

Solar+

An EU pathway to achieve renewable targets,
price affordability, and energy security



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Foreword

The European Union stands at a decisive moment in its energy transition.

With less than five years remaining to achieve its 2030 climate and energy targets, we face a significant gap between ambition and delivery. At the same time, the war in the Middle East has brought to the surface once again what many had tried to push aside in a very short time since the first energy crisis in this decade: our persistently high exposure to fossil fuels continues to undermine industrial competitiveness, energy affordability, and energy security. In this context, the question is no longer whether we need to accelerate the energy transition, but how.

The question is no longer whether we need to accelerate the energy transition, but how — and Solar+ provides a clear and immediate pathway forward

This report, *Solar+: An EU pathway to achieve renewable targets, price affordability, and energy security*, provides a clear and evidence-based answer. It demonstrates that scaling up solar power and battery storage, as the cheapest and most versatile forms of power generation, offers the most effective and immediate pathway to deliver on all three pillars of the energy trilemma: sustainability, affordability, and security.

This analysis – modelled by SolarPower Europe's prime market research partner, Rystad, Energy and authored by our market intelligence team – compares a business-as-usual trajectory with a more ambitious Solar+ scenario. The findings are unequivocal: accelerating solar and storage deployment can set the EU power system in alignment with its 2030 renewable energy goals, significantly reducing reliance on fossil fuels. In doing so, solar + battery storage not only supports the EU's climate objectives. It also delivers tangible economic benefits: halving power system operating costs, lowering wholesale electricity prices significantly, and reducing price volatility for consumers and industry alike.

The report identifies a sweet spot where consumers benefit from lower average prices, while preserving the business case for large-scale solar investments, which has become increasingly unattractive as more frequent negative price-hour events decrease the value of solar power. Despite the expansion in variable renewables, the occurrence of negative pricing hours does not increase and wholesale day-ahead electricity prices are reduced.

Key is the contribution to reducing Europe's energy dependence in an increasingly uncertain geopolitical environment. By replacing imported fossil fuels with domestically produced renewable electricity, solar PV already delivers substantial savings – in the two months since the start of the Middle East war, solar has saved 8.5 billion EUR on gas imports. Under the higher ambition pathway, these savings could exceed 50 billion EUR per year by 2030. At a time when several policy leaders still count on fossil fuels in the medium term, it needs to be emphasised: Solar+ is not only a climate solution, it is an economic and strategic imperative for the EU.

However, realising this fast track requires decisive policy action. The report highlights that the main barriers are no longer technological, but structural and regulatory. To unlock the full potential of solar + storage, Europe must adopt a comprehensive flexibility-first approach to its energy system. This includes establishing an EU Flexibility Strategy, supported by a dedicated Battery Storage Action Plan, to ensure that storage and demand-side flexibility are fully integrated into market design, grid planning, and investment frameworks. As the analysis shows, battery storage is the key enabler of a high-renewables EU energy system, allowing solar power to be shifted in time, stabilising prices, and enhancing system efficiency.

With the EU's share of electrification having not increased for several years, it is clear that electrification in all sectors must be significantly accelerated. An ambitious and coordinated EU Electrification Action Plan is needed to align price signals, infrastructure development, and regulatory frameworks, making renewable electricity easy to deploy and the most competitive choice across industry, transport, and buildings. This also requires addressing distortions that continue to favour fossil fuels, while ensuring that the benefits of the transition are shared broadly across society.

Solar+ shows that the European Union has within reach a brighter energy future. With the right policy frameworks, what is often perceived as a long-term transformation, can deliver substantial benefits already within this decade. The opportunity is clear: by accelerating solar + storage today, Europe can secure its energy system for tomorrow – cleaner, cheaper, and more secure.



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The EU is falling short of its 2030 energy targets; accelerating solar and storage is the fastest way to close the gap and cut costs

With less than 5 years left to attain its 2030 climate and energy targets, the European Union still faces a significant shortfall in meeting these goals. Despite an acceleration on the deployment of renewable energy capacity in recent years, notably solar PV, current projections indicate that 2030 solar and wind capacity targets won't be met on time, leaving a gap to bridge in the EU renewable power and energy shares.

While the 2030 targets have been set with the objective to curb the negative effects of climate change, the attainment of these targets can reap massive additional benefits for EU citizens and businesses. An electrified and renewable-based energy system brings huge system cost savings to EU taxpayers, lower and less

volatile electricity prices for energy consumers, and reduced dependence on expensive and unreliable fossil fuel imports – a critical issue that the EU is experiencing for the second time in less than five years.

This study outlines and compares two different scenarios for the EU power sector in 2030, with the purpose of highlighting the positive synergies between decarbonisation efforts and the socio-economic benefits that come along with them. A business-as-usual Base Case scenario is compared to the Solar+ Scenario, which represents higher ambition towards the attainment of the 2030 targets. In this scenario, the most versatile and rapid-to-deploy technology solutions, primarily solar PV and battery storage, become more prominent in the EU power system.



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Sellingen, Netherlands.

Solar + BESS is the silver bullet to meet the EU 2030 renewable targets

Solar power and battery storage are the decisive technologies for delivering the EU's 2030 climate and energy goals in a context of growing power demand, which is expected to exceed 3,000 TWh by the end of the decade.

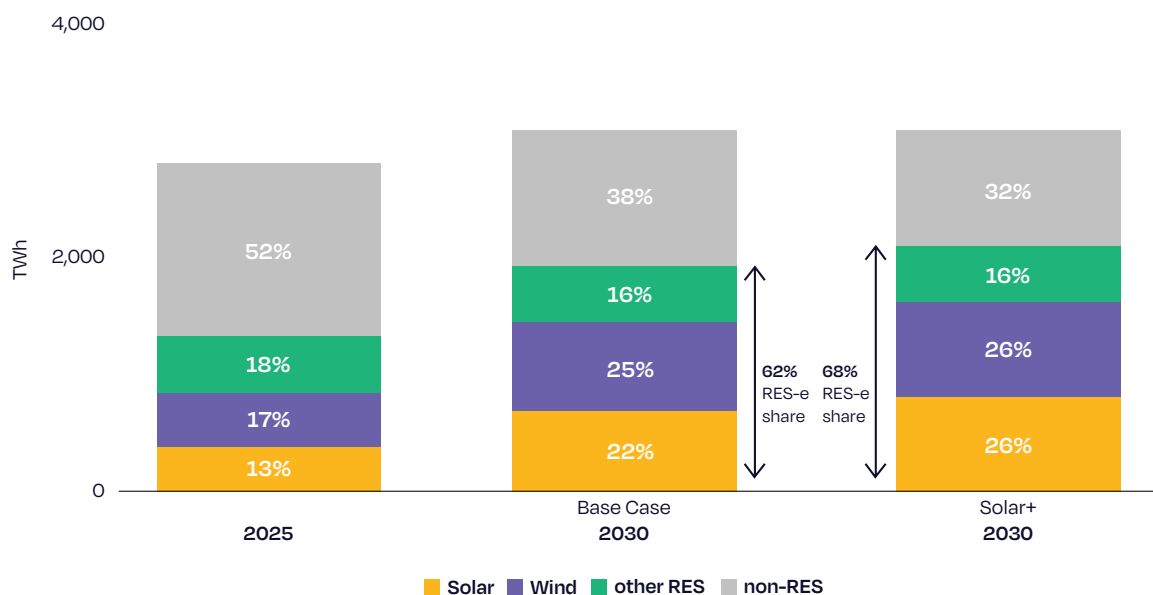
In both scenarios assessed, this growth is fully met by the expansion of variable renewables, while non-renewable generation declines in absolute and relative terms (Fig. 1). In the Base Case scenario, solar and wind together generate more than 1,400 TWh, covering 46% of demand and raising the overall renewable share to 62%. In the Solar+ scenario, renewables reach nearly 70% of electricity demand, reducing EU reliance

on fossil fuel generation. In this scenario, solar provides the single greatest amount of generation, thanks to its cost competitiveness, versatility and unmatched speed of deployment, meeting over 26% of EU electricity demand in 2030. With the right framework conditions in place and in tandem with adequate system flexibility, solar offers by far the greatest upside potential to accelerate the EU's power sector decarbonisation this decade. Rapid battery storage capacity expansion goes hand in hand with solar deployment, reaching 170 GW and 600 GWh by 2030 in the more advanced Solar+ scenario.

Figure 1

Driven by solar, renewable expansion reduces fossil generation in the 2030 power mix

EU electricity generation by source 2025 and 2030, Base Case and Solar+ scenarios



Higher solar and storage ambition leads to lower electricity costs in 2030

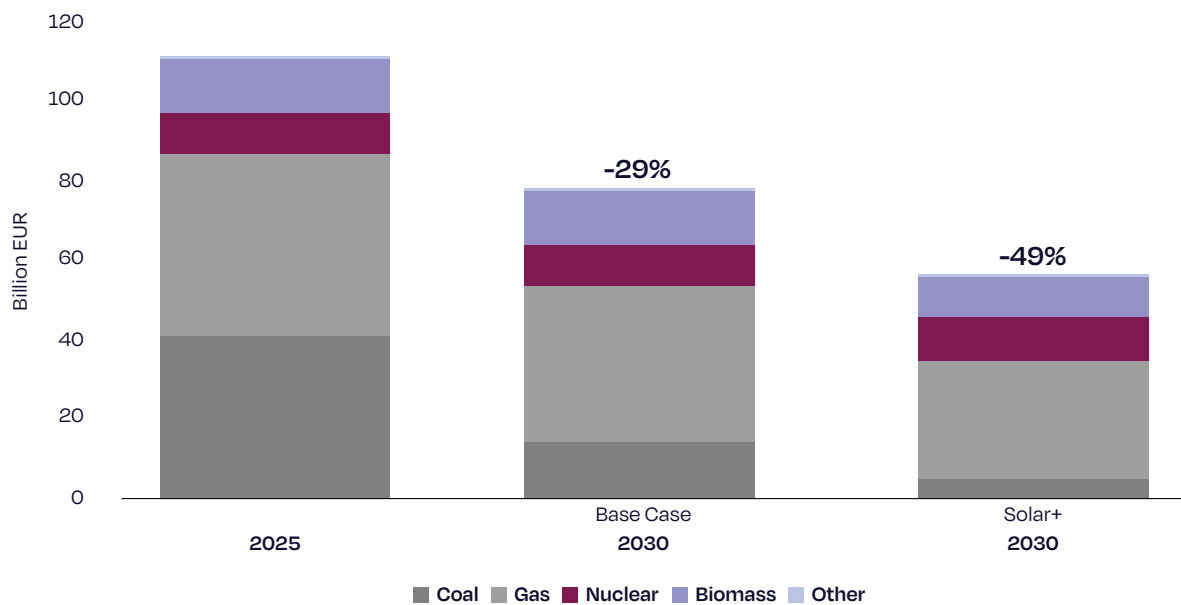
In a context of extreme price volatility and excessive reliance on expensive energy imports, an accelerated expansion of renewables brings crucial economic benefits to EU citizens and businesses.

The operating costs of the EU power system are drastically reduced in 2030, thanks to a steep reduction in fossil fuel usage. In the Base Case scenario, operating costs are reduced by 29% or 33 billion EUR annually compared to 2025. In the Solar+ scenario, these costs are cut by half, with savings amounting to 55 billion EUR annually (Fig. 2).

Figure 2

Accelerating renewables and storage deployment halves EU power system operating costs by 2030

EU power system operational expenditures (2025 real prices), 2025 vs 2030 Base Case and Solar+ scenarios



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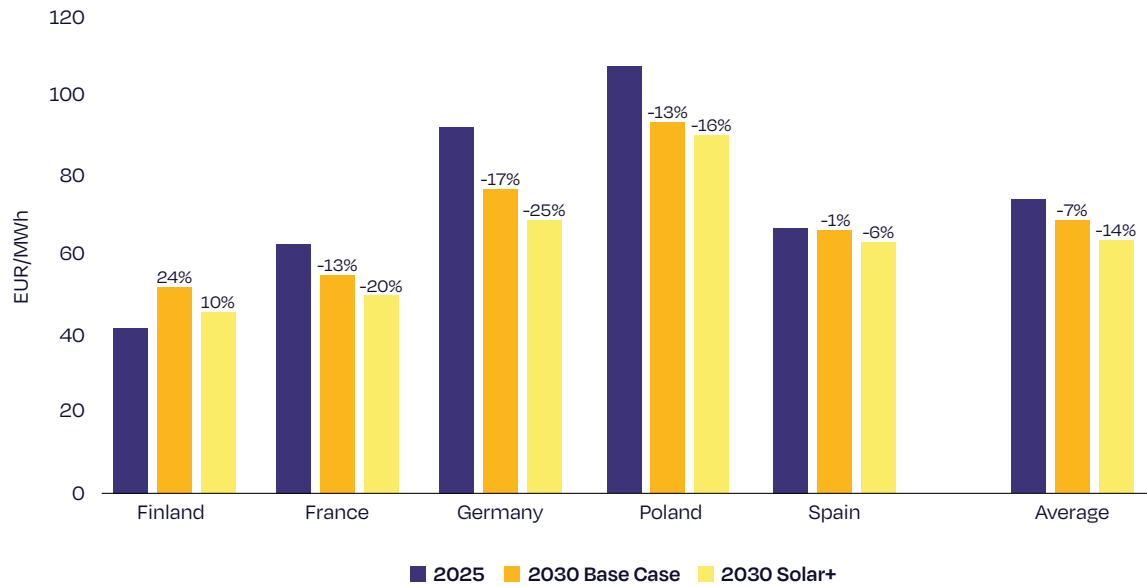
Wholesale power prices decrease thanks to a wider penetration of renewables coupled with battery storage (Fig. 3). Both the Base Case and the Solar+ scenarios feature lower electricity prices compared to 2025 levels, but the reduction is significantly larger in the Solar+ scenario. In the Base Case, prices in selected EU countries are on average 7% lower, down to

68.5 EUR/MWh. In the Solar+ scenario this trend is more pronounced, with 14% lower prices on average (63.4 EUR/MWh). This decrease is more apparent in countries with higher electricity prices, such as Germany and Poland. Notably, a decrease in power prices does not correspond to a steep increase in the number of negative price hours.

Figure 3

Across EU countries, more renewable ambition brings lower electricity spot prices in 2030

Average day-ahead wholesale electricity prices (2025 real prices) in selected EU countries, 2025 vs 2030 Base Case and Solar+ scenarios



© SolarPower Europe



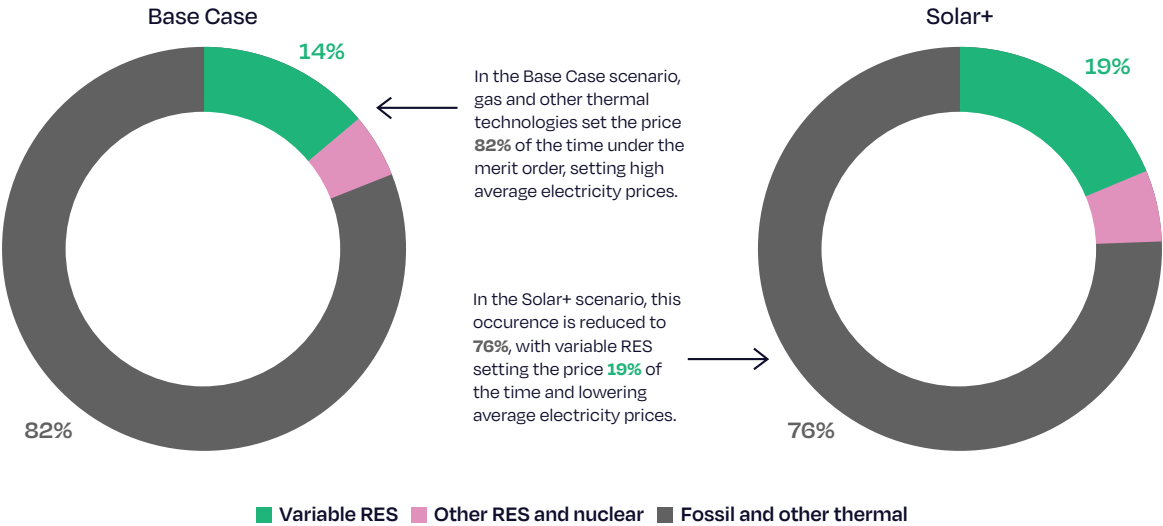
The decline in average wholesale electricity prices is mainly driven by a shift in price-setting technologies under the merit order, as higher shares of variable renewables reduce the hours in which fossil-fired plants, especially gas, set marginal prices. In the Base Case, gas and other OPEX-intensive thermal assets set prices for 82% of the year, while low-OPEX renewables

do so only 14% of the time, resulting in higher wholesale prices. In the Solar+ scenario, increased renewable generation lowers price levels by raising the share of hours in which variable renewables set prices to 19% and reducing the price-setting role of gas and other thermal technologies to 76%.

Figure 4

More renewables in the EU power mix set the electricity price more often, leading to lower average prices

Price-setting technology occurrence 2030, average of selected EU countries (Finland, France, Germany, Poland, Spain), Base Case and Solar+ scenarios



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A faster transition enables massive savings in fossil fuel imports and increases EU energy security

Solar PV deployment delivers substantial economic benefits to the EU by reducing the need for imported natural gas for electricity generation and replacing it with domestically produced renewable power.

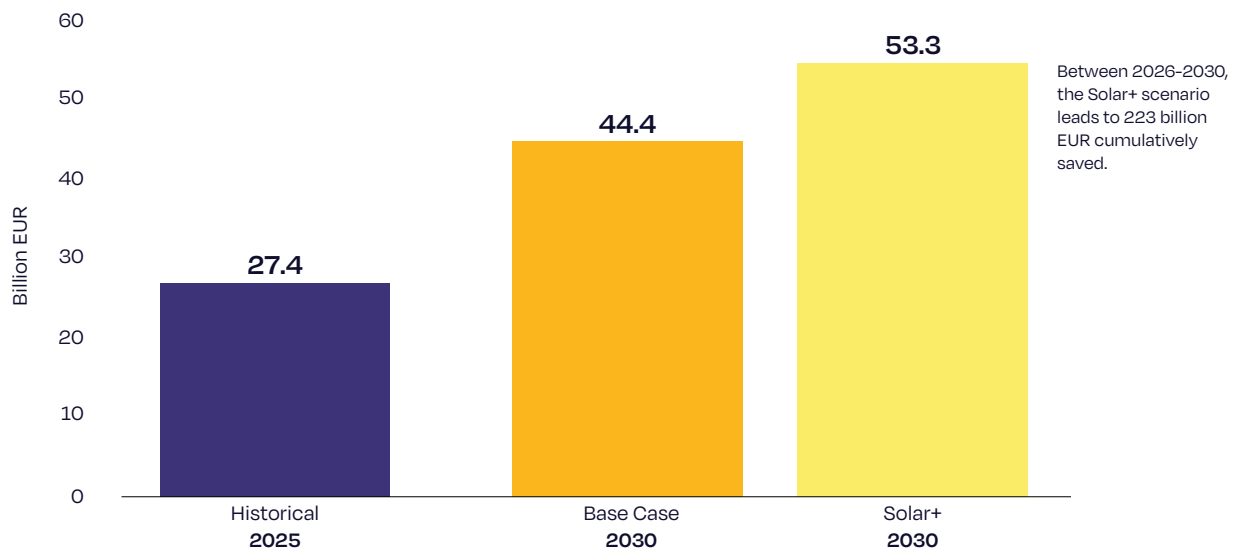
In 2025 alone, solar PV is estimated to have avoided 27.2 billion EUR in gas imports, shielding consumers and businesses from

gas price volatility while strengthening energy security. Under the Base Case, annual gas import savings rise to 44.4 billion EUR by 2030, while higher renewable ambition in the Solar+ scenario increases these savings to 53.3 billion EUR per year. Between 2026 and 2030, the Solar+ scenario avoids a cumulative 223 billion EUR in gas imports for power generation, 15% more than in the Base Case.

Figure 5

The EU could save up to € 53 billion in annual gas import costs in 2030 thanks to solar

Annually avoided EU gas imports thanks to solar electricity in 2025 and 2030, Base Case and Solar+ scenarios

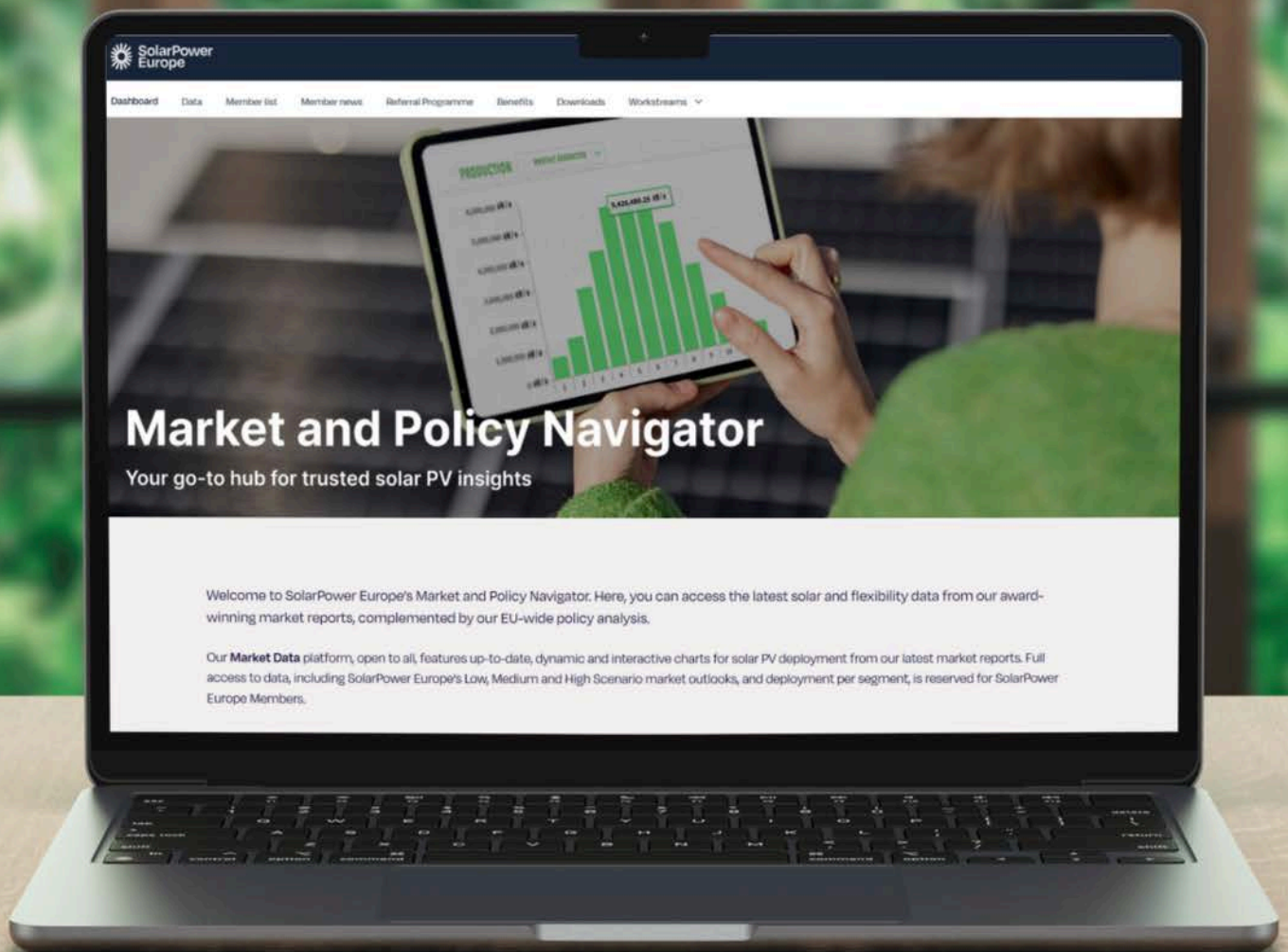


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Europe's energy vulnerability demands a rapid shift to renewables and storage to cut costs and secure its future

Yet again, the European Union finds itself impacted by high fossil fuel prices caused by geo-political events outside its control. This vulnerability is hurting the European economy – households and industries alike – and needs to be structurally solved.

Good energy policy considers affordability, sustainability and security alike. For the EU, these considerations now point decisively in the direction of shifting swiftly to home-grown European clean energy, demanding an acceleration of investment in renewables, flexibility and electrification.

These solutions are proven to be effective. It is thanks to progress in renewable energy that the EU is in a better position to winter the current fossil fuel price crisis compared to 2022 crisis. SolarPower Europe calculated that, at the time of publication of this study, solar alone saved the Union 8.5 billion EUR of fossil gas imports cost since the beginning of the Middle East crisis.¹ Depending on developments in the Middle East, solar and storage are projected to save the Union up to 67.5 billion by the end of the year.

This report looks at the possibilities to structurally improve the EU's energy resilience in the period up to 2030. It shows that what many describe as long-term solutions can, with the right policy decisions, deliver significant improvements in just a matter of years, making electrification the economically rational and attractive option for industries and households.

Central to the challenge is the cost of electricity in wholesale electricity markets. In 2025, gas power plants still very often influenced the electricity price across Europe. As the recent geo-political developments have once more reminded us about fossil price volatility, the current surge in gas price has been driving up the cost of gas-fired electricity generation, leading to high power prices for EU end-consumers. This report highlights how renewables and battery storage can actually reduce the role of gas in electricity generation and setting power prices, in turn lowering average wholesale electricity prices by 14% and price spreads by 42%, and cutting operational expenditure in the power system by half.

Accelerating investment in renewables and non-fossil flexibility should, therefore, be the absolute priority. We urge EU decision-makers to take the following actions:

1

Adopt an EU Flexibility Strategy with a dedicated Battery Storage Action Plan

Europe needs a coherent and proactive roadmap to integrate non-fossil flexibility across the energy system. While the Grids Package is currently under discussion, the EU still lacks an overarching implementation strategy to ensure that the full flexibility potential of demand-side resources and storage is systematically unlocked in a cost-efficient way.

¹ Up to 5 May 2026.

An EU Flexibility Strategy should provide this missing framework by embedding a flexibility first approach across grid planning, market design and regulation. This requires ensuring better use of the existing grid by conducting cost-benefit analyses of alternatives such as flexibility before investing in new cables, thereby avoiding unnecessary grid investments and reducing overall network charges and system costs.

Yet, we should continue to call on regulators and system operators to make the necessary anticipatory investments in grids to meet future renewables and electrification. To support this, grid tariffs should be designed to be cost reflective so, they provide clear price signals that encourage efficient use of the grid, including through locational tariff signals such as reduced connection charges for battery storage and electrification assets located near renewables or, for BESS, in congested areas.

For this approach to be effective, flexibility solutions must be consistently reflected in regulatory decisions, including tariff design, grid investment incentives and system planning methodologies. Unlocking demand response is central to this strategy and requires enabling households, businesses and industry to actively participate in energy markets and to be properly rewarded for the flexibility they provide.

Battery storage is the game-changing technology for flexibility. As outlined in AccelerateEU, the EU should aim at increasing storage from 55 GW today to 200 GW in 2030. This requires full focus on the investability of BESS across Europe, including EU-level instruments that can provide long-term revenue stability and de-risks utility-scale BESS investment. Several Member States, including Bulgaria, Italy, and Spain, already demonstrate effective approaches that have enabling around 33.1 GWh of utility-scale BESS, with Bulgaria deploying **RRF-funded** CAPEX grants covering up to 50% of eligible costs for approximately 3 GWh of storage capacity, Italy implementing the **MACSE mechanism** as a centralised capacity auction providing long-term availability contracts and stable revenue streams for storage assets, and Spain using **ERDF-funded** competitive CAPEX grants for both standalone and hybrid storage projects to accelerate deployment and grid integration. These models can be supported on EU-level and replicated across other Member States to accelerate deployment of non-fossil flexibility.



2

Adopt an ambitious and coordinated EU Electrification Action Plan

Electrification is a cornerstone of Europe's decarbonisation pathway and a key driver of competitiveness, energy security and industrial resilience, yet progress across industry, transport and buildings remains too slow. A strengthened EU Electrification Action Plan is needed to translate existing legislation into tangible deployment by aligning regulatory frameworks, price signals, infrastructure planning and permitting procedures, so that electrified solutions become the most cost-effective choice for consumers and industry. This includes correcting distortions that disadvantage electricity compared to fossil fuels and reforming taxes and levies to lower the electricity-to-fossil fuel price ratio.

To accelerate delivery, the EU should set an EU-wide target for electrification post-2030 and ask Member States to systematically integrate electrification objectives into their NECPs, supported by clear indicators, milestones and demand forecasts. Achieving these goals should be prioritised across EU funding instruments including on industrial electrification, infrastructure modernisation and skills development. Faster and more predictable permitting and grid connection procedures are essential, alongside regulatory frameworks that enable smart and flexible electrification, including demand response and smart charging. Ensuring affordability and social fairness through measures such as social leasing and one-stop shops will be critical to secure broad uptake and lasting impact.



Monti di Eboli, Italy.

Introduction and methodology

Over the past years, the EU has made tangible progress on its decarbonisation pathway. Under the European Climate Law² adopted in 2021 and the 2023 revised Renewable Energy Directive³, the EU set a legally binding goal to reduce greenhouse gas (GHG) emissions by at least 55% compared to 1990 levels, and to reach at least 42.5% in the share of renewable energy sources (RES) in final energy consumption, with an ambition to reach 45%, by 2030.

This political momentum has translated into an acceleration on the deployment of renewable energy capacity, notably solar PV, which has seen annual installation volumes growing threefold between 2020 and 2023, reaching over 60 GW_{DC} per year. Steep solar technology cost declines, both at module and system level, alongside with increased energy security considerations and a growth in demand for clean electricity, have been the main drivers for this remarkable expansion.

With less than 5 years left to attain its 2030 climate and energy targets, however, the EU still faces a significant shortfall in meeting these goals (see Fig. 6). According to EEA data⁴, by 2025 GHG emissions have decreased by 37% compared to 1990 levels, with an 18 percentage point gap towards the 2030 goal. Similarly, the RES share in the EU energy mix stood at an estimated 26% in 2025, which is 16.5 percentage points lower than the minimum RES target for 2030.

Specifically for the power sector, according to European Commission modelling under the REPowerEU plan⁵, the EU electricity sector would need to reach a renewable share around 69% by 2030 to align with its climate and energy goals. In other words, well over two-thirds of EU electricity is set to come from renewable sources by 2030. Having reached in 2025 an estimated 48% RES share in the electricity mix⁶, current levels are 21 percentage points lower than the 69% indicative benchmark from the EU Commission. Against this background, a rapid acceleration in RES deployment and GHG emission reduction is required to meet the EU climate and energy targets for 2030.



² Regulation (EU) 2021/1119 of the European Parliament and of the Council.

³ Directive (EU) 2023/2413.

⁴ 2025 EEA projection "with existing measures" (WEM).

⁵ Commission Staff Working Document COM(2022) 230 final.

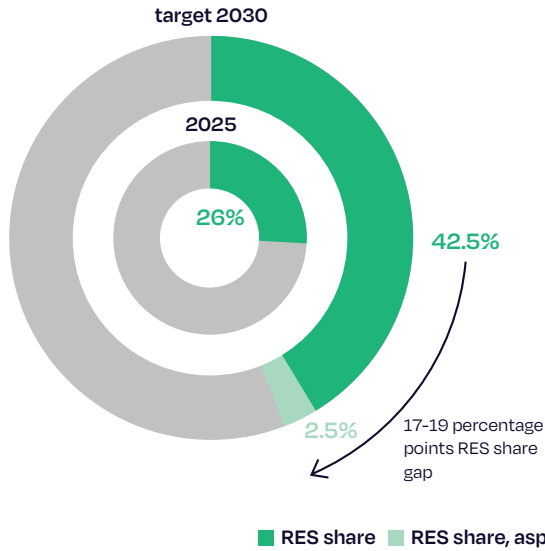
⁶ Ember (2026): [European Electricity Review 2026](#).

Figure 6

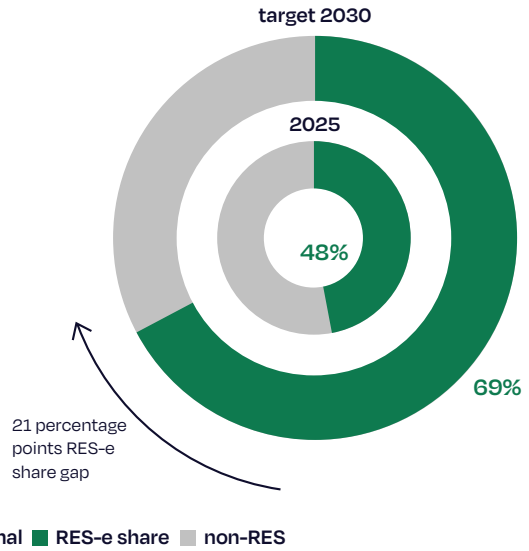
Reaching EU 2030 climate & energy targets requires a 20% jump from 2025

EU climate and energy targets 2030 and indicative benchmark for RES electricity compared to 2025 levels

Renewable energy share in the EU energy mix, 2025 and 2030 target

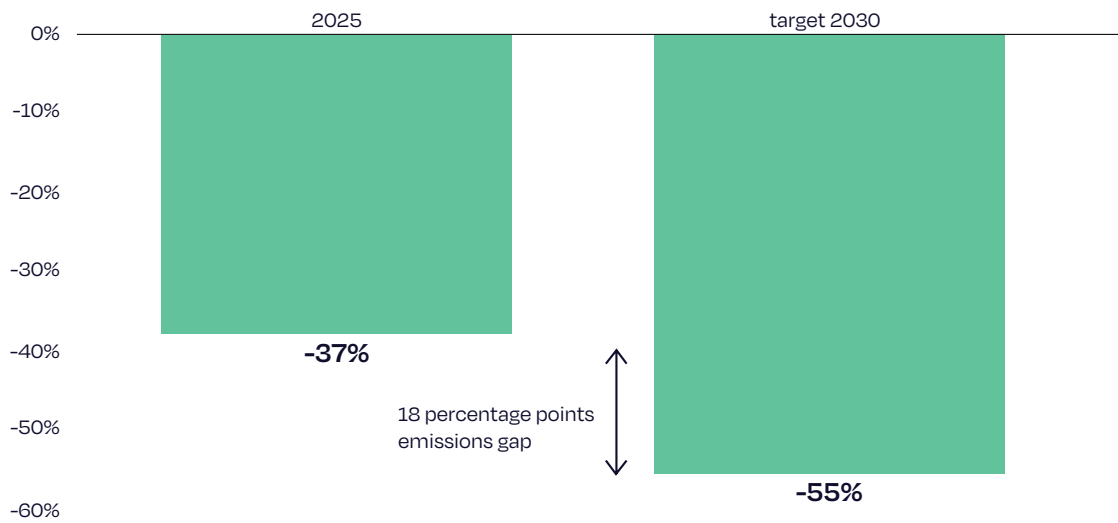


Renewable energy share in the EU electricity mix, 2025 and 2030 indicative benchmark



■ RES share ■ RES share, aspirational ■ RES-e share ■ non-RES

EU GHG emission reduction from 1990 levels, 2025 and 2030 target



Note: The EU climate and energy targets for 2030 include binding targets for the RES share in the energy mix and for GHG emissions reduction. The RES share in the energy mix has a 42.5% binding target, with an aspirational extra 2.5%. The GHG emissions reduction has a binding target of -55% compared to 1990 levels. The RES share in the electricity mix (RES-e share) is an indicative benchmark from the EU Commission's Impact Assessment.

© SolarPower Europe. Source: EEA, Ember

As the most cost-competitive decarbonisation technologies in the power sector, solar and wind have been the backbone of renewable expansion in the EU. Currently, solar and wind power together already account for a substantial share of the EU's electricity mix. In 2025, wind power generated 473 TWh or 17% of EU electricity, and solar 369 TWh, which corresponds to slightly above 13% of the power mix.⁷ Notably, distributed solar systems provide an important share of total solar generation – as the majority of today's EU solar capacity is installed on rooftops – but their contribution is often underrepresented in official statistics (see Box 1).

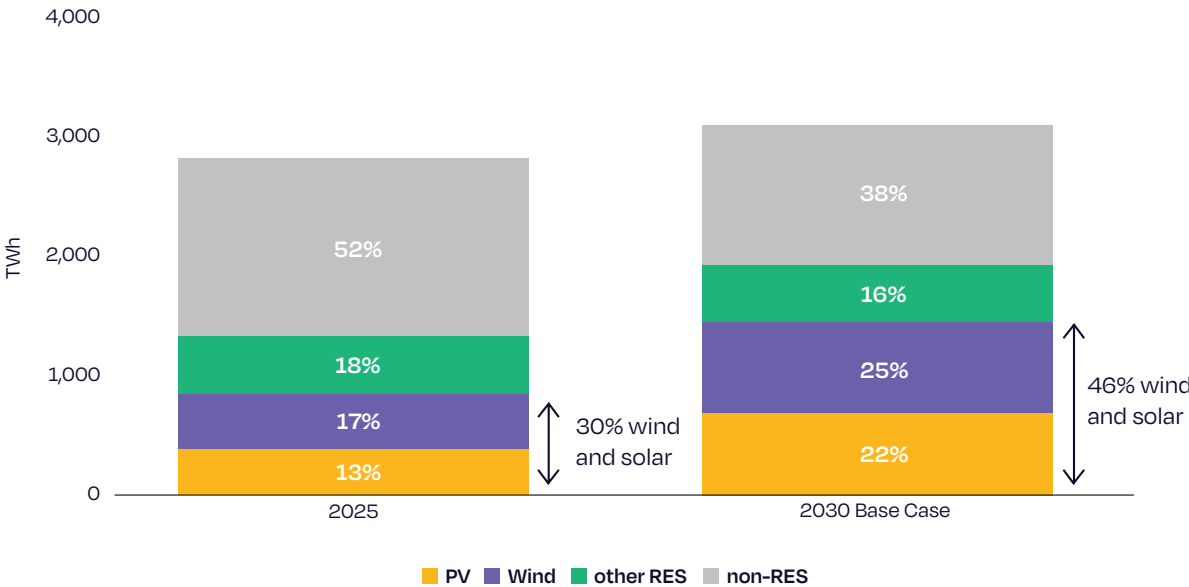
Combined, wind and solar provided a record 30% of EU electricity in 2025, surpassing fossil fuel generation for the first time. All renewable energy sources combined met 48% of the EU power demand (see Fig. 7).⁸

Under business as usual conditions – that is, according to the most updated expectations of renewable deployment and growth in electricity demand – wind and solar generation is poised to expand further and reach a 46% share in the EU power mix by 2030. Renewables as a whole are expected to provide a 62% share, bringing non-RES electricity to 38%.

Figure 7

Solar and wind already cover 30% of EU power demand, rising beyond 45% by 2030

EU power generation 2025 and forecast 2030 under Base Case scenario



© SolarPower Europe

⁷ Ember (2026): [European Electricity Review 2026](#).

⁸ Electricity demand is expressed as gross demand, including transmission and distribution losses, for direct comparability with gross generation data, in line with historical Eurostat reporting.

Rooftop solar generation tends to be underrepresented in EU statistics

Solar PV is growing into an essential piece of the EU electricity system. From less than 1% of the electricity generated in the EU in 2010, solar has reached over 13% in 2025. However, tracking solar electricity generation with precision remains challenging and can lead to sharp underestimation of its actual contribution. Solar is a versatile and distributed electricity source, ranging from a few kilowatts installed on residential rooftops to large ground-mounted solar farms representing hundreds of megawatts. While large solar assets are typically well accounted at transmission levels, the distributed rooftop systems are more difficult to track for several reasons.

First, rooftop solar systems must be registered with local network operators. While many countries do have such a registration process, they are often incomplete or not well transposed into the national energy statistics. In some cases, only systems which benefit from support schemes are being accounted for, leaving all unsubsidised systems invisible. As a result, official installed capacity statistics frequently underestimate the true scale of rooftop solar. Even when PV systems are captured, delays often occur between the households' notice and the actual accounting in system operator data.

Secondly, a substantial share of electricity generated by rooftop solar is consumed directly on site by households and businesses, without ever passing through DSO or TSO networks. Electricity statistics, however, are largely based on electricity injected into public networks. This creates a structural bias whereby higher self consumption rates translate into lower recorded solar generation. The effect is further amplified by the rapid deployment of residential batteries, which are charged with solar electricity during the day and discharged in the evenings and mornings. Combined solar plus storage systems can raise self consumption rates towards 80%, in particular when energy needs for heating and transport are electrified at home, making a large share of rooftop solar generation effectively invisible to conventional electricity statistics.

Thirdly, rooftop solar systems are typically connected to local DSOs, which must then aggregate data across millions of small installations. Unlike large, centralised generators, rooftop systems are numerous, geographically dispersed, and heterogeneous, increasing the administrative and data management burden for DSOs. While some DSOs have developed robust processes to address this challenge, many have not yet fully adapted their internal systems to accurately account for the rapid growth of distributed solar capacity on their networks.

Fourthly, even when solar installations are properly registered, monitoring and aggregating accurate generation data remains challenging. While smart meters can improve data availability, they are not systematically configured to measure on-site solar generation directly. In many cases, only the net consumption or grid feed-in is recorded, which limits visibility on the real rooftop PV generation. Consequently, accurately capturing distributed solar generation often requires combining multiple data sources and estimation methods. In systems with limited metering infrastructure or restricted data access, rooftop PV generation must frequently be inferred indirectly, leading to uncertainties in the estimates.

For these reasons, electricity generation reporting in the EU often underrepresents rooftop solar and disproportionately reflects utility scale installations. This can lead to extreme cases: reported solar generation in the Netherlands' electricity mix is minimal, despite the country hosts more than 20 GW of solar PV capacity, around 75% of which is installed on rooftops.

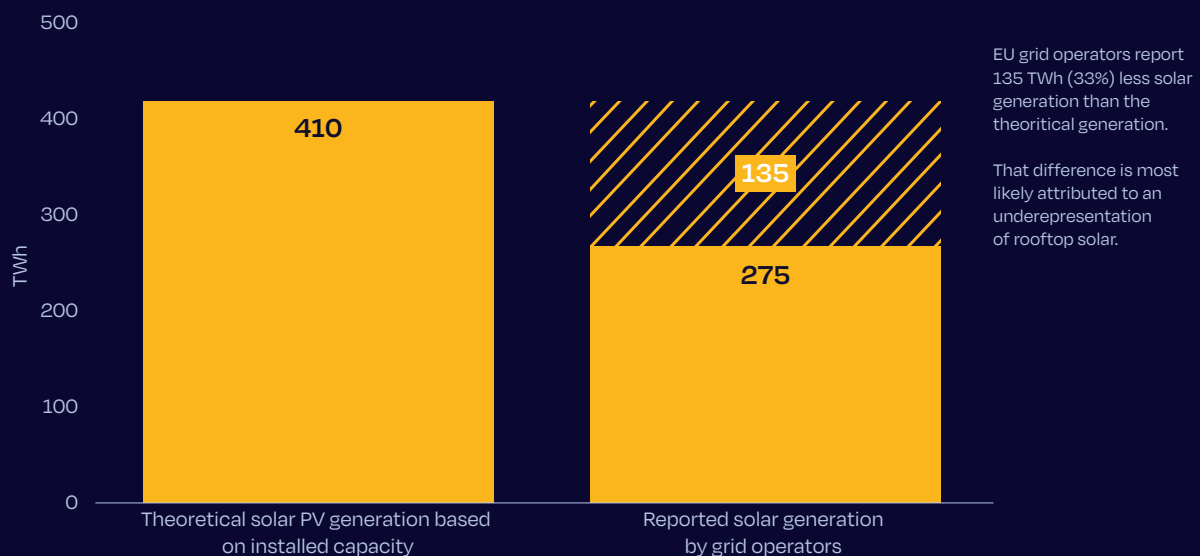
Extrapolated to the EU level, this underrepresentation can reach a substantial scale. Taking 2025 as an illustrative case, the EU had 406 GW of installed solar PV capacity at the end of the year, of which around 247 GW, or 61%, was installed on rooftops. Applying each Member State's installed solar capacity to its median yield, the total EU solar PV capacity would theoretically generate around 410 TWh of electricity over the year.⁹ In comparison, the solar electricity generation officially reported by system operators reached 275 TWh in 2025.¹⁰ This is 135 TWh, or 33%, short of the theoretical PV generation (Fig. 8). While this gap cannot be attributed to a single factor, given the dominant share of rooftop systems in EU solar capacity and the measurement limitations discussed above, the underrepresentation of distributed solar generation is likely to be the main cause of the observed difference.

The 2025 solar PV generation value used in this report, sourced from Ember, falls between these two ranges, at 369 TWh. This is 34% higher than the officially reported generation but 10% lower than the theoretical PV output.

Figure 8

EU grid operators underestimate rooftop solar generation; 33% of total solar generation goes uncounted

EU officially reported solar PV generation vs theoretical output of installed PV capacity in the EU in 2025



© SolarPower Europe. Source: SolarPower Europe; Energy-Charts (ENTSO-E, AGEE-Stat, Destatis, Fraunhofer ISE, AG Energiebilanzen)

⁹ Solar PV yields (kWh/kW/year) are taken from the World Bank Group's Global Solar Atlas. For each EU Member State, the monthly solar PV generation is estimated by applying country specific monthly yields to the cumulative installed PV capacity at the end of each month. Annual generation is the sum of the monthly estimates. A downward correction factor was applied to Global Solar Atlas yields to reflect lower average output of rooftop solar systems with suboptimal configurations, compared to utility-scale systems with optimised performance.

¹⁰ As reported by Energy-Charts, sourcing ENTSO-E, AGEE-Stat, Destatis, Fraunhofer ISE, AG Energiebilanzen.

The expansion of wind and solar capacity is not progressing at the same pace. In recent years, wind growth has been hindered by various headwinds, including protracted permitting processes, supply chain bottlenecks, social acceptance, and rising costs of capital and materials. All these factors are slowing the pace of new wind farm installations. In 2025, the EU built only 15.1 GW of new wind capacity (14.2 GW onshore, 0.9 GW offshore), reaching 246 GW of total installed capacity.¹¹ While a partial acceleration in annual additions is expected in the next few years, total wind capacity is poised to reach 343 GW by 2030 according to WindEurope, missing the EU wind capacity target of 425 GW by 82 GW or 19% (Figure 9).

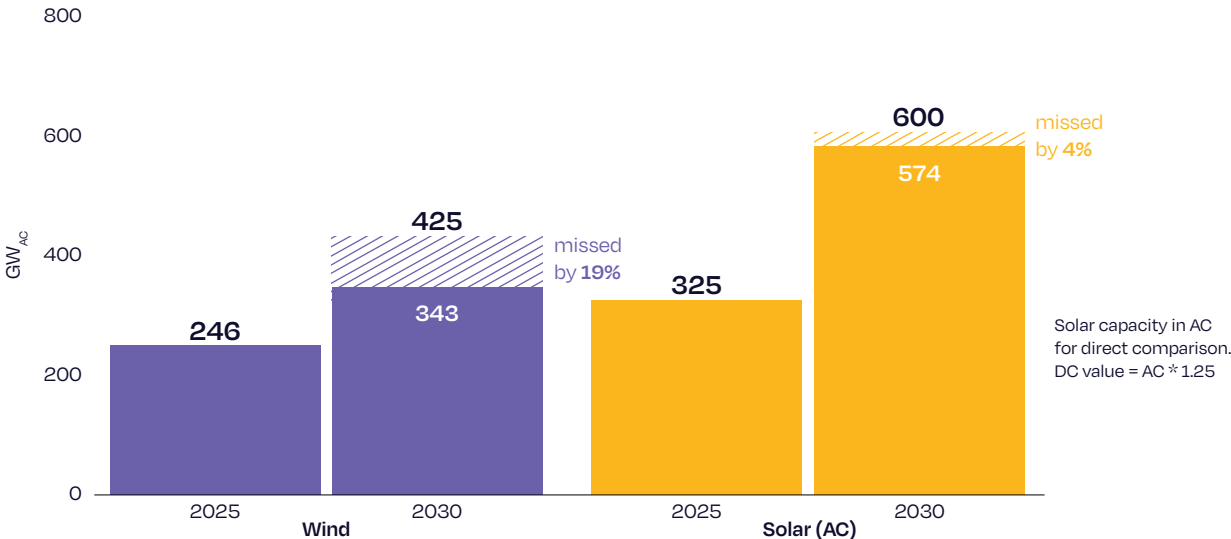
In contrast, the EU solar PV market has gained considerable traction in recent years, reaching an installed base of 325 GW_{AC} (406 GW_{DC}) by the end of 2025.¹² However, in recent times it has also started to face significant challenges, mainly related to the lack of flexibility of today's energy system, which is not fit to accommodate high shares of variable renewable (VRES) generation. As a result, both technical and financial challenges have emerged, undermining the attractiveness of new investments in solar and resulting in a slowdown of deployment. Across Europe, negative price hours have soared in the last couple of years, posing a serious challenge to the PV business case as solar capture prices are pushed significantly down.

Under current policy and investment conditions, and without a swift policy intervention to unlock flexibility solutions, annual solar's rapid deployment growth from the early 2020s is expected to halt, with annual installations remaining below the 70 GW level until 2030. As a result, total solar PV capacity is currently forecast to reach only 574 GW_{AC} (718 GW_{DC}) by 2030, failing to attain the EU target of 600 GW_{AC} / 750 GW_{DC} by 4%.¹³

Figure 9

Under current conditions, wind installations will miss the EU 2030 target by 19%, and solar by 4%

EU wind and solar capacity 2025 and forecast 2030 under business-as-usual scenario compared to EU 2030 capacity targets



Note: Unlike typical SolarPower Europe reporting, solar PV capacity is expressed in AC, to allow for a better comparison with other technology sources. A 1.25 DC/AC conversion ratio is assumed.

© SolarPower Europe. Source: SolarPowerEurope, WindEurope

¹¹ WindEurope (2026): [Wind energy in Europe - 2025 Statistics and the outlook for 2026-2030](#).
¹² Unlike typical SolarPower Europe reporting, solar PV capacity is expressed in AC values throughout the study, to allow for a better comparison with other technology sources. A 1.25 DC/AC conversion ratio is assumed.
¹³ SolarPower Europe (2025): [European Solar Market Outlook 2025-2030](#).

While the 2030 targets have been set with the objective to curb the negative effects of climate change, it is key to highlight that the efforts towards the attainment of these targets can reap massive additional benefits for EU citizens and businesses. An electrified and renewable-based energy system brings huge system cost savings to EU taxpayers, lower and less volatile electricity prices for energy consumers, and, perhaps most importantly, reduced dependence on expensive and unreliable fossil fuel imports – a critical issue that the EU is experiencing for the second time in less than five years.

This study outlines and compares two different scenarios for the EU power sector in 2030, with the purpose of highlighting the positive synergies between decarbonisation efforts and the socio-economic benefits that come along with them.

To do so, the analysis first considers a business-as-usual scenario, building on Rystad Energy's Base Case, to illustrate current deployment pathways for the EU power system towards 2030.¹⁴ This scenario is compared to the Solar+ Scenario, which represents higher ambition towards the attainment of the 2030 targets. In this scenario, the most versatile and rapid-to-deploy technology solutions – primarily solar PV and battery storage – become more prominent in the EU power system.

While the Base Case scenario represents Rystad Energy's central scenario forecasting European power system developments, the Solar+ scenario is built through the Rystad Power System Analysis (REPSA) capacity expansion model. REPSA is a sector-coupled power system model with high spatial and temporal resolution and multi-carrier transmission representation building on Rystad Energy's data on power generation assets, electrification, and energy demand forecasting to represent each individual country in the short, medium and long-term. Based on the PyPSA energy system modelling framework, the model co-optimises investment and operations of generation, storage, conversion, and transmission infrastructures for the least-cost outcome in a linear optimisation problem covering the European synchronous area. The model incorporates spatially distributed demand across residential, commercial, industry, agriculture, and transport sectors, including a variety of fuels and energy carriers. Flows between energy carriers are modelled by technologies including heat pumps, boilers, thermal storage, and power-to-X processes.

Data on electricity prices is based on Rystad Energy and Volt Power Analytics' hourly price forecasting model in conjunction with SINTEF Energy Research's software tool EMPS. The main objective of the model is to achieve the optimisation of the power system by minimising the expected cost subject to all generation and transmission constraints. The model design simulates the interconnected Nordic and pan-European electricity markets hour-by-hour over 30 weather years over the long-term horizon to 2050. It also includes comprehensive modelling of price volatility (including negative prices) due to the combined weather effects in wind, solar, and hydro power, combined with the weather effects in power consumption.

14 Rystad Energy's Base Case presents minor differences from SolarPower Europe and WindEurope estimations and forecasts.

Key results

Solar + BESS is the silver bullet to meet the EU 2030 renewable targets

The penetration of renewable energy sources in the EU power system increases at different paces by 2030 across the two scenarios considered in this study (see Fig. 10).

In 2025, renewables covered 48% of the EU electricity demand, with wind, solar, and other RES technologies each providing roughly one-third of that green electricity.

Electricity demand surpasses 3,000 TWh by 2030 in both scenarios, an increase of over 10% compared to 2025. In both scenarios, a decrease in non-renewable generation is more than compensated by variable renewable generation growth, which enables a larger share of renewables to meet power demand.

Under the Base Case scenario, solar and wind generation reach 668 and 764 TWh respectively, corresponding to an increase of 299 and 291 TWh, or 81% and 61%, compared to 2025 levels. Together, they provide over 1,400 TWh of electricity, contributing 46% of total demand. Renewables as a whole reach a 62% share, reducing non-RES generation to 38%, down from 52% in 2025.



Katrineholm, Sweden.

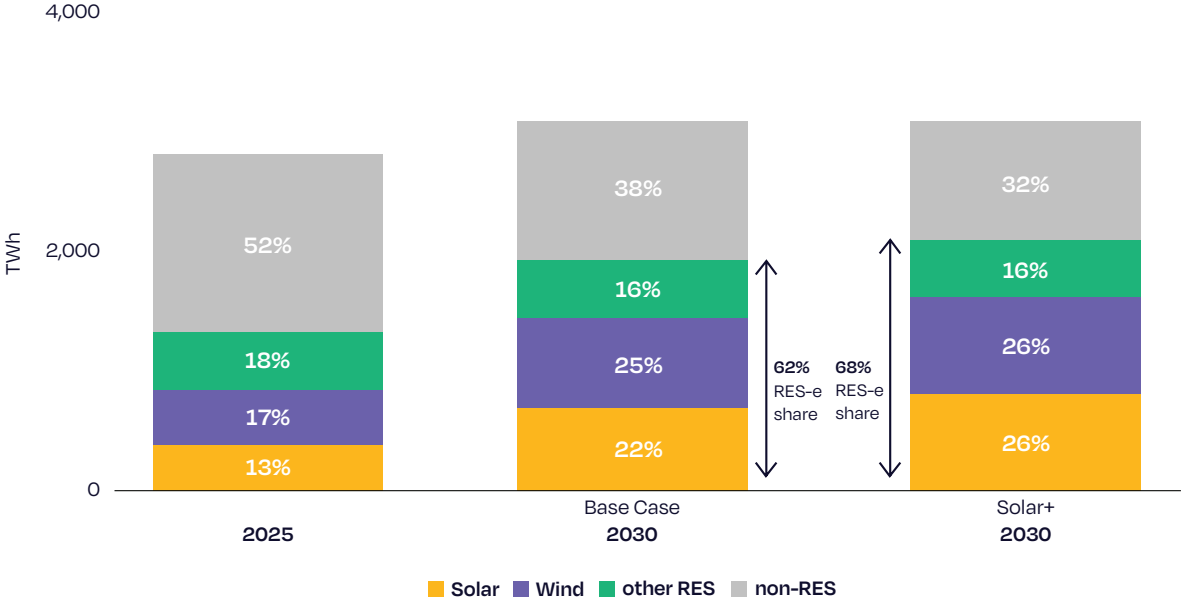
Under the Solar+ scenario, all these trends become even more pronounced. Solar and wind generation combined provide 1,600 TWh of electricity, capturing a 52% share; all renewables aggregated reach a 68% share, pushing non-renewables down to 32% – broadly aligned with the EU Commission’s 69% indicative RES benchmark. Reflecting its competitiveness and rapid scalability across different geographies and market conditions, solar in particular takes the lead in pushing non-renewables out of the power mix, providing the largest generation share across all technologies. More than doubling its absolute contribution to 803 TWh, solar reaches a share slightly above 26%.

Overall, the Solar+ scenario features an electricity RES share that is 6 percentage points higher than in the Base Case scenario, where fossils, led by gas-fired electricity, still meet 38% of the EU power demand.

Figure 10

Driven by solar, renewable expansion reduces fossil generation in the 2030 power mix

EU electricity generation by source 2025 and 2030, Base Case and Solar+ scenarios



Note: 2025 data based on Rystad Energy presents marginal differences from previously reported generation data.

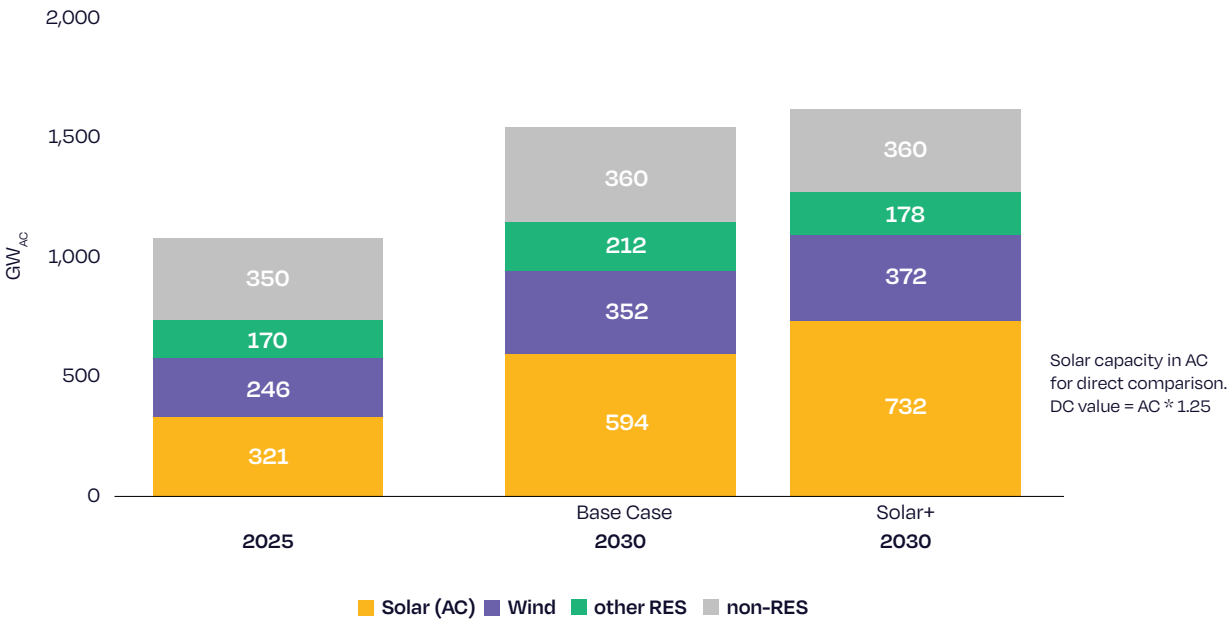
The increase in renewable energy generation is well reflected in the EU installed capacity through 2030 (Figure 11). Across the two scenarios analysed, solar and wind installations grow significantly, without notable variations in other technologies. In the Base Case scenario, solar capacity grows 85% from 2025 and reaches 594 GW_{AC}, falling marginally short of the EU 2030 solar target, while wind capacity grows 38% to 352 GW, which means a 17% miss of the EU 2030 wind target.¹⁵

By contrast, the Solar+ scenario features a rapid acceleration of solar deployment in the next five years, which brings total capacity to 732 GW_{AC}. This is 23% higher than the Base Case and largely surpasses the EU solar target for 2030. Wind capacity is marginally (6%) higher than the Base Case, at 372 GW, and still fails to reach the EU solar target of 425 GW. Wind installation volumes over the next five years are largely locked in, reflecting the comparatively long lead times of investment decisions and project development. Solar, by contrast, is faster and more flexible to deploy. With the right framework conditions, solar projects can be grid-connected within a short timeframe. As a result, solar offers much greater upside potential in capacity projections than any other generation technology.

Figure 11

With increased ambition, EU solar capacity more than doubles by 2030

EU power capacity by source 2025 and 2030, Base Case and Solar+ scenarios



Note: Unlike typical SolarPower Europe reporting, solar PV capacity is expressed in AC, to allow for a better comparison with other technology sources. A 1.25 DC/AC conversion ratio is assumed. 2025 solar and wind capacities are based on SolarPower Europe and WindEurope data.

¹⁵ Rystad Energy's Base Case forecasts slightly higher solar and wind capacity in 2030 than SolarPower Europe and WindEurope.

Strong battery storage deployment accompanies the penetration of variable renewables in the EU power mix

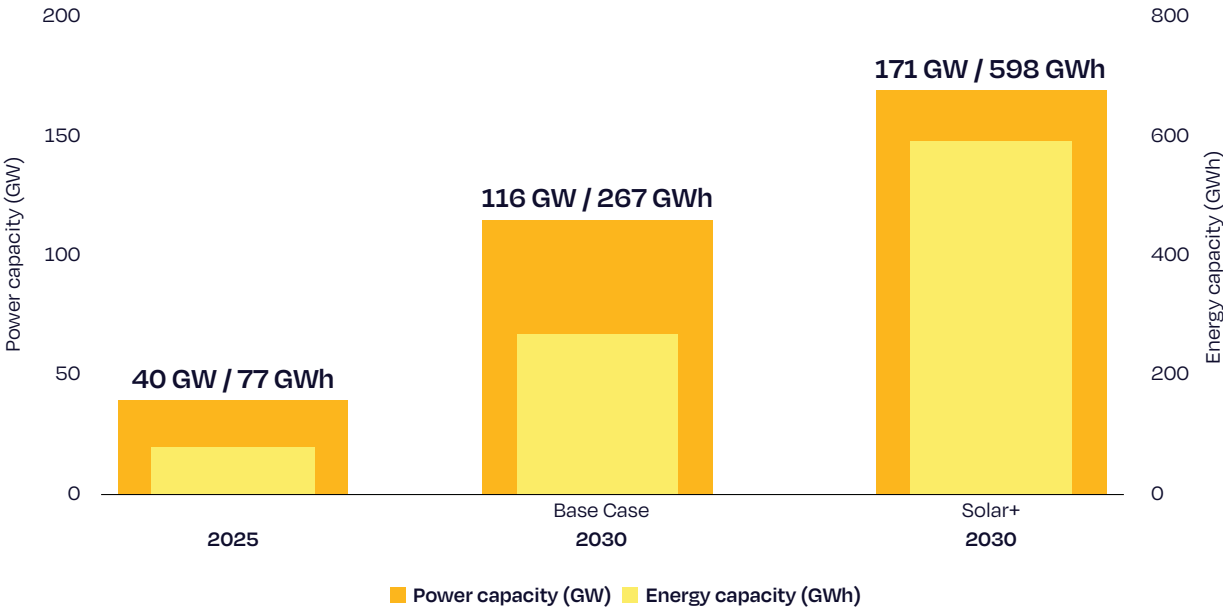
A crucial feature of a renewable-based power system is flexibility – and the deployment of a key flexibility solution for further RES growth is battery storage, which is highly visible in the two scenarios considered by this study (Fig. 12).

By the end of 2025, totally installed EU battery storage capacity reached 40 GW of power capacity and 77 GWh of energy capacity, in a market characterised by high annual growth, with a rate over 45% year-on-year.¹⁶ This acceleration is poised to keep a strong momentum for the next years. Under the Base Case scenario, operating BESS capacity in the EU reaches 116 GW and 267 GWh by 2030 – basically a threefold growth compared to 2025 volumes. Under the Solar+ scenario, a larger share of variable renewables is coupled with additional storage capacity, which reaches 171 GW of power capacity and 598 GWh of energy capacity. While falling short of SolarPower Europe's ask for a 10X growth in battery storage by 2030 to roughly 750 GWh, this still corresponds to a fourfold increase in power capacity and an eightfold increase in energy capacity compared to 2025. Notably, an increased penetration of solar and wind in the power mix corresponds to a longer average storage duration to reap more benefits from energy shifting. Average storage duration reaches 3.5 hours in the Solar+ scenario, compared to 2.3 hours in the Base Case scenario and 1.9 hours in 2025. A longer duration also reflects the increasing shift towards larger-scale battery storage systems.

Figure 12

With more ambition, EU batteries reach 600 GWh by 2030, optimising a renewable-based power system

EU BESS installed power and energy capacity 2025 and 2030, Base Case and Solar+ scenarios



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16 SolarPower Europe (2025): [European Market Outlook for Battery Storage 2025-2029](#).

A renewable-based power system leads to substantially lower operating costs

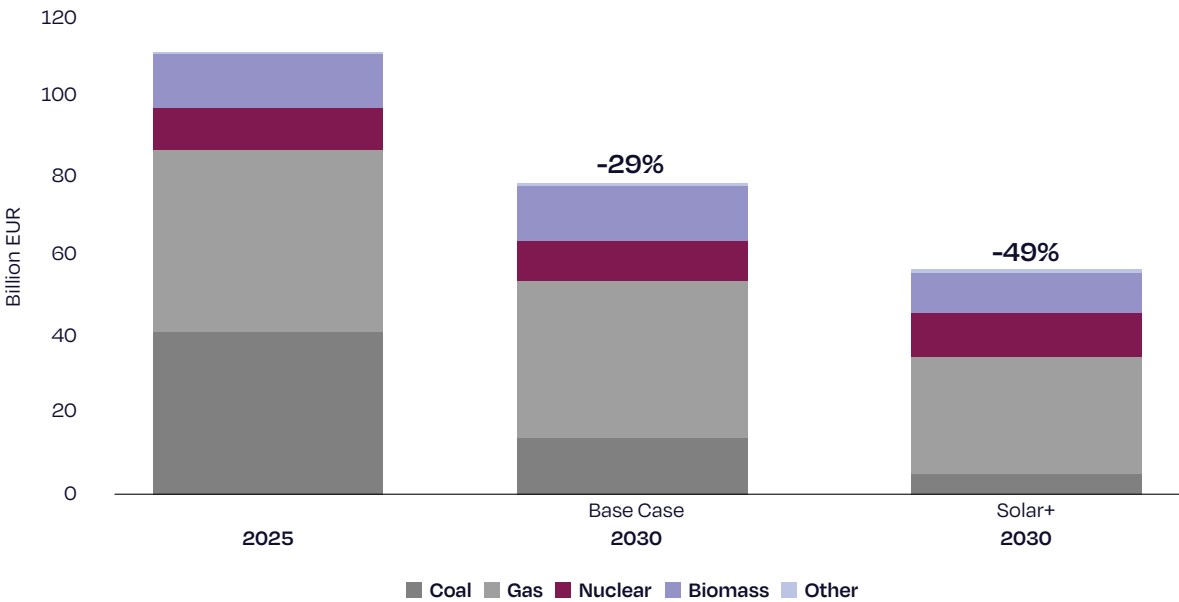
In 2025, the annual operating costs (OPEX) of the EU power system stood at 112 billion EUR, mainly comprising the costs of running fossil-fired power plants (78%), complemented by nuclear and bioenergy operating costs with lower but significant shares (Fig. 13).¹⁷ All other power system components combined, including variable renewables and distribution grids, amounted to just 0.5% of total operating costs.

In both 2030 scenarios, a power system that is more reliant on variable renewables drastically cuts its operating costs, thanks to a steep reduction in fossil fuel usage. In the Base Case scenario, power system OPEX are reduced by 29% or 33 billion EUR annually compared to 2025; in the Solar+ scenario, system cost savings amount to 55 billion EUR annually – which means that OPEX are basically cut by half compared to 2025 levels.

Figure 13

Accelerating renewables and storage deployment halves EU power system operating costs by 2030

EU power system operational expenditures (2025 real prices), 2025 vs 2030 Base Case and Solar+ scenarios



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¹⁷ Operating costs of fossil-based generation are mainly due to fuel costs, and, to a lower degree, carbon prices.

Solar PV deployment cuts fossil fuel import costs and strengthens EU energy security

Solar PV deployment is delivering significant cost savings to EU citizens and businesses by reducing the spending on imported natural gas for electricity generation. By replacing gas fired power with domestic solar generation, solar PV directly lowers the EU's gas import bill, protects consumers and economies from extremely volatile gas prices, and reduces import dependency, strengthening EU energy security.

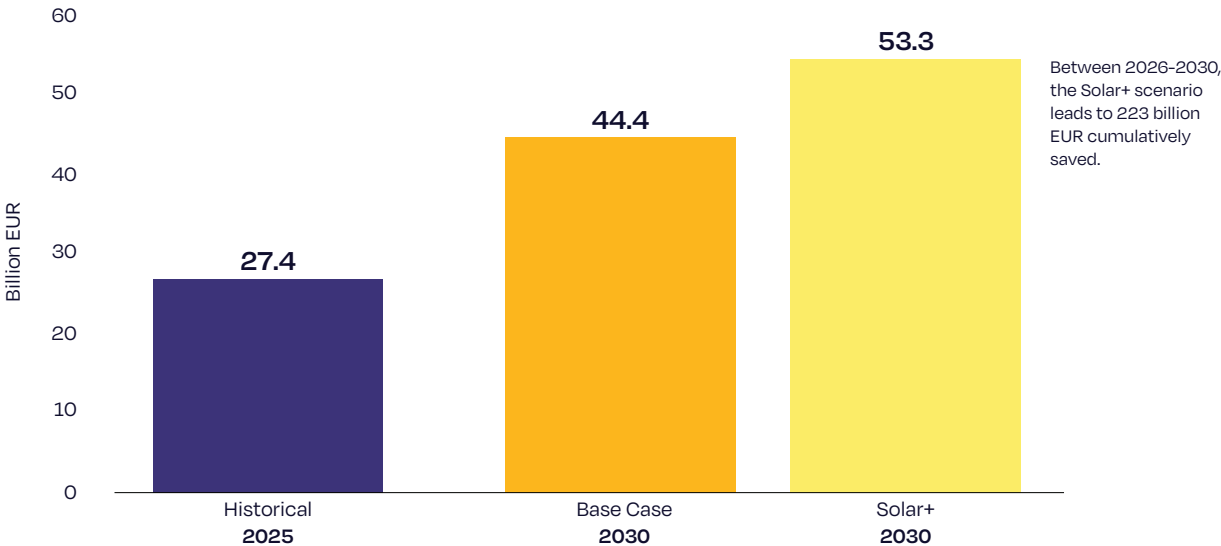
In 2025, solar PV generation is estimated to have avoided 27.4 billion EUR in EU natural gas imports used for electricity production.¹⁸ Under the Base Case scenario, continued solar deployment and increased PV generation leads to annual gas import savings of 44.4 billion EUR by 2030 (Fig. 14).¹⁹ These savings further rise under the Solar+ scenario, reaching 53.3 billion EUR per year by 2030, thanks to additional solar electricity reducing gas dependency.

The cumulative impact of higher renewable ambition on fossil fuel import savings is substantial. Between 2026 and 2030, in the Solar+ scenario an estimated 223 billion EUR worth of EU natural gas imports for electricity generation are avoided. This is 15% higher than the import savings in the Base Case scenario.

Figure 14

The EU could save up to € 53 billion in annual gas import costs in 2030 thanks to solar

Annually avoided EU gas imports thanks to solar electricity in 2025 and 2030, Base Case and Solar+ scenarios



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¹⁸ Assuming solar electricity replaces gas-fired electricity.
¹⁹ Assumptions on future gas prices are based on Rystad Energy data. Gas price is expected to recede below 2025 levels from 2027 onwards.

EU wholesale prices and price volatility decrease thanks to wider renewable deployment and battery storage

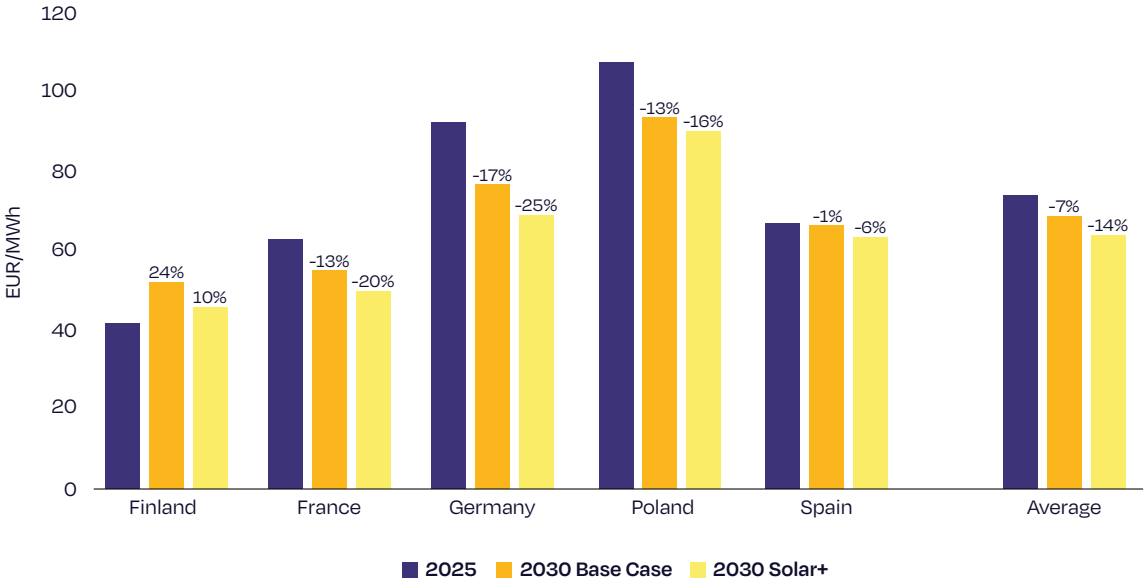
An analysis of wholesale day-ahead electricity prices in selected EU countries illustrates that with increased renewable energy ambition, electricity prices tend to be lower (Fig. 15).

Both the Base Case and the Solar+ scenarios feature lower electricity prices in most of the selected countries compared to 2025 levels. However, while in the Base Case prices in these countries are on average 7% lower, in the Solar+ scenario this trend is more pronounced, with 14% lower prices on average. Wholesale power prices in these countries decrease on average from 74.0 EUR/MWh in 2025 to 68.5 and 63.4 EUR/MWh in the two 2030 scenarios respectively. This trend is more apparent in countries with higher electricity prices, such as Germany and Poland, where prices decrease by 25% and 16% respectively.

Figure 15

Across EU countries, more renewable ambition brings lower electricity spot prices in 2030

Average day-ahead wholesale electricity prices (2025 real prices) in selected EU countries, 2025 vs 2030 Base Case and Solar+ scenarios



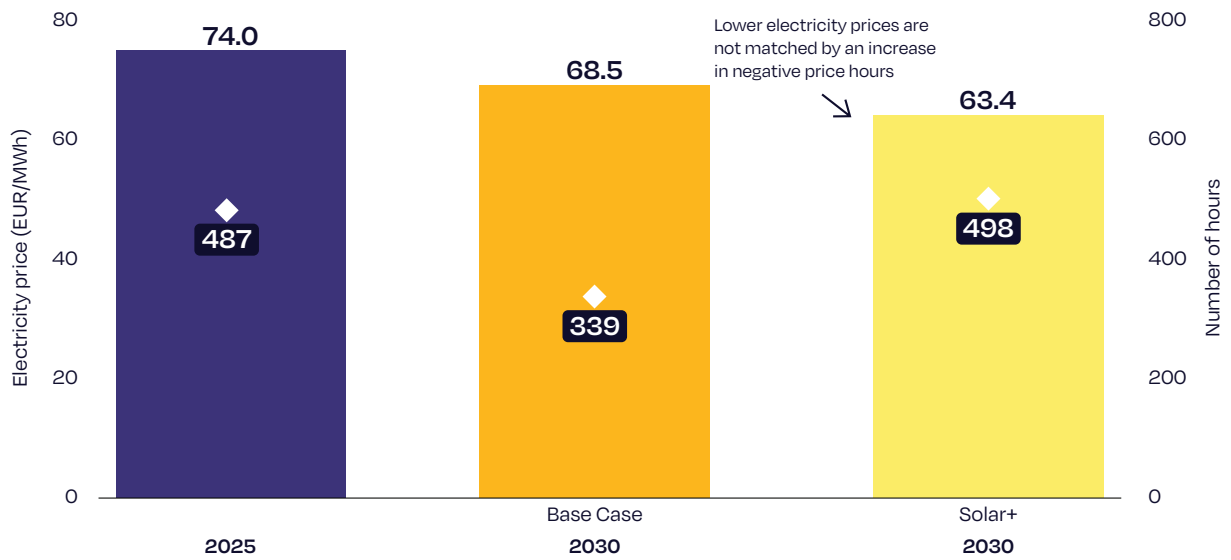
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Lower average prices do not translate into a sharp rise in negative price hours. Thanks to the deployment of battery storage as a flexibility solution, the EU power system is better equipped to accommodate higher shares of renewable generation and handle abundant electricity generation. As a result, the occurrence of negative price hours in the Base Case scenario decreases by 30% compared to 2025 levels; in the VRES-dominated Solar+ scenario it increases by merely 2% (Fig. 16).²⁰

Figure 16

Solar and storage lower electricity prices without endangering investments with excessive negative price hours

Average wholesale day-ahead electricity prices (2025 real prices) and average number of hours with negative electricity prices in selected EU countries (Finland, France, Germany, Poland, Spain), 2025 vs 2030 Base Case and Solar+ scenarios



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²⁰ Due to the nature of the modelling tool, real-world volatility, which is reflected in historical data, could periodically move outside modelled ranges.

The decrease in average wholesale electricity prices is primarily due to the shift in the occurrence of the technologies that set the price under the merit order. A higher penetration of variable renewables in the power mix reduces the time fossil-fired technologies, especially gas turbines, set the marginal electricity price. An analysis of the average price-setting technology occurrence in selected EU countries well displays this trend (Fig. 17).

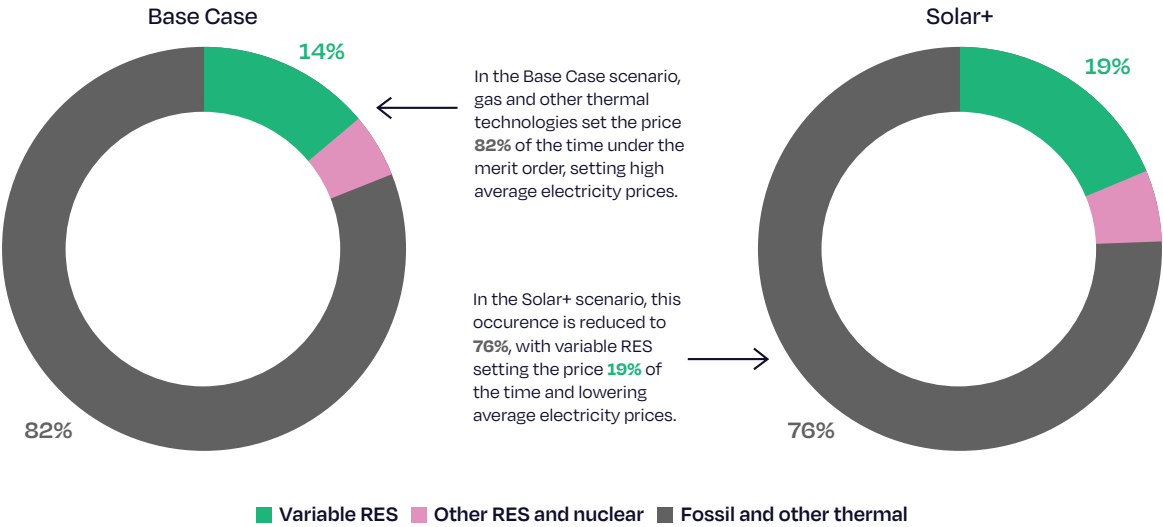
In the Base Case scenario, gas and other OPEX-intensive thermal assets set the price a large majority of the time (82% of the hours of the year), while low-OPEX variable renewables only set the marginal price 14% of the time. The result is that wholesale electricity prices are often set by expensive technologies.

In the Solar+ scenario, this trend is curbed thanks to a larger presence of renewable generation over the course of the year, setting power prices at low levels. In this scenario, VRES set the price 19% of the time, while gas and other thermal technologies set the marginal price less often, falling to 76% of the hours.

Figure 17

More renewables in the EU power mix set the electricity price more often, leading to lower average prices

Price-setting technology occurrence 2030, average of selected EU countries (Finland, France, Germany, Poland, Spain), Base Case and Solar+ scenarios



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An analysis of wholesale electricity price spreads is useful to assess price volatility and the value of flexibility. When more variable renewable capacity is added to an inflexible power system, it tends to lower average power prices due to low marginal costs, but also to increase volatility and widen price spreads. This can raise social acceptance concerns for end-consumers with limited flexibility options, who are exposed to very high peak prices and don't enjoy the benefits of overall lower prices brought by renewables. To address this issue, an adequate deployment of flexibility solutions would limit power price volatility.

In 2025, several EU markets experienced high wholesale price volatility, reaching 100 EUR/MWh and beyond in 4-hour price spreads, indicating limited system flexibility (Fig. 18). This trend is less pronounced in the 2030 scenarios, where increased battery capacities help reduce price volatility. In the Base Case scenario, average wholesale price spreads in a selection of representative EU markets are reduced by 38% on average. In the Solar+ scenario, despite a larger increase of variable renewable capacity, price volatility does not increase – it rather decreases further (42%) compared to 2025 levels, thanks to additional flexibility provided by battery storage. As a result, price spreads remain within acceptable levels – which is, high enough to ensure cost recovery of investments in flexibility resources for project developers, and low enough to avoid excessive price volatility for end-consumers.

Figure 18

Variable renewables and batteries reduce daily electricity price volatility

Average wholesale day-ahead electricity price spreads (4 hours, 2025 real prices) in selected EU countries and their average, 2025 vs 2030 Base Case and Solar+ scenarios



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Price cannibalisation is emerging as a key risk for the economics of variable renewables, in particular solar projects. As renewable capacity grows and weather-dependent resources generate electricity all at the same time, abundant output pushes wholesale electricity prices down. As a result, solar capture prices, which are the prices at which solar power is sold, are today usually below the average electricity price. This leads to low solar capture rates – the ratio between solar capture prices and the average electricity prices – making solar victim of its own success.

In 2025, PV capture rates reached historic lows across some of the most mature EU solar markets. In selected EU Member States, capture rates stood in the 50–60% range, corresponding to average capture prices as low as 37 EUR/MWh, putting the economics of solar projects at risk (Fig. 19).

Up until recently, solar projects used to be built stand-alone without battery storage, making their business case potentially much affected by price cannibalisation. As batteries' competitiveness keep improving and they are increasingly recognised as a key solution to flexibility challenges, coupling PV with BESS is becoming the new normal for project developers in more mature markets. As such, our analysis of capture prices and capture rates in 2030 considers solar + storage rather than solar alone. In both the Base Case and the Solar+ scenarios, matching solar with batteries strongly improves project economics. Despite an overall decrease in electricity prices, PV + BESS capture prices in selected EU countries are on average 82% and 73% higher respectively compared to PV capture prices in 2025 (upper graph). A corresponding result is visible on capture rates (lower graph), which reach on average 84% in both 2030 scenarios compared to 58% in 2025. Markets where a decline in capture prices in 2030 is visible – Germany and Poland – are also among the markets with the highest electricity prices in 2025, which are set to recede to lower levels by 2030. In countries like France and Spain, coupling solar with storage ensures capture rates above 100%, which means capture prices above average electricity prices.



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Meuselwitz, Germany.

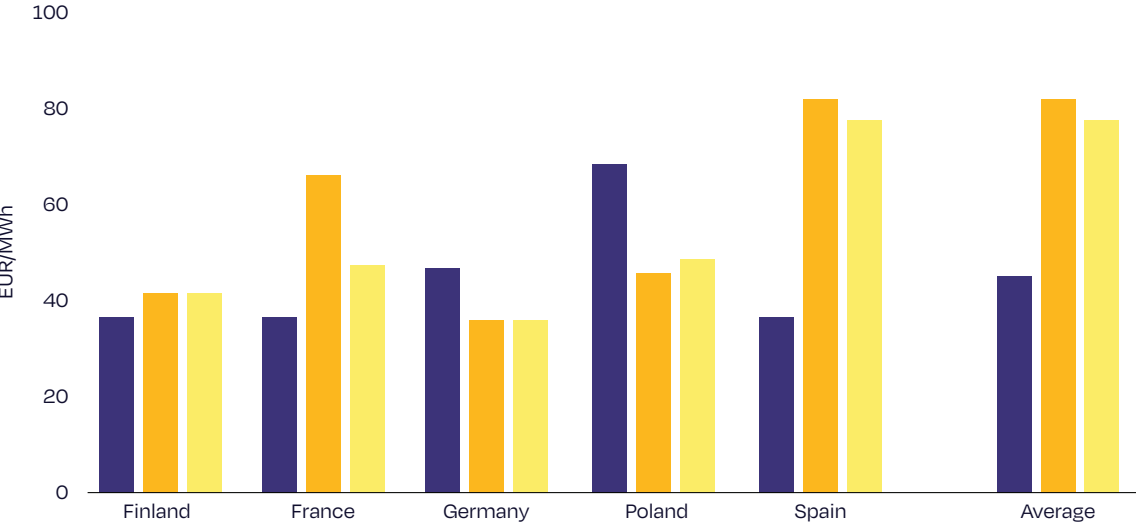
The comparison between PV capture prices in 2025 with PV+BESS capture prices in 2030 illustrates an additional facet of these market dynamics. In the most mature solar markets, BESS is no longer only a powerful tool to improve project economics – it becomes an essential feature to continue develop economically viable merchant projects.

Figure 19

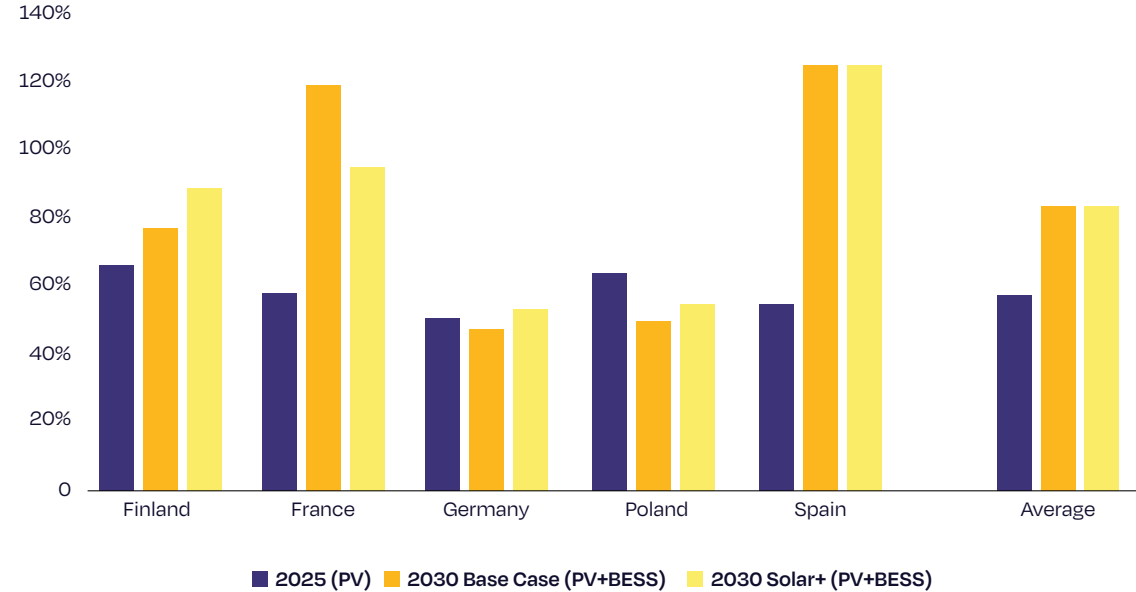
Coupled with batteries, investments in solar projects become more attractive by 2030

PV and PV+BESS capture prices (2025 real prices) and capture rates in selected EU countries, 2025 vs 2030 Base Case and Solar+ Scenarios

PV and PV+BESS capture prices



PV and PV+BESS capture rates

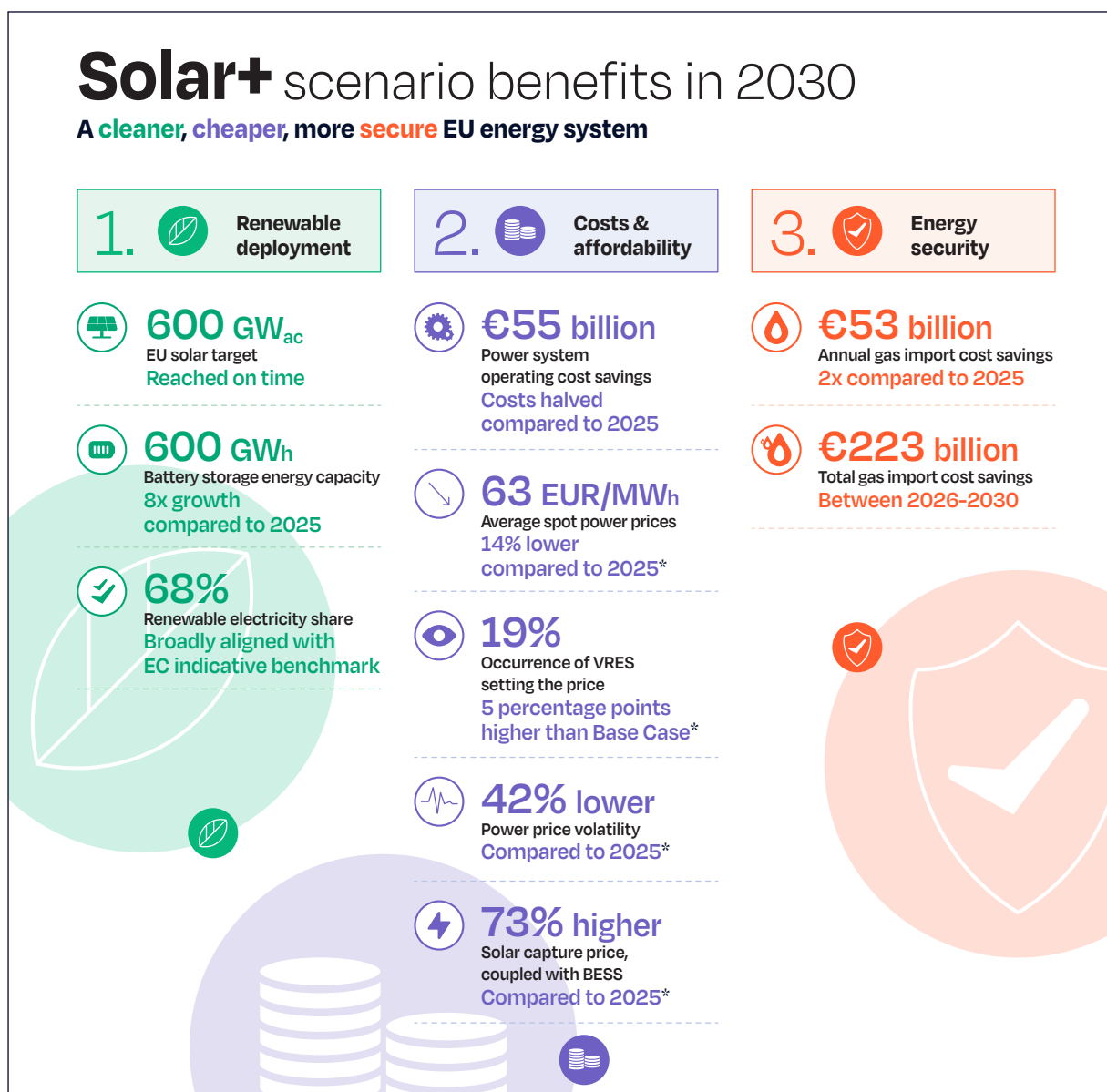


Note: PV+BESS capture price assumes a 1:1 sizing of PV and BESS.
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In conclusion, the Solar+ scenario demonstrates that accelerating the deployment of solar PV and battery storage delivers clear and near-term benefits for the EU power system (see below). In less than five years, Solar+ leads to structurally lower system operating costs, reduced wholesale electricity prices and significantly lower price volatility for end-users. At the same time, Solar+ keeps the EU firmly on track towards its 2030 climate and energy goals.

Reaching 600 GW_{AC} of solar capacity, supported by an eightfold expansion of battery storage energy capacity to 600 GWh, enables a power system with 68% renewables share. This is broadly aligned with the European Commission's indicative benchmark. As variable renewables set prices more frequently and gas-fired generation is displaced, power system costs are halved compared to 2025. Wholesale prices fall by 14% and price volatility declines by 42% in selected markets.

At the same time, the integration of storage materially improves the solar business case. PV capture prices in these markets increase to 79 EUR/MWh or 73% higher than in 2025. Capture rates rise to 84%, representing an improvement of 26 percentage points compared to 2025.



*: in selected EU markets.

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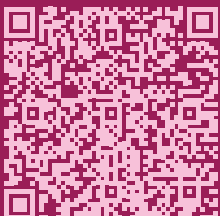
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