programmes, where BESS helps prevent grid overloads.

15 Developers, independent power producers (IPPs) or fund managers.
16 And this despite the fact that nearly all offshore wind PPAs are signed with utilities, as they are the primary owners.

ELECTRICITY PRICE VOLATILITY IN GERMANY



Source: Aquila Group

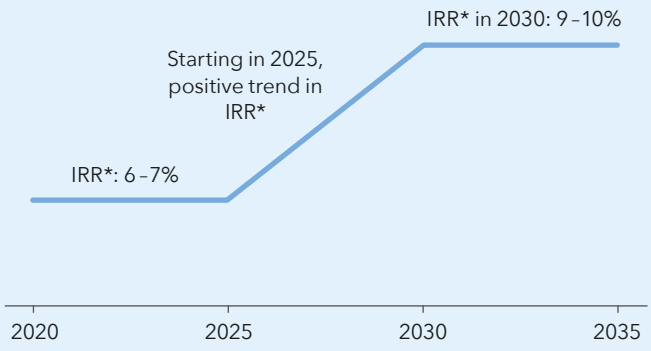
Volatility in power grids is expected to increase further in the coming years due to growing complexity, which in turn will drive greater demand for investments in BESS

6. Opportunities for investment in renewable energy

As outlined in Chapter 4, developments in the corporate PPA market provide a promising foundation for attractive returns in renewable energy. With electricity demand on the rise, companies are seeking to secure long-term clean energy contracts. At the same time, the expansion of electricity supply and grid infrastructure is lagging behind. Strongly growing demand combined with only moderately increasing supply inevitably leads to higher prices. Every new renewable energy project can therefore sell its electricity at more favourable rates, resulting in compelling returns. This combination of rising demand, limited supply and a growing corporate PPA market is expected to become a key driver, potentially pushing internal rates of return gradually higher from 2025/2026 and reaching levels of 8 to 10% p.a. by 2030.

EXPECTED RETURN DEVELOPMENT FOR RENEWABLE ENERGY

Percentage points



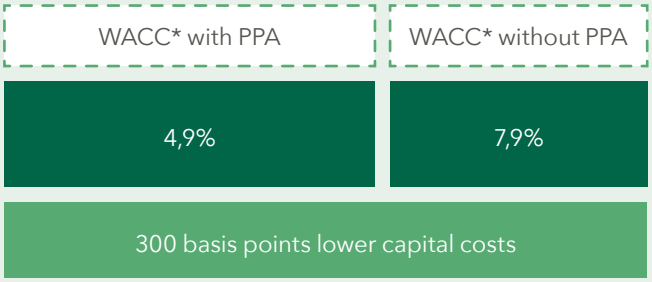
* Internal rate of return

The return development shown is based on an illustrative scenario that takes into account general market developments and current trends in the sector. It does not constitute a forecast and should not be interpreted as a specific return expectation for individual projects or portfolios.

The further development of the corporate PPA market would not only lead to predictable revenues but also lower the cost of capital for renewable energy projects. Fully contracted PPA projects can achieve cost savings of up to 300 basis points compared to projects without long-term, predictable income streams.

REDUCTION OF THE WEIGHTED AVERAGE COST OF CAPITAL

Capital costs for renewable energy



* Weighted Average Cost of Capital

Source: Goldman Sachs Global Investment Research

This reduction in capital costs through increased use of debt capital improves the economic viability of projects, making investments in renewable energy more attractive and sustainable in the long term.

7. Conclusion

Europe stands on the brink of an unprecedented transformation of its energy and infrastructure markets – and this moment presents a historic investment opportunity. Rising electricity demand, driven by the electrification of heating, mobility and industry, as well as the rapid expansion of data centres and AI applications, is setting the pace for a new era. At the same time, decarbonisation requires ambitious action, making substantial investments in renewable energy, modern grid technologies and sustainable infrastructure indispensable.

The Draghi Plan represents a key economic policy milestone for the EU. With a planned CAPEX cycle of up to EUR 450 billion annually for the energy transition, the expansion of the corporate PPA market and the reduction of capital costs, Europe is creating a solid, growth-oriented foundation for investors. In parallel, the Affordable Energy Plan addresses rising energy costs and supply security by promoting joint energy purchasing, price stabilisation, and an accelerated rollout of renewable energy.

Momentum for investment is also building at the national level in Germany: the expected future federal government, formed by CDU/CSU and SPD, plans to introduce stronger state incentives through guarantees and direct fiscal spending to support infrastructure and the transformation of the economy. This combination of European and national measures signals a clear commitment to modernisation, the energy transition and strengthening Europe's competitiveness.

These are highly favourable conditions for investors. The transition to an electrified and digital world offers tremendous return potential—combined with a positive contribution to climate protection.

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