## ENTSO-E Policy Paper – Short Summary

# Market Design for Utility-Scale Energy Storage

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Europe's pathway to decarbonisation, as enshrined in the EU Green Deal, Fit-for-55, and REPowerEU, requires a rapid, coordinated and system-optimised scale-up of utility-scale energy storage.

As the share of variable renewable energy (vRES) grows continuously across all Member States, the power system is increasingly exposed to structural challenges: frequent periods of overgeneration, insufficient vRES output during peak demand hours, grid congestions, and higher flexibility needs.

A diversified portfolio of storage technologies, from pumped hydro to lithium-ion batteries and emerging long-duration technologies, can provide an essential contribute to security of supply, affordability, and decarbonisation simultaneously.

Despite strong market interest and unprecedented volumes of battery storage connection requests in several Member States, actual deployment rates remain below what will be needed in the European power system. The challenge ahead is not only to deploy more storage, but to deployand operate it where and when it delivers the highest system value, in line with system needs, including network constraints, and renewable integration. Well-sited asset investment and system-aligned operation will be a cornerstone for integrating high shares of vRES while limiting the reliance on fossil-based flexibility.

Against this background, and building on the revised Electricity Regulation, and the evolving flexibility policy framework, this policy paper sets out how Europe's electricity market design can support the timely, cost-effective and locationally-optimised deployment of storage, and ensure its efficient operation across day-ahead, intraday and balancing markets. Three different investment frameworks are assessed: merchant investments, capacity mechanisms, and non-fossil flexibility support schemes; alongside key operational enablers required to translate investment into system-beneficial behaviour.

## 1 Strengthening merchant investments

Merchant storage investments rely on revenue stacking across day-ahead, intraday and ancillary services markets. While increasing price volatility in energy markets boosts arbitrage opportunities (i.e. charging during low/negative price hours and discharging in period of higher prices), several barriers undermine bankability of investments: regulatory uncertainty, double charging of network tariffs, limited access to ancillary services, and limited long-term revenue visibility.

**To reinforce the merchant case for utility-scale energy storage while steering investments to system-friendly locations, closer coordination among policymakers, regulators and system stakeholders is needed to:**

- Ensure non-discriminatory access to all value streams including balancing, ancillary services and congestion management
- Remove double charging in the short term and evolve tariff design to reflect storage's net system value over time
- Enhance locational transparency, hosting capacity visibility and short-term signals reflecting structural congestion
- Enable flexible and non-firm connection agreements to accelerate deployment without compromising operational security
- Where needed, complement market-based revenues with EU/national de-risking tools (EIB instruments, CEF, Innovation Fund) to address financing barriers and unlock large-scale storage investments

While indispensable, merchant investments alone are unlikely to deliver the scale, timing and geographical distribution of storage required to meet future system adequacy and flexibility needs across Europe.

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## 2 Adapting capacity mechanisms

The revised Electricity Regulation recognises capacity mechanisms (CMs) as a structural market feature and requires Member States to adapt them to better enable non-fossil flexibility including storage. While storage can make a significant contribution to adequacy, many existing CM designs still reflect the technical characteristics of thermal generation, which remains the predominant provider of capacity.

**To ensure storage can participate on a level playing field, CMs should:**

- Align auction timings with storage lead times (e.g., Y-2 auctions, as already implemented in Belgium)
- Apply duration-differentiated derating factors and proportionate performance requirements
- Allow multi-year contracts for capital-intensive storage and enable degradation-adjusted delivery obligations
- Introduce locational signals to steer siting towards areas where it alleviates network constraints and delivers the highest marginal adequacy value
- Establish transparent contribution methodologies for hybrid vRES + BESS assets

Well-designed CMs can deliver long-term revenue predictability, mitigate investment risks, and support a diversified portfolio of adequacy-contributing non-fossil resources in line with EU decarbonisation objectives.

## 3 Designing effective non-fossil flexibility support schemes

Under the amended Electricity Regulation, Member States may introduce non-fossil Flexibility Support Schemes (NFFSSs) – either as an alternative to or in parallel with CMs – to ensure timely and sufficient deployment of non-fossil flexible resources. NFFSSs therefore constitute a targeted and complementary instrument to procure flexibility where system needs are most acute, particularly under very high shares of vRES.

**A robust NFFSS should:**

- Provide long-term revenue stability while preserving efficient short-term price formation
- Deliver granular locational signals to prioritise investments in congested or vRES-rich areas
- Include operational incentives that reward system-friendly behaviour – possibly via dynamic constraints or performance-based rewards
- Require participation in balancing and redispatch markets with clear performance and penalty frameworks
- Ensure coordination with national CMs to avoid double remuneration of the same asset and inefficient capacity over-procurement

## 4 From investment to operation: enabling system-friendly use of storage

Even well-sited storage may operate inefficiently if short-term price signals fail to reflect local grid conditions, leading to counterproductive charging and/or discharging patterns and unnecessary redispatch.

**To better align market outcomes with physical system needs, regulators and TSOs should:**

- Enable flexible connection agreements (temporary or permanent), with transparent curtailment and compensation rules.
- Investigate Dynamic (i.e., time- and location-varying) grid tariffs, to reflect actual local grid conditions.
- Adopt dedicated market rules limiting actions that worsen congestion, while also encouraging availability for redispatch.
- implement ramping constraints to avoid frequency disturbances linked to ultra-fast BESS response.
- In line with the existing legal framework, consider bidding zone reconfiguration where structural congestions are persistent and cannot be addressed by operational measures.

Taken together, these measures ensure that storage is not only deployed at scale but also operated in a manner that maximises its value to the electricity system, while providing flexibility where and when it is needed most, and supports secure operation under high vRES penetration.

A robust investment framework (whether achieved by strengthened merchant signals, adapted CMs, or well-designed NFFSSs) combined with future-proof operational rules, is essential to ensure that storage is deployed where it matters most and operated when it is most valuable. This dual focus on both investment and operation is therefore is key to unlocking the full potential of storage within an integrated European power system.

For supporting evidence, detailed analysis and a full description of relevant national experiences and case studies from Belgium, Italy and Germany, readers are encouraged to consult the full version of the report.

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