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SEE ENERGY BRIEF

Monthly Analysis

Improving Electricity Grid Performance Through Battery Storage

Introduction

Improving the performance of electricity grids has become a pressing challenge as energy demand grows and renewable energy sources become more widespread. Traditional grids were designed for steady, centralized power generation, but today's energy landscape is more dynamic and dotted with thousands of RES generators. With the rise of solar and wind power, which are intermittent by nature, grid operators face new challenges in maintaining a reliable and stable energy supply. These fluctuations can lead to imbalances, blackouts, or the need for costly backup generation, especially during peak demand or low renewable output periods.

Battery storage technology offers a promising solution to these challenges. By storing excess energy during periods of low demand or high generation, batteries can release power when it is needed most, smoothing out fluctuations and helping maintain a stable grid. This flexibility not only enhances reliability but also reduces the need for fossil-fuel-based power plants, which are often used to meet short-term demand spikes. In addition, battery systems can support grid functions, such as frequency regulation, voltage control, and emergency backup power.

As battery technology continues to advance and costs decline, its integration into the electricity grid becomes increasingly practical and beneficial. Countries and utility providers around the world are investing in grid-scale battery projects to modernize infrastructure and support the transition to a cleaner, more resilient energy system. This shift not only helps optimize the use of renewables but also lays the groundwork for a more sustainable and efficient energy future. The current Analysis examines in some detail today's electricity grid performance at European level, where SE Europe currently stands and how the power grids can be improved through battery storage in the near future.

Current Situation of Electricity Grids in Europe

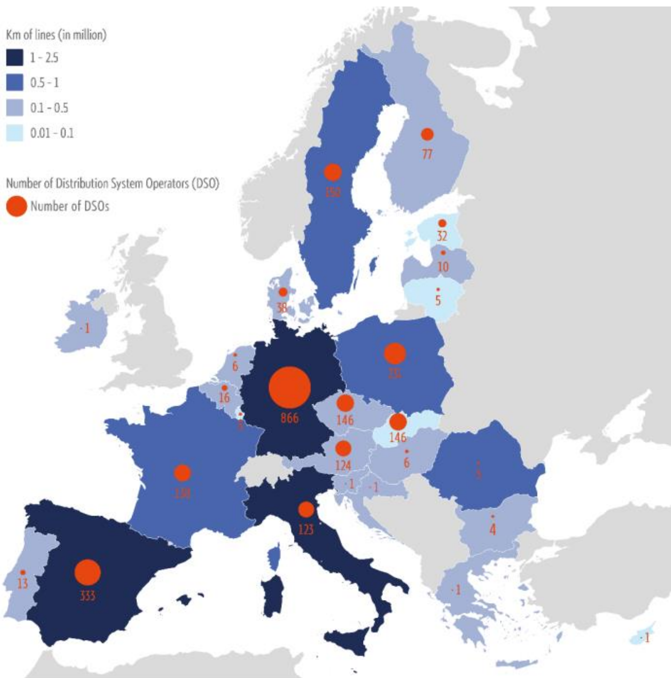
Electricity grids in Europe are undergoing a significant transformation, driven by the twin imperatives of decarbonization and energy security. Historically built around centralized fossil-fuel and nuclear power plants, today's European grids must accommodate an increasing share of variable renewable energy sources, such as wind and solar. While this transition is crucial for meeting the EU's climate goals, it poses substantial challenges for grid operators in terms of reliability, flexibility, and efficiency. As demand grows and becomes more dynamic, maintaining grid stability across diverse regions has become a complex task.

One of the primary issues facing the European electricity grid is the variability of renewable energy generation. Wind and solar power are highly dependent on weather conditions, and their output can fluctuate significantly over short periods. These fluctuations can lead to imbalances between supply and demand, creating stress on the grid. Countries like Germany and Denmark, which have high shares of renewables, frequently experience such challenges. Managing these imbalances requires fast-responding solutions, and without them, system reliability may be compromised, leading to curtailment of clean energy or reliance on carbon-intensive backup generation. **(1)**

Another key concern is the cross-border nature of Europe's electricity market. The European Union has made significant efforts to interconnect national grids through initiatives like the European Network of Transmission System Operators for Electricity (ENTSO-E) **(2)**. While this improves energy security and supports the internal energy market, it also introduces complexity in coordinating electricity flows across countries. Grid congestion, market fragmentation, and regulatory differences can hinder efficient energy transfer, especially during periods of high demand or low generation.

Moreover, the aging infrastructure in many parts of Europe adds to the pressure. Much of the continent's high-voltage transmission lines and substations were built decades ago and require modernization to cope with new patterns of electricity generation and consumption. Urbanization, electrification of transport, and increased use of digital technologies are altering demand profiles, necessitating smarter, more adaptable grid systems. The challenge is not only technical but also financial and to a certain extent social in view of the electrification drive, requiring large-scale investments in infrastructure upgrades and innovation.

Figure 1: The Largest EU Infrastructure: Electricity Grids and Operators, 2024

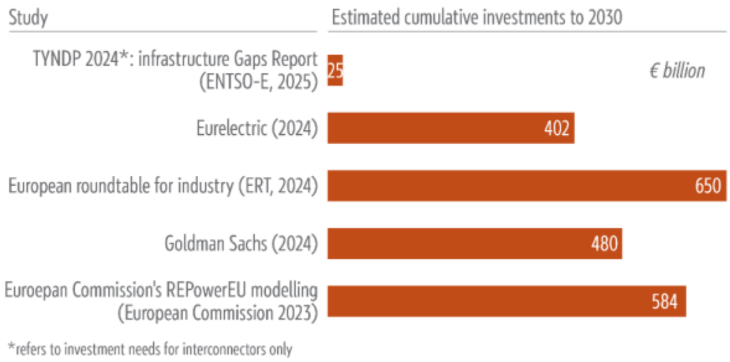


Source: European Parliament

Grid resilience is also a growing concern, particularly in the context of extreme weather events and geopolitical tensions that can threaten energy supplies. The energy crisis following the conflict in Ukraine underscored the need for a more self-sufficient and robust electricity grid in Europe. In this context, the ability to store electricity and deploy it when needed has become a strategic asset. Battery storage, alongside other flexibility measures such as demand response and interconnectors, is now recognized as a critical enabler of energy resilience.

From a policy perspective, the European Commission has recognized the role of energy storage in achieving a climate-neutral economy. The EU's Clean Energy for All Europeans package **(3)** and the European Green Deal **(4)** both emphasize the importance of flexibility solutions, including battery storage, in supporting renewable integration and enhancing grid performance. Funding mechanisms, such as the Innovation Fund and the Connecting Europe Facility, are actively promoting investment in grid-scale storage projects across EU member states. Globally, electricity grids will need to increase by more than 20% in length by 2030 to meet energy and climate pledges in time and in full, which requires annual average investment in grids to rise to US$600 billion from around US$300 billion today, according to the International Energy Agency **(5)**.

Figure 2: Assessment of European Electricity Grid Investment Needs



Source: European Parliament

Concerning supply chain risks, the need for resilient and effective grid manufacturing supply chains is recognised by the Net-Zero Industry Act **(6)**, which designates grid technologies as strategic net-zero technologies. Recognising the critical importance of grids for the EU Energy Union and economy as a whole, the European Commission came forward with an EU action plan for grids in November 2023 **(7)**, while a new European grids package is expected in the coming months.

To sum up, Europe's electricity grid is at a pivotal moment. While the push for a cleaner, more sustainable energy system is making great strides, it also demands a fundamental rethink of how electricity is produced, transmitted, and consumed **(8)**. The current grid performance reflects both the progress made and the limitations faced in adapting to a new energy paradigm. To maintain reliability and efficiency in this evolving landscape, battery storage is emerging as an essential tool, capable of bridging the gap between intermittent supply and dynamic demand, and ensuring a resilient and future-ready European electricity grid.

Current Situation of Electricity Grids in SE Europe

The electricity grids in SE Europe are facing a complex set of challenges as they strive to modernize and adapt to changing energy dynamics. Many countries in this region, including Greece, Bulgaria, Romania, Serbia, North Macedonia, are transitioning from aging, fossil-fuel-based power systems to more modern grids capable of integrating renewable energy sources. However, this transition is uneven across the region, and significant disparities remain in terms of infrastructure quality, investment levels, and regulatory frameworks. **(9)**

One of the major issues affecting grid performance in SE Europe is the outdated and underdeveloped transmission and distribution infrastructure. Many grid components are decades old and require urgent upgrades to handle increasing demand and support renewable energy integration. Frequent maintenance issues and technical losses remain common in several countries, resulting in inefficiencies and higher operational costs. These weaknesses hinder the overall reliability of electricity supply, especially in rural and less-developed areas.

The integration of renewable energy sources, while growing, is still limited in much of SE Europe. Countries like Greece and Romania have made substantial progress in deploying solar and wind energy, but others remain heavily reliant on coal and hydroelectric power. The lack of grid flexibility and storage capacity makes it difficult to absorb fluctuating renewable energy, leading to curtailment or underutilization. Moreover, weak interconnections between national grids limit the ability to share surplus energy across borders, which could otherwise help balance supply and demand.

Cross-border electricity trading is another area that requires improvement. While the SE European countries are gradually participating in regional and European electricity markets, progress has been slow. The Western Balkans region, for example, has limited integration with the EU internal electricity market due to technical, political, and regulatory barriers **(10)**. Efforts are being made through the Energy Community and other EU-supported initiatives to harmonize market rules, improve interconnections, and build capacity for market-based electricity exchange.

Energy security and grid resilience are also major concerns in the region. Many countries remain dependent on imported fuels or single sources of supply, making them vulnerable to external shocks or geopolitical tensions. Grid operators are under pressure to ensure a stable power supply in the face of growing demand, aging infrastructure, and the impacts of climate change. Extreme weather events, such as heatwaves and floods, have already tested the resilience of electricity networks, exposing gaps in planning and emergency response.

Figure 3: Electricity Interconnections in SE Europe

Source: IPTO (11)

Despite these challenges, there are positive developments underway. EU funding and international support are helping to finance grid modernization projects, renewable energy installations, and regional interconnection efforts. Smart grid technologies are beginning to be introduced in urban centers, and several countries are exploring battery storage and other flexibility solutions. Greece, for example, has launched significant investment programs aimed at enhancing grid capacity and supporting clean energy transition through island interconnections and storage projects **(12)**.

The electricity grids in SE Europe are at a critical turning point. While the region faces considerable infrastructure and integration challenges, the opportunities for improvement are clear. By investing in grid modernization, embracing regional cooperation, and accelerating the adoption of clean energy technologies, SE Europe can strengthen its electricity systems and align more closely with European energy and climate goals. Battery storage, improved interconnections, and regulatory reform will all play a vital role in this transformation.

The Importance of Battery Storage

Battery storage offers a powerful solution for enhancing the flexibility, reliability, and efficiency of electricity grids. One of the main benefits of battery systems is their ability to balance supply and demand in real time.

As electricity consumption varies throughout the day, batteries can store excess energy during periods of low demand and release it when demand peaks. This reduces strain on the grid and helps avoid blackouts or the need for expensive backup generation.

Another key advantage of battery storage is its support for the integration of renewable energy. Solar and wind power, while essential for decarbonizing the grid, are variable and unpredictable. Battery systems can smooth out these fluctuations by absorbing surplus energy during periods of high generation and discharging it when renewable output drops. This ensures a more consistent and dependable flow of electricity, which is critical for grid stability and for increasing the share of renewables in the energy mix.

Battery storage also plays a significant role in enhancing grid resilience. In the event of power outages, natural disasters, or cyberattacks, batteries can provide backup power to essential services and critical infrastructure. This is particularly important in regions prone to extreme weather events or where grid infrastructure is aging and vulnerable. By enabling decentralized storage solutions—such as those installed in homes, businesses, or local substations—battery technology supports a more robust and adaptable grid. **(13)**

In terms of grid management, battery systems offer valuable services such as frequency regulation, voltage control, and load shifting. These ancillary services help maintain the technical stability of the grid, especially as electricity flows become more complex with the addition of distributed energy resources. Batteries can respond almost instantaneously to changes in grid conditions, making them an ideal tool for supporting real-time system balancing and reducing reliance on slower, conventional power plants.

From a market perspective, battery storage can increase the efficiency of electricity markets by reducing price volatility and supporting time-shifting of electricity use. During periods of low prices (often when renewables are generating abundantly), batteries can charge up, and then sell electricity back into the grid when prices are higher. This not only creates revenue opportunities for storage operators but also contributes to more stable and predictable energy pricing for consumers.

The deployment of battery storage can also help delay or avoid costly investments in grid expansion. Instead of building new transmission lines or upgrading substations to handle short-term peaks, utilities can use strategically placed batteries to manage congestion and defer infrastructure upgrades. This makes battery storage an economically attractive option for improving grid performance while minimizing capital expenditure and environmental disruption.

Moreover, battery storage is a transformative technology for electricity grids, offering benefits that range from operational flexibility to long-term resilience. As battery costs continue to fall and technology improves, their role in modern grid systems will only grow more central. Governments, utilities, and private investors all have a role to play in scaling up battery deployment through supportive policy frameworks, targeted investments, and innovation. With the right strategies in place, battery storage can become a cornerstone of a smarter, cleaner, and more reliable energy future.

In July 2025, SolarPower Europe launched the Battery Storage Europe Platform, a major new initiative to drive forward the business case and regulatory framework for battery storage across the European Union. The Battery Storage Europe Platform is calling for a ten-fold increase in battery storage by 2030 to sustain the growth of solar and other renewable energy developments. The Platform will facilitate the engagement with policymakers and deliver constructive legislative trade and investment frameworks for battery storage manufacturing and deployment. The new Platform seeks to fill the gap of specific representation for battery storage companies in the EU. **(14)**

The Case for SE Europe

As of mid-2025, the installed capacity of battery storage in SE Europe remains limited but is expanding rapidly due to new national energy strategies, EU funding, and the pressing need for grid flexibility. According to IENE calculations, the region currently has an estimated installed capacity of 0.3–0.5 GW, with most of it concentrated in Greece and Romania. While this represents a very small fraction of the EU's total, the trend indicates that SE Europe is entering a phase of accelerated deployment.

Greece leads the region with concrete steps toward scaling up storage. In 2023-2024, the country approved and began implementing a support scheme for up to 900 MW of battery systems through competitive tenders, co-financed by the EU Recovery and Resilience Facility. Until now, no utility-scale battery energy storage systems (BESS) are operational in Greece, but Public Power Corporation recently launched the construction of the country's first two BESS (Melitis 1 of 48 MW and Ptolemaida 4 of 50 MW) in northern Greece, which are expected to be completed within the year. Greece aims to reach 4.3 GW of installed battery capacity by 2030, supporting its high renewable energy targets. **(15)**

Romania's government has set a specific target of installing 1,200 MW of battery storage capacity by 2030, with potential for storage of 2,400 MWh and 2,000 MW by 2035 **(16)**. However, actual deployment has been slower than expected. By mid-2025, Romania's installed capacity was estimated to be around 50-80 MW, mostly from pilot and commercial demonstration projects. Larger utility-scale projects (50-200 MW) are under development, often co-located with solar PV plants and supported by EU Modernisation Fund grants.

In Bulgaria, battery storage development is still in early stages, though reforms to grid codes and market rules in 2024 have paved the way for future growth. The country has several projects in planning, with some 20–30 MW in pre-commissioning phases. Like other countries in the Western Balkans (e.g. Serbia and North Macedonia), Bulgaria is expected to benefit from cross-border transmission initiatives and EU support for regional energy system upgrades.

By 2027, total installed battery storage capacity across SE Europe could reach 3-5 GW, according to conservative industry forecasts. With national strategies aligning more closely with EU climate goals and greater renewable integration, the region is expected to scale up battery deployments significantly. Greece and Romania will likely remain frontrunners, but Bulgaria and the Western Balkans are expected to gain momentum, especially with improved financing and regulatory frameworks. **(17)**

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