EU battery storage is ready for its moment in the sun

Coupling renewables and clean flexibility growth, the EU can benefit from abundant home-grown wind and solar, reduce dependence on imported fossil energy, and avoid costs.

Published date: 26 September 2024

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About

This report analyses the system benefits of coupling renewables with clean flexibility, with a focus on the opportunity for pairing solar electricity generation and battery storage in the EU.

Using Ember's dataset on hourly generation mix and power prices in the EU, the analysis demonstrates that midday solar abundance is a valuable resource. It illustrates the opportunity for clean flexibility to reduce the EU's fossil dependance and avoid energy costs. It concludes with recommendations for next steps on clean flexibility in the EU to keep pace with ambitious decarbonisation goals, with a focus on deploying battery storage immediately.

Highlights

€9bn

In 2030, the EU could avoid gas costs worth €9bn by capturing excess wind and solar.

80%

Between August 2023 and July 2024, nine EU countries saw solar alone exceeding 80% of their hourly domestic demand.

36 GWh

Germany could have avoided 36 GWh of expensive fossil power and up to €2.5mn fuel costs in June 2024 alone with 2 GW more of additional batteries.

Executive Summary

More flexibility brings benefits

With faster clean flexibility rollout, the EU can get home-grown cheap renewable power around the clock.

A power system backed by renewables will need to be flexible and responsive. While renewable shares are quickly growing across the EU, measures to provide that flexibility have not yet been equally planned for or implemented. Now is the time for all Member States to give strong policy signals and remove existing barriers to swiftly deploy clean flexibility solutions alongside new and existing wind and solar capacity.

The opportunity is particularly clear for pairing solar with battery storage, taking advantage of their mutually reinforcing business cases. Years of strong solar growth and high gas prices have increased electricity price volatility across the EU, strengthening opportunities for battery storage. In turn, batteries can increase power demand at peak solar times, supporting solar revenues. If existing barriers to the deployment of battery storage are removed, countries can shift abundant and cheap solar power beyond sunny hours and reduce reliance on expensive fossil fuels.

01 EU countries could save €9bn in gas costs by capturing excess wind and solar

By 2030, wind and solar power could exceed domestic demand by 183 TWh across all EU countries, equivalent to the annual power consumption of Poland. If EU countries were to deploy flexibility solutions, such as batteries and interconnectors, they could shift this excess clean power to replace fossil gas generation. Doing so would avoid gas purchase costs worth €9 billion annually.

02 Solar surpasses 80% of demand at peak hours in nine countries

Between August 2023 and July 2024, nine EU countries saw solar share peaking at or above 80% of their hourly power demand, including the Netherlands and Greece where solar generation at times surpassed 100% of demand.

03 Germany could have avoided up to €2.5mn fuel costs in June alone with 2 GW additional battery storage

If Germany had an additional 2 GW (+20%) of battery capacity in operation in June 2024, the ability to shift midday solar power to the evening could have displaced 36 GWh of fossil power. Depending on which fuel was displaced, this would have avoided €1.3 million in hard coal costs or €2.5 million in fossil gas costs.

"It just makes sense to capture all the low-cost renewable power we can. As solar continues to soar, batteries will help ensure that abundant power can be used at all hours. While the EU's renewables scale-up has been rapid and ambitious, the same focus on clean flexibility is still lacking. This needs to be addressed, and quickly, for consumers and businesses to feel the benefits of reducing fossil dependence."

Beatrice Petrovich
Senior Energy and Climate Analyst,
Ember

More flexibility brings benefits

Renewables are growing, flexibility must grow too

Within the next six years, wind and solar generation will surpass EU demand in certain hours of the year. Being able to shift that power to where and when it can be used through clean flexibility solutions is an enormous opportunity.

Renewables and clean flexibility are a perfect match

As wind and solar grow rapidly in the EU, a swift scale-up of clean flexibility will be needed to enable decarbonisation across the system. Flexibility can include any measures to match supply and demand, including grid connections, demand side flexibility, pumped hydro storage and battery storage. These solutions help shift power generation or consumption across time or geographies, helping balance the grid when weather-dependent generation such as wind and solar either exceeds or falls short of electricity demand.

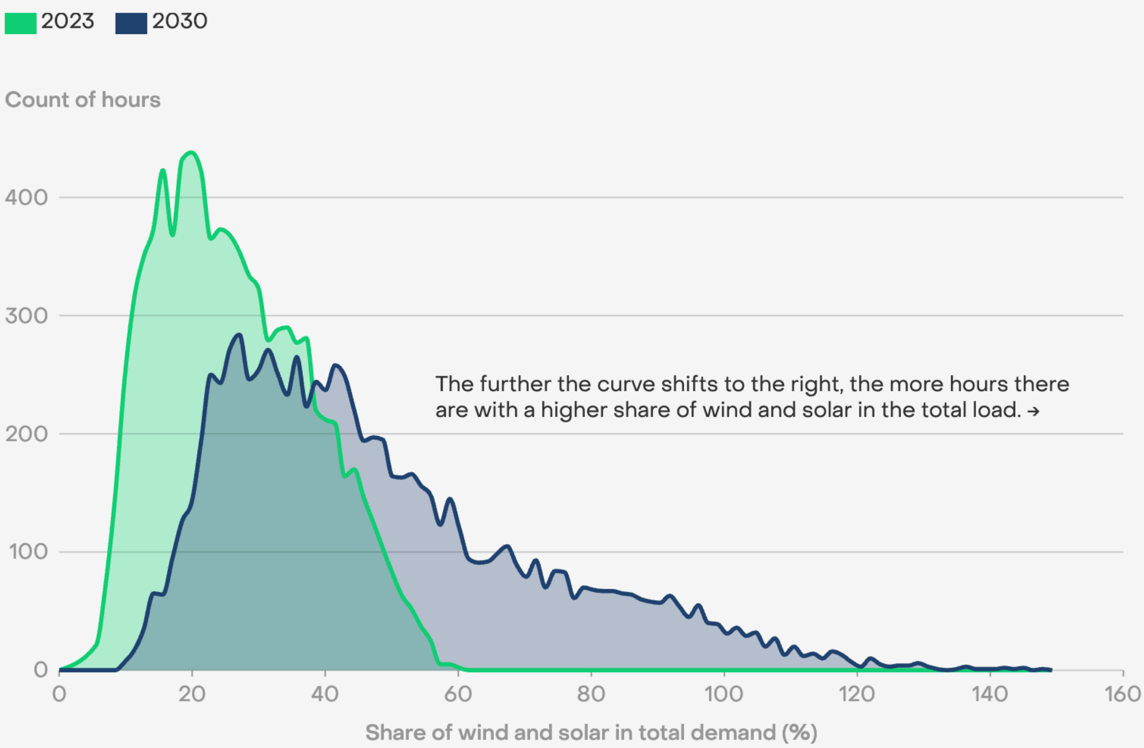
The EU cannot afford to delay clean flexibility deployment

The switch to a predominantly renewable system is already racing ahead in the EU, with progress set to continue according to targets and plans set out by the EU and national governments. Draft National Energy and Climate Plans (NECPs) signal an intent to triple EU solar capacity and double EU wind capacity (from 2022 levels) and reach a 66% renewable share in the yearly generation mix by 2030, just short of ambitious targets in the REPowerEU plan.

A larger EU solar and wind fleet means that within the next six years renewable power will become abundant at certain times in many countries. This dynamic will arrive quickly, making planning for it now critical. According to the latest official targets and Ember's simulations for the year 2030, solar and wind are expected to meet on average 49% of total EU demand on an hourly basis, which is almost twice their average contribution in 2023 (27%). Moreover, hours with a high contribution from solar and wind will occur much more frequently; they will generate more electricity than the EU's total demand in an estimated 4% of hours, and will exceed more than half of EU power demand in 35% of hours, up from 3% of hours in 2023. This will represent an entirely new dynamic in the EU's power system.

Wind and solar will meet higher share of EU demand in many more hours by 2030

Share of wind and solar in total EU demand for each hour of year (%)



2023: Ember hourly electricity generation data. 2030 data calculated using 2009 climate year weather data for 2030 wind and solar profiles multiplied by targets for installed wind and solar capacity in EU-27 countries. 2030 country load profiles taken from ENTSO-E European Resource Adequacy Assessment 2024 input data for National Trends scenario.

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Plentiful renewable generation will be an enormous resource for the EU, but it requires careful system planning now to fully capture the benefits. Ember modelling suggests that in 2030, wind and solar power could exceed demand across all individual Member States by a total of 183 TWh, which is equivalent to the power consumption of Poland in 2023 and around 40% of last year's total EU fossil gas generation. If EU countries were to shift this excess entirely in time, using storage, or space, using interconnectors, to replace fossil gas generation, they would reduce their reliance on imported gas and avoid gas purchase costs worth €9 billion.

More hours already powered by wind and solar in the EU

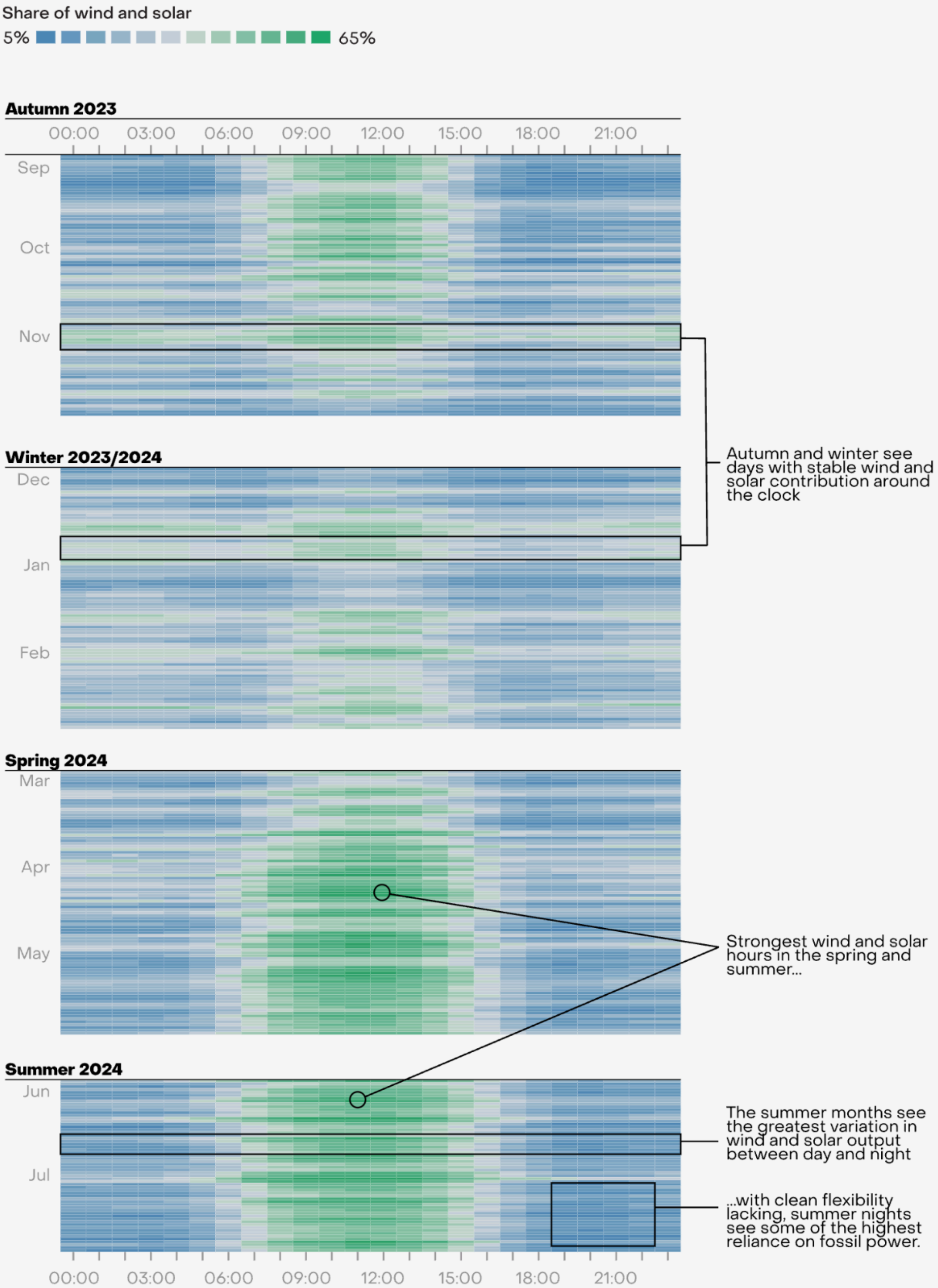
Planning for more clean flexibility now can accelerate the trend towards EU independence from fossil power. The unprecedented growth of wind and solar in recent years has already reduced the share of fossil fuels in the EU electricity supply to its lowest ever level. Fossil fuels generated 17% less in the first half of 2024 compared to the same period in 2023, falling to 27% of generation and lagging behind wind and solar which generated 30%. Solar in particular has experienced remarkable growth, with capacity additions growing by more than 40% for three consecutive years between 2021-2023.

With more wind and solar in operation across the EU, these sources are already dominating power output at certain times of the year at both EU and national levels, leaving less space for expensive fossil power in the mix. In the twelve months to July 2024 (inclusive), wind and solar produced more than half of EU power in 7% of hours, up from just 2% of hours in the twelve months prior. In the same period, solar and wind covered a minimum of 6% of EU electricity demand across all hours. Their maximum share was much higher, reaching almost two thirds (64%) of total EU electricity demand.

The rise to dominance of wind and solar is particularly stark in countries already undergoing a solar boom. For example, in Germany in the twelve months to July 2024, wind and solar provided the majority of power generation in 36% of hours, up from 26% in the twelve months prior. The same figure increased from 26% to 38% in Greece, from 31% to 44% in the Netherlands, and from 7% to 16% in Hungary — where growth is due to solar alone as installed wind capacity remains among the lowest in the EU. Between August 2023 and July 2024, fifteen EU countries saw wind and solar share peaking at above 80% of their hourly power demand.

Wind and solar meet 6% to 64% of EU power demand in any given hour

Hourly share of EU demand met by solar and wind, September 2023-July 2024



Source: Ember hourly electricity generation data

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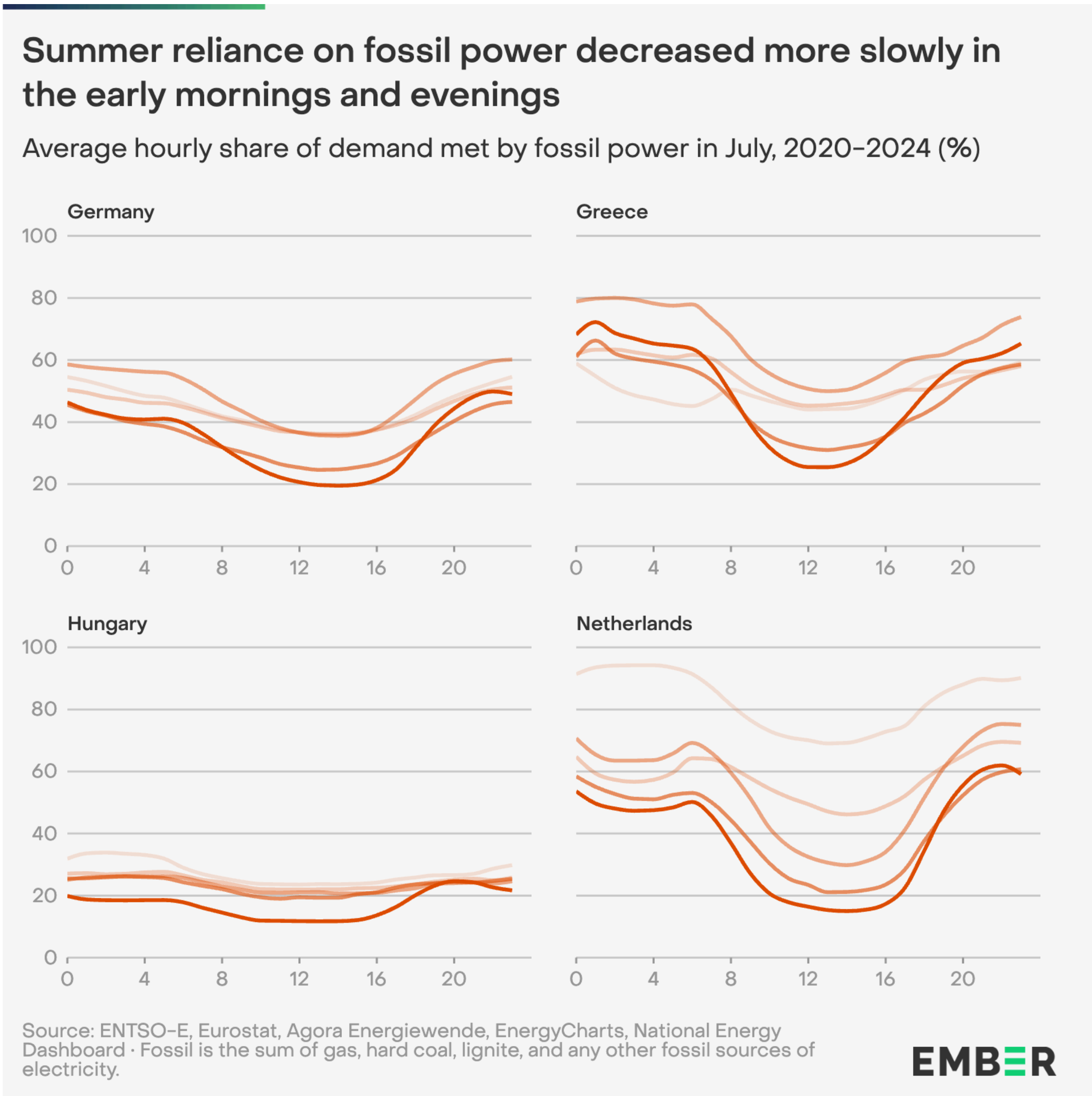
A lack of system flexibility is already holding back wind and solar progress

In summer 2024, EU wind and solar contribution was particularly strong during daylight hours. In June and July, solar and wind generation made up at least 20% of EU demand between 7am and 4pm, reaching peaks of over 60%. As a result, reliance on fossil power has fallen quickly during daylight hours, but remains relatively high during early mornings and evenings. In Germany, for example, the average share of fossil power at 1pm in the month of July almost halved from 36% to 20% between 2021 and 2024, whereas the share of fossil power at 8pm only went from 47% to 44%.

Increasing clean flexibility, in particular energy storage, would remedy this. This would enable spreading summer solar peaks into summer evenings where reliance on fossil power tends to be relatively high due to weak wind conditions.



Fossil reliance at time of peak solar production could be even lower if the power system was more agile. Even at times of abundant renewables, fossil power plants often continue generating. In some cases this leads to curtailment of renewable sources, such as in Poland. Some fossil plants are forced to maintain production as they are technically unable to ramp up and down quickly, or because network operators require them for ancillary services. In Germany for example, fossil generation very rarely drops below 10 GW, even during periods of negative electricity prices.

Progressive approaches taken by some grid operators suggest that more can be done to raise the instantaneous share of renewables that can be accepted into the system. For instance, the Irish network operator plans to raise the technical cap for wind and solar share of generation to 95%. Others such as PSE, the Polish grid operator, are more conservative, and limit solar and wind once they reach around 55-60% of the country's electricity mix at any given time.

Pairing solar with batteries

Batteries can help capture the benefits of rising renewables

Renewables are already growing swiftly in the EU, particularly solar. Batteries will play a crucial role in keeping that momentum going.

While all types of flexibility solutions will be needed for an effective system, batteries are a ready-to-deploy technology that could scale quickly, offering immediate cost benefits and improvements to security.

Batteries have seen dramatic cost reductions in recent years, driven by an increase in production for electric vehicles. In the power system, they can be deployed at grid-scale, connected to the transmission grid, or at smaller scale in a residential or commercial building to enhance consumption of energy produced on site (known as behind-the-metre). A combination of grid-scale battery and utility solar can now produce electricity more cheaply than coal- or gas-fired power plants, according to a recent study of generation costs in Germany.

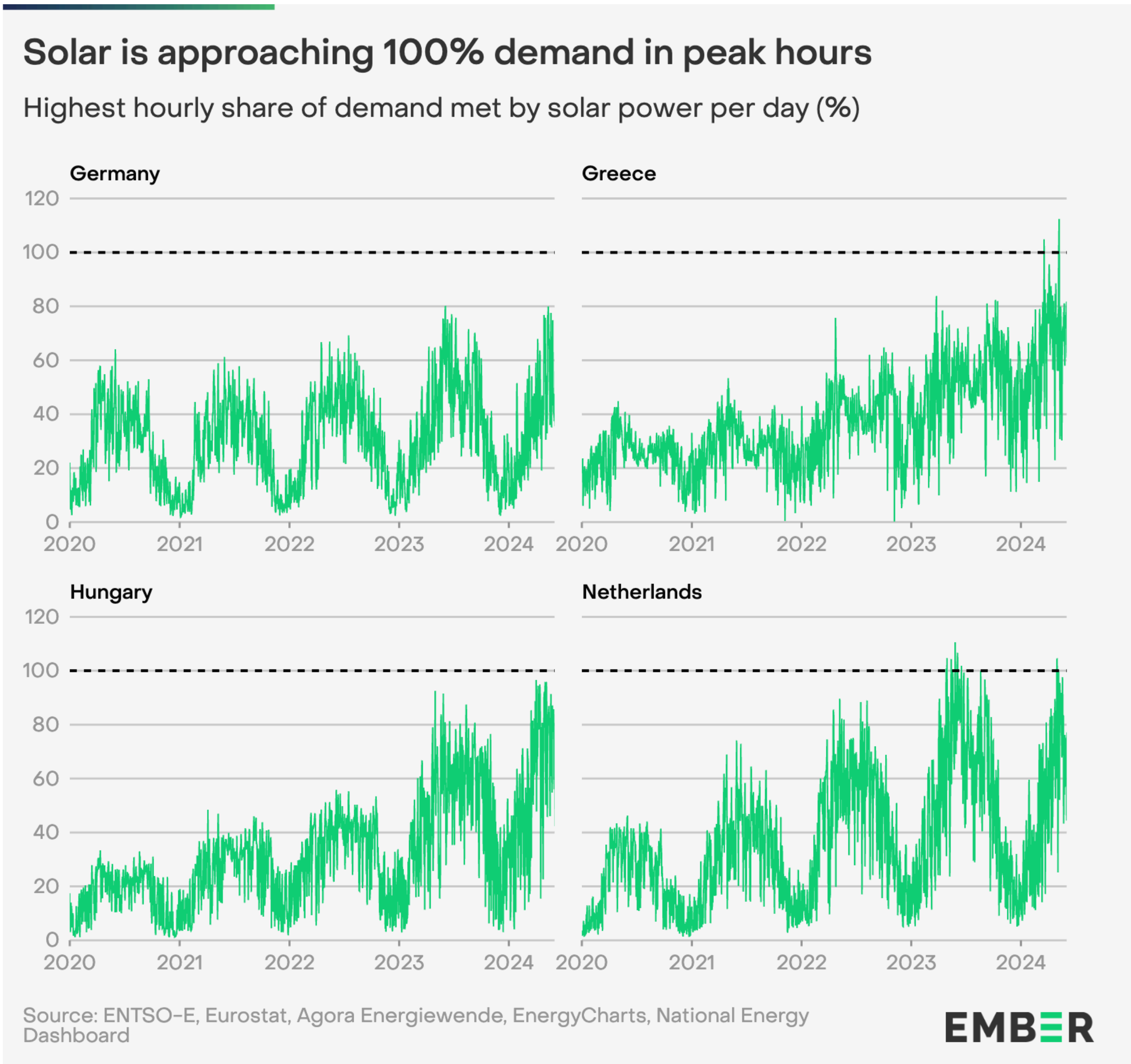
Battery storage is a useful intervention for shifting power across short periods of time: batteries can store electricity when wind and solar generation is high, and make that power available when there is more demand. Solar has predictable peaks and troughs in generation, across both seasons and times of day. This makes the combination of solar with battery storage particularly effective at redistributing solar power throughout the day, smoothing mismatches in supply and demand and reducing the need for fossil power.

Currently, most installed batteries in Europe are designed to charge and discharge over relatively short time scales. By the end of 2023, the 16 GW of batteries operating across the EU could store about 23 GWh of power, meaning an average duration of about 1.5 hours if charging/discharging at full power. However, batteries' duration and their performance over longer time frames has been improving, with 2-hour duration projects becoming common over the last two years and 4-hour duration expected in the short-term future across Europe. New storage tenders are creating demand for projects up to 8-hour duration.

An opportunity for batteries emerges as solar booms

It is essential that Member States start planning how to integrate rapidly growing volumes of solar generation, and batteries will be a key part of this. In multiple countries, during the sunniest hours, solar alone is already approaching or matching 100% of power demand. Between August 2023 and July 2024, nine EU countries saw peak solar shares above 80% of their power demand. In fact, in certain hours in Greece and the Netherlands, solar outstripped demand, with others such as Spain and Hungary reaching over 90%.

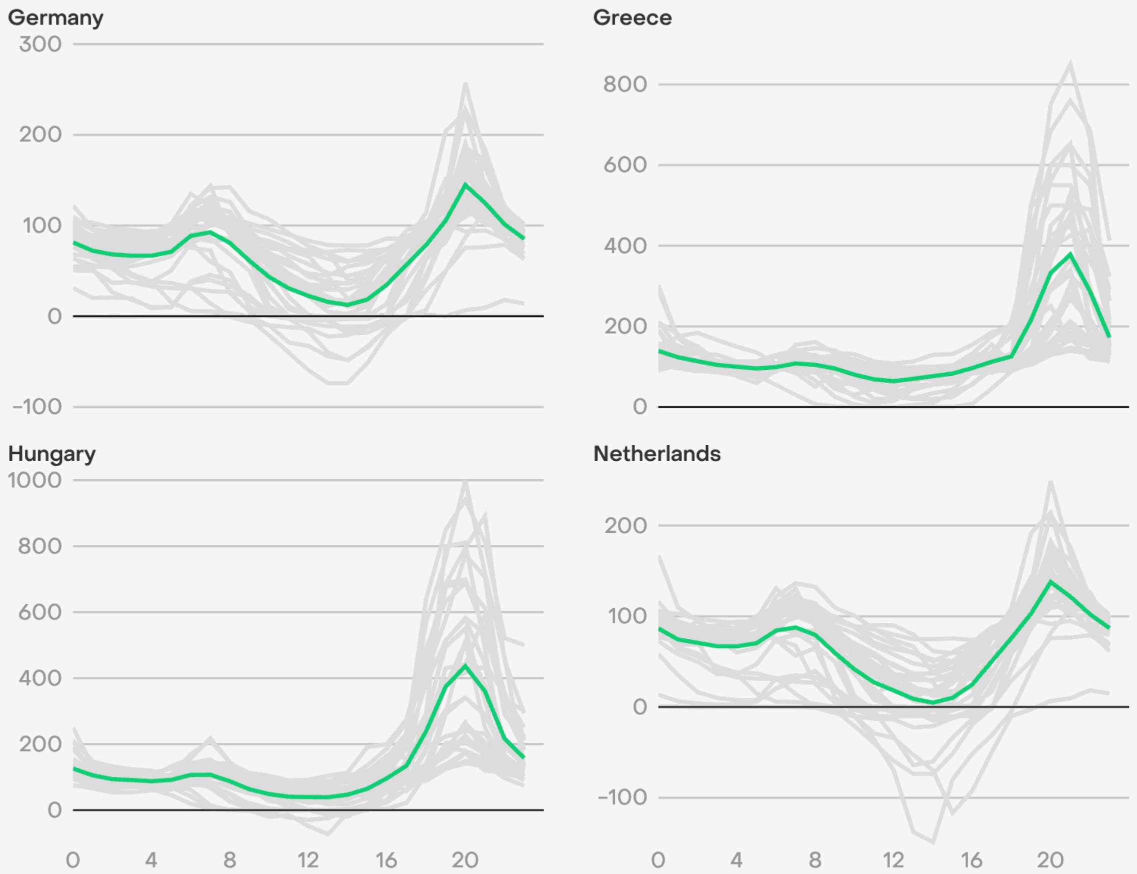
During these high solar generation hours, it is not just solar on the system. Additional supply also comes from must-run generators such as CHP plants, other non-dispatchable renewables such as wind and run-of-river hydro, and large inflexible nuclear units. This means that often during these times there are low or negative prices on the system and high volumes of exports to neighbouring countries as power flows from regions of lower to higher prices.



Zero and negative prices are becoming more common across Europe and have happened virtually everywhere in the EU in the last 12 months. Nowhere is this trend more visible than in Spain, which in the first half of 2024 experienced zero or negative prices in 14% of hours, compared to just 1% of hours in the first half of 2023. In the Netherlands, July 2024 saw a record 12% of hours with zero or negative prices, which occurred most frequently at 2pm.This is more than in winter 2023-24, when zero or negative prices occurred on average for 3% of hours and almost exclusively at night. Although the causes of negative prices can be complex and varied, booming solar is playing a role in many countries.

Solar lowers prices in the middle of the day, increasing intra-day price volatility

Day-ahead wholesale power price by hour in July 2024 (€/MWh)



Source: ENTSO-e wholesale day-ahead electricity prices · The green line shows the average day-ahead price by hour in July 2024.

Low and negative prices detrimentally impact the business case for solar, reducing the revenues that solar producers receive for selling their power on the market. This decline in utility solar capture rates – the price received for solar electricity compared to the baseload price – is a phenomenon which is set to worsen if more solar is added to the system with limited growth in flexibility, especially amid a slow recovery in power demand.

In contrast to very low and negative prices in the central part of the day, in June and July 2024 many EU countries saw extreme power price spikes in the evenings. In the summer evenings when fossil power reliance is still high, electricity tends to be more expensive. The link between power prices and fossil fuel prices exposes consumers and businesses to the price of imported fossil gas, which is highly susceptible to geopolitics and global events.

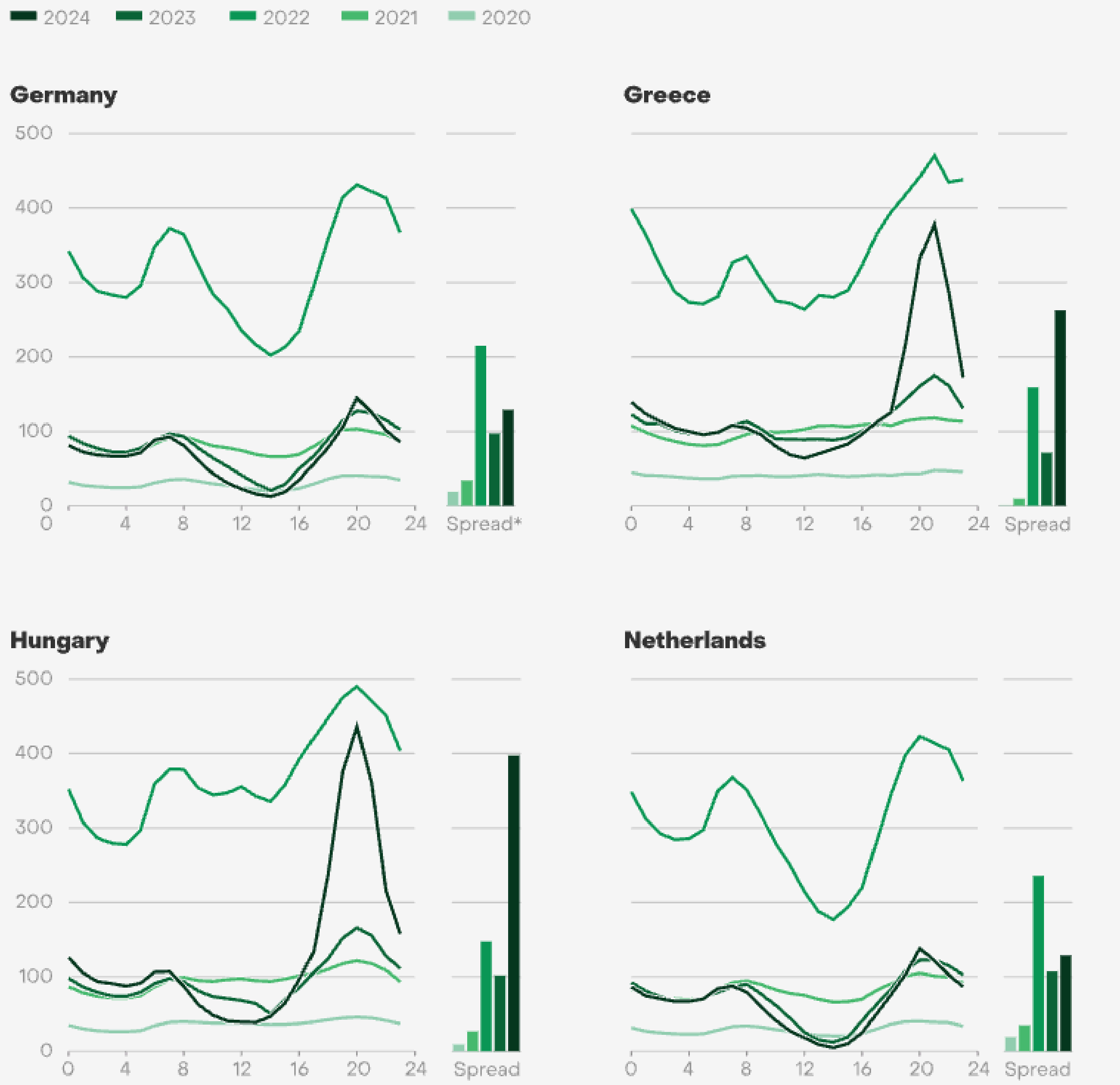
The difference in prices between midday and evenings, also known as price spreads, were significantly higher in summer 2024 than summer 2023, especially where solar growth has been strong. In Greece and Hungary, like other countries in Southern and Eastern Europe, the increase in spreads has been particularly extreme, going from €71/MWh to €262/MWh, and €102/MWh to €397/MWh.

This widening of price spreads within the day strengthens the business case for battery storage that can earn revenues from price arbitrage (buying low cost power and selling when prices are higher). Such battery behaviour can lower peak power prices by providing increased competition to flexible gas assets, while also reducing reliance on fossil power at times of peak demand. More batteries will also increase power demand at peak solar times, supporting solar capture rates and the business case for investing in solar capacity.

As an increase in storage capacity causes the price profile to flatten, the drop in revenues available to batteries from arbitrage can be compensated by revenues for the multiple services that batteries can offer for system operation (such as fast response frequency reserve).

Large and widening intra-day price spreads strengthen the business case for battery storage

Average hourly day-ahead wholesale power prices and intra-day spread in July, 2020-2024 (€/MWh)



Source: ENTSO-e wholesale day-ahead electricity prices · Spread refers to difference in day-ahead prices between 8pm and 1pm

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Batteries can reduce evening fossil reliance

California provides a compelling example of how batteries can lower dependence on fossil fuels at times of low renewable output and high demand. Battery capacity was expanded thirteen-fold in five years, reaching 10 GW in April 2024, and has reshaped the way the grid is powered. The role of gas in the evening peak in April 2024 has been roughly halved compared to April 2021.

Europe could follow the same path to reduce its reliance on imported fossil fuels. Batteries have been growing rapidly in recent years in the EU. However, capacity is concentrated in a small number of countries.

Germany, in particular, is the EU front runner, accounting for 46% of total EU battery capacity by the end of 2023 and with 9.5 GW installed by June 2024. Germany could boost its battery capacity up to 11.4 GW by the end of 2024 under the best case scenarios of policy support and financial conditions, based on Ember's estimations and market forecasts. If such battery capacity had already been installed this summer, Germany could have displaced 36 GWh of expensive fossil power during evening peaks in June alone. Hard coal, usually the most expensive generator in Germany, could have been completely kicked out of the mix in 12 hours, reducing prices during the most expensive hours of the day. This avoided fossil fuel electricity production could have saved € 1.3 million in hard coal imports or € 2.5 million in fossil gas imports, depending on which fuel was displaced.

Recommendations

Clean flexibility should be swiftly deployed to complement renewables

Improved policy frameworks for flexibility solutions can help capture the benefits of fast-growing wind and solar.

The growth of wind and solar is happening fast and is set to accelerate. With adequate growth in electricity storage, demand side flexibility and cross-border interconnectivity to help take advantage of abundant home-grown clean power, the EU could reduce fossil dependance, avoid costly energy imports, and protect consumers and businesses from volatile international energy prices.

Batteries, in particular, are a ready-to-deploy tool to harness the huge resource of midday solar, as well as being faster and cheaper to deploy than alternatives such as gas peaker plants or grid interconnections.

The business cases for solar and batteries are mutually reinforcing. Increased price volatility, exacerbated by years of strong solar growth and high gas prices, has increased the ability of battery storage to earn revenue through price arbitrage. In turn, batteries will increase power demand at peak solar times, supporting solar capture rates and smoothing price extremes.

Batteries are growing strongly in some countries but not in others. Solar, by comparison, is growing quickly everywhere. Stronger policy signals and early planning can accelerate the growth of batteries across the EU, bringing forward the economic, security and climate benefits of the energy transition.

The Strategic agenda for the new EU mandate is a good step in this direction, as it plans for ambitious electrification and investment in grids, storage and interconnections. The political priorities of the newly designated EU Commission also include scaling-up investments in grid infrastructure and storage capacity. The following recommendations can provide guidance for EU policymakers looking to accelerate clean flexibility deployment and investments.

Key recommendations

Remove barriers to co-location of batteries with renewables
A simple way to start planning for clean flexibility is to consider the potential for co-location of solar with batteries. This should be unlocked by removing existing regulatory barriers and improving system planning.

- It should be made easier for solar and batteries to be installed behind the same grid connection point, for instance by acting on the grid connection rules or considering targeted and accelerated grid connection access for co-located batteries where the grid is congested.
- Co-located battery storage should be considered in spatial planning and permitting, including when identifying renewable acceleration areas.
- Grid operators should make available granular and timely data on the status of the grid. Lack of information can delay the much needed investment decisions. Key data concerns storage capacity and utilisation, grid capacities, grid connection queues and renewable curtailment. Grid hosting capacity maps are an effective way to communicate such information.

Implement national clean flexibility strategies early, starting with NECPs
Clear policy signals for accelerated deployment of flexibility are still limited in many NECPs. Most revised draft NECPs do not provide details of future flexibility strategies and targets. This gap should be swiftly addressed, since countries with an early clean flexibility needs assessment and targets can benefit sooner from growth in renewable power.

Final NECPs, the majority of which remain unpublished despite being due in June 2024, remain an opportunity to send strong policy signals on how countries plan to transition away from reliance on fossil flexibility and ensure the integrated and complementary deployment of clean flexibility solutions.

- National governments should strive to disclose flexibility needs assessment and targets for storage and demand-side flexibility in the final NECP. Where a detailed flexibility assessment is unavailable, countries should commit to a process that will achieve this as soon as possible.

- National governments should implement measures to support the roll out of clean flexibility alongside renewables. Key measures are listed in European Commission guidelines on storage, and start with the removal of 'double charging' of grid fees on battery storage. National governments should ideally include these measures in their final NECP.
- National governments should introduce additional specific support schemes where needed, as envisaged in the latest Electricity Market Design reform.

Improve market access for batteries and demand flexibility

- Revenue stacking for batteries, and clean flexibility in general, should be allowed. Enabling multiple revenue streams opens up routes to market, foster private investments, and provide important system services.
- National governments should remove restrictive requirements for the participation of battery storage and demand side flexibility in capacity markets and grid services (such as frequency response).
- The design of capacity mechanisms should also promote clean flexibility, for example through lowering the carbon cap.

Improve data and representation for clean flexibility in EU energy system planning

The technical representation of clean flexibility is still limited in EU-level system planning processes. Robust modelling and greater transparency on the clean flexibility potential are necessary to build awareness and confidence in the solutions, and therefore facilitate private investment decisions. Underestimating and misrepresenting the clean flexibility potential brings the risk of overinvesting in fossil assets.

- As the energy system becomes more complex, modelling methodologies must take account of the need to reduce reliance on fossil flexibility and adequately represent clean substitutes.
- Better representation of clean flexibility sources starts with transparent and accurate input data. Currently, there is limited visibility on the rollout of battery storage and demand-side flexibility utilisation. Whilst ensuring privacy and commercial confidentiality, improvement to data transparency would help system operators, flexibility providers, investors and consumers to maximise their efficiency and cost-effectiveness.
- Member States and national regulatory authorities should make such data publicly available, as recommended by the European Commission. Data on existing and planned flexibility sources will be key for the new flexibility target-setting exercise established by the latest EU Electricity Market Reform.

Publish an EU strategy for clean flexibility

An EU strategy for clean flexibility can guide the transition away from reliance on fossil flexibility and ensure the complementary deployment of clean flexibility solutions across the

EU. The European Commission already issued guidelines for unlocking the potential of energy storage, but storage is only one tool in the flexibility toolbox.

- An EU action plan on electrification should include a strategy to unlock the potential of all clean flexibility sources. If the increase in electrified demand is managed smartly it can play a key role in providing flexibility and lower energy bills.
- Smarter solar and wind generation can also play an important role. For instance, adding panels facing west rather than south could help powering the late afternoon demand rise with solar power.
- Batteries, innovative energy storage solutions and demand-side flexibility enablers (e.g. smart heating and cooling systems, industrial processes and EV charging) should be priorities in the new Clean Industrial Deal to secure the value chain, skilled workers and circularity, ultimately benefiting the local economy and jobs.

Supporting Materials

Methodology

Hourly electricity generation data

For the majority of European countries, hourly generation data by fuel and hourly net flows are taken from ENTSO-E's transparency platform. Hourly load is then calculated as the sum of total generation and net imports.

For certain countries, a different source is used. These are:

- **Austria** uses ENTSO-E hourly data for all fuel codes except hydro. Hydro hourly data is scaled using the ratio of aggregated monthly values to Eurostat monthly data.
- **Cyprus** hourly data is taken from the transmission system operator (TSOC) website. Solar and bioenergy are disaggregated from the fuel source 'distributed' energy by assuming the minimum hourly amount per day comes from bioenergy, and solar is the difference between the 'distributed' value and derived bioenergy number.
- **Germany** uses energy-charts for gas and solar and Agora Energiewende for all other fuel codes.
- **Estonia** uses ENTSO-E hourly data for all fuel codes, but a small fix is applied to correct for errors with bioenergy and other fossil fuel codes between May and September 2022.
- **Finland** uses ENTSO-E hourly data scaled with Eurostat monthly data for onshore wind, offshore wind, solar, gas, bioenergy and hydro fuel codes. All other fuel codes taken from ENTSO-E hourly data.
- **Hungary** uses ENTSO-E hourly data scaled with Eurostat monthly data for solar. All other fuel codes taken from ENTSO-E hourly data.
- **Ireland** data was provided by Green Collective
- **Italy** data comes from TERNA, the Italian grid operator.
- **Netherlands** data is taken from Nationaal Energie Dashboard.
- **Poland** data comes from ENTSO-E with the exception of solar generation pre-2021, which is estimated using insolation data and installed capacity numbers.
- **Spain** generation data comes from ENTSO-E. Flow data comes from ESIOS.
- **Sweden** solar generation comes from the system operator website, all other fuel codes are from ENTSO-E.

Estimation of excess wind and solar generation in 2030

The hourly domestic wind and solar excess across all EU countries is calculated as the difference between domestic solar and wind generation and domestic load. In this calculation, the following assumptions are made:

- The daily load profile in 2030 is based on ENTSO-E ERAA 2024 provisional input demand data. It is taken from the 'National Trends' scenario, which is the baseline scenario given current country policies. This scenario might underestimate the potential of demand side flexibility and smart electrification, however, this is hard to judge as ENTSO-E and grid operators do not disclose how these load profiles are generated.
- Solar and wind hourly generation is computed based on Ember's estimation of solar, onshore and offshore wind installed capacities by 2030, multiplied by solar and wind capacity factors for 2030 using the climate year 2009. This climate year is generally considered to be conservative. Ember estimates of 2030 installed capacities are based on latest NECP figures where possible, otherwise national organisation estimates are used.
- The total EU excess is calculated as the sum of excess across each individual country. This does not take into account interconnection across the region.

Excess wind and solar generation in 2030 is translated into avoided fossil costs based on the following assumptions:

- It is assumed that domestic excess of renewables is either displacing fossil gas power at the same time in other countries (with interconnections) or fossil gas power at a later time in the same country (with battery or demand-side flexibility)
- This hypothetical shifting does not take into account interconnection constraints
- Fossil gas purchase cost in 2030 is based on settlement price for fossil gas with delivery at TTF in 2030, as traded on 5th September 2024.
- Fossil gas power plant efficiency (high calorific value) : 50%

Simulation of the benefits of additional battery storage

- A simulation of additional battery capacity in Germany in June 2024 is run using an additional 1.9 GW of batteries with 1.6 hours duration. This duration is in line with the average duration of batteries currently in operation in Germany as of July 2024. The additional battery capacity is estimated based on Solar Power Europe's high scenario.
- The additional batteries charge during times when Germany is exporting and generating solar power, subject to constraints of the maximum charging rate per hour (1.9 GW) and maximum power storage capacity (3.04 GWh).
- The additional batteries discharge with a flat rate in the 2 evening hours of 9 pm - 10pm, when there is no solar and generally more hard coal in the mix, discharging up to 1.9 GW per hour

- Additional battery discharge displaces fossil generation in those hours. In Germany during 2024, fossil gas and hard coal have alternated as the marginal price setter, therefore two examples are given of the cost: one if the batteries had displaced fossil gas, the other hard coal.
- Fossil gas purchase cost in June 2024 is based on average settlement day ahead price for fossil gas with delivery at THE in June 2024
- Hard coal purchase cost in June 2024 based on average month ahead settlement price for API2 in June 2024.

Acknowledgements

Special thanks to

Green Collective for providing Irish hourly data.

The authors would like to thank several Ember colleagues for their valuable contributions and comments, including Sarah Brown, Ali Candlin, Reynaldo Dizon, Dave Jones, Nicolas Fulghum, Sam Hawkins, and others.

We would also like to extend our gratitude to Solar Power Europe for insightful comments.

Header image

JT Energy Systems GmbH new energy storage facility in Bobritzsch Hilbersdorf, Germany.

Credit: dpa picture alliance / Alamy Stock Photo