ACER

European Union Agency for the Cooperation of Energy Regulators

Security of EU electricity supply

2026 Monitoring Report

19 November 2026

Report in PPT format

ACER
European Union Agency for the Cooperation of Energy Regulators

Introduction & report flow

The 2026 security of supply Monitoring Report focuses on **resource adequacy** and assesses recent developments in system flexibility needs. Some consideration is also given to the broader resilience of the electricity system.

Electricity demand is growing, partly due to the fast expansion of data centres, while the increasing share of weather-dependent generation changes the nature of scarcity risks. Storage and demand response are becoming more important for assuring flexibility, while the gas-fired generation, despite its declining share, still continues to play a role.

At the same time, the number of capacity mechanisms* assuring security of supply is set to increase. This Report argues that the contribution of different types of technology to mitigating scarcity must rely on a fair and robust approach in order to promote competition and minimise costs.

The Report also recognises the growing complexity of ensuring security of supply. Extreme weather conditions such as protracted droughts, heat waves and cold spells are increasingly impacting both energy consumption and generation. Such conditions can simultaneously impact large amounts of generation capacity at national and regional levels, as experienced in August 2026 with cooling water shortages for power plants. Proper consideration of resources available cross-border, when assessing future needs, allows better preparedness at a lower cost.

Contents

1 Annual developments
2 How clean is Europe's capacity support?
3 Gas–electricity linkages
4 Technologies' contribution to security of supply
5 Efficiency of capacity markets
6 Coordination and regionalisation
7 Flexibility measures

* The reference to capacity mechanisms in this report includes both market-wide mechanisms and strategic reserves. Operational security is outside the scope of this report.

ACER
European Union Agency for the Cooperation of Energy Regulators

Executive overview 1/2

Outages happened, not due to the lack of resources

- The average interruption experienced by consumers in 2025 was 98 minutes.
- None of the interruptions were due to resource adequacy issues.

Correlated shocks test the resilience of the electricity system

- Rare but correlated external shocks (e.g. summer droughts) affect adequacy and thus their impact should be properly assessed.
- Diversity of assets (technological and geographical) is important to withstand such shocks.

More EU countries rely on capacity mechanisms to ensure security of supply, with fossil generators still benefitting the most

- Capacity mechanisms' (CMs') costs continue to rise, amounting to **€6.9 billion** in 2025.
- Capacity support to fossil-fuelled assets still dominates (**76%**), even among newly contracted resources.

Flexibility measures spread to enhance renewables integration, mostly battery storage targeted

- 18 Member States have at least one flexibility measure, mostly targeting battery storage, but most battery deployment is market-driven.
- Renewable curtailment has increased significantly in recent years. However, its monitoring is sparse.

Source: NRAs as reported to ACER in the security of supply report survey.
Report and its findings refer to 2025 in the EU, unless otherwise indicated.

ACER
European Union Agency for the Cooperation of Energy Regulators

Executive overview 2/2

Getting demand projections right helps contain costs that support security of supply

- Electricity demand is projected to increase, with data centres emerging as an important driver in some countries.
- A robust assessment of the target capacity reduces costs. Implementing smart policies including flexible operation requirements can help too.

Coordination increases efficiency by reducing CM capacity needs and costs

- Member States with a CM benefit their neighbours by reducing adequacy risks across Member States without CMs potentially up to **66%**.
- Today, Member States could save **34%** of the additional capacity by establishing their needs jointly. If CMs spread further, the potential for saving grows..

Level playing field keeps costs down in capacity markets

- Measuring benefits from various resources to adequacy will ensure a fair and technology-neutral support.
- Assessing resources based on their adequacy contribution promotes competition, over prescriptive requirements such as fixed battery durations.

Design choices in capacity mechanisms impact costs

- Up to **28%** increase in payments to capacity providers between 2024 and 2026 in some CMs.
- Remuneration rules influence participants behaviour and the overall cost of the CM.

Source: NRAs as reported to ACER in the security of supply report survey.
Report and its findings refer to 2025 in the EU, unless otherwise indicated.

ACER
European Union Agency for the Cooperation of Energy Regulators

Key findings and proposed actions

More countries are relying on capacity mechanisms, with fossil generators benefiting the most	→ Monitor measures against their objectives e.g. adequacy, renewable integration → Ensure that all technologies compete on a level playing field based on robust design criteria
Coordination increases efficiency by reducing CM capacity needs and costs	→ Identify interdependencies between flexibility and adequacy decisions → Adequacy assessments should consider resources available cross-border → Opt for coordinated CM dimensioning to increase efficiency and decrease procured volumes
Getting demand projections right helps contain costs that support security of supply	→ Assess reliability of ambitious growth plans for fact-based demand projections → Assess the robustness of connection requests from all potential network users, ensuring that speculative requests (e.g. for data centres) do not skew the forecasts
Design of capacity mechanisms can impact level playing field and costs	→ Use robust approaches to fairly assess the contribution of all technologies (ACER's ERAA methodology) → Price caps applied should be based on reliable resource cost calculation (ACER's EU-wide CONE dataset)
Improving flexibility measures	→ Remove market barriers for non-fossil flexibility assets → Monitor the effect of flexibility measures to better inform decisions on flexibility needs

Note: The analysis and modelling results found in this report are intended to inform policy discussions and support evidence-based decision-making. Policy conclusions may nevertheless be informed by a broader set of considerations beyond the analytical findings alone.

ACER
European Union Agency for the Cooperation of Energy Regulators

Annual developments

Taking stock of recent developments

Outages happened, not due to the lack of resources

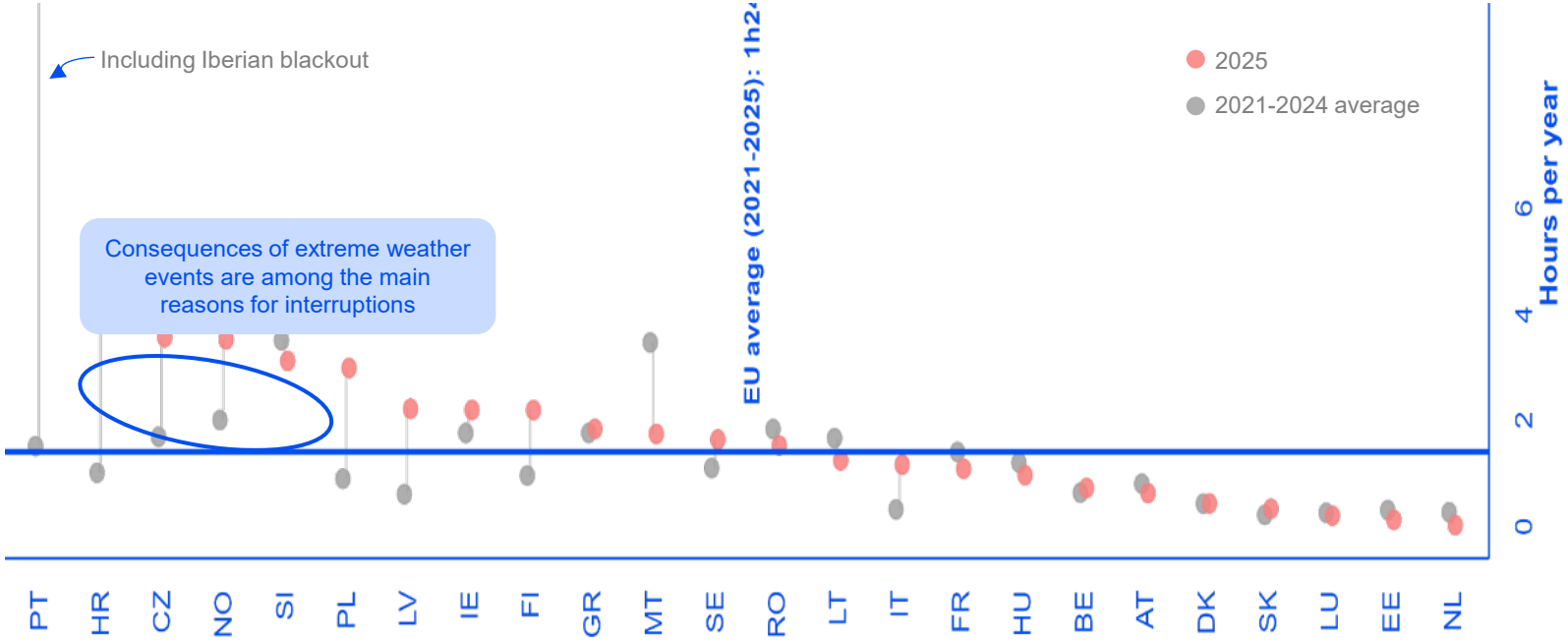
The average interruption experienced by consumers in 2025 was 98 minutes*. None of the interruptions were due to resource adequacy issues.

For a consumer, the level of supply continuity is captured by the SAIDI[1] indicator. It shows the average amount of time per year where a consumer is without power (averaged for the member state).

Most supply interruptions happen at the level of distribution networks, designed and operated differently from transmission networks, and more susceptible to incidents such as severe weather events. SAIDI mostly reflects interruptions at the distribution network level.

For more information on the operational security of the transmission network, follow ACER's work on the revision of the System Operation Guidelines.

System Average Interruption Duration Index (SAIDI), EU & Norway, 2021-2025 (hr)



Warnings issued in August 2026

Slovenia, Hungary and Bulgaria have issued early warnings while **Romania** declared an electricity crisis situation under the EU Risk Preparedness Regulation due to the impact of the stark decrease in water levels in the Danube and connected rivers on the operation of energy generation facilities. Some nuclear units underwent or were close to a controlled shut down.

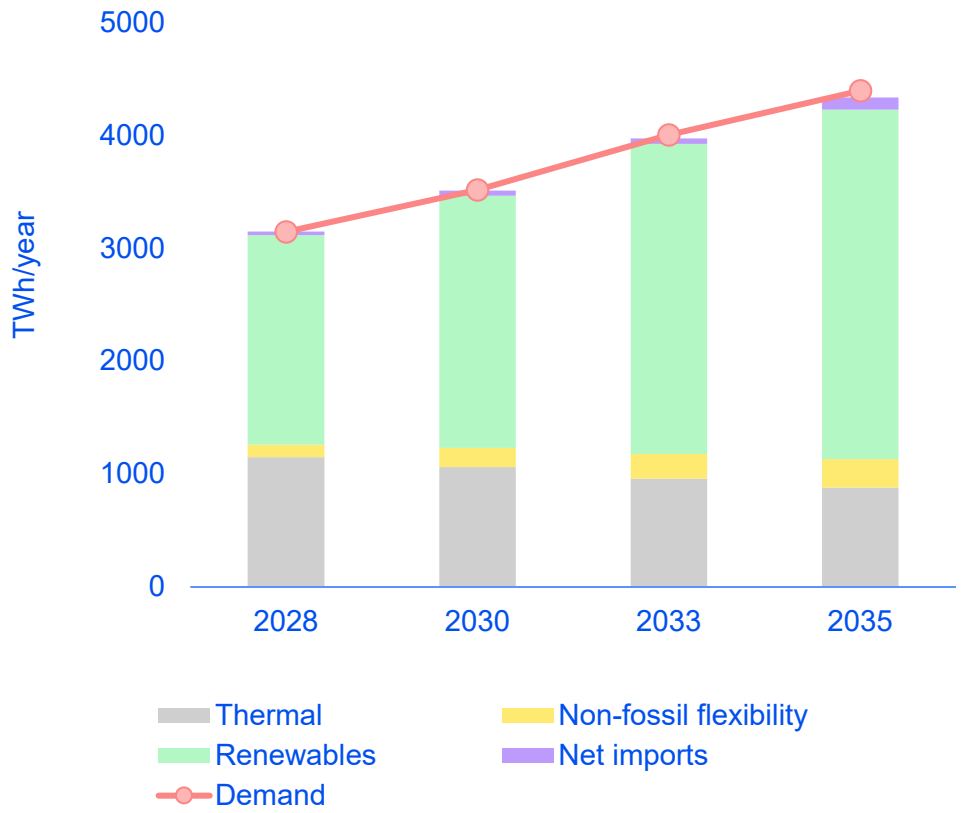
Yet, the situation remained stable and did not lead to disconnection of consumers. Voluntary load shifting helped.

*Average SAIDI in 2025 does not include values from PT.
[1]SAIDI stands for System Average Interruption Duration Index.
Source: ACER based on NRA data. Includes unplanned and planned outages on all available voltage levels. When the SAIDI value on all voltage levels was not available, low-voltage SAIDI was used. DE and CY data not available, ES does not report SAIDI. Reliability level 99.98%. Average SAIDI experienced by end-users in the EU in 2021-25 (weighed with population) is lower at 72min.

Changing generation mix to meet rising electricity demand

EU electricity demand and production are projected to rise

Projected electricity demand and generation mix per type: EU[1]



While the generation mix is becoming cleaner and more flexible, the system also needs to keep up with growing demand.

On the one hand

Europe's electricity system is moving toward increasing renewable generation, storage and demand flexibility. Renewables are expected to meet nearly two thirds of electricity demand by 2028 and three-quarters by 2035, while thermal power plants (mostly fossil) are expected to generate less electricity and operate for fewer hours (see Report page 19 on Gas generation). The diminishing thermal capacity is, however, expected to persist in the medium term with an important contribution during periods when renewable generation is low.

While on the other hand

The **EU-wide electricity demand is projected to increase**, with some of its main drivers being a rapid expansion of data centres along with increasing demand by electrolysers, heat pumps and electrification of transport.

Evolving data centre scene

In 2024, demand from data centres in Europe was estimated as **87 TWh** and it is projected to grow to **134 TWh by 2030** and up to at least **199 TWh by 2035**[2]. Based on available adequacy assessments, the steepest growth is expected in Portugal, while Ireland maintains its lead in data centre demand as a share of its overall demand.

[1]Source: ACER based on ERAA 2025 data. Note, thermal comprise generation from fossil fuel and nuclear, while renewables mostly cover wind, solar, hydro and biomass.
[2]As a minimum projection and up to 254 TWh as a maximum projection (ENTSO-E's report).

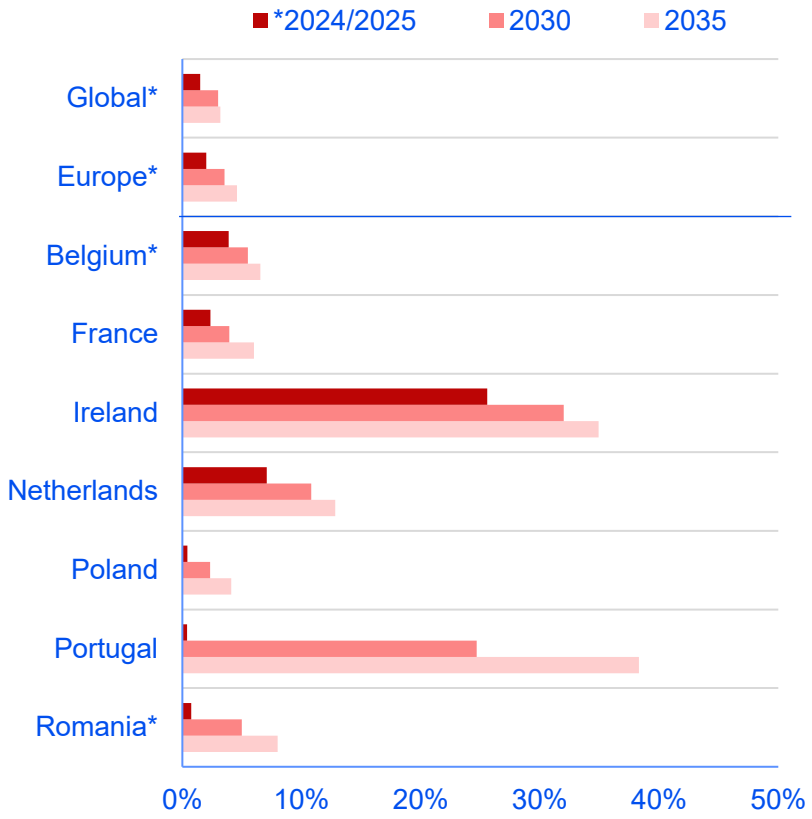
ACER
European Union Agency for the Cooperation of Energy Regulators

In the spotlight

Managing data centre expansion across the EU

The share of data centre demand is increasing

Share of data centre demand in total demand (%) as represented in national resource adequacy assessments compared to global and Europe-wide projections.[1]



* Data centre demand available for 2024, not 2025.

How are EU countries responding?

Some accelerate, some slow down:

- In France, classifying data centres as projects "of major national interest" facilitates their development while a fast-track grid connection procedure will ease constraints for new data centres.
- On the other hand, Denmark introduced a moratorium on new connections to deal with the increasing number of applications.

Navigating speculative requests:

- France follows "use it or lose it" principle to release unutilised allocated grid capacity. Belgium is considering a similar measure[2].
- Portugal introduced a scheme for new connections of energy-intensive consumers requiring financial guarantees and timeline commitments.

Managing increasing demand:

- Ireland and Spain[3] have implemented or considered requirements for proximate, renewable generation[4].
- France introduced a scheme to offer shared connections to anticipate future connections requests in zones of high demand[5].

Flexibility reduces system impact

Requiring data centres to provide flexibility reduces the system-level resource capacity and infrastructure needed to ensure security of supply.

- The Commission points towards delivering solutions for data centre flexibility.
- Finland is seeking to incorporate flexibility requirements for large demand units and is also developing a priority procedure for allocating scarce grid-connection capacity considering flexibility commitments[4].
- Belgium is developing temporary flexible connection agreements to allow new connections in congested zones. The Belgian NRAA assumes 20% data centre demand flexibility[6].
- Industry stakeholders are exploring how flexible data centres may contribute to the electricity system[7].

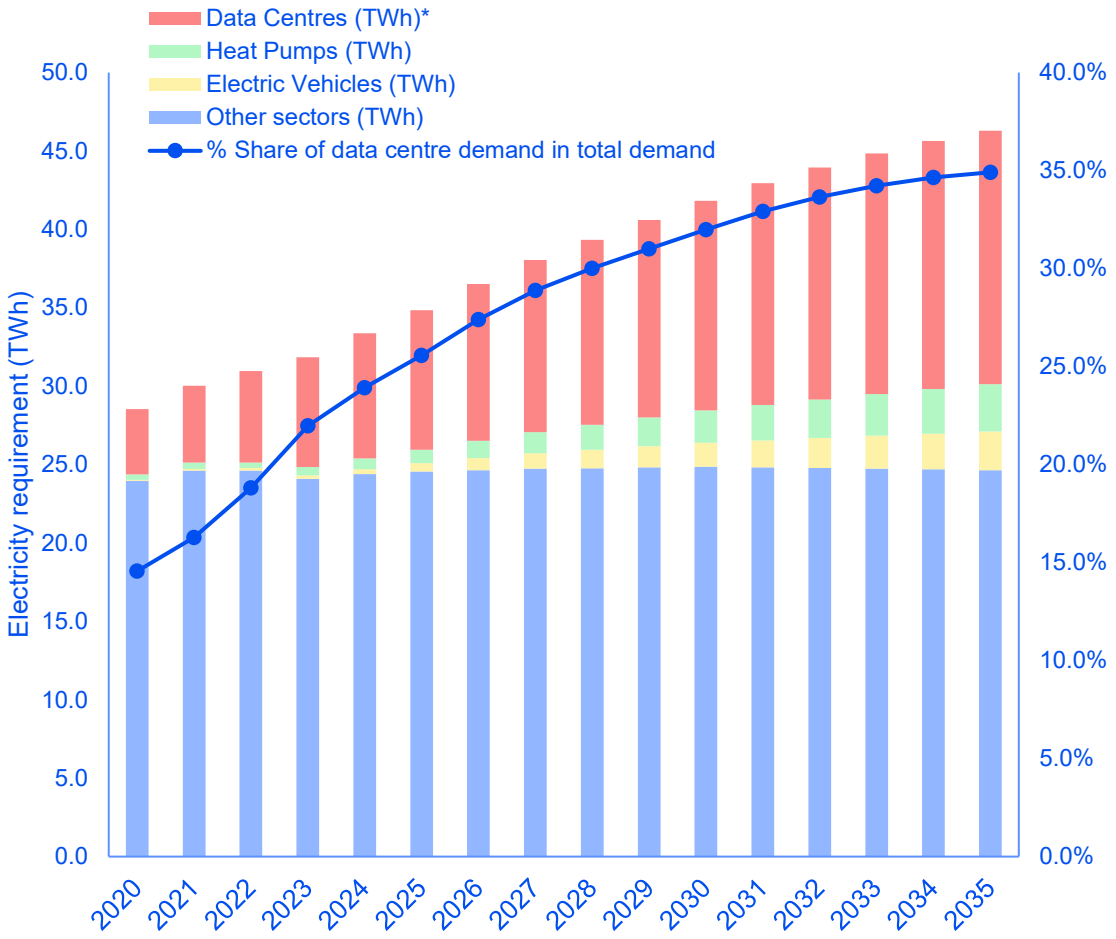
[1] Source: See Annex Note (1). Ireland groups data centres with New Technology Loads, Portugal groups data centres with other energy-intensive consumers. [2] Belgium is considering applying a "use it or lose it" principle to release unutilised reserved or allocated grid capacity. [3] Regulatory proposal under consultation. [4] Further details in Annex Note (2). [5] As described in Article 32 of the French APER Law (Law n°2023-175 of 10 March 2023). [6] Not yet demonstrated through operational experience. [7] For example, see Agora Energiewende report.

ACER
European Union Agency for the Cooperation of Energy Regulators

Case study

Data centres drive 63% of Ireland's demand growth

Data centre expansion leading demand growth in Ireland[1]



*Mostly data centres with a minor share of other loads ('New Tech Loads').

Ireland responds with a new data centre connection policy

Step change in data centre demand in Ireland

The total electricity demand has grown by 30% over the past 10 years, largely driven by the increase in data centre developments. **Demand from data centres is expected to double between 2025 and 2035 which accounts for 63% of the overall demand growth.** The rest comes from heat pumps and EVs.

Fast-growing data centre industry places a strain on the system

- **Grid constraints:** data centre expansion is surpassing the development of network infrastructure, restricting where new data centres can connect.
- **Security of supply:** risk that demand for electricity from data centres is growing faster than delivery of new generation capacity.
- **Decarbonisation:** influx of demand could impact gas usage and national carbon emissions

The policy[2] requires new data centres to:

- Deliver **associated generation to match their demand capacity (derated).**
- Install **onsite or proximate** generation to reduce risk on adequacy while taking account of grid congestion.
- Meet at least 80% of their annual demand with **additional renewable** electricity generated in Ireland.

[1]Source: ACER reproduced from AIRAA 2026-2035 data.
[2]The Irish NRA (CRU) published the Large Energy User Connection Policy, in December 2025. For specific requirements of the LEU Connection Policy see Annex Note (3).

Capacity mechanisms price influenced by supply and demand

The lower the volume of eligible capacity relative to the target demand, the closer the clearing price tends to be to the price cap. This may result e.g. from reduced competitive pressure among participants, that strategically bid closer to the price cap and still get accepted (driving up the clearing price) or from stringent timelines and delivery requirements for eligible assets that increase participation costs.

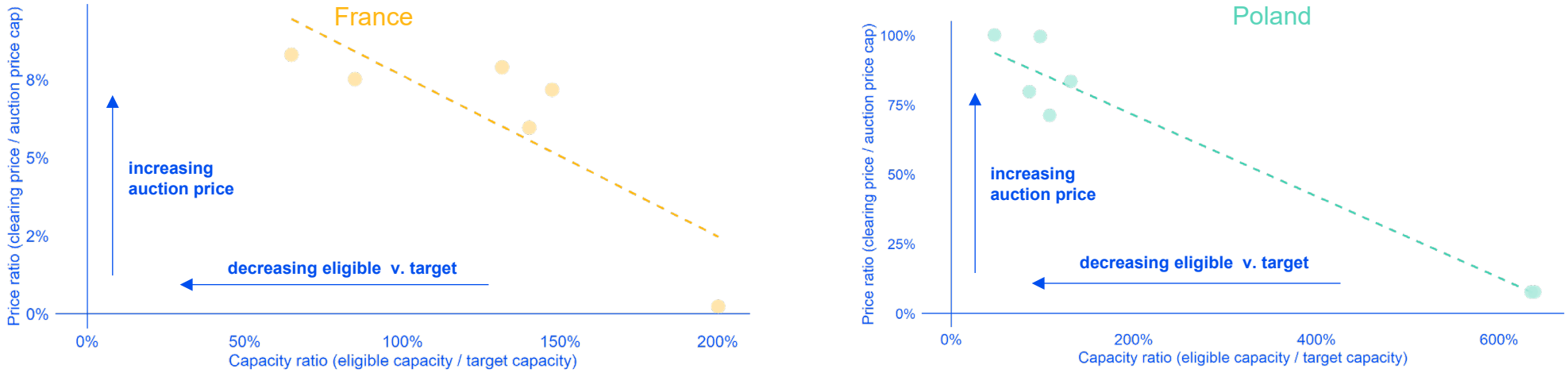
Eligible capacity

Amount of capacity that has been qualified to participate in the auction, based on verified availability and compliance with technical requirements.

Target capacity

Amount of capacity the system intends to procure, established through adequacy assessments and aligned with the reliability standard.

Ratio of clearing price to auction price cap related to ratio of eligible to target capacity, CM auctions 2025



Ensure participation through precise eligibility rules reflecting technical availability that includes all technologies able to provide support during scarcity periods. Demand targets should be calibrated as accurately as possible, as overestimation increases both procurement volumes and clearing prices.

Source: ACER based on NRA data.

[1]Note: For in-depth discussion of capacity auction design related to price caps see the section on Efficiency of Capacity Markets

ACER
European Union Agency for the Cooperation of Energy Regulators

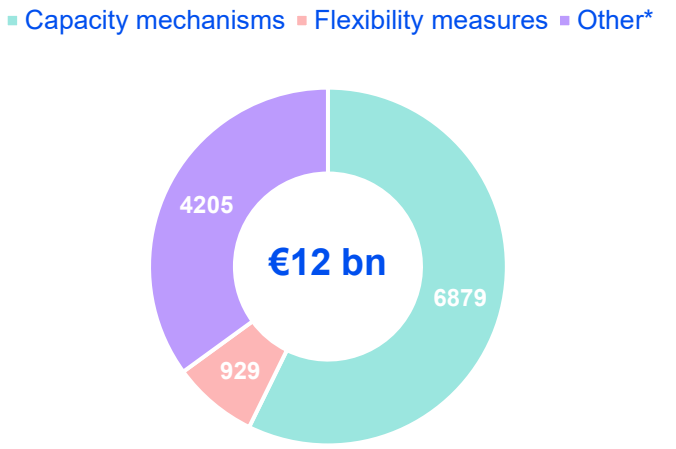
More spent EU-wide as support measures multiply

In 2025 there was a marked increase in the number of security of supply and flexibility measures in the EU, with the total amounting to 63 measures, up from 39 in 2024. The biggest growth has been registered in the number of flexibility measures, with six Member States introducing new measures and three Member States introducing them for the first time.

The overall cost of the support measures increased to 12 billion Euro. The costs of capacity mechanisms continued on a steady rising trend, reaching 6.9 billion Euro. The costs of flexibility measures increased significantly by 76% from last year, albeit still accounting for less than 10% of all support costs.

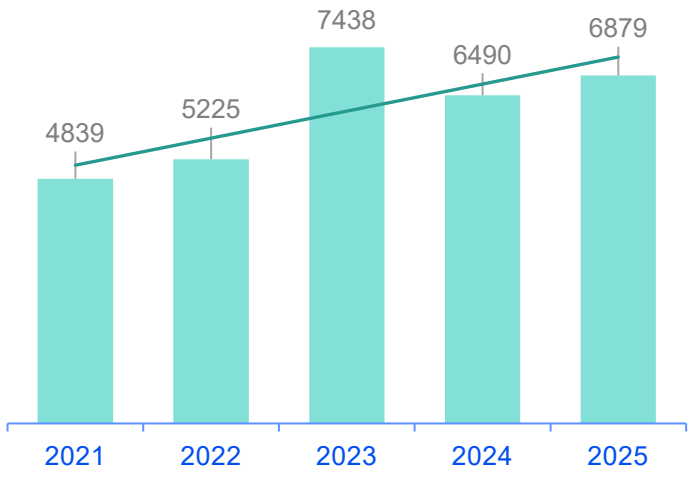
Further growth in EU-wide spending on support measures

Cost of all support measures, EU-27, 2025 (million EUR)

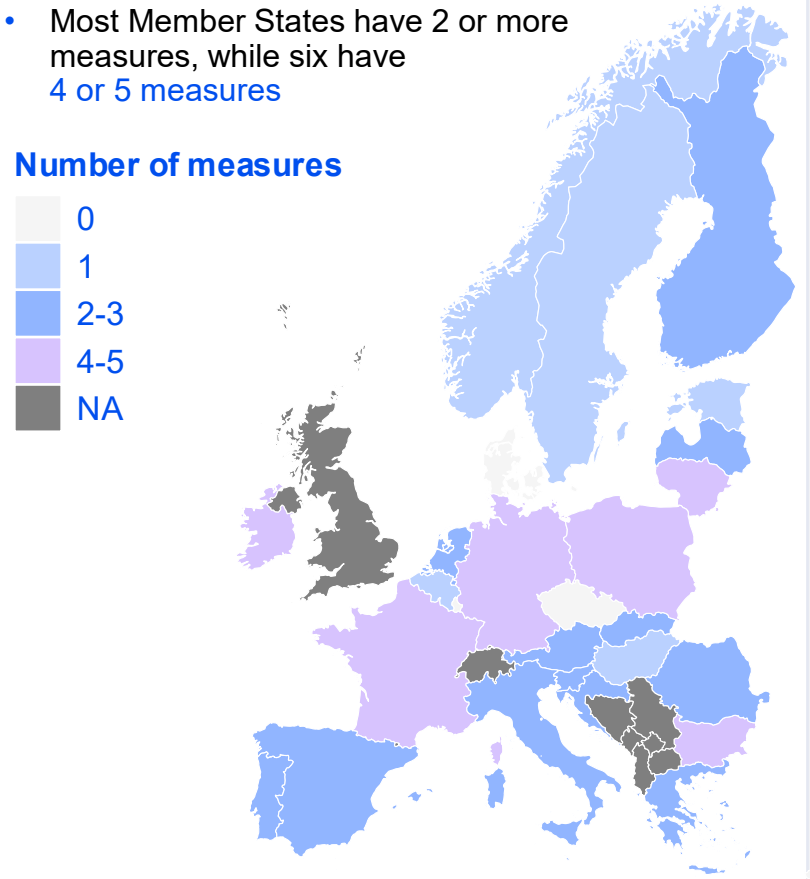


The increasing cost trend continues

Cost of capacity mechanisms[1], EU-27, 2025 (million EUR)



- **63 support measures[2]** related to security of supply and flexibility reported in total
- Most Member States have 2 or more measures, while six have 4 or 5 measures



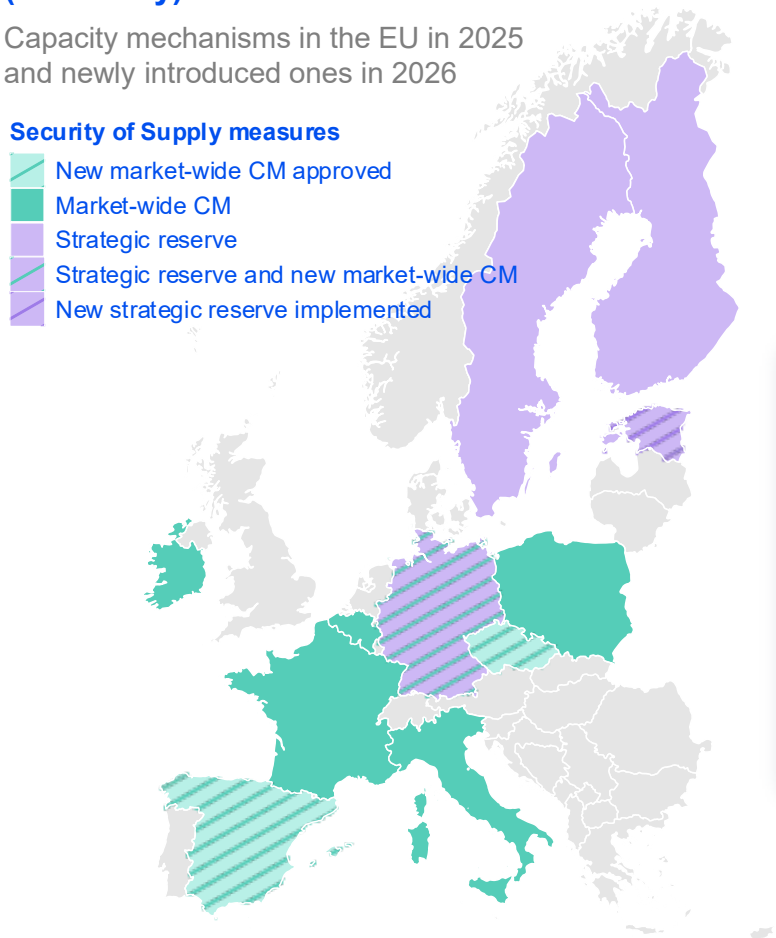
Source: ACER based on NRA data.
*Other measures refer to support schemes that do not fall under the categories of 'capacity mechanisms' or 'flexibility measures'. For more information about 'other' measures, see Annex Note (4).
[1]For CM cost calculation assumptions see Annex note (5). [2] For more information on additional SoS measures introduced or modified by MS in 2025 see Annex Note (6).
Note: on the map Northern Ireland shows "NA" for the number of measures as it is not an EU Member State, yet in fact it is bound by EU regulations and is part of the Single Electricity Market on the island.

ACER
European Union Agency for the Cooperation of Energy Regulators

… in more Member States

Several EU Member States introduce (or modify) CMs

Capacity mechanisms in the EU in 2025 and newly introduced ones in 2026



Three new market-wide capacity mechanisms approved by the European Commission in 2026

- **Czechia:** First CM to be approved under the new fast-track state aid rules (CISAF) that fully rely on the ACER-approved ERAA assessment.
- **Germany:** CM will be open to existing and new capacity, both domestic and cross-border. It will require all beneficiaries of long-term contracts to operate in a climate-neutral way by 2045.
- **Spain:** CM will be open to both existing and new capacity located in Spain. It will include support to the development of flexibility services to help reach Spain's national flexibility target.
- **France:** is moving from a decentralised to a centralised CM, with the TSO to contract capacity directly through pay-as-clear auctions. (See more on page 31).

Cost recovery examples

Estonian CM[1]: The mechanism is funded by all end consumers based on their total electricity use (including both domestically produced & imported).

The financing mechanism aims at ensuring that consumers who create the need for the reserve, bear its costs. The charge is thus **levied on respective consumers during peak hours.**

Czech CM[2]: 10 % of the costs for the CM will be included in the regulated prices as a payment for "related electricity services" and distributed among market participants.

90 % of the payments are proposed as a **dynamically determined fee** triggered when the price threshold[2] is exceeded on the Day-ahead markets.

Cost-reflective cost recovery can encourage demand response and reduce overall costs.
Read more in ACER's 2024 security of EU electricity supply Monitoring Report.

Source: ACER based on NRA data.
[1] For more information on the Estonian cost recovery see Annex Note (7). [2] For more information on the Czech cost recovery model see Annex Note (8).
[2] The price threshold will be set as a 95 percentile of the prices from Day-ahead market from the previous year (or of average of the highest prices from the past 3 years).

In the spotlight

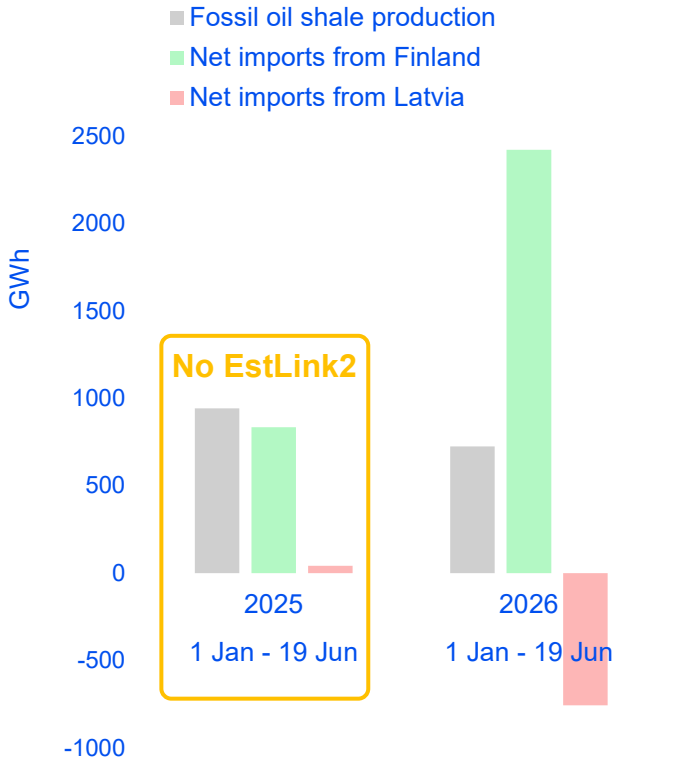
EstLink 2: Estonia's six-month security test

On 25 December 2024, the suspected sabotage to the EstLink 2 subsea cable between Finland and Estonia reduced the transmission capacity from 1 000 MW to 350 MW until 20 June 2025. The immediate impact was limited by the low-demand Christmas-period, with no demand curtailment.

The incident was particularly relevant for Estonia, a net importer of Finland's relatively low-cost nuclear and renewable electricity. EstLink 2's 650 MW import capacity represents around 40% of Estonia's 2025 peak demand.

Impact on the energy mix

Outage period compared with the same period next year[1]

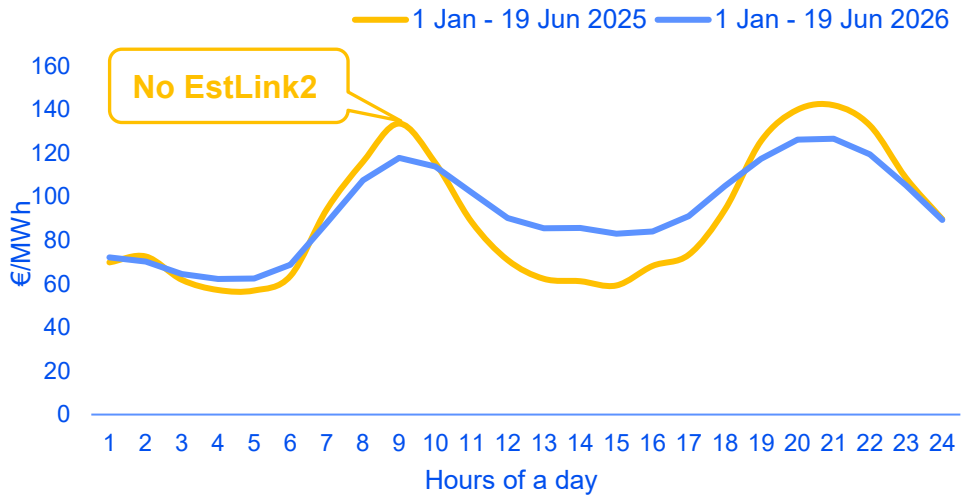


Changing flows: Reduced EstLink 2 import capacity was partly offset by Estonia's lower exports to Latvia. During the outage, exports to Latvia were approximately 900 GWh lower than in the same period in 2026.

Volatile prices: Estonia relied more on expensive domestic oil-shale generation during peak hours, while high renewable generation and limited exports reduced off-peak prices.

Less cross border flows lead to price swings

Average daily price profile in Estonia: with and without EstLink 2[1]



Estonia's resource adequacy assessment indicated that unviable oil-shale plants could exit the market and that imports may be unavailable during scarcity. ACER`s Opinion found these findings justified. The Commission subsequently approved a €750 million Estonian strategic reserve to support security of supply based on the ERAA 2024.

[1]Source: ENTSO-E Transparency Platform.

ACER
European Union Agency for the Cooperation of Energy Regulators

How clean is Europe's capacity support

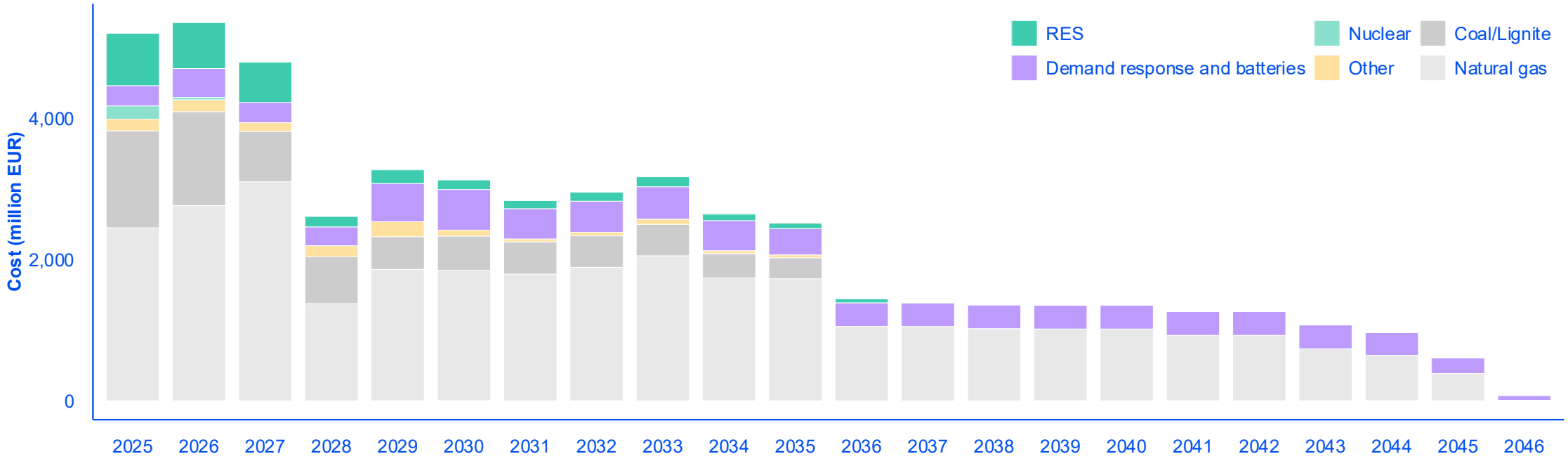
What technologies does the capacity support go to?

ACER
European Union Agency for the Cooperation of Energy Regulators

Where does the money go?

Capacity support goes predominantly to conventional assets, with only a quarter supporting ‘clean’ technologies

Auctioned costs of capacity mechanisms per technology from delivery year 2025 to 2046



Conventional generation assets remain the main recipients of support through capacity mechanisms. For the next decade, natural gas persists as a single biggest technology contracted under CM support, and the coal/lignite contracts remain sizeable. **Only 24%** of overall capacity mechanism payments **go to non-fossil technologies** demand response (DR) & battery storage being the main beneficiaries.

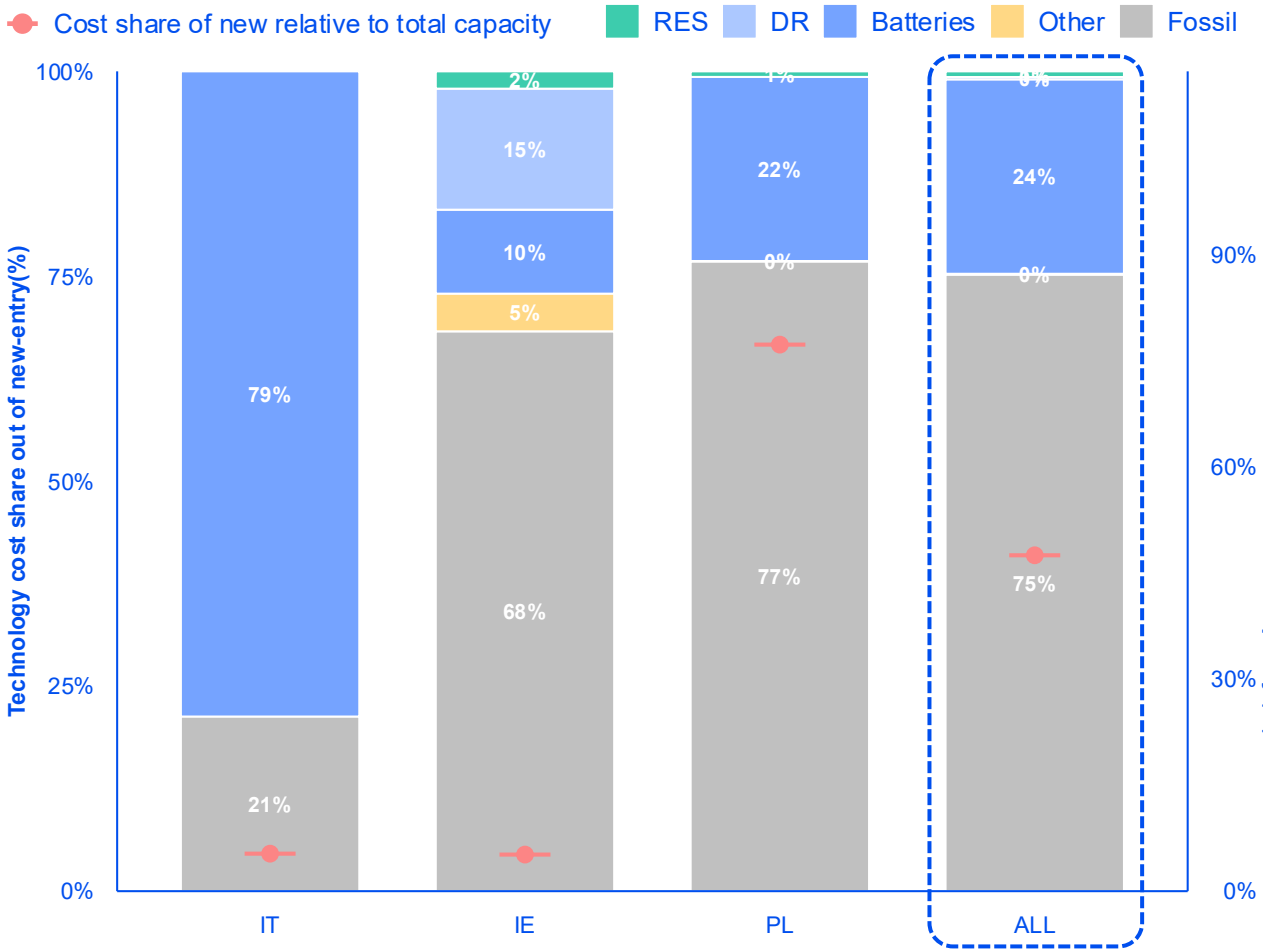
At the same time, other technologies like RES and nuclear receive aid through other channels than CM. For example, the Council of European energy Regulators noted that in the past 20.8% of electricity produced was supported under national RES schemes*.

ACER
European Union Agency for the Cooperation of Energy Regulators

Two different pathways for new-entry capacity

Capacity support to fossil-fuelled generation remains substantial, even if only considering new-entry assets

Cost share of each technology out of new capacity and share of new relative to total capacity (for all contracted delivery years (2025 to 2046)



The **picture does not change** when looking exclusively at costs of new-entry capacity. However, we observe **two different pathways** across countries:

Mostly batteries entered the system:

- In Italy, batteries are the main beneficiary for the new-entry capacity. New-entry support represents 5% of total cost.

Fossil fuels still dominate:

- In Ireland, 2 out of 3 EUR are directed towards fossil. Ireland currently has little interconnection available, while its demand profile is expected to increase significantly. Energy creating assets entering can have a sizeable impact in this context. Still, the share of new-entry remains limited (5%).
- In Poland, the high shares of new-entry capacity (77.3%) and fossil fuels (77%) are largely explained by coal plants under construction at the time being awarded in the early auctions (2018).

Source: ACER based on NRA data
Note: Fossil technologies category does not include any nuclear capacity, and no nuclear reactor is planned to be commissioned in countries with CMs; For France, there was no contracting of capacity that had not yet been built. Data for Belgium is not available.

ACER
European Union Agency for the Cooperation of Energy Regulators

Case study
Trapped in a high-emission challenge

For years, German power resources have relied on a **web of revenues** alongside the market: large redispatch payments, network reserve, network stability reserve, strategic reserve, combined heat and power capacity support (the country has over 25 GW of installed CHP), support for dispatchable renewables, etc.

Germany is now moving towards a capacity market with an ad-hoc capacity mechanism for delivery in 2031, to be followed by a structural capacity market for delivery in 2032.

Although these tenders do not explicitly favour any technology, their conditions are **geared towards additional long-term resources**, such as gas-fired generation. Specifically, resources bidding in 2026 auctions must sustain output for 10 consecutive hours[1]. This significantly limits, if not effectively prevents, participation of short-duration storage. The "bridge" auctions are expected to lock in additional gas-fired gigawatts in the system[2]. Battery is still likely to participate, but only in a very limited way.

The Y-4 capacity auction expected in December 2027 will rely on derating factors calculated by the German NRA rather than requiring continuous output.

Carbon cost of Germany's flexibility

After nuclear closures Germany turned to fossil fuels for firm capacity to support renewable deployment and address dunkelflaute. In fact, gas is a go-to dispatchable supply when solar and wind generation is low. This way, gas took over the role of country's hydro.

This helps explain Germany's **high power-sector carbon intensity** in 2025 (around 240 $kgCO_2$ per MWh), behind only Poland and Czechia and on par with the Netherlands.

READ MORE ABOUT RE-DISPATCHING COSTS →

Upcoming German y-5 capacity auctions

Auction	Provisional date	Derated capacity	Delivery year	Conditions
Round 1	September 2026	**4.5 GW**	2031	New/retrofit units; No DSR participation; Made with Europe (30%); Long continuous output
Round 2	December 2026	**4.5 GW**	2031	
Round 3	May 2027	**2 GW**	2031	

Impact on the eligibility of batteries

Sources: German security of supply act. Proposal and justification; BNetzA's Monitoring report 2025; Montel Clean Power Progress Index 2026.
[1] To ensure eligibility, energy storage units should also charge within 3 hours.
[2] All new gas-fired power plants should demonstrate hydrogen-readiness.

ACER
European Union Agency for the Cooperation of Energy Regulators

Focus topic: Gas-electricity linkages

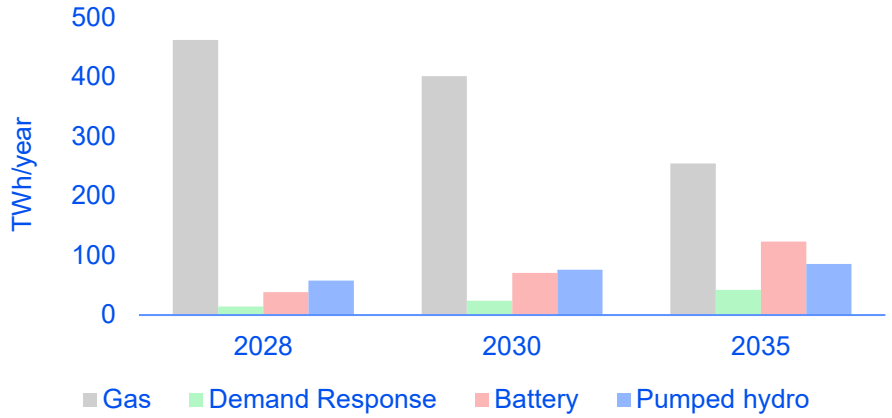
Gas-fuelled electricity generation

ACER
European Union Agency for the Cooperation of Energy Regulators

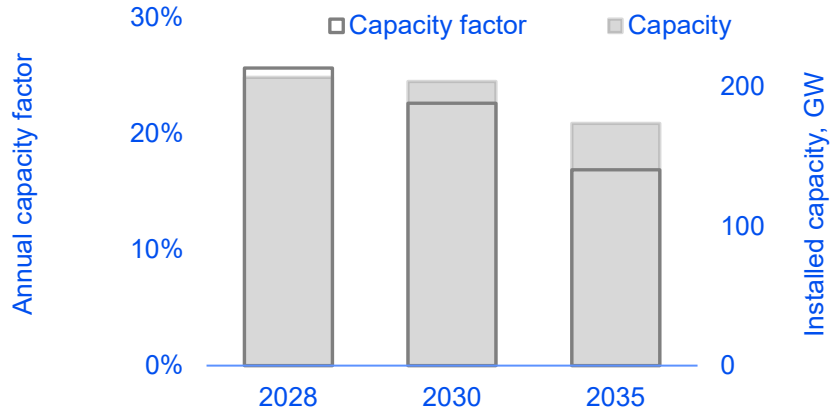
Gas generation is shrinking, but persists as a safety net

Projection[1]: non-fossil flexibility gradually adds up, gas generation declines

Electricity production from gas and non-fossil flexible technologies[1]



Gas-fired power plant capacity and capacity factor[1]



As the EU electricity system moves towards decarbonisation, clean energy is being produced from more renewable sources and with added clean flexibility.

The adequacy contribution of energy limited resources (e.g. battery technologies) is influenced by the length of the scarcity period. It is, in particular, relevant during rare periods of high demand and prolonged low wind and solar generation – known as Dunkelflaute. (See Report page 23 on Scarcity lengths)

At the same time, due to decreasing use of gas in electricity generation, the **gas capacity factor is projected to decline**[1]. It means fewer operating hours per year, which may reduce revenues from the energy-market.

This effect may be partially offset by other revenues such as providing re-dispatching and ancillary services, as well as by more frequent high-price periods. (See Report page 48 Annex: Where is the missing money?)

About one third of gas capacity is supported through capacity mechanisms EU-wide.[2]

SEE THE ACER REPORT
on the decarbonisation of the EU's natural gas market

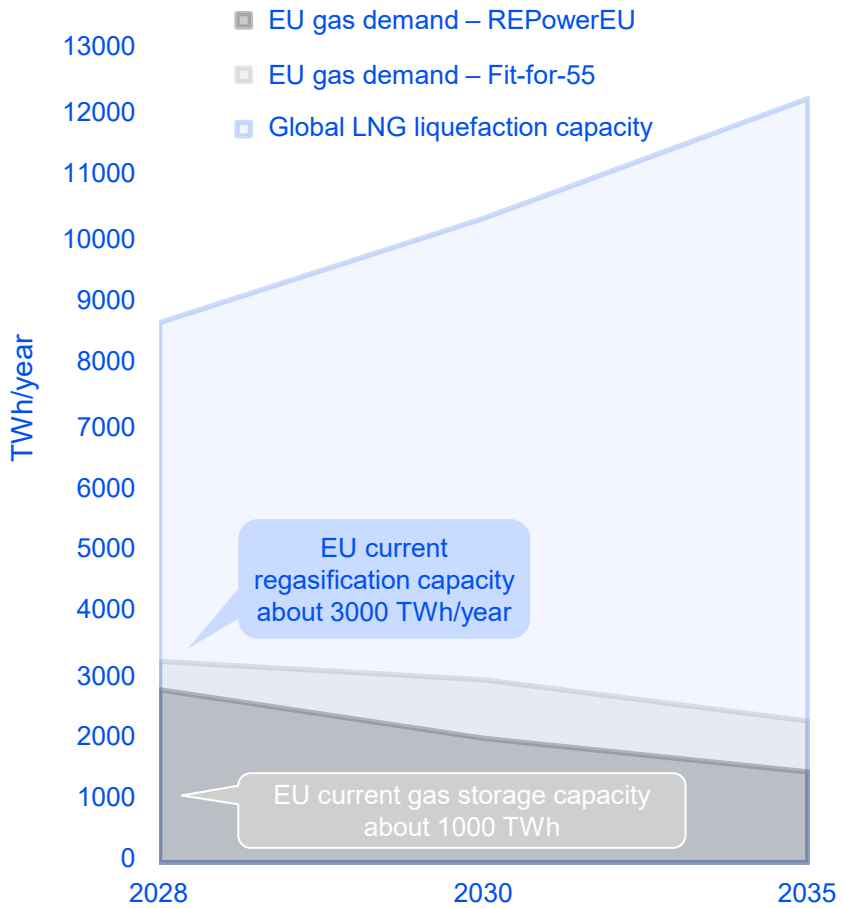
[1]Source: ACER based on ERAA 2025 data.
[2]2025 data. Source for installed capacity: ENTSO-E Transparency Platform. Source for capacity procured in capacity mechanism: Survey.

ACER
European Union Agency for the Cooperation of Energy Regulators

LNG buys Europe flexibility, at a cost

More LNG, lower demand but higher price risk

Total EU natural gas and electricity demand, and global LNG regasification capacity projections for 2028-2035[1]



With reduced Russian pipeline deliveries, the EU has become increasingly dependent on deliveries of liquified natural gas (LNG), which accounted for around 40% of gas imports.

Positive supply-demand dynamics:

- The EU gas demand is projected to decline due to efficiency in energy use, electrification, renewables deployment and industrial changes. This should reduce the risk of gas supply shortages.
- On the supply side about 500 TWh/year of new global LNG liquefaction capacity is expected every year. The EU has about 3000 TWh/year of LNG regasification capacity that is close to the expected total EU gas demand already in 2028.

Yet, key vulnerabilities remain:

- Global gas demand and supply are both expected to rise, with the balance between the two potentially intensifying competition for available LNG cargoes.
- Geopolitical events also play a role. E.g. following the disruption of gas supplies through the Strait of Hormuz in March 2026, Dutch TTF gas prices rose about 70%, according to ACER.

Europe's long-term resilience depends on a combination of measures: accelerating decarbonisation by reducing structural gas demand and expanding domestic production of decarbonised gases, while securing additional LNG supply under flexible contract terms.

SEE THE ACER REPORT ON KEY DEVELOPMENTS IN GAS MARKETS (SUMMER 2025/2026) →

[1]Source for EU gas demand: ACER 2026 Monitoring Report on the decarbonisation of the EU's natural gas market. Source for the global liquefaction capacity: S&P Global. Source for the current EU regasification capacity and storage size: gas infrastructure Europe.
Note, the analysis does not consider hydrogen, as any significant use of H_2 for power generation is expected to arise only beyond the time horizon assessed here.

ACER
European Union Agency for the Cooperation of Energy Regulators

Focus topic: Contribution of different technologies to security of supply

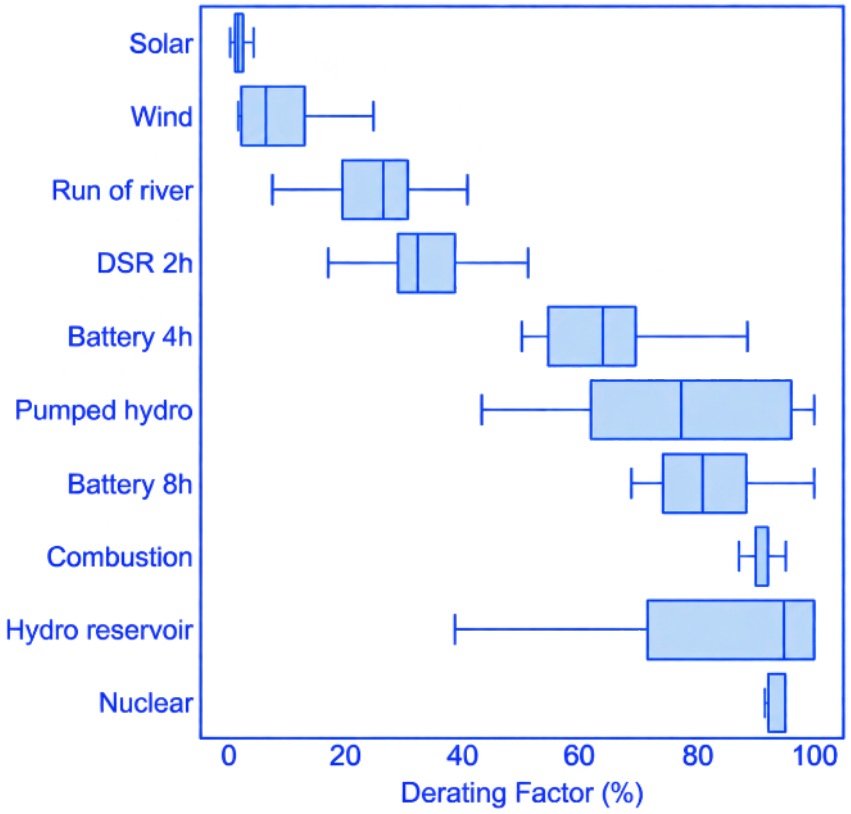
Measuring the benefits of different technologies and ensuring technology neutrality

ACER
European Union Agency for the Cooperation of Energy Regulators

How to ensure technology neutrality in CMs

Not all capacity is equally available during system stress

Distribution of derating factors by main technology group, EU, for delivery in 2028[1]



Derating factors (DFs) in capacity markets reflect the **contribution to security of supply** that is expected from a given technology in times of scarcity.

For instance, the contribution of a **4-hour battery**[2] is, on average, **28% lower than** of a combined-cycle gas turbines (**CCGTs**) that is almost "always there" (90-95%).

But cost matters too - **batteries are** approximately 30% **cheaper** per MW.[3]

When **costs are assessed per unit of reliable** (derated) **capacity**, the gap between the two technology costs narrows considerably. Notably, batteries still remain less expensive in roughly half of the relevant bidding zones with better overall **contribution to adequacy per EUR**.

Derating factors provide a more nuanced, performance-based approach than imposing fixed requirements, such as restrictive minimum-duration or availability criteria for batteries.

Correlated external shocks impact reliability

The 2026 summer drought lowered the Danube and Sava water levels, constraining cooling-water availability for nuclear reactors in Romania, Hungary, Bulgaria and Slovenia. 13-22 August nearly 3GW of nuclear generation capacity was thus simultaneously unavailable in the region.

Similar events also happen in other contexts. In 2024, due to a single design issue, a large share of the nuclear fleet had to go under maintenance in France.

The impact of such rare correlated events is not captured by those estimates that rely only on independent average outage rates. Analysis of historical events should inform availability assumptions in adequacy assessments.

[1]The DFs shown have illustrative purposes and have been estimated by ACER form ERAA 2025 edition datasets following ERAA methodology. More details in Annex Notes (9) and (10).
[2]Battery duration means how long a fully charged battery can provide full power before it needs to be recharged [3] Equivalent Annualised Cost - Costs' value are based on ACER`s EU CONE data set. For additional information on cost values see Annex Note (11).

Scarcity lengths drive battery's adequacy contributions

Battery derating factors are influenced by the expected duration of scarcity events, as battery capacity may be insufficient to sustain full power output throughout every scarcity period. Also, battery requires time to recharge between consecutive events.

Scarcity events generally occur due to a combination of factors in the electricity system, such as high demand coinciding with low renewable generation and unavailability of dispatchable power plants due to outages. In some cases, these conditions can occur simultaneously across several neighbouring countries, limiting the availability of electricity imports.[2]

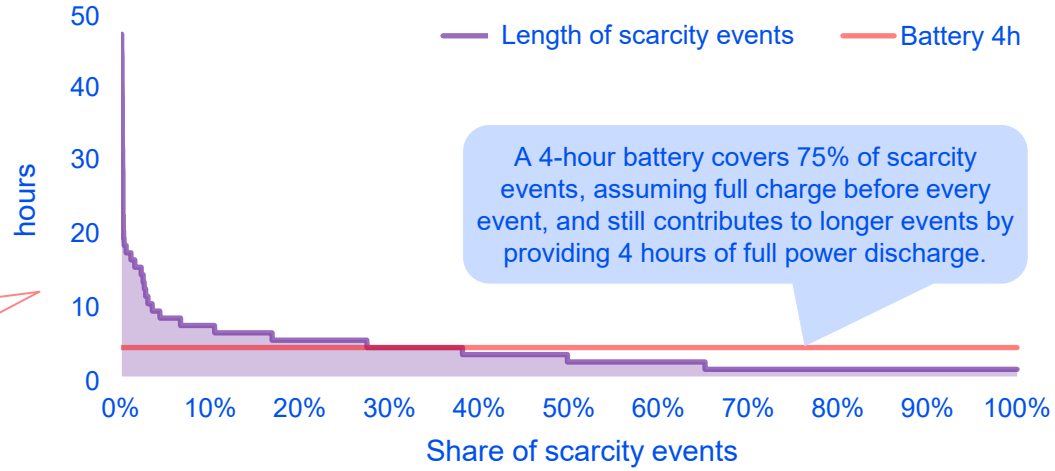
Projected scarcity durations across the EU countries can range from as short as one hour to as long as two days. While two-day events are very rare, around 3% of scarcity events last 10 hours or longer. This means that fully charged 10-hour batteries can contribute to most events.

Even where a scarcity period exceeds the battery's nominal duration, the battery can still provide its full power output during the scarcity period.

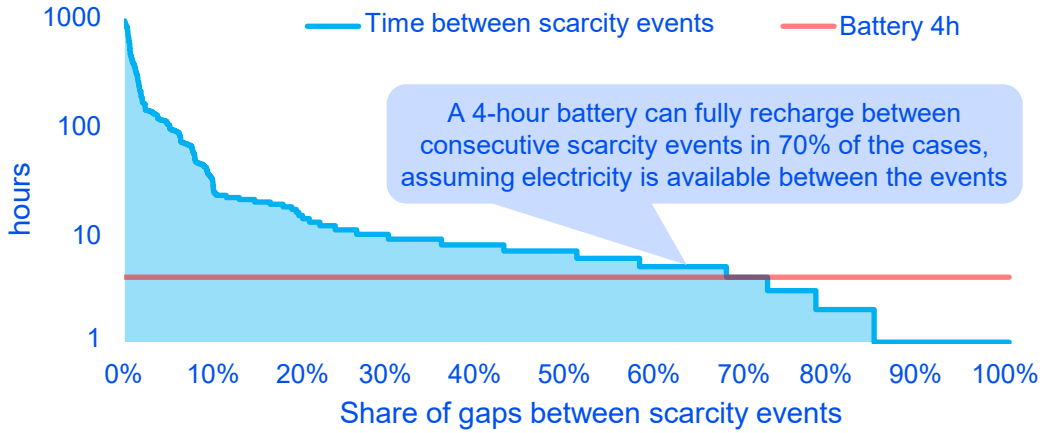
Consequently, covering longer scarcity events may require additional battery capacity or batteries with a longer duration. Derating factors capture the contribution that batteries (and other technologies) can make to scarcity events of different durations. The economically efficient mix of technologies is determined by considering these derating factors together with the associated costs.

A 4-hour battery covers most scarcity events[1]

Projected length of scarcity events in 2028 in EU, source: ERAA 2025



Projected time gap between scarcity events in 2028 in EU, source: ERAA 2025



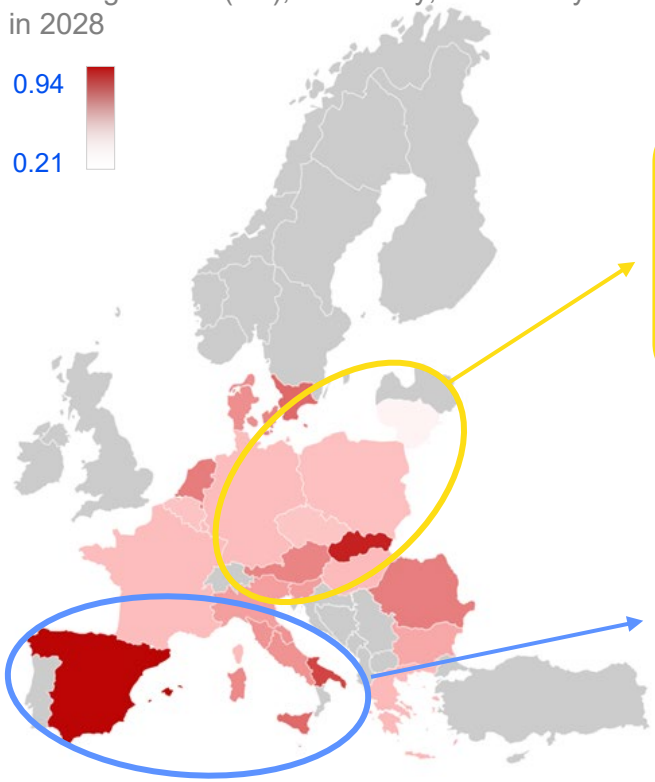
[1]Four-hour battery was taken as an example for this analysis as it is the reference storage size in ERAA 2025.
[2]Longer scarcity events can result inter alia from prolonged periods of low wind generation lasting several days or from consecutive / extended power plant outages. Shorter scarcity events are more typical in electricity systems with strong intra-day generation and demand dynamics, such as systems with substantial solar generation and pronounced daily demand peaks. In the future, scarcity events are expected to become rarer, but their duration is expected to increase, as was shown in the analysis on this in the ACER 2025 security of supply Monitoring Report (p. 30).

ACER
European Union Agency for the Cooperation of Energy Regulators

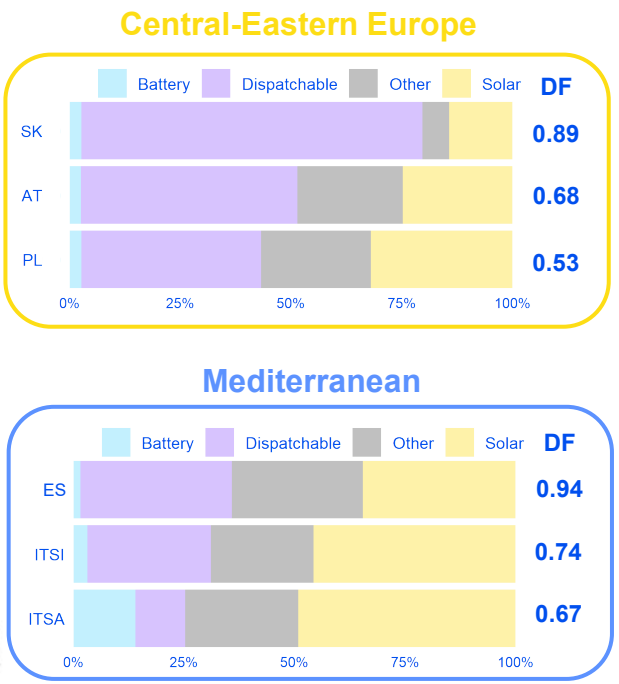
Energy mix impacts batteries' contribution to adequacy

How battery DFs vary across bidding zones with different capacity mixes

Derating factors (DF), 4h battery, for delivery in 2028



Projected energy capacity mix across market zones in 2028, ERAA 2025



Spain combines a high share of dispatchable generation with good solar penetration + high irradiation, resulting in the highest derating factors.

Derating factors are shaped by multiple inputs; the observations below focus on the impact of capacity mix

Dispatchable (thermal & hydro) technologies have the capability to sustain supply through prolonged tight-system periods, concentrating scarcity into shorter daily peak-demand hours. This is particularly evident in **Central-Eastern Europe:** Slovakia, with almost 80% dispatchable capacity, has a battery DF of 89%, compared with lower battery DFs in Austria and Poland, where the penetration of dispatchable is significantly lower.

Solar can shorten scarcity events, as its daily cycle limits them mainly to non-daylight hours. In the **Mediterranean** region, this effect remains significant even in winter, as sunnier weather, less cloud cover and longer daylight hours sustain solar output. This helps limit the duration of winter scarcity events and contributes to the high battery DFs observed in Sicily, Sardinia and Spain (all having significant solar penetration).

Battery contribution to adequacy can be subject to cannibalisation. As battery capacity increases, more net energy creating assets are needed to recharge the additional storage before the scarcity event. This is shown by the three **Mediterranean** regions in the chart, where an increase in battery penetration corresponds to a decrease in DFs.

Note: The DFs shown have illustrative purposes and have been estimated by ACER from ERAA 2025 edition input datasets following ERAA methodology Article 12 (7). The scarcity events taken from ERAA have been processed assuming the addition of a perfectly reliable resource so that each bidding zones has 3 hours of scarcity. For more details see Annex Note (10).

Circularity between derating factors and capacity mix

Derating factors depend on the capacity mix. (See previous page) However, the capacity mix is not fully known when the derating factors are calculated, since it is itself partly an outcome of the capacity mechanism and depends on which resources are ultimately selected.

This creates a circularity. If a Member State assumes that only limited battery capacity will enter the mechanism, batteries may receive relatively high derating factors, increasing their likelihood of being selected in the auction. Conversely, an assumption of a large amount of battery entry may result due to cannibalisation in lower derating factors, thereby reducing their attractiveness and the final amount of battery capacity selected.

The **French adequacy analysis** illustrates strong mutual impact of different combinations of two types of capacity on meeting adequacy needs:

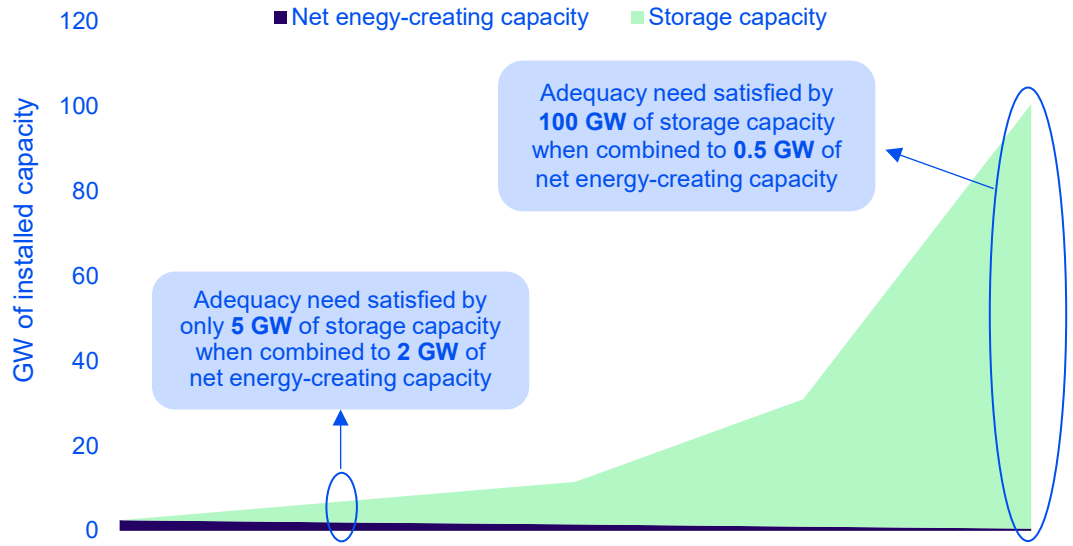
- around 5 GW of storage is sufficient when combined with 2 GW of net energy-creating capacity (e.g. gas generator), whereas
- around 100 GW of storage would be needed when combined with 0.5 GW of net energy-creating capacity.

Temporary solution*

Set a minimum volume of net energy-creating capacity, or equivalently a cap on storage. Limiting the possible amount of storage selected reduces the uncertainty surrounding storage's contribution to adequacy and allows a less conservative de-rating factor to be applied. From 2031–2032 onwards, France intends to move to a more refined methodology for storage de-rating factors.

Storage contributes best when supported by additional generation

Composition of new entry capacity to cover adequacy needs in France, delivery period 2030-2031



A possible more **enduring solution** to this circularity is to provide the capacity mechanism with a set of de-rating factors corresponding to different capacity mixes, and to align the applicable de-rating factors with the capacity mix ultimately selected. The calculation of such set of de-rating factors within the ERAA is explicitly enabled by Article 12(8) of the **revised ERAA methodology**.

Source: The State aid decision on the reform of the French capacity mechanism and the French national resource adequacy assessment 2025.
*For the 2030–2031 delivery period, the State aid decision approved a temporary safeguard.

ACER
European Union Agency for the Cooperation of Energy Regulators

Case study

MACSE: incentivising longer battery durations

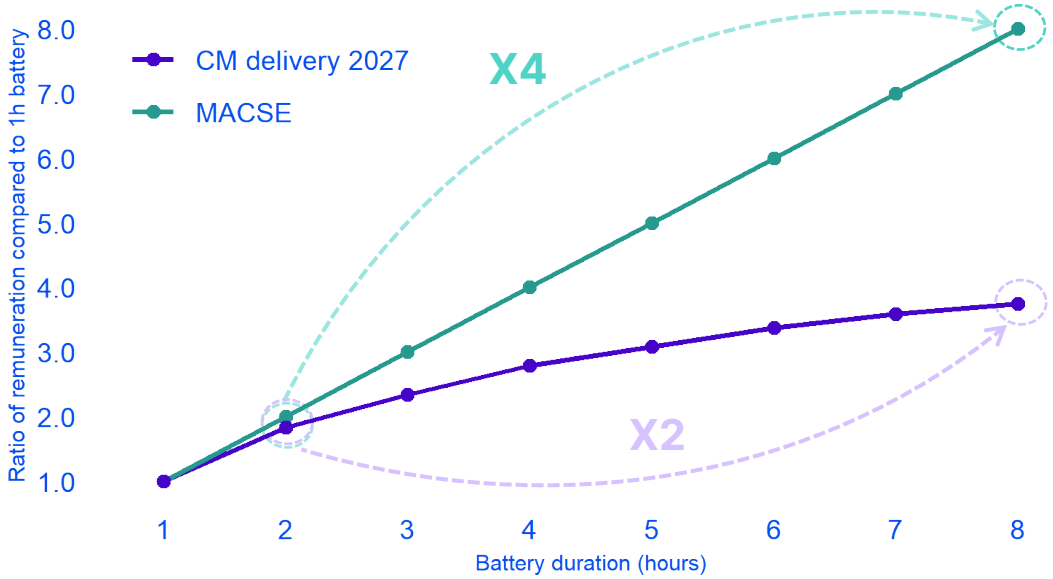
MACSE MACSE is Italy's recent mechanism for procuring new energy storage capacity (~42 GWh by 2030)[1] supporting renewable integration and system flexibility.

Resources are awarded through a **pay-as-bid** tender, with a **15-year fixed annual remuneration**[2].

So far, two tenders awarded **10 GWh** in 2025 for delivery in 2028 and **16 GWh** in 2026 for delivery in 2029.

Different mechanisms reward battery duration differently

Relative remuneration across battery durations compared with 1-hour storage, for a given power capacity



Under **MACSE**, remuneration to awarded battery assets is based on their nominal energy capacity (MWh), without differentiating by storage duration.[3] As a result, **for a given power capacity (MW), remuneration increases linearly with duration: an 8-hour battery receives four times the remuneration of a 2-hour battery**.

In the **Italian CM** for delivery year 2027, the remuneration of batteries is linked to the derating factors assigned to different durations.[3] **As a result, the increase in remuneration is more limited: an 8-hour battery (90% DF) receives roughly twice the remuneration of a 2-hour battery (44% DF).**

The stronger relative increase in remuneration with increasing battery duration in MACSE may help explain why batteries awarded in the first MACSE auction had an average duration of **6.7 hours**, compared with **3.9 hours** in the CM auction for delivery in 2027, despite both auctions being held in 2025.

Remuneration logic for different battery duration

Derating factors used in CM auctions reflect the adequacy contribution of batteries with different durations by accounting for their actual availability during scarcity periods.

MACSE supports RES integration by procuring time-shifting services. However, the link between remuneration of different battery durations and their actual contribution to this objective is less explicit.

[1]The storage needs progression is updated by TERNA on an annual basis through the corresponding needs document. [2]Awarded capacity receives fixed remuneration from the TSO, then is centrally allocated to market operators through a dedicated time-shifting-contract platform, enabling its participation in the energy markets. [3]During each MACSE auction, the related technical sheet applies corrective coefficients linked to battery duration when ranking and selecting offers; however, these coefficients do not affect the final remuneration awarded to successful participants. [4]CMs pay the amount of derated capacity [MW], given by the nominal capacity multiplied for the derating factor of the corresponding technology. Source: ACER calculations based on TERNA data about design and auction results of CM and MACSE.

The expected size of demand curtailment is limited

Member States' target level of security of supply – the reliability standard – is based on the LOLE indicator expressing the number of expected scarcity hours.

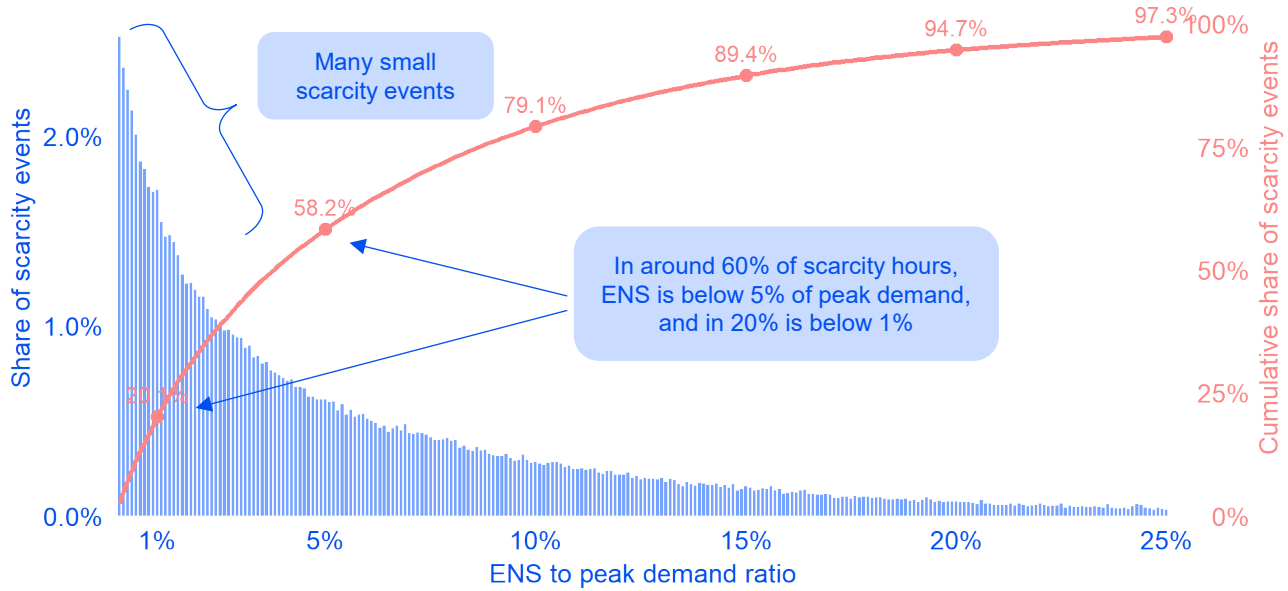
LOLE value may exceed the reliability standard while the volume of unserved energy remains relatively limited.

ERAA 2025 results show that scarcity events (LOLE) generally tend to be **limited in volume** (measured by ENS).

- In 60% of scarcity hours **ENS is below** 5% and in 20% is below 1% of peak demand.
- In 32% of scarcity hours the **ENS is lower** than 100 MWh and in 20% of cases lower than 50 MWh which, by way of example, could be the consumption of one hyperscale data centre.*

Compared to peak demand, most scarcity events are small

Distribution of expected scarcity hours by the ratio of ENS on peak demand, ERAA 2025



The [revised **ERAA methodology**] introduces a new metric: the **adequacy gap.** It represents the additional capacity required in a bidding zone to meet its applicable reliability standard.

Key adequacy indicators:

LOLE measures the expected number of hours when electricity supply is insufficient to meet demand.

ENS measures the volume of unmet electricity demand during scarcity

Source: ACER based on ERAA 2025 data, all BZs, all Tys.
Histogram with bins of width 0,001 (i.e. 0.1 percentage points); values above 25% of peak demand omitted for readability
*Source: Data centres and the power system.

Case study

Batteries in the Polish CM: impact on prices

Over the past years, batteries have been gaining ground in European capacity markets driven in large part by their comparatively low operating expenses and decreasing upfront costs.

In Poland, battery participation shows no sign of slowing down in capacity auctions, even with the low derating factor (currently around 13% placing it on the lower end of the distribution showed in Slide 22).

The comparison of the awarded capacities with the clearing prices reveals a pattern: **as batteries win more contracts, prices decline.**

One bidder, three small bids and their impact

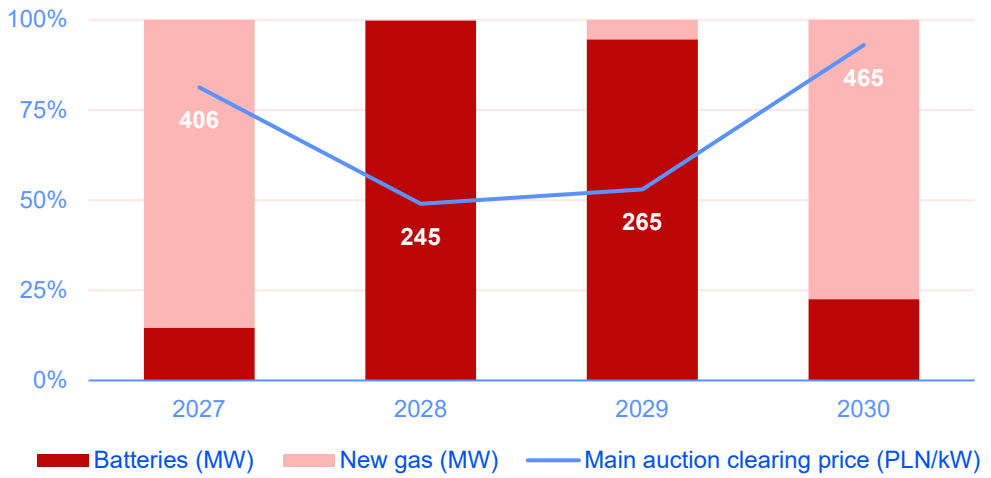
Lithuanian bids in the Polish capacity auction for the 2030 delivery year

Company	Offered capacity (MW)	Bid (PLN/kW/year)	
Ignitis gamyba	64	186.00	
Ignitis gamyba	40	208.00	+22
Ignitis gamyba	20	228.00	+20
Ignitis gamyba	20	249.00	+21
Ignitis gamyba	2	324.00	+75
Ignitis gamyba	2	418.00	+94
Ignitis gamyba	2	512.00	

Low-capacity high-price bids

Successful bids

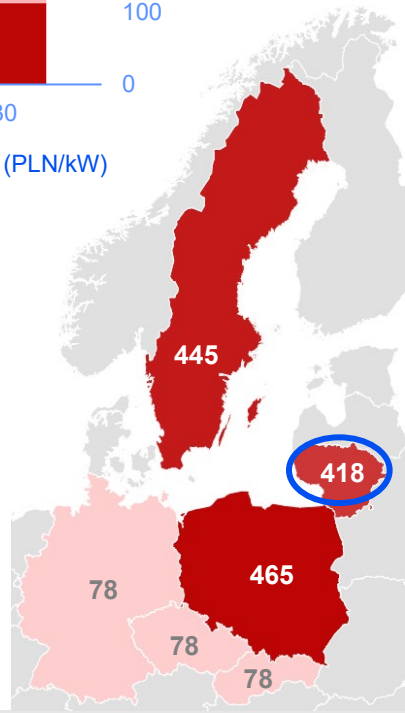
Results of Poland's main capacity auctions (new capacities)



Foreign capacity competing in the Polish auctions is divided into three zones: Sweden, Lithuania and a "synchronous profile" covering the other neighbours. The auction sets a separate price for the three zones.

For 2030, the synchronous profile price was shaped by strong competition for limited capacity. At the same time, Sweden and Lithuania each had just one bidder. Their bids reveal a price-to-capacity pattern that allowed bids **as low as 2 MW lift the prices significantly**.

Main auction prices for the 2030 delivery year, PLN/kW



Sources: 2030 auction preliminary results, 2030 auction final results.
[1]See Slide 22 and ACER's reference derating values in Annex: Derating factors for 1-8-hour batteries.

ACER
European Union Agency for the Cooperation of Energy Regulators

Focus topic: Efficiency of capacity markets

Improving capacity mechanism design to reduce costs

ACER
European Union Agency for the Cooperation of Energy Regulators

Different approaches to remunerate capacity resources

In CM auctions new assets compete with existing ones. Their bids are capped at different levels: (i) the cap for new assets reflect their investment cost (ii) while existing assets only need to cover their fixed costs. The payout will depend on both the caps and the remuneration rules. The design differences[1] across Member States are summarised below:

Member State	Payment approach	Bidding price cap		Remuneration price		Remuneration outcome
		New-entry capacity	Existing capacity	New-entry capacity	Existing capacity	
	Pay-as-bid	Global price cap set as net CONE * X factor[2]	Intermediate price cap[2]	Equal to bid	**Equal to bid**	**Existing capacity cannot be remunerated above its applicable cap.** In Belgium, this is achieved inherently through the pay-as-bid mechanism, while in Italy, the existing capacity bidding price cap also applies to the remuneration, independently from the final clearing price.
	Pay-as-clear	OCGT CONE	CCGT fixed annual operational cost	Clearing price	**Minimum between clearing price and bid cap for existing**	
	Pay-as-clear[3]	1.5 * net CONE	0.5 * net CONE	Clearing price	**Clearing price**	**Existing capacity always gets the clearing price,** even when the clearing price exceeds the existing capacity's bidding price cap.
	Pay-as-clear	Capital and operational costs for new plant	Capital and operational costs existing plant	Clearing price	**Clearing price**	
	France had a decentralised CM until 2025. From 2026, the new centralised CM has price caps applied to new entry and existing capacity bids. The remuneration of existing capacity is capped at the intermediate price cap, similar to Italy.					

A well-estimated price cap for the participant's bid requires robust CONE values covering the related key techno-economic parameters for all Member States.

SEE ACER'S EU CONE DATASET →

[1]The table shows general design rules. Specific adjustment might then be applied based on additional national exceptions. [2]In Belgium, the price cap setting doesn't explicitly refer to "existing" and "new entry capacity", but to "one-year" or "multi-year" contracts. Consequently, the intermediate price cap could also be applied to new entry capacity (if for a one-year contract) and the global price cap could be applied to existing for multi-year contract. However, this situation is quite rare. [3]Ireland permits a derogation and pay-as-bid approach under the Unit Specific Price Cap (USPC) for existing units that can demonstrate that the standard Existing Capacity Price Cap (ECPC) would not allow them to recover their justifiable costs. See Annex Note (12) for more information on Ireland's capacity auction bidding & remuneration structure.

ACER
European Union Agency for the Cooperation of Energy Regulators

Different designs, diverging costs

The remuneration approach (see previous slide) for existing capacity is a key design feature explaining some of the differences in the costs of capacity markets.

For countries where existing capacity can be remunerated above its bidding price cap, any increase in the clearing price beyond this cap raises the remuneration paid to all existing capacity.

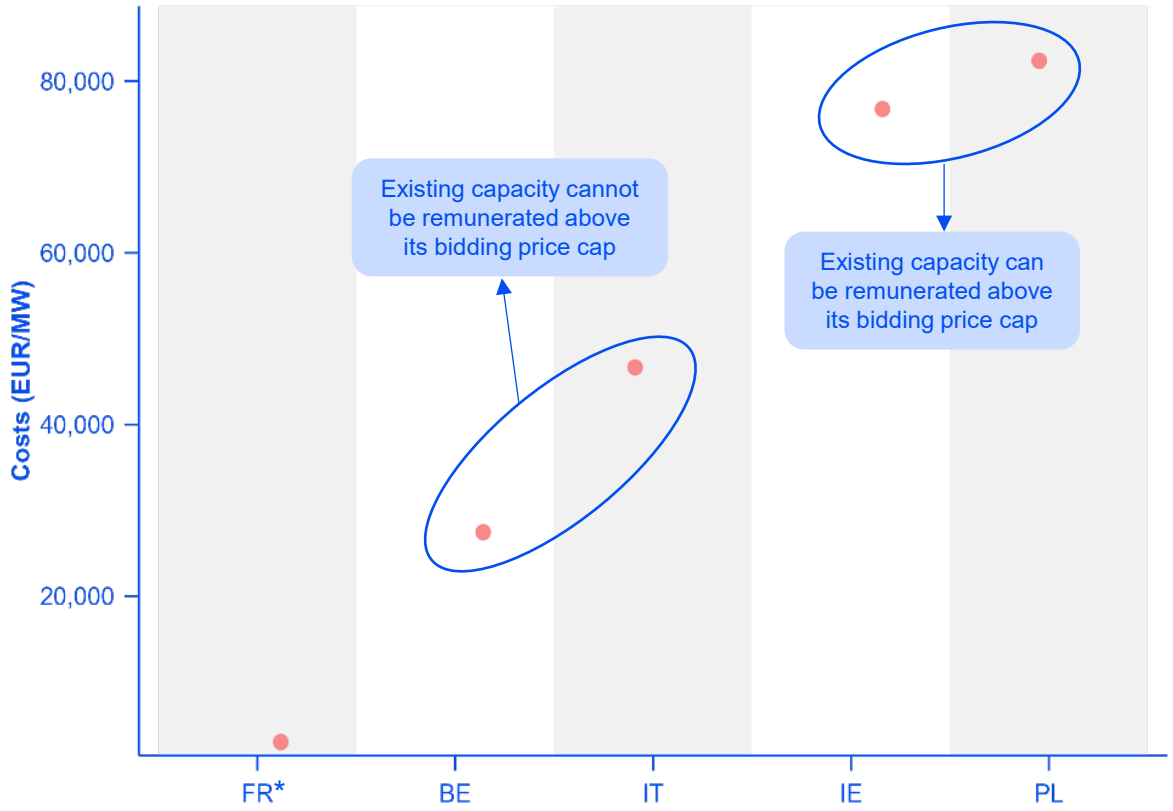
Consistent with this, the two countries applying this approach show considerably higher average costs (EUR/MW) of their CM mechanisms.

Applying the same remuneration price to existing and new capacity may create a strategic incentive for large owners of existing generation to withhold part of their existing capacity and bid a small amount of new-entry capacity above the existing-capacity price cap, thereby raising the clearing price and increasing the remuneration of their entire awarded portfolio[1].

Note: Several factors linked to national specificities can influence CM prices, some of them circumstancial, *e.g.* the existence of older powerplants being kept in the market could temper prices.

Cost of CMs strongly depends on remuneration rules adopted

Average payments to providers remunerated for delivery based on all applicable auctions and corresponding volumes, delivery year 2026



Note: This analysis links to the issue raised in 2024 SoS Monitoring Report of "the market participants that would be expected to realise comparatively high revenues from electricity markets are also securing the highest levels of remuneration through capacity mechanisms". Source: ACER based on NRA data.
[1]For a caveat of capping the remuneration of existing capacity to the dedicated bidding price cap, see Annex Note (13). *FR is the only Member State with a decentralised market-wide CM.

ACER
European Union Agency for the Cooperation of Energy Regulators

Persisting cost disparities

Actual and projected payments to providers between 2024 and 2026 suggest that the higher prices in the Polish and Irish CMs was not a one-off snapshot. **Disparities persist** over the past years.

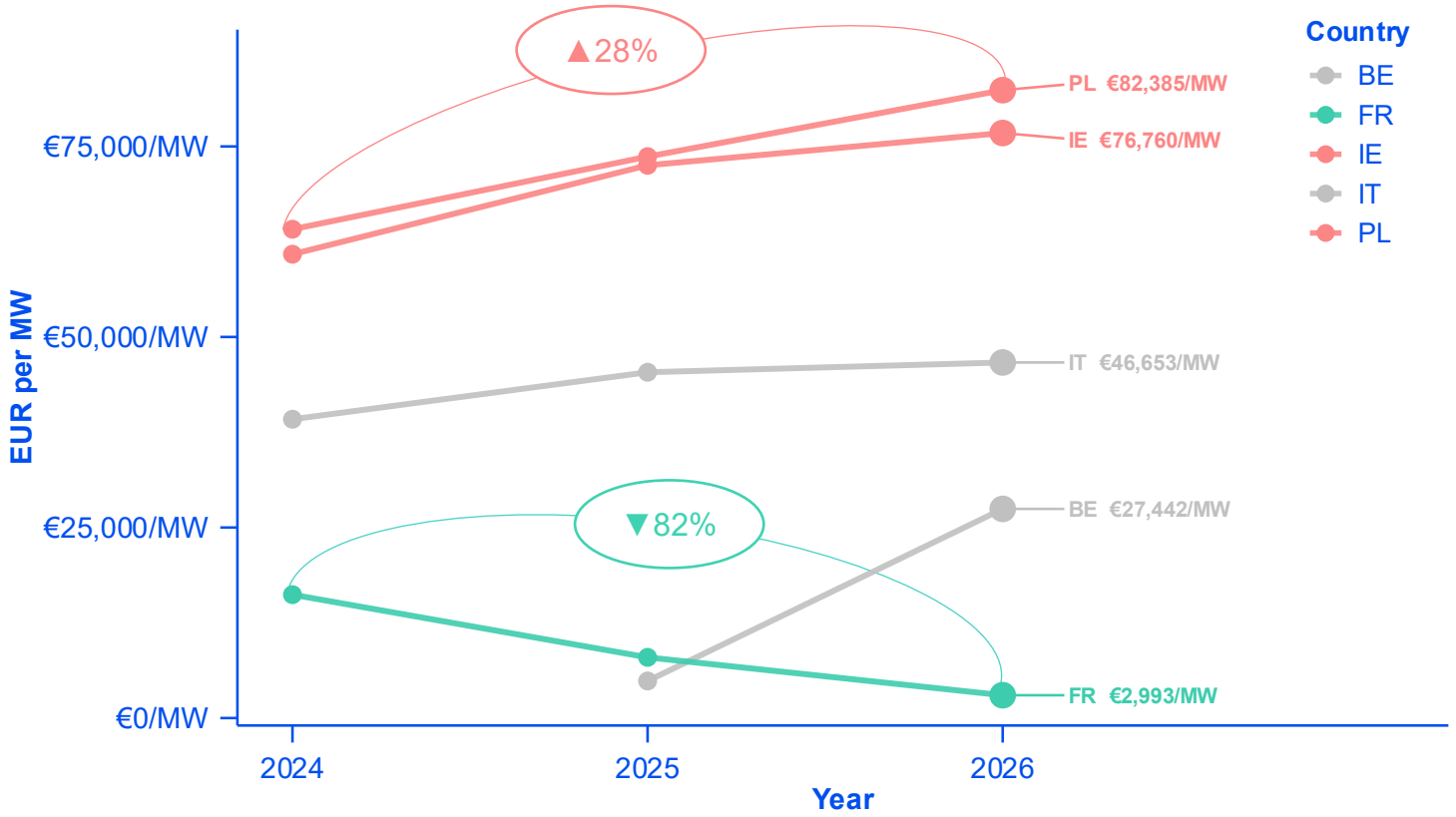
For Poland and Ireland, payments in 2025 increased by 15% and 19% respectively. In 2026 further increase is expected.

In contrast, payments in France decreased by 41% in 2025[1] and expected to further decrease in 2026. The decrease is largely linked to improved French nuclear availability.

Even if the trends are influenced by national specificities, the structural differences in price levels across CMs reflect the design choices in remuneration rules.

Cost disparities in capacity mechanisms across countries

Payments to providers remunerated for delivery based on all applicable auctions and corresponding volumes*



Source: ACER based on NRA data. *2026 values are projected costs and volumes. **For Belgium, the value for 2025 represents only the payments to contracted capacities for two months (November and December), as the first delivery period began on 1 November 2025. [1]For France, the decline in costs is mainly due to an improved availability of the French nuclear power plants and a historically high contribution of interconnectors. At the time of data collection, the only available data was related to auctions organised under the previous design of the French CM. For 2026/27 delivery, the first auction organised under the new design resulted in costs for consumers of €18,647/MW. Comparisons with the previous design remain difficult due to the substantial changes introduced by the reform.

ACER
European Union Agency for the Cooperation of Energy Regulators

Focus topic: Coordination and regionalisation

Capacity mechanism procurement and co-optimisation with flexibility

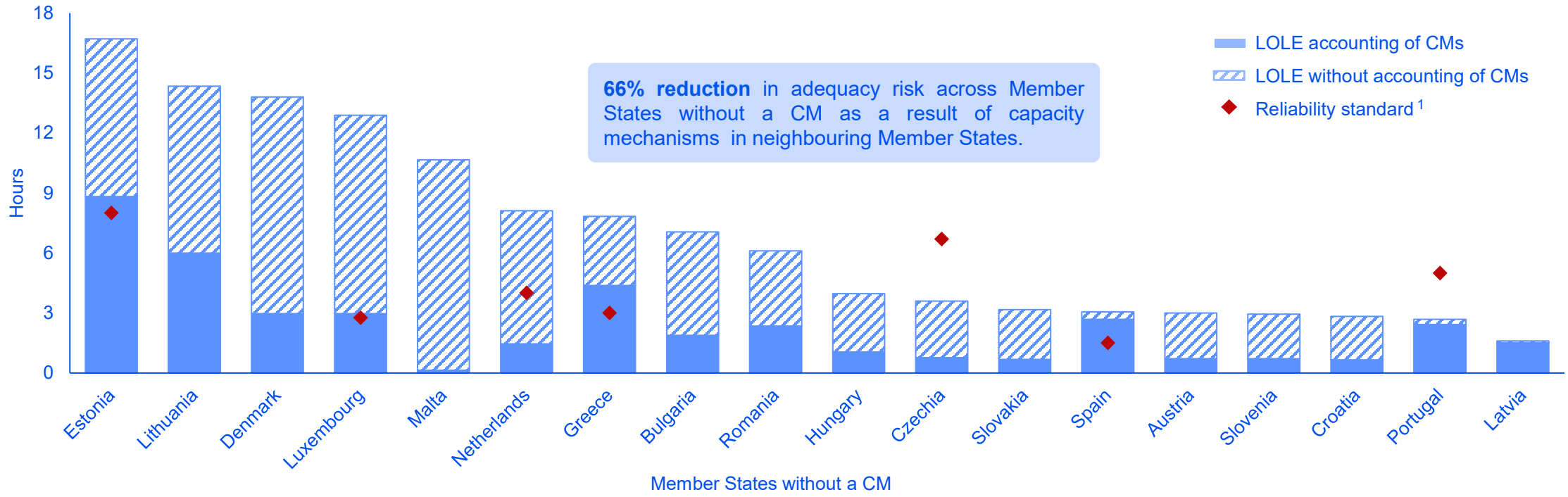
ACER
European Union Agency for the Cooperation of Energy Regulators

Case study

Member States with a CM benefit their neighbours

Adequacy impact of capacity mechanisms on Member States without a CM

Test case: LOLE difference for Member States without a CM depending whether approved CMs are considered, hours



Observed effect

Capacity added in Member States with a CM significantly lowers adequacy risk (LOLE) in Member States without a CM.

Policy implication

Adequacy assessments should consider the development of CMs in all Member States to properly assess the adequacy situation.

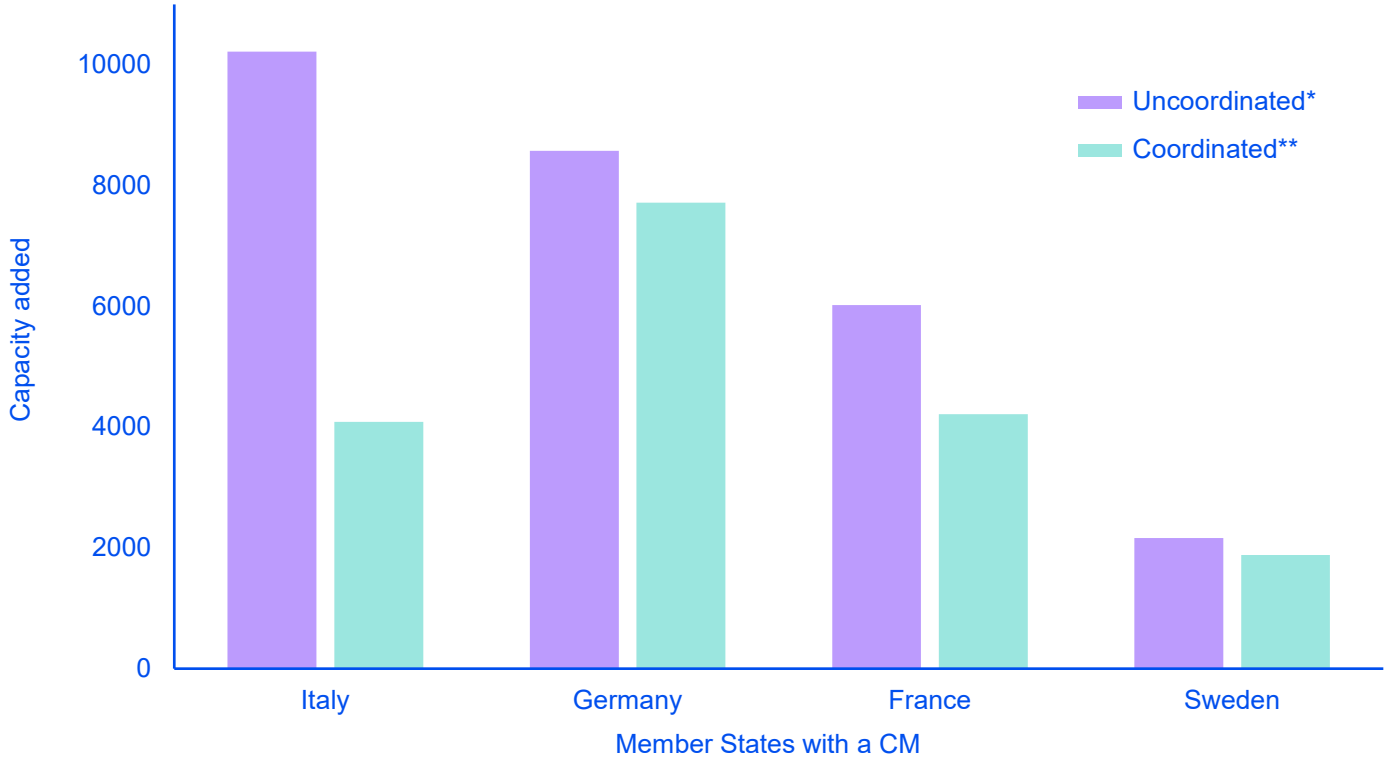
Source: Test case defined by ACER and modelled by M. Zampara, D. Avila, and A. Papavasiliou. See Annex on Coordinated CM dimensioning for more information.
Note: The analysis illustrates the impact of coordinated CM dimensioning; results should not be interpreted as projections of future adequacy risks or capacity mechanism requirements for individual Member States.
[1] The reliability standard values adopted are based on 2025

Case study

Coordination reduces CM capacity needs

Approved CMs: uncoordinated vs coordinated dimensioning

Test case: Difference of additional capacity to reach reliability standard for Member States with a CM depending whether CMs are dimensioned in a coordinated way, MW



*Uncoordinated: dimension each CM in isolation (not considering capacity additions abroad)
**Coordinated: dimension all CMs jointly (considering cross-border effects)

34% less additional capacity is required when capacity mechanisms are dimensioned jointly.

- Capacity is added only in Member States with an approved CM, on top of the capacity already procured in previous auctions
- Uncoordinated dimensioning of each CM separately ignores the adequacy contribution of CMs in other Member States. The coordinated scenario captures these cross-border benefits and therefore requires materially less additional capacity.
- To avoid over-procurement, CM dimensioning should account for **capacity procured through CMs in other Member States**.

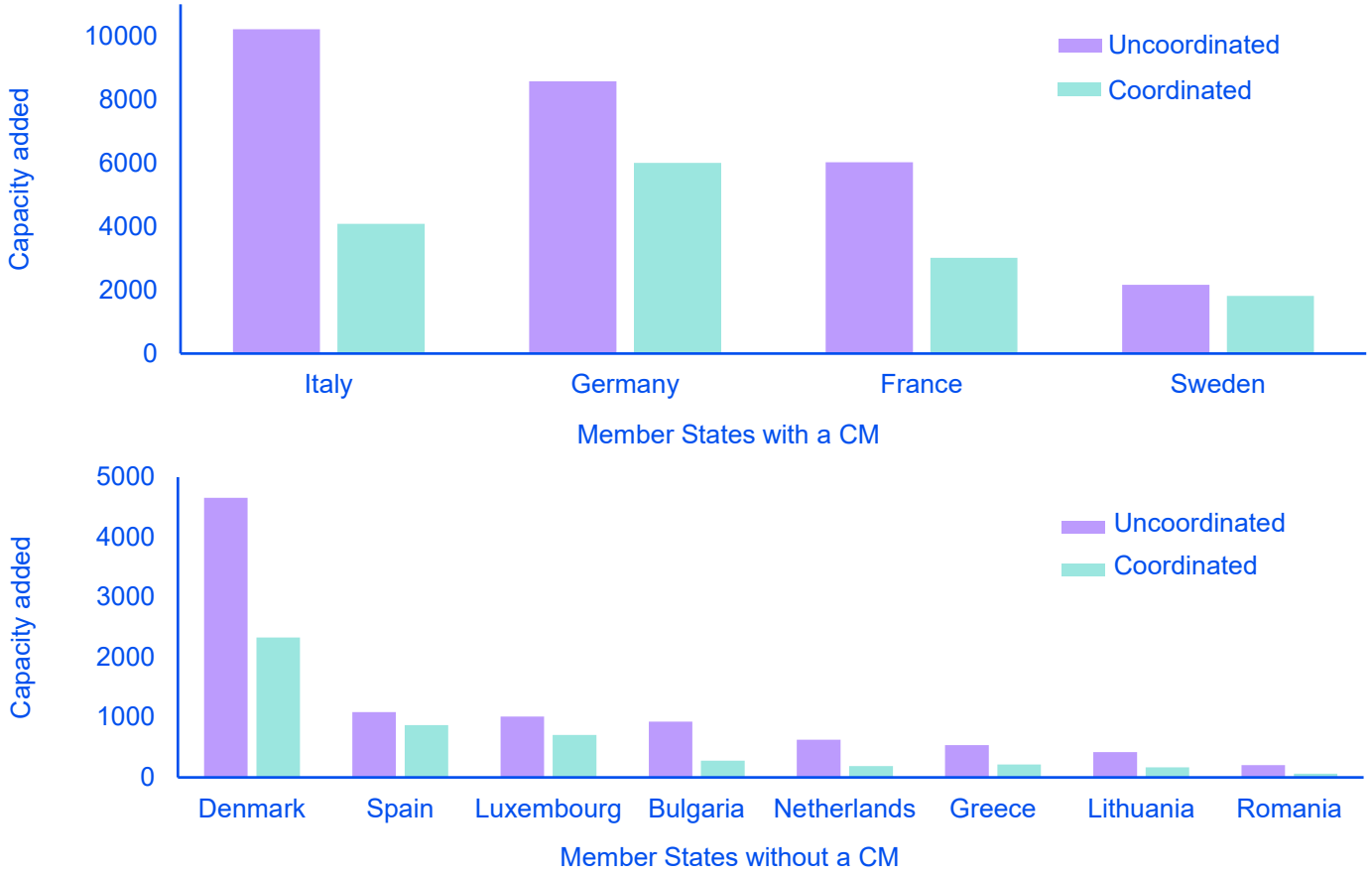
Source: Test case defined by ACER and modelled by M. Zampara, D. Avila, and A. Papavasiliou. See Annex on Coordinated CM dimensioning for more information.
Note: The analysis illustrates the impact of coordinated CM dimensioning; results should not be interpreted as projections of future adequacy risks or capacity mechanism requirements for individual Member States. Results for countries with capacity addition lower than 100 MW (i.e. Belgium and Poland) are not shown.

Case study

More CMs, more need for coordination

Looking forward: What if CMs introduced more broadly across Europe

Test case: Difference of additional capacity to reach reliability standard[1] for Member States with an adequacy concern depending whether CMs are dimensioned in a coordinated way, MW



46% less additional capacity is required under coordinated dimensioning.

- Several Member States are considering introducing capacity mechanisms, making broader CM deployment a relevant prospect.
- As more CMs are introduced, **over-dimensioning** from the uncoordinated approach **increases** because each national calculation ignores capacity procured in other Member States.
- The coordinated (with-CM) scenario accounts for these combined adequacy contributions and reduces the additional capacity requirement from 36.6 GW to 19.8 GW.
- The **ERAA** Methodology requires ENTSO-E to progressively include the with-CM scenario **from 2027 onwards**.

Source: Test case defined by ACER and modelled by M. Zampara, D. Avila, and A. Papavasiliou. See Annex on Coordinated CM dimensioning for more information.
Note: The analysis illustrates the impact of coordinated CM dimensioning; results should not be interpreted as projections of future adequacy risks or capacity mechanism requirements for individual Member States. Results for countries with capacity addition lower than 100 MW (i.e. Belgium, Estonia, Hungary, Malta and Poland) are not shown.
[1]For Member States without a defined reliability standard, a reliability standard of three hours has been assumed.

ACER
European Union Agency for the Cooperation of Energy Regulators

Co-optimisation of CMs and flexibility measures

Co-optimisation of measures is still at an early stage

The 2024 recast of the Electricity Regulation leaves the door open for Member States to promote the participation of non-fossil flexibility in CMs *or* use the then newly created flexibility support schemes. To avoid creating market barriers and overcompensation, CMs and non-fossil flexibility measures should be coordinated in one of the following ways according to the CISAF state aid guidance.[1]

Optionality	France	Italy
Capacity should be jointly procured	✓	-
Resources must choose between participating in only one measure (non-fossil flexibility support scheme or CM)	-	✓



The volumes from the Capacity Mechanism are considered to dimension the flexibility measures included in the new French Capacity Mechanism. Capacity and flexibility can be jointly procured. Assets cannot receive remuneration from both support types.

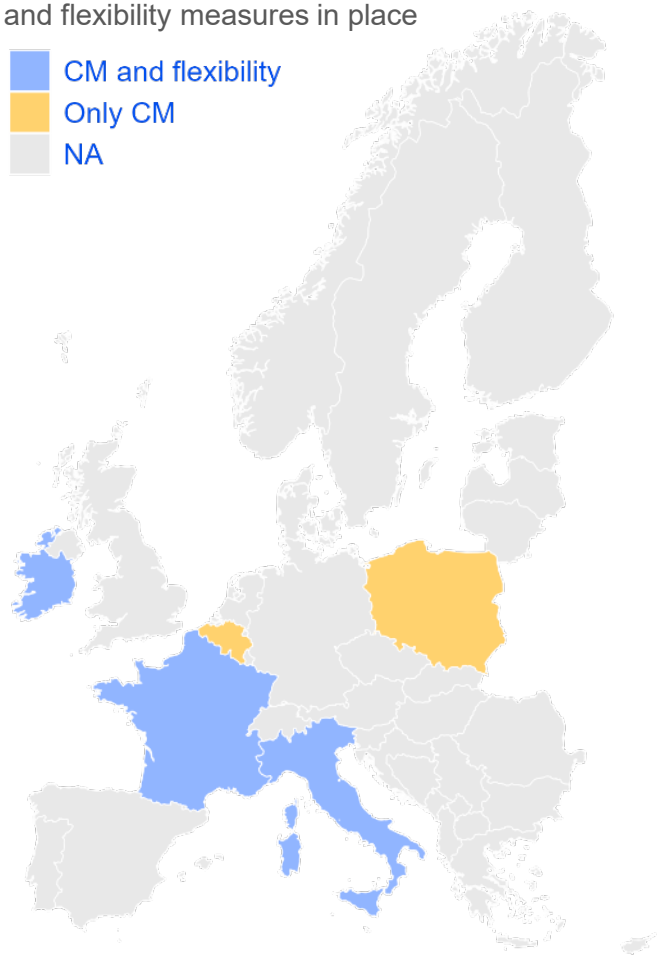


In IT the dimensioning of the CM is evaluated considering existing flexibility measures. The assets that participate in the CM cannot participate in flexibility measures and vice versa. Thus, flexibility is considered but not co-optimised.[2]



In IE there is no process yet for co-optimising the procurement of capacity and flexibility support. Integration of flexibility was considered in the consultation about its capacity mechanism that took place in summer 2026.[3]

Member States with both capacity mechanisms and flexibility measures in place



[1]Criteria set in paragraph 100 of the CISAF (Clean Industrial Deal State Aid Framework). CMs shall comply with one of the criteria. [2]The concept of co-optimisation is the use of a single clearing algorithm that jointly considers market participants' bids for their assets alongside the system's adequacy and flexibility needs. The algorithm then minimises total procurement costs, while simultaneously ensuring that both adequacy and flexibility requirements are met. [3]Consultation on High Level Design Options for CRM 2.0, now closed.

ACER
European Union Agency for the Cooperation of Energy Regulators

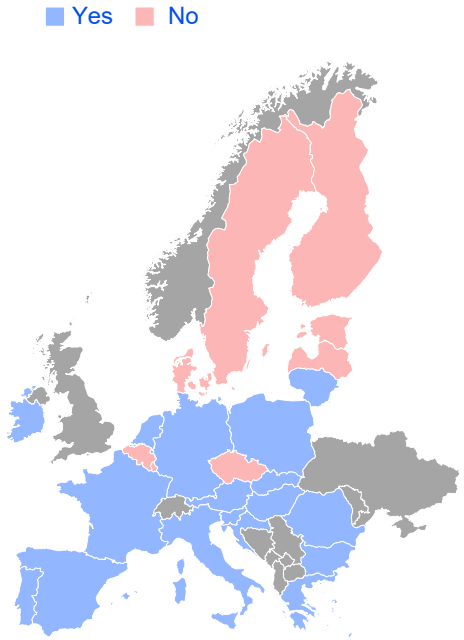
Focus topic: Flexibility measures

Analysing the state of play of flexibility measures

ACER
European Union Agency for the Cooperation of Energy Regulators

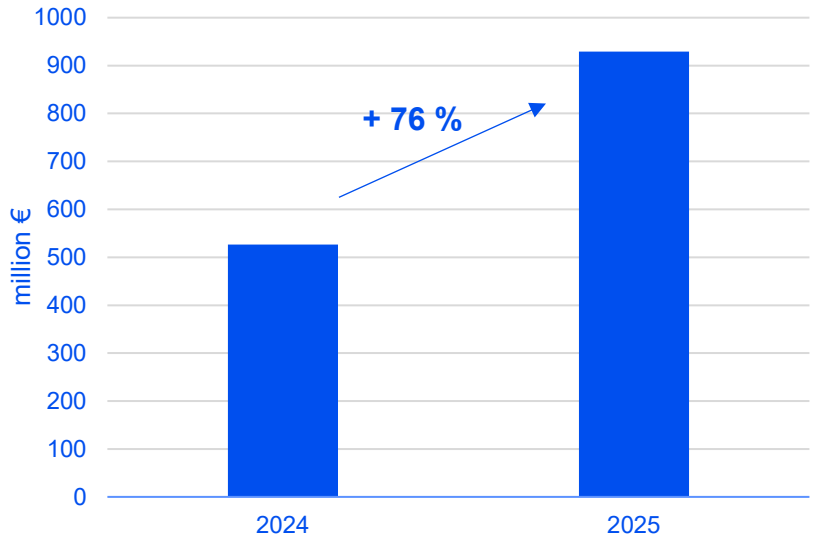
Widespread use of flexibility measures across the EU

18 Member States had an active flexibility measure in 2025*



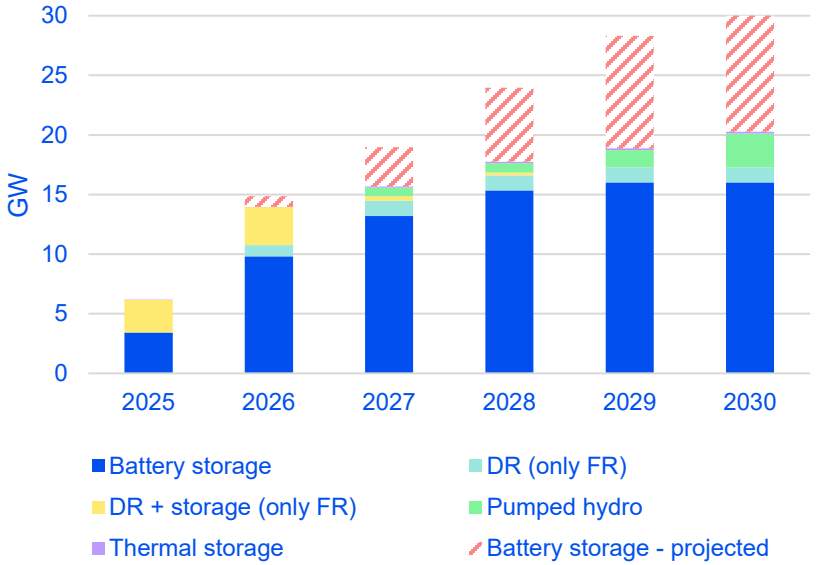
Flexibility measures' costs were on the rise in 2025**

Incurred costs of flexibility measures in 2024 and 2025



Total capacity supported through flexibility measures triples over the next five years***

Cumulative flexible capacity awarded in 2025-2030



Costs of flexibility measures increased significantly in 2025, mainly due to the commissioning of assets. 18 Member States reported having active flexibility measures in 2025, up from 15 in 2024 (new additions: IE, NL and SI). Support remained concentrated primarily on batteries, while demand response, thermal storage and pumped storage hydro were rarely targeted.

Current flexibility measures do not fall into non-fossil flexibility support schemes as defined under Article 19g of the Electricity Market Design Reform Regulation. Future non-fossil flexibility support schemes will need to align with the Electricity Regulation and be notified for assessment under CISAF.

*Notes (14)(15) – see Annex.
**Notes (16)(17) – see Annex.
***Notes (17)(18)(19)(20)(21)(22) – see Annex.

ACER
European Union Agency for the Cooperation of Energy Regulators

Flexibility measures clear notably lower than the cap

FLEXIBILITY AUCTIONS



COMPETITIVE PROCESS, WITHOUT AUCTIONS



FIRST-COME-FIRST SERVED



Note (23)– see Annex.

Average awarded support in relation to the cap (%)*

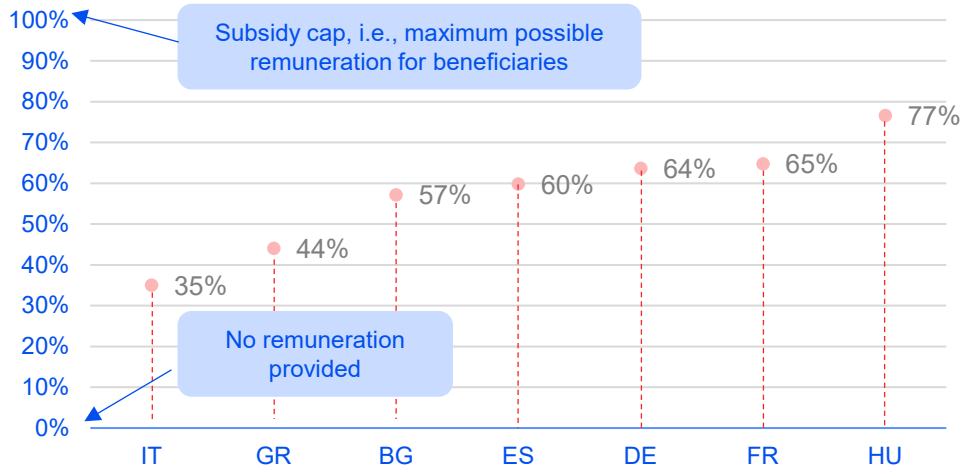


Figure based on 2025 data, latest developments are not reflected.

The chart shows clearing prices, expressed as a share of the applicable cap, for selected flexibility measures awarded through competitive processes.

Flexibility measures' auctions have generally cleared at significantly lower levels than the maximum allowed subsidy levels. These flexibility auctions involve the commissioning of new assets. Possible reasons for these moderate clearing levels relative to the auction caps include:

- Declining costs of batteries.[1]
- High competition (oversubscription to the auctions).[2]
- Favourable energy market revenue expectations.[3]
- Aggressive bidding for first-mover advantage.

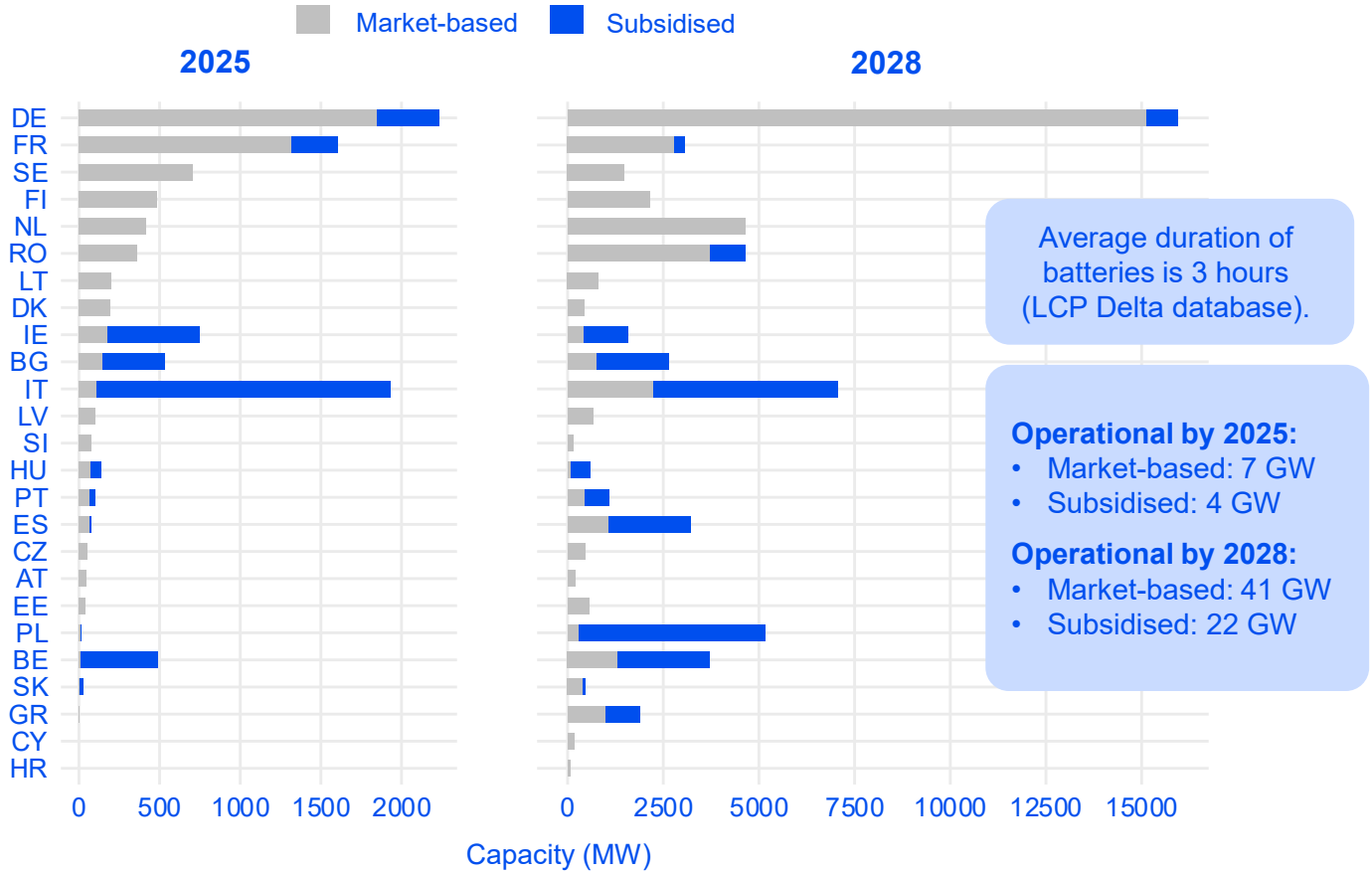
[1]Lithium-ion battery pack prices fell by around 20% in 2024, followed by a further decline of about 8% in 2025. Flexibility – Electricity 2026 – Analysis – IEA.
[2]For example, bids in MACSE (IT) exceeded demand by more than four times and submitted bids for InnoAus (DE) were also over 4 times higher than the targeted quantity in 2025.
[3]EUR-Lex - 52020SC0335 - EN - EUR-Lex.
*Note (24) – see Annex.

ACER
European Union Agency for the Cooperation of Energy Regulators

EU battery deployment is mostly market-driven

Total operational battery storage capacity in the EU*

Market-driven and subsidised[1] (flexibility measures and capacity mechanisms), based on announcements by developers, front-of-meter[2]



Average duration of batteries is 3 hours (LCP Delta database).

Operational by 2025:
- Market-based: 7 GW
- Subsidised: 4 GW

Operational by 2028:
- Market-based: 41 GW
- Subsidised: 22 GW

KEY FINDINGS

1. Battery storage capacity across the EU is expected to grow rapidly through 2028 and beyond.

2. A significant share of existing and new capacity relies on revenues from the energy market, without the need for financial support[3]. About two thirds of installed and expected battery capacity is market-driven, both in 2025 and 2028.

3. National approaches to battery deployment differ considerably. Some Member States rely primarily on state support (e.g. BG, IT, PL, ES), while others rely on market dynamics (e.g. SE, DE, FI, NL).

*Note (25)– see Annex. Source: LCP Delta, Energy Storage Asset Pipeline Database.
[1]Market-driven: deployed without the need of public support. Subsidised: deployed with public support (financial support). [2]In BE & IE, subsidised batteries come from capacity mechanisms, not flexibility measures. Subsidised values for PL & IT consider batteries subsidised both through capacity market auctions & flexibility measures. [3]Stronger peak-valley spread and more pronounced evening ramps signal reinforced investment incentives for short term flexibility. ACER Key developments in European electricity and gas markets - 2026 Monitoring Report

ACER
European Union Agency for the Cooperation of Energy Regulators

Case study

Baltic battery storage shows strong growth

The Baltics emerge as a strong market for battery storage, underpinned by attractive arbitrage opportunities and enabling regulation*

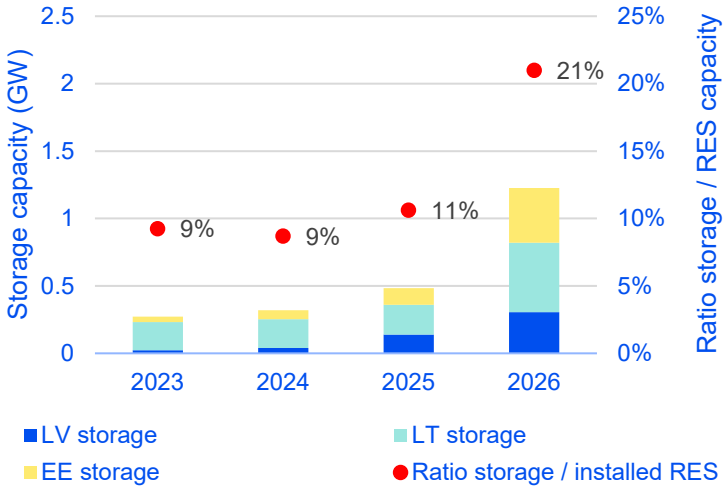
Main battery storage revenues come from ancillary services - and increasingly wholesale markets - including the stacking of revenues across them

- Balancing capacity
- Balancing energy / activation
- Day ahead / Intraday arbitrage

Regarding energy arbitrage, large day-ahead price spreads – around 176 (EUR/MWh) on average in 2020-2025 - provide a good business case (ACER Key developments 2026 report).

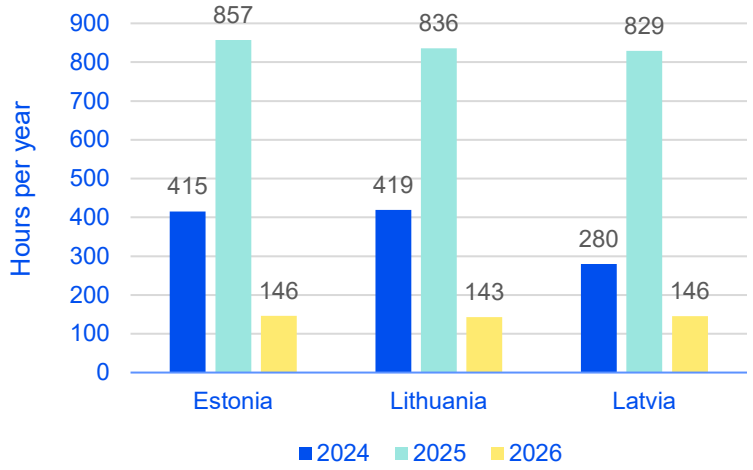
Storage and RES installed capacity (GW)[1]

Source: LCP Delta, Energy Storage Asset Pipeline Database and ENTSO-E TP



Annualised[2] hours with mFRR prices below -200 or above 400 EUR/MWh

Source: ENTSO-E TP



Battery storage deployment was incentivised by a profitable business case for private investors, while the synchronisation with continental Europe in 2025 strengthened regional market integration[3] and opened new opportunities in European balancing markets.

Balancing price fluctuation notably increased in 2025, as activity in the Baltic balancing energy market raised.[4] The sharp fall of hours with extreme prices in 2026 suggests that increased participation of battery capacity, improved interconnection, greater market liquidity and competition contributed to containing balancing prices.

*Note (26) – see Annex.
[1]TSO-owned assets have been reported to amount to 80 MW in Latvia and 200 MW in Lithuania. In Estonia, the TSO cannot own, develop, operate or manage storage assets. See also note (27) – Annex. [2]Annualised - the data available for 2026 has been extrapolated to an annual equivalent to allow comparison across the different time periods. [3]See ACER Market Integration report 2026. [4]Few participants and generation units involved in balancing and market sensitivity to even small supply changes contributed to this volatility (AST electricity market overview).

ACER
European Union Agency for the Cooperation of Energy Regulators

Monitoring of RES curtailment is generally lacking

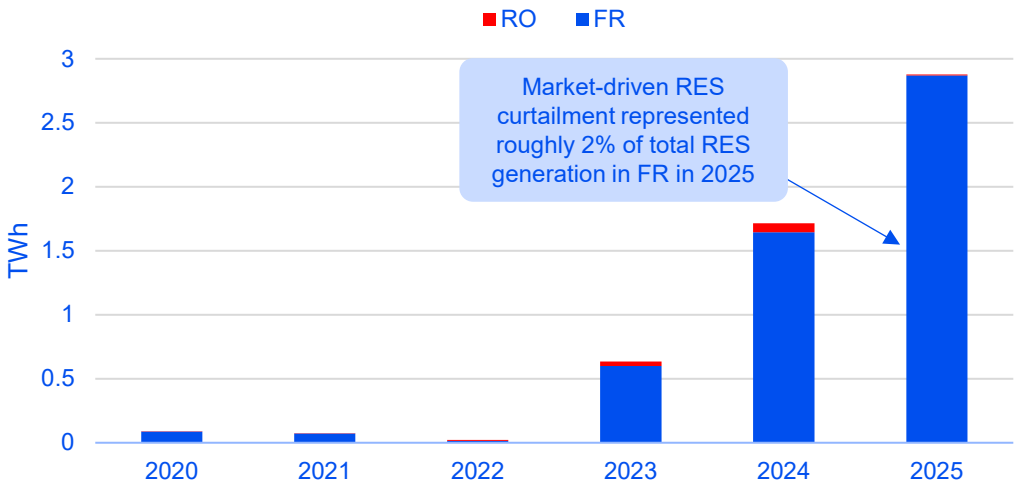
Defining market-driven RES curtailment[1]

Market-driven RES curtailment refers to the **voluntary reduction of renewable output** by generators responding to market price signals. It usually occurs when high-RES generation combined with low demand pushes prices to zero or negative levels. Market-driven RES curtailment can be a cost-efficient outcome when the costs of avoiding additional curtailment exceed system benefits.

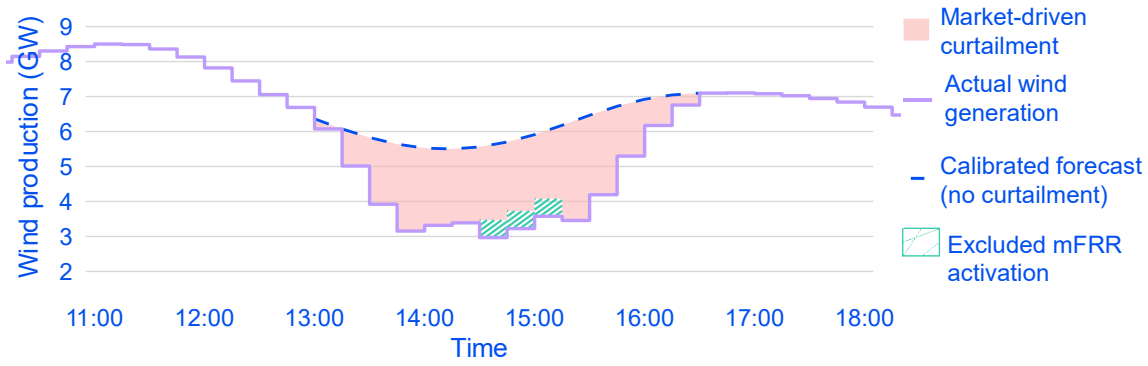
KEY FINDINGS

- Market-driven RES curtailment has increased significantly over the past few years.[2]
- However, the bulk of Member States do not monitor market-driven RES curtailment. More broadly, RES curtailment (both market- and congestion-driven) is monitored inconsistently.
- Member States do not sufficiently monitor whether flexibility measures achieve their intended objectives, such as integrating RES and alleviating congestion.

Market-driven RES curtailment



Assessing market-driven RES curtailment in France*



[1]Market-driven RES curtailment is closely related to the system needs in the FNA methodology, i.e., whether the power system has sufficient flexibility to accommodate renewable generation.
[2]Another important driver of RES curtailment is grid congestion. Different methodologies are needed to assess market-driven and congestion-related curtailment.
*Note (28), see Annex.

ACER
European Union Agency for the Cooperation of Energy Regulators

Annexes

ACER
European Union Agency for the Cooperation of Energy Regulators

Adequacy metrics per Member State

Member State	Single VOLL €/MWh	CONE fixed technology[1]	CONE fixed €/MW	Reliability standard h/year
Belgium	12,832	Demand response	30,000	3.00
Cyprus	-	-	-	15.00
Czechia	16,003	Open cycle gas turbine	105,800	6.70
Denmark	23,500	Diesel engine: extension	34,990	1.50
Estonia	9,206	Open cycle gas turbine	72,859	8.00
Finland	8,000	Renewal & prolongation	17,000	2.10
France	33,000	Demand response	60,000	2.00
Germany	12,240	Demand response/ open cycle gas turbine	2,072 & 57,067/ 23,377	2.77
Greece	6,838	Demand response	18,735	3.00
Ireland	17,909	Open cycle gas turbine	115,990	3.00
Italy	20,000	Open cycle gas turbine	53,000	3.00
Luxembourg	12,240	Demand response/ open cycle gas turbine	33,905	2.77
Netherlands	68,887	-	-	4.00
Poland	17,173	Demand response/ open cycle gas turbine	30,183/ 119,256	3.00
Portugal	12,433	Renewal & prolongation	18,200	1.46
Slovenia	17,233	Demand response	21,753	-
Spain	22,879	Renewal & prolongation	34,400	1.50
Sweden	7,065	Demand response	9,124	1.00

Source: ACER based on information from NRAs.
[1]Marginal technology to meet the Reliability Standard. If minimum capacity to meet Reliability Standard is not known, technology with the lowest CONE (fixed) is listed.
Notes per Member State: see Annex II.

ACER
European Union Agency for the Cooperation of Energy Regulators

Indicative derating factors for 1-8 hour batteries

Biding Zone	1 hour	2 hours	3 hours	4 hours	5 hours	6 hours	7 hours	8 hours
AT00	30%	48%	60%	68%	74%	78%	81%	83%
BE00	17%	31%	42%	51%	58%	64%	67%	69%
BG00	23%	39%	52%	61%	67%	71%	74%	76%
CZ00	18%	31%	42%	50%	57%	62%	67%	71%
DE00	19%	34%	46%	55%	62%	67%	71%	74%
DKE1	24%	43%	58%	68%	76%	80%	83%	85%
DKW1	22%	40%	55%	66%	75%	81%	85%	88%
EE00	6%	12%	17%	21%	26%	30%	34%	38%
ES00	37%	64%	85%	94%	99%	100%	100%	100%
FR00	18%	34%	47%	55%	61%	67%	71%	74%
GR00	23%	37%	48%	56%	63%	69%	72%	74%
GR03	20%	36%	50%	62%	72%	78%	83%	85%
HU00	18%	34%	46%	56%	64%	69%	72%	75%
ITCN	22%	40%	55%	65%	72%	76%	79%	81%
ITCS	23%	41%	56%	65%	72%	77%	80%	83%
ITN1	24%	41%	54%	63%	69%	73%	76%	78%
ITS1	30%	52%	69%	81%	89%	93%	95%	96%
ITSA	32%	49%	60%	67%	72%	76%	78%	80%
ITSI	27%	46%	61%	74%	83%	89%	93%	95%
LT00	10%	17%	22%	27%	31%	34%	38%	41%
LUG1	19%	34%	46%	55%	62%	67%	71%	74%
MT00	27%	48%	67%	83%	91%	95%	96%	97%
NL00	30%	50%	63%	70%	74%	78%	80%	82%
PL00	18%	33%	44%	53%	60%	66%	71%	76%
RO00	23%	42%	57%	70%	78%	84%	87%	89%
SE04	27%	48%	63%	74%	80%	85%	88%	91%
SI00	27%	44%	56%	63%	68%	73%	76%	78%
SK00	37%	60%	77%	89%	94%	97%	98%	98%

Note: The DFs shown have illustrative purposes and have been estimated by ACER form ERAA 2025 edition input datasets following ERAA methodology Article 12 (7). For more details see Annex Note (10).

ACER
European Union Agency for the Cooperation of Energy Regulators

Coordinated CM dimensioning through with-CM scenario

Without-CM scenario

Purpose	Assess adequacy assuming that no additional capacity is supported through capacity mechanisms in Europe (other than what was already secured in CM contracts).
Use	Identify adequacy concerns to justify capacity mechanism.
Dimensioning	Capacity needs do not account for capacity procured through CMs in other Member States.

With-CM scenario

Purpose	Reflect the expected contribution of capacity mechanisms across Europe. The model adds capacity in countries with established CMs for all target years with an adequacy risk.
Use	Provide a more realistic adequacy view, including for countries without a CM.
Dimensioning	Capacity needs account for interactions between capacity mechanisms. Additional capacity is measured relative to the capacity already present in the without-CM scenario.

Simplified implementation option

To facilitate implementation, ACER introduced the possibility for ENTSO-E to construct the with-CM scenario using a simplified approach.

Feasibility test

Test model: Academic model based on ERAA 2021, using 35 weather scenarios and incorporating flow-based allocation. Generation capacities are calibrated so that LOLE values align approximately with ERAA 2025 for the 2028 target year.*

This test confirms the feasibility of implementing the simplified with-CM approach.

35
weather scenarios

5-6 hours
Total run-time

Test case defined by ACER and modelled by M. Zampara, D. Ávila and A. Papavasiliou using the economic dispatch (ED) module described in their paper. For this test case, we extended the model to include flow-based constraints on cross-zonal exchanges.M. Zampara, D. Ávila, and A. Papavasiliou, “Capacity Expansion Planning Under Uncertainty Subject to Adequacy Constraints,” IEEE Transactions on Power Systems, vol. 41, no. 6, pp. 4520–4531, Nov. 2026

*The calibration aimed to reflect the broad distribution of adequacy risks across Europe and provide a common starting point for comparing coordinated and isolated CM dimensioning. The results are therefore illustrative and should not be interpreted as projections of future adequacy risks or capacity mechanism requirements for individual Member States.
Note 1: Results are based on a simplified modelling exercise and should not be interpreted as a counterfactual assessment of future adequacy risks or capacity mechanism requirements at the Member State level.
Note 2: The case study does not include the curtailment sharing feature implemented in ERAA.

Annex

- Note (1): ACER calculation derived from: Romanian NRAA 2026 (central and realistic scenarios); Portuguese RMSA-E 2025 (ambition and complementary scenarios); Polish NRAA 2025-2040; Dutch NRAA 2026; Irish AIRAA 2026-2035 (median scenario); French NRAA 2025; Belgian Adequacy and flexibility study 2026-2036 (Current commitments scenario); ENTSO-E Data centres and the power system report; ERAA 2025 (EU and non-EU annual demand); IEA Energy and AI 2025 report (base case) and Eurostat (Final electricity consumption).
- Note (2): Spain: new renewable energy will have to cover at least 80% of the new data centre energy supply (in consultation). Finland: A revision of the Finnish Grid Code specifications (KJV2026) is seeking to introduce flexibility requirements for large demand facilities (above 30 MW), including data centres that would be required to have the capability, upon request, to reduce their active power consumption by at least 30% from the pre-activation level within a period of no more than 15 minutes. Additionally, the Finnish Government published a draft amendment to the Electricity Market Act (in consultation) concerning the grid connection process, which would prioritise data centres in capacity-scarce areas voluntarily committing to flexibility (including demand response). Germany, France and others are transposing the EED directive that requires stricter energy efficiency targets, heat re-use requirements, and a transition to renewable energy.
- Note (3): Requirements from the Irish LEU connection policy: Install onsite or proximate generation. The associated generation should cover the contracted capacity. System Operators to consider the location (constrained or unconstrained) of the requested data centre connection application and associated generation. Capacity eligible to participate in the Capacity Market – restricted to one-year contracts and a maximum bid volume equal to the data centre contracted MIC. Meet at least 80% of their annual demand with additional renewable electricity generated in Ireland (6-year adoption timeline).
- Note (4): ‘Other’ security of supply support measures are defined as initiatives that relate directly or indirectly to security of supply and provide remuneration to market participants for capacity outside of balancing mechanisms. Most frequently used `other’ measures in 2025 are interruptibility schemes, network congestion schemes, and non-standardised ancillary service-related schemes.
- Note (5): Costs for 2026 reflect the expected costs. The overall costs for France up until 2026 are an approximation considering that all capacity certificates are valued at the market reference price. A significant share (which varies year-on-year) of the capacity certificates is implicitly valued through the Accès Régulé à l’Electricité Nucléaire Historique (ARENH) mechanism, a scheme that enables suppliers to purchase electricity from nuclear generators at a regulated price. Therefore, the actual costs for France are dependent on the reference used to value the capacity certificates related to the ARENH mechanism.
- Note (6): More information on SoS measures introduced or modified by MS in 2025: Austria - the EC approved in October 2025 a new network reserve measure until December 2030; Estonia - EC state aid decision to introduce strategic reserve auction if necessary; Romania - retention of existing generation; Sweden - introduced a new legal framework for a capacity mechanism in the form of a strategic reserve in 2025. The new framework replaces the previous regulation on the “power reserve” and aligns with the requirements of Regulation (EU) 2019/943.

- Note (7): Estonia's strategic reserve mechanism was launched on 1 January 2026. The mechanism is funded by electricity consumers. The charge is collected by either the TSO or DSOs uniformly from all end consumers based on their total electricity use (including both domestically produced and imported electricity). The financing mechanism aims at ensuring that consumers who create the need for the reserve, bear its costs. Thus the charge is levied on respective consumers during peak hours. Most of the consumption in peak hours comes from households which have limited price elasticity and need extra time to adapt to the charge. Additionally, network operators and electricity suppliers need to invest in additional IT tools to enable a charge to be effectively levied on consumers in peak hours. To allow time for this, Estonia is allowed to collect the costs of the measure from consumers, based on a flat charge per MWh of consumption for up to two years after the implementation of the measure (state aid case no. SA.112459). Since the measure was started at the beginning of 2026, a small flat charge will apply to all consumers all year round until the end of 2027**.** Starting from 2028, Estonia will need to allocate the charge based on a maximum of 25% of all annual hours, with those hours designed to reflect expected annual peak demand. The peak hours will be defined in a ministerial decree.
- Note (8): New Czech CM's cost recovery model is based on the requirements of CISAF Annex I, point 26. In the Czechia, cost recovery will not be implemented as a lump-sum payment based on a specific period of the year, certain days of the week, or specific hours of the day. 10 % of the payments for the capacity mechanism will be included in the regulated prices as a payment for "related electricity services" and distributed among market participants. The remaining 90 % of the payments are proposed as a dynamically determined fee that will be triggered when the price signal is exceeded on the Day-ahead markets. The price signal will be set as a 95 percentile of the prices from Day-ahead market from the previous year (or of average of the highest prices from the past 3 years). Consumers will pay the price for capacity mechanism in every 15-minute interval triggered each time the Day-ahead prices reach the price signal. The unit price for the capacity mechanism fee will be set as a sum of annual costs for capacity mechanism divided by the sum of consumed electricity in all triggered 15-minute price signal intervals. The price signal and expected unit price shall be announced by the NRA for each year and will be subject to possible regulatory decision update according to actual occurrence of price signals and expected amount of consumed electricity in those intervals compared to the predictions.
- Note (9): A Derating Factor (DF) is the percentage of a resource's installed capacity that can be reliably expected to be available during periods of electricity scarcity.
- Note (10): Derating Factors (DFs) are derived in accordance with the ERAA methodology using the latest ERAA 2025 edition input datasets, including resource characteristics, availability, storage parameters, together with hourly energy not served (ENS) outputs from the economic dispatch module. The ENS time series represent scarcity events and are the result of a simulation of future year 2028, which is simulated 540 times (with 36 weather scenarios and 15 forced outage samples for each scenario). The scarcity events are calibrated so that Loss of Load Expectation (LOLE) meets an assumed target of 3-hour LOLE / year for each bidding zone for illustrative purposes. Calibration is performed by adding a perfectly reliable reference technology that reduce ENS until the LOLE drops to 3 hours. Bidding zones with LOLE less than 3 hours are excluded from these estimates. **Batteries, hydro storage and Demand Response**: DF is estimated in accordance with ERAA methodology Art. 12(7d). For each scarcity event, the proportion of the event duration that the technology can sustain output is calculated based on its available discharge (activation) duration relative to the event length. This contribution is capped at 100% and then averaged across all scarcity events, with longer events given greater weight. Contribution of storage to each scarcity event depends on (i) residual energy from previous events, and (ii) recharge between events. **Wind, solar and run-of-river hydro**: DF is estimated as a ratio of average available generation during scarcity hours to installed capacity, as per ERAA methodology Art. 12(7c). These resources rely on predefined hourly generation profiles. Availability during scarcity periods is assumed to match the availability reflected in these predefined hourly profiles. **Thermal resources**: DF is estimated as DF = 1 − Forced Outage Rate − Planned Maintenance Rate during scarcity, as per ERAA methodology Art. 12(7b).

Annex

- Note (11): The upfront investment and annual operating cost are respectively 40-50% and 35-45% lower than those of CCGTs. Equivalent annualised cost' represents the constant annual payment over the economic lifetime of a project which allows to pay back the capital costs and annual fixed costs.
- Note (12): In Ireland existing capacity can bid into the auction above the Existing Capacity Price Cap (ECPC) if they are approved by the Regulatory Authorities for a Unit Specific Price Cap (USPC). Existing capacity gets paid the same auction clearing price as new capacity in the unconstrained auction run (pay-as-clear) and can get paid up to their USPC in the constrained auction (pay-as-bid). New capacity can bid up to the Auction Price Cap.
- Note (13): The caveat of setting a lower remuneration cap for existing capacity is that it may risk to create a strategic incentive to withdraw existing plants from the auction, retire them and bid with new capacity instead, if the latter offers higher overall remuneration.
- Note (14): Flexibility measures are defined in this report as subsidy mechanisms that aim at incentivising the deployment and utilisation of non-fossil flexible resources.
- Note (15): Many flexibility measures continue active from previous years. 6 Member States introduced new measures in the year 2025 (ES, BG, SI, NL, IE, HR). From those, SI, NL and IE did not have an active flexibility measure in 2024. Some measures expired and were discontinued.
- Note (16): Where information on the distribution of support is lacking, ACER has applied assumptions about its distribution throughout the years. Normally a linear cost distribution has been applied among the years when aid is expected to be distributed in each Member State.
- Note (17): Due to unavailability of data, or because some data provided were estimations of maximum amounts of support rather than data from actual contracts or auction results, some data points have not been reflected in the figures:
  - Cost data for the Irish flexibility measure (no published clearing price at the time of writing), cost data for the German InnoAus (aggregated cost data not available), cost data for the Croatian co-located storage measure, cost data for the Greek distributed battery measure, cost data for the Lithuanian measure (State Aid 115362), cost and volume data for the Romanian distributed battery measure, volume data for the Dutch and Slovenian measures. Figures for AT may not cover all flexibility measures (lack of complete overview, as they exist at regional and local levels) and provided values of total capacities and costs may change until every funded project is fully realized.
- Note (18): Category definitions changed from last year. Previously, Grid-scale batteries, Distributed batteries, Co-located storage, Pumped storage hydro, DR, and Thermal storage were reported separately. This year grid-scale, distributed and co-located storage are combined into "Battery storage"; DR combined with storage measures is labelled "DR and Storage" – available only in France.

Annex

- Note (19): The flexibility volumes are plotted starting in the year they expect to be commissioned, all the way out to 2030, cumulatively. Some assets had been awarded support in previous years and are plotted starting from 2025. The graph reflects that these volumes of flexible assets remain operational across the period presented in the graph. The plot shows data as reported by NRAs and official documents for public support, it does not reflect necessarily the volumes of assets in operation – there can be notable differences between the reported information and assets entering actual operation (e.g., due to project delays, among others).
  - In FR the auctions for DSR and DSR + storage are carried out yearly. French flexibility auctions have stopped with the AOFD 2026, future support will be included in the new capacity mechanism.
- Note (20): The battery storage projections include volumes from Irish, Croatian, Polish, Greek, Romanian and Italian flexibility measures.
- Note (21): Most countries have provided data in terms of capacity (MW) and a few have provided data in terms of energy (MWh), reflecting the way the flexibility measures were procured. ACER converted all data received in terms of energy (MWh) -excepting data from Italy and Poland- to capacity (MW) assuming batteries with a duration of 2 hours. In the case of Italy, a battery duration of 6.69 hours was used, as this was the result in the first MACSE auction in September 2025. In Poland, a 4h duration of batteries has been used, as informed by the NRA.
- Note (22): German auction results provide the volume of RES and battery systems combined, where battery storage must be at least 25% of the total capacity. Battery storage volumes were plotted for Germany by summing all auction results in the 2020–2025 period and multiplying by 25%.
- Note (23): RO was not included in any of these groups due to lack of information on the aid granting process.
- Note (24): ACER understands that the cap in the Italian measure, MACSE, as well as the French AOFD[1] for the underlying capacity mechanism, are linked to CONE estimates. French flexibility auctions have stopped with the AOFD 2026, and future support will directly be included in the new capacity mechanism.
- Note (25): The graph contains standalone and co-located battery storage. The countries for which subsidized capacity comes only from flexibility measures are RO, BG, ES, SK, DE, PT, HU, GR.

[1]AOFD: Appel d'Offres Flexibilités Décarbonées -Call for tenders of non-fossil flexibility.

Annex

- Note (26): Some examples of enabling regulation in the Baltic countries for battery storage are:
  - LV: Cabinet of ministers regulations No. 1227, paragraph 2.7., identifying energy storage as a separate type of regulated activity;
  - LV: Electricity Market Law, Section 1, Paragraphs 13., 25., 26., 27., 28., 45., 57., defining energy storage and its operators as components of electricity market;
  - LV: Decision of the Council of the Public Utilities Commission No. 1/1 "Regulations Regarding General Authorisation and Registration in the Energy Sector", providing for the rules of registration of energy storage operators.
  - LT: Law on Electricity (No. VIII-1881), introducing electricity storage as a separate electricity-sector activity and defining electricity storage facilities and storage operators within the electricity market.
  - LT: Law on Energy (No. IX-884), recognising storage as an energy-sector activity and establishing the general legal framework for energy storage.
  - EE: Electricity Market Act (Elektrituruseadus):
    - introduces a legal definition of electricity storage and recognising storage as a separate electricity-market activity.
    - Articles (§5–6), recognise storage operators as electricity undertakings and market participants alongside generators, suppliers and network operators.
    - implements ownership and operation rules for electricity storage in line with the EU Clean Energy Package, including provisions on TSO/DSO ownership restrictions and exceptions for network-integrated storage.
- Note (27): Some battery storage capacity currently in operation has been developed via TSO procurement. Latvian and Lithuanian TSOs have received a temporary derogation from EU regulations and procured their own battery storage (e.g., see Section 16.3 of the Latvian Electricity Market Law). Lithuania approved support in 2025 -amounting to 140 million € - to expand battery storage capacity in two different auctions, the first one which awarded 4000 MWh (1750 MW), and the second one which awarded 1600 MWh (725 MW) of battery storage.
- Note (28): The French TSO, RTE, estimated solar and wind market-driven curtailment volumes during negative price periods in the 2025 Electricity Review. Their method measures the difference between the generation forecast and actual generation. The generation forecast is then calibrated against the actual generation curve and actual generation is adjusted to exclude solar and wind activations for mFRR (manual Frequency Restoration Reserve), to isolate market-driven curtailment.



ACER

European Union Agency for the Cooperation of Energy Regulators

info@acer.europa.eu
acer.europa.eu
@eu-acer.bsky.social
linkedin.com/company/eu-acer