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Europe's energy system at a crossroads: green energy supply is possible and necessary

The energy transition in Europe is delivering tangible results. Dependence on fossil fuels, particularly in electricity generation, is declining sharply. Renewable energy sources are increasingly dominating the system, which is undergoing constant transformation: from centralised to decentralised structures, baseload generation to flexible supply and from analogue to digital technologies.

These rapid changes bring significant challenges, but even greater opportunities. The technical and economic solutions required to transform the system already exist. Moreover, Europe cannot afford to revert to fossil and thermal generation. Doing so would increase geopolitical risks and prove financially damaging. What is needed now is swift implementation, courage, commitment to innovation and the right regulatory framework to make it happen.

In 2025, according to Ember, wind and solar energy produced 30% of electricity in the EU, while fossil fuels accounted for only 29%. In the same year, photovoltaics overtook coal as a power source in the EU, as reported by the Fraunhofer Institute for Solar Energy Systems ISE. Falling costs, economies of scale and the virtually unlimited availability of renewable resources are driving this global success.

Global electricity demand rose by 2.6% in the first half of 2025, equivalent to an additional 369 terawatt hours. Over the same period, solar generation grew by 31% and wind by 7.7%, together producing an additional 97 terawatt hours. Solar and wind met the entire increase in demand, with solar alone covering around 83% of the additional consumption.

Renewable energy remains highly cost-competitive. In 2024, the global average levelised cost of electricity from ground-mounted photovoltaics was around 4.3 US cents per kilowatt hour, according to the International Renewable Energy Agency. This was approximately 43% less than electricity generated from the cheapest fossil fuel source. Thanks to this cost advantage and the flexible, decentralised nature of photovoltaics, markets are expanding significantly, including beyond established solar economies.

Saudi Arabia increased its solar generation capacity from 2.4 gigawatts in 2023 to 6.2 gigawatts in 2024, an increase of around 156%. In Pakistan, grid-connected rooftop systems measured through the net metering scheme grew from 4 gigawatts in 2024 to 5.3 gigawatts in 2025. The country's total installed photovoltaic capacity is already estimated at more than 27 gigawatts.

Challenges for renewable electricity systems

By early 2026, global cumulative photovoltaic capacity had reached almost three terawatts. The new energy era is characterised by steadily rising shares of renewable generation.

However, further expansion is being constrained by the structural limitations of centralised energy systems and the slow integration of variable energy sources. These challenges require urgent action, particularly from regulators, to enable innovative and integrated solutions.

In many mature solar markets, negative or very low electricity prices during peak production periods have become a significant issue. Oversupply of photovoltaic power at midday reduces project profitability and can lead to inefficient measures such as curtailment.

The variability of renewable energy also presents challenges for grid stability. As

renewable capacity increases, more thermal and fossil fuel plants are being decommissioned. The physical inertia once provided by synchronous generators must now be replaced by alternative technologies.

Power grids are being stretched by the lack of adaptation to a decentralised generation landscape. Simply expanding network infrastructure is not sufficient. Existing assets are used inefficiently because grids and consumers are not yet adequately digitised and the rollout of smart meters remains incomplete.

Flexibility is essential to balance production and consumption and to deliver electricity where and when it is needed. Yet many systems still lack sufficient incentives for energy storage and flexible demand and in several countries, the regulatory framework remains unclear.

Encouragingly, suitable solutions already exist. Hybrid photovoltaic installations that combine solar power with battery storage or wind generation can address several of these challenges simultaneously. Battery storage systems offer multiple applications and play a central role in the energy transition. Combined generation facilities are creating new business models that significantly improve the financial viability of photovoltaic projects. The commercialisation of flexibility is increasing its availability within the system.

These and other solutions will be presented at The smarter E Europe in June 2026, Europe's largest alliance of exhibitions for the energy industry.

Sector coupling and electrification

To enable photovoltaics to supply as many sectors as possible with affordable electricity, electrification and sector coupling must accelerate. This involves integrating the electricity, heating and transport sectors.

In 2023, China covered 32% of its final energy consumption with electricity and this share is increasing by around one percentage point per year. Major markets such as India and the EU have set clear electrification targets: 40% by 2047 in India and 32% by 2030 in the EU. A reliable 24-hour renewable energy supply is achievable and practical examples will be showcased at the Renewables 24/7 special exhibit at The smarter E Europe.

A game changer for the energy transition: battery storage

Battery storage systems are becoming a central pillar of the energy transition. They enable the integration of variable renewable generation by storing electricity during periods of surplus and supplying it during periods of low output. This enhances grid stability and reduces curtailment when network capacity is constrained.





In 2025, the EU installed an additional 27.1 gigawatt hours of battery storage capacity, an increase of 45% compared with 2024, according to SolarPower Europe. Notably, 55% of the new capacity consisted of large-scale systems. These systems are emerging as key components of flexibility and are enabling new business models.

Revenue stacking, combining income streams from day-ahead and intraday trading, capacity markets and network services, is becoming increasingly important. Energy storage plants are evolving into professionally managed portfolios rather than single-purpose projects.

Hybrid photovoltaic systems: new financing models for large-scale plants

Hybrid photovoltaic systems are rapidly becoming standard practice. By combining solar generation and battery storage at a single grid connection point, infrastructure can serve multiple purposes. This arrangement enables planned feed-in, shifts electricity from midday peaks to evening demand and captures higher market prices.

These developments are opening new financing models for hybrid systems, particularly for large-scale solar plants that have faced declining market values. In addition to multi-use models, hybrid power purchase agreements are gaining importance.

Software is the next step. Artificial intelligence-supported dispatch strategies, digital twins and automated operational modes managed through advanced energy management systems are transforming solar installations into adaptive assets. This strengthens bankability and accelerates the deployment of hybrid and storage projects.

Storage and grid-forming inverters

Power systems require inertia as well as frequency and voltage stabilisation. Grid-forming inverters, in combination with battery storage, can provide synthetic inertia and essential system services. This technology is becoming indispensable in renewable-based systems operating around the clock.

Several countries, with the United Kingdom playing a leading role, are introducing auctions to procure system stability from grid-forming plants. These facilities typically include battery storage, although some photovoltaic plants equipped with grid forming inverters can provide reactive power services without batteries.

Grid-forming technology enhances system stability while creating additional revenue opportunities for both battery storage systems and solar power plants.

Unlocking potential: bidirectional charging

The EU holds considerable potential in the form of electric vehicles as mobile energy

storage units. Electric cars can contribute to grid stability and provide demand-responsive storage. According to E.ON, a single bidirectionally capable electric vehicle could supply up to 11 German households overnight.

Bidirectional charging is gaining momentum across Europe through initiatives led by industry, municipalities and governments. Germany has recently abolished dual grid charges, removing a major barrier to adoption. The ISO 15118 standard is being rolled out across the EU, enabling seamless communication between vehicles and charging stations without the need for additional devices or applications.

In 2025, the Dutch city of Utrecht launched a vehicle to grid car sharing scheme that supports local grid stability while offering affordable, sustainable mobility. Major manufacturers such as BMW and Elli are actively developing bidirectional charging solutions. The first commercial vehicle to grid offering for private customers in Germany is scheduled for launch in March 2026 by BMW and E.ON.

Flexibility: the underestimated grid booster

Flexibility refers to the ability of consumption and decentralised generation to respond to supply, pricing and grid conditions. It is essential for maintaining stability and affordability in systems dominated by wind

and solar power. EU projections indicate that demand for flexibility could increase by 133% by 2030.

Typically, flexibility is aggregated and marketed by specialised service providers rather than individual companies. Aggregators and energy service platforms combine controllable loads, storage assets, charging infrastructure and generation into virtual power plants. They manage forecasting, dispatch, verification and market access.

This creates a new ecosystem of services, including energy as a service, white label solutions for utilities and software platforms for automated control based on price and grid signals. Businesses benefit through lower energy costs, reduced peak demand and additional revenue from dynamic tariffs, spot market optimisation and system services. Flexibility reduces bottlenecks, flattens demand peaks and minimises curtailment.

Renewables 24/7 at The smarter E Europe

The Renewables 24/7 special exhibit at The smarter E Europe 2026 will present these system solutions in a comprehensive and practical format. It will outline a vision of a resilient, economically viable and socially accepted renewable energy system.

The exhibit will cover four thematic areas: industry, commerce, residential applications

and mobility. Using realistic scenarios, it will demonstrate how generation technologies, storage, load management, digital grids and intelligent control systems interact to ensure reliable supply at all times. Key challenges such as variability, excess production and prolonged periods of low renewable output will be addressed alongside practical solutions.

Displays, live demonstrations and expert contributions will explore regulatory and market developments and highlight international best practice examples.

The smarter E Europe 2026

The energy sector is evolving rapidly, along with its technologies, applications and business models. The smarter E Europe provides a key platform for dialogue, collaboration and knowledge sharing. More than 100,000 visitors are expected to meet 2,800 exhibitors across 19 exhibition halls and the outdoor area at Messe München.

The event brings together four exhibitions: Intersolar Europe, ees Europe, Power2Drive Europe and EM Power Europe. It will take place from 23rd to 25th June 2026, running from Tuesday to Thursday for the first time.

Across 200,000 square metres of exhibition space, the latest innovations in photovoltaics, energy storage, electric mobility, charging

infrastructure and integrated energy solutions will be showcased. Seven exhibition forums will host conference sessions on topics including large-scale storage, hybrid photovoltaic systems, bidirectional charging and grid-forming technologies.

Four parallel conferences will take place from 22nd to 23rd June at the International Congress Center Messe München. A single ticket provides access to all four events. The Midsummer BBQ on 22nd June will offer additional networking opportunities.

Award-worthy solutions for a sustainable energy supply

Each year, The smarter E AWARD recognises outstanding innovations in the categories of Photovoltaics, Energy Storage, E Mobility, Smart Integrated Energy and Outstanding Projects. Exhibitors from all international editions of The smarter E are eligible to participate. The 2026 awards ceremony will be held on 22nd June at the International Congress Center Messe München.

A sustainable energy future requires innovation, practical solutions and determined implementation. Europe has both the technology and the opportunity. Now it must deliver.

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