eurelectric
powering people

Energy Storage:

Enabling higher integration and utilisation of variable renewables

Eurelectric position paper

October 2023

Eurelectric represents the interests of the electricity industry in Europe. Our work covers all major issues affecting our sector. Our members represent the electricity industry in over 30 European countries.

We cover the entire industry from electricity generation and markets to distribution networks and customer issues. We also have affiliates active on several other continents and business associates from a wide variety of sectors with a direct interest in the electricity industry.

We stand for

The vision of the European power sector is to enable and sustain:
- A vibrant competitive European economy, reliably powered by clean, carbon-neutral energy
- A smart, energy efficient and truly sustainable society for all citizens of Europe

We are committed to lead a cost-effective energy transition by:

investing in clean power generation and transition-enabling solutions, to reduce emissions and actively pursue efforts to become carbon-neutral well before mid-century, taking into account different starting points and commercial availability of key transition technologies;

transforming the energy system to make it more responsive, resilient and efficient. This includes increased use of renewable energy, digitalisation, demand side response and reinforcement of grids so they can function as platforms and enablers for customers, cities and communities;

accelerating the energy transition in other economic sectors by offering competitive electricity as a transformation tool for transport, heating and industry;

embedding sustainability in all parts of our value chain and take measures to support the transformation of existing assets towards a zero carbon society;

innovating to discover the cutting-edge business models and develop the breakthrough technologies that are indispensable to allow our industry to lead this transition.

Dépôt légal: D/2023/12.105/38

WG RES & Storage
WG R&NC
WG WMD & IF
WG Hydro
NEIS

Contact:
Aida García
Advisor Renewables & 2030 Framework Lead
agarcia@eurelectric.org

Energy Storage: Enabling higher integration and utilisation of variable renewables

The Renewable Energy Directive (RED) sets a binding target of 42.5% of renewable energy in final energy consumption by 2030. This translates into roughly 70% of renewables in the electricity mix in 2030, getting close to a tipping point where the flexibility needs could increase exponentially[1]. In an increasingly renewables-based electricity system, the importance of flexibility solutions – and in particular short-, medium- and long-term storage – is crucial for ensuring security of supply during times of lower generation from variable renewable energy sources. Furthermore, when renewable electricity cannot be efficiently transported to the end consumer, or when there is not enough demand to absorb electricity generation, it leads to curtailments. Ahead of 2030, curtailments are forecasted to reach 30-36% in several regions in Europe,[2] resulting in increased costs for consumers and often elevated carbon emissions.

There are diverse flexibility solutions to reduce curtailments of renewable generation and contribute to security of supply. This paper focuses on the policy framework needed to incentivise the uptake of energy storage[3] as a key element in the search for flexibility in the power system. In Eurelectric's recent study *Decarbonisation Speedways*, storage is estimated to offer between 361 and 486 GW of flexible capacity in 2050[4] and 191 GW by 2030[5]. This is a huge increase from today's 60 GW[6], over 90% of which is provided by pumped storage hydropower. Meanwhile, the financing required to support a major step-up in energy storage systems leading up to 2050 is estimated at between €100 and 300bn[7].

Five policy actions to boost energy storage and integrate more renewables

The EU energy strategy relies on the availability of energy storage, but the specific framework for scaling it up is lacking. Although the recent Commission recommendations to Member States on Energy Storage (2023/C 103/01) are a positive development, there is still a need for further action. In this context, we review five fundamentals for boosting energy storage across Member States.

[1] According to the JRC, flexibility needs would reach 24% (288 TWh for daily flexibility needs, 288 compared to 258 TWh for weekly and 173 TWh for monthly flexibility needs) of total electrical EU demand in 2030 and 30% (2189 TWh for daily+weekly+monthly flexibility needs) by 2050. Source: JRC Flexibility requirements and the role of storage in future European power systems, 2022, here.
[2] ENTSOE projections in the Annex.
[3] Energy Storage as defined in Directive (EU) 2019/944, Art 2 (59)
[4] Eurelectric Decarbonisation Speedways, 2023. Electricity storage offerings included utility scale batteries, prosumer scale batteries, V2G and Hydropower pump storage for EU 27+UK. Hydrogen is expected to contribute with 312 TWh for the power sector, providing controllable generation via seasonal storage. Available here.
[5] Eurelectric Power Barometer 2023. See here.
[6] European Commission's data here
[7] European Commission's SWD(2023) 57 final here

1	2	3	4	5
Consider storage as a flexibility option	Provide long-term visibility & predictability of revenues	Make use of existing funding opportunities for the transition	Build up capacities	An EU-wide methodology to assess the nature of the stored electricity
✓ Member States shall assess their flexibility needs and meet them cost-efficiently. ✓ System operators should consider storage among the flexibility solutions available in their network assessment	✓ Stop electricity market interventions that have eroded investors confidence ✓ Abolish double taxes, charges and grid tariffs issues for storage ✓ Implement the Clean Energy Package ✓ Facilitate capacity mechanisms ✓ Ensure adequate remuneration for the multi-service utilisation of storage capacities ✓ Enable PPA development	✓ Launch dedicated tenders for standalone storage and co-located storage when market incentives are insufficient. ✓ Consider storage as one of the flexibility options eligible for competitively-designed EU and Member State funds for the transformation of our energy system.	✓ Streamline permitting by implementing RED & NZIA ✓ Allow for flexible connection agreements, with the appropriate terms and conditions ✓ Ensure supply chain resilience	✓ Develop an EU-wide methodology to assess whether stored electricity is renewable/low carbon

1) Flexibility needs assessment & network planning

It is crucial for governments to incorporate flexible solutions such as additional storage assets and grid capacity into their long-term strategic energy plans. These plans should align with the development of homegrown wind and solar photovoltaic (PV) capacity as well as consider the development of the generation mix and consumption profile in neighbouring countries. Ensuring flexibility is at the heart of policy design is essential.

With regard to network planning, market-based mechanisms for procurement of energy storage technologies can increase system value and help support system operators to opetimise infrastructure operations and investments needs. The construction of energy storage should be efficiently complementary to grid systems and their extension. At the same time, grid capacities, including interconnectors between Member States, allow for a better distribution of storage capacities from Member States with more favourable resources and, therefore, must also be considered when accelerating permitting procedures.

- ✓ To this end, Member States should carry out an economic assessment to understand the flexibility needs with their various storage capacities and ultimately meet them in the most cost-efficient way. Member States have to work with all stakeholders and market actors to remove barriers and, if needed, define incentives to promote the uptake of flexibility solutions in a technology-neutral manner, including the different capabilities of energy storage.
- ✓ System operators should consider storage among the flexibility solutions available in their network assessments and clearly identify (i) the flexibility issues that they are facing, (ii) the locations where flexibility would be most valuable for both current grid operation and development plan optimisation and (iii) service definition.[8]

2) Market and Regulatory Signals: Long-term visibility and predictability of revenues

A lack of visibility on long-term revenue has stalled energy storage development. To make energy storage projects more appealing to investors, it is important to enhance the returns they can yield, monetising positive externalities such as curtailment reduction, while also minimising or redistributing the risks associated with such ventures. This can be achieved through the following:

a) Regulatory certainty: Stable regulations are crucial for capital-intensive investments in energy storage, providing long-term visibility and allowing stakeholders to make informed decisions.

[8] Charge! - Deploying secure & flexible energy storage, Eurelectric 2020, Available here.

Recent market interventions, such as the temporary emergency measures related to the energy price crisis in 2021/2022 (2022/0289/NLE), erode investor confidence.

b) Abolish double taxes, charges and grid tariff inconsistencies for storage. In some Member States, energy storage is still exposed to double taxes and levies and/or to inconsistent grid tariffs. As storage facilities do not consume the energy, they should not be taxed twice for the energy stored to be reinjected, in line with Art 18 of EU/2019/943[9]. Regarding levies, while all service providers should be able to fully cover their costs and a fairsharing of the burden should take place, there should be no market distortion between storage and other flexibility options. As for grid tariffs, they shall also not be double charged and must always be cost-reflective and non-discriminatory, while taking into account the possibility of storage to balance the grid and reduce congestion.[10]

c) An electricity market design that incentivises storage by:

- Implementing the Clean Energy Package: First, Member States should fully implement the 2019 market design regulation (EU/2019/943) and directive (EU/2019/944), i.e., by adopting a definition for energy storage, removing price caps, reducing minimum bid sizes, developing new flexibility services where needed, and limiting as much as possible non-remunerated, non-frequency ancillary services. At the EU level, storage is recognised as an independent pillar of energy supply, as it constitutes neither generation nor consumption, and this shall also be the case at the national level. Among others, this means that storage should be registered statistically separately.
- Facilitating technology-neutral capacity mechanisms: Going forward, capacity mechanisms could be crucial for the development of energy storage, while also pursuing an interconnected European electricity market. Many countries have already deemed it necessary to introduce capacity mechanisms to reach their desired level of security of adequacy and to support additional investments if needed. These mechanisms are heterogeneous across Europe, but most involve some form of long-term contracts. In some countries, targeted support schemes have also been considered or implemented on storage and demand-side response. Current legislation defines capacity mechanisms as temporary additions to the energy-only market model and as a last-resort measure to address security of supply concerns, and subject to DG Competition approval. We recommend[11] the EU to:
  - ✓ Embed technology-neutral capacity mechanisms as an integrated option within the market design by no longer treating them as a last resort and temporary solution.
  - ✓ Develop guidelines to simplify the ex-ante approval process and foster harmonisation of capacity mechanisms while keeping sufficient flexibility to address national adequacy needs and specificities.
  - ✓ Guarantee storage ability to participate in capacity mechanism and valorise their contribution to security of supply.

d) Adequate remuneration in line with the ability of energy storage capacity to provide multiple products and services: Energy storage technology may provide a wide range of products and services. Although each technology group has a dominant income stream, effectively remunerating storage's multi-service capacity utilisation can significantly enhance the business case for energy storage by diversifying revenue streams and increasing profitability[12]. Some of those services that are currently not valued could be provided by storage also – like 'conventional' non-frequency ancillary services such as voltage control and black start or synchronous inertia. In addition, recent analysis[13] shows that in most countries which allow some

9 Art. 18 of EU/2019/943: The network charges shall not discriminate either positively or negatively against energy storage or aggregation and shall not create disincentives for self-generation, self-consumption or for participation in demand response.
10 Charge! Deploying secure & flexible energy storage. Eurelectric 2020 Study accessible here.
11 For more details on capacity mechanisms, see page 56 of Eurelectric's 2023 Study 'A Market Fit For Net-Zero Power System' here.
12 See annex here.
13 2023 ENTEC Study here.

level of value stacking, only a certain combination of service stacking is allowed or possible. Therefore, it is necessary to ensure that all services needed to fulfil the system operation's objectives are appropriately valued and that any revenue combination restriction applied to any technology (including storage) is duly justified.

- ✓ As already established in the design of the union electricity market, Member States should allow access to technology-neutral competitive markets as this would help the emergence of viable business models for energy storage while strengthening the flexibility of the electricity grid and reducing material demand.

e) Enabling the development of the power purchase agreements (PPAs) market: The multi-technology PPA market in Europe is still incipient. As regulatory barriers are lifted and the market evolves, contractual arrangements that are more sophisticated than plain "pay-as-produce" will emerge[14], including those in which profile and volume risk sit more on the sellers' side. In the context of accelerated decarbonisation, such arrangements will trigger the demand for contracts with fossil-free flexibility providers, including storage operators, thus providing them with long-term revenue certainty/investment signals.

- ✓ Member States shall lift all the regulatory barriers and enable the development of the PPA market – including avant-garde 24/7 Carbon-Free PPAs – as it offers consumers increased long-term hedging alternatives and incentivises decarbonisation, promoting the development of non-fossil flexibility. In this sense, adopting the voluntary Granular Guarantee of Origin system, as recently established in the reviewed Renewables Energy Directive (2021/0218/COD), is a positive step.

3) Making use of existing EU and Member States funding opportunities

The high upfront costs and uncertain revenue streams can make energy storage projects financially challenging. Investment aid (CapEX) and operational aid (OpEX) are crucial for electricity storage projects to attract investors, whenever market conditions are insufficient to incentivise the storage needs that were identified. By combining both, energy storage projects become more bankable and secure investments in the emerging storage era.

Considering this, the EU and Member States should make use of existing EU and national public funding where energy storage is eligible such as:

- The inclusion of energy storage and demand response in the Guidelines on State aid for Climate, Environmental Protection and Energy (CEEAG) will greatly help the financing of new storage projects, provided that they comply with the conditions defined in such CEEAG and with a technology neutral approach. Such market mechanisms can take different forms, but the common goal is to reduce the investment risk (mainly related to the uncertainty on future energy price spreads and ancillary services remuneration) and consequently reduce the cost of capital and increase bankability. In any case, it is important that the design of such mechanisms consider the essential balance between the need to secure a share of project revenues and increase visibility, and at the same time, the need to preserve the incentive to dispatch the asset efficiently on spot markets maximising plant efficiency and availability. In addition, the dedicated section in the General Block Exemption Regulation (GBER) in 2023 should also help the financing of capital-intensive storage projects.
    - ✓ Member States must launch dedicated tenders for standalone storage and co-located storage for both existing and new capacity according to the storage needs identified in the flexibility analysis, when market incentives are not sufficient and in line with the EU Competition rules.
- EU funds, and notably the Innovation Fund, shall continue to play a role in the development of new storage and flexibility services based on innovative technologies.

[14] 2022 McKinsey/LDES Council Study: A path towards full grid decarbonization with clean Power Purchase Agreements. Exhibit 6 here.

- Other important funding opportunities for well-designed measures to promote storage include the Recovery and Resilience Plans (RRP) and Facility (RRF), the Connecting Europe Facility funding stream for energy, European Regional Development Funds, Cohesion Fund, Just Transition Fund, the EU Renewable Energy Financing Mechanism, or the Modernisation Fund.

Attention shall also be paid to Europe's islands. Many exist in relative isolation, with no or limited interconnection to the mainland or to other islands. Consequently, it becomes significantly challenging to meet their energy security needs in a manner that is sustainable, affordable and reliable. On the other hand, in view of islands' smaller size systems, they can serve as ideal use cases for implementing advanced solutions for energy storage and other flexibility technologies that aim to further electricity system decentralisation. Therefore, backing energy storage for Europe's islands not only encourages the adoption of renewable energy integration in their power systems but also holds potential benefits for the mainland's future power system.

4) Building up capacities: Streamlining permitting, grid connections and ensuring supply chain resilience

Accelerate permitting

The uncertainties regarding the different steps of the permitting process that have to be followed in a storage project also represent a challenge that must be overcome to develop projects. For instance, a lack of defined permitting processes and the many possibilities for legal claims against permit applications are delaying potential deployments, or in some cases are not allowing the deployment at all.

- ✓ Member States should expedite the implementation of the Renewable Energy Directive's framework for accelerated permitting for storage (2021/0218/COD), including the obligatory streamlined provisions for co-located storage and for hydropower[15] as well as the optional framework for the rest of storage technologies. In parallel, the possibility of legal claims against permit applications should be streamlined.

Streamline grid connections

Energy storage holds significant promise in mitigating congestion within power systems. Effective management of energy storage systems through well-planned charge and discharge scheduling complements the upgrade or expansion of grid lines. In many Member States, grid operators are mandated to facilitate the integration of energy storage systems into the grid and allocate grid capacity for their complete charging and discharging cycles. Nevertheless, it is important to acknowledge that, in certain scenarios, the intermittency inherent to energy storage systems can also introduce congestion challenges within the grid.

- ✓ To address this specific challenge and prioritise the overall efficiency and reliability of the electricity grid, it is helpful to promote grid-neutral connections for energy storage systems, ensuring that connecting assets does not contribute to or exacerbate grid congestion. Offering the possibility for system operators and energy storage to contract Flexible Connection Agreements, with appropriate terms and conditions, or to participate in congestion markets will allow energy storage to actively contribute to the reliability of our electricity grid. These agreements and mechanisms allow storage to connect to the grid and reduce risks of congestion. In doing so, they enhance the overall stability and performance of the electricity supply.
- ✓ Market stakeholders should participate actively in the drafting of the Network Development Plans led by system operators, in particular by providing a forward-looking (5 to 10 years ahead) storage connection and quantifications of the flexibility capacities attached to it in order to map overall flexibility solutions.

[15] Read more about the role of upgrading EU Hydropower for future needs in Eurelectric's 2023 publication here.

Supply chain resilience

For battery storage specifically, costs have increased due to higher demand and logistical challenges, resulting in greater uncertainty and expenses. While, to name one technology, lithium-ion battery prices have decreased in the past decade, further reductions depend on both technological advancements and the rate of increase in battery mineral prices.[16][17]

- ✓ Europe should secure a sustainable supply of raw materials. The EU Sustainable Batteries Regulation and initiatives like the European Battery Alliance or the Critical Raw Materials Act already identified the need to address the risk of disruption in the supply chain for batteries. In parallel, the EU should remove unnecessary barriers to the use of recycled raw materials.

Beyond that, it is positive that the Net Zero Industrial Act (NZIA) recognises battery/storage technologies as strategic net-zero technologies. However, there is a need to extend the scope of the supply chain for different storage technologies to minimise any potential supply chain disruption.

- ✓ All storage technologies should be included in the list of Strategic Net Zero Technologies, including pumped hydro storage. Companies, suppliers and subcontractors, must be given a clear signal to further develop and modernise their production sites in Europe.

5) Develop an EU-wide methodology to assess the nature of the stored electricity

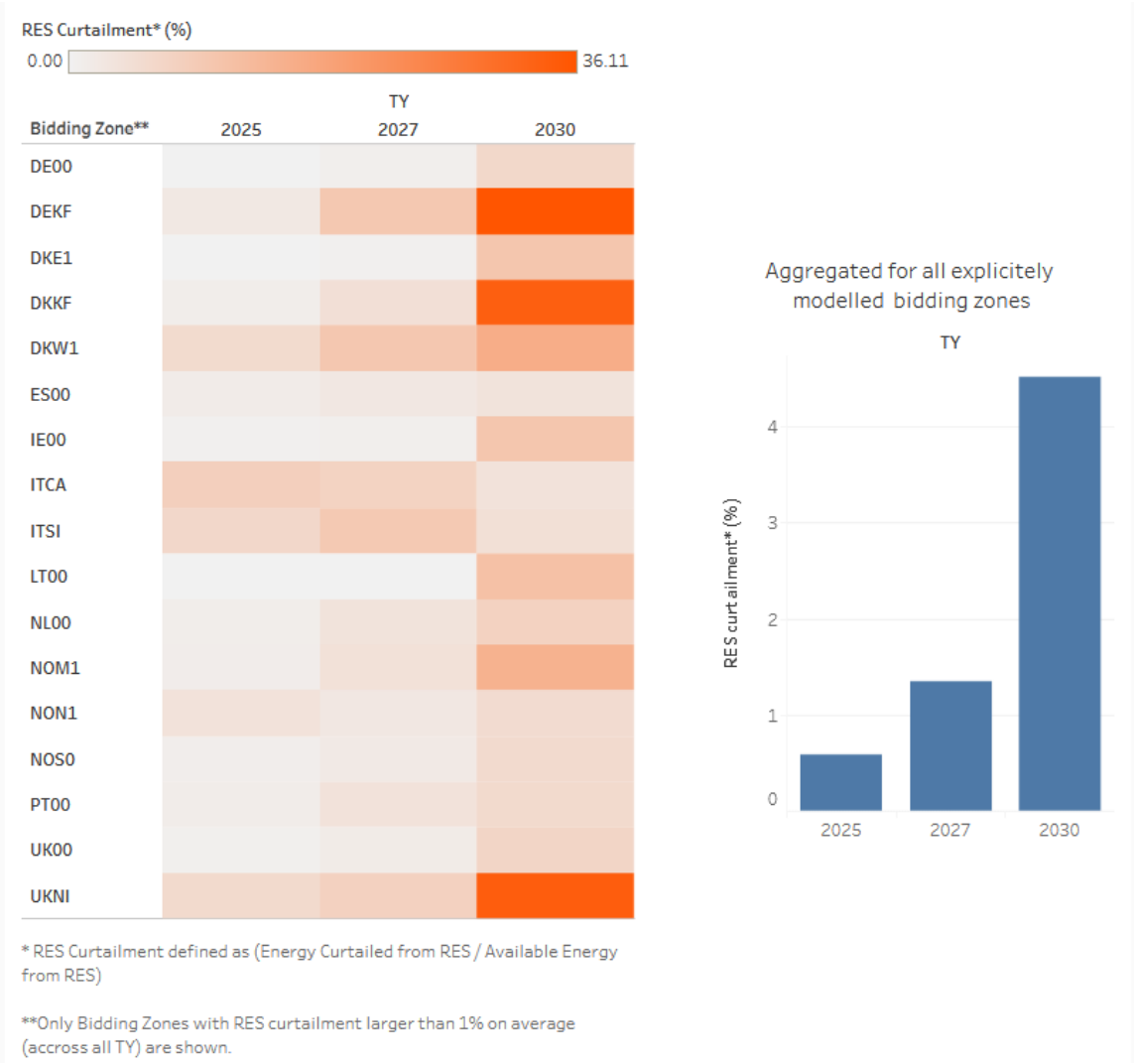
Today there is no common European methodology to assess which part of stored electricity is renewable. In some countries like Germany, as soon as 1 kWh of non-renewable electricity is stored in a storage facility, the entire stored electricity is considered non-renewable. In this case, while renewable electricity released from storage is not regarded as generation, the electricity should not lose its renewable property.

- ✓ The EU ought to establish an EU-wide methodology to assess if stored electricity is renewable/low carbon.

[16] https://www.iea.org/reports/grid-scale-storage
[17] In 2022, Li-ion battery pack prices rose by 7% per kWh, the first increase since 2010, due to higher raw material prices.

Annex

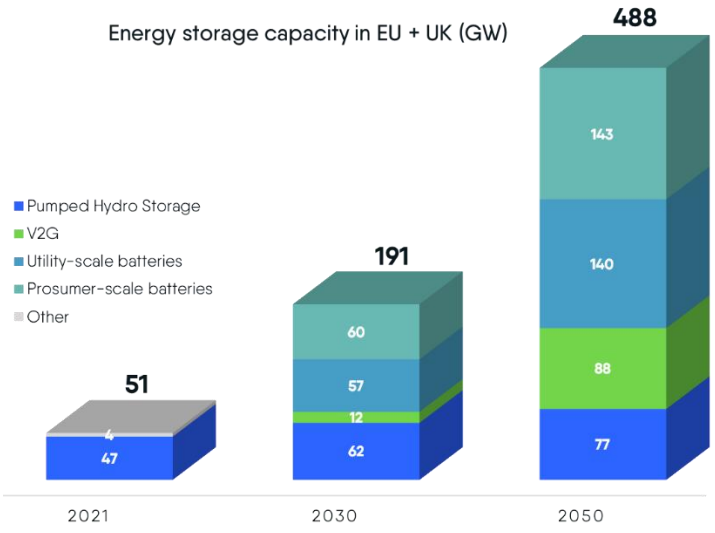
i. Expected RES curtailment ratio for selected bidding zones



European Resource Adequacy Assessment [here]

ii. Energy Storage Needs in a net-zero power system

Today, Europe relies on pumped hydro for 90% of its storage needs but the need for more storage capacity is pressing. Altogether, storage technologies should reach in total 191 GW of capacity by 2030 and up to 488 GW by 2050. This is a huge increase from the 2021 levels, which stood at 51 GW.



Source: Eurelectric Power Barometer 2023, based on Eurelectric Decarbonisation Speedways, International Hydropower Association, EASE (Energy Storage Targets 2030 and 2050; Activity Report 2022)

iii. Different storage solutions have different capabilities

- Short duration (Seconds-minutes-hours): superconductors, electromechanical, flywheels, pumped hydro & mechanical.
- Medium duration (days – weeks): electromechanical, thermal, mechanical, pumped hydro, hydrogen. All small capacity, except for hydro, some mechanical energy storage.
- Long duration (months): pumped hydro, thermal, hydrogen, mechanical. Thermal small capacity and hydrogen and mechanical large capacity.

iv. Energy storage services

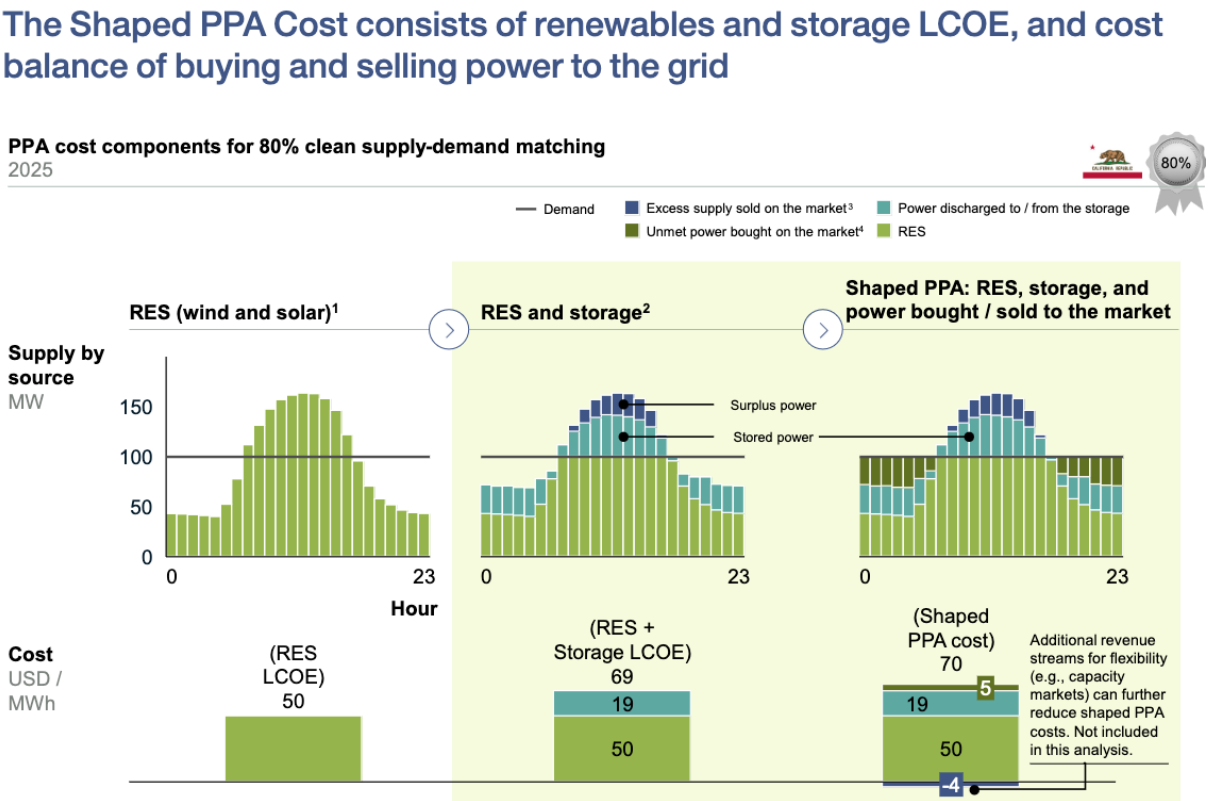
The below table indicates that energy storage policy intended to target the entire range of technologies should take into account the fact that different technologies rely on different market mechanisms; there is no one size that fits all.

Figure 41 Share of revenue by service group and by technology in the present

Technology group	Generation Support Services and Bulk Storage Services	Services to Support Transmission Infrastructure	Services to Support Distribution Infrastructure	Services to Support Behind the Meter Customer Energy Management	Ancillary Services	Any other service
Chemical	59%	14%	9%	1%	3%	13%
Mechanical	49%	12%	16%	1%	21%	0%
Electrochemical	28%	3%	4%	10%	54%	1%
Thermal	0%	5%	13%	73%	3%	8%
Mix	35%	0%	4%	9%	35%	16%

Source: 2023 ENTEC Study here

v. How cleanly shaped PPAs reduce exposure to spot market volatility



Eurelectric pursues in all its activities the application of the following sustainable development values:

Economic Development

- Growth, added-value, efficiency

Environmental Leadership

- Commitment, innovation, pro-activeness

Social Responsibility

- Transparency, ethics, accountability

Union of the Electricity Industry - Eurelectric aisbl
Boulevard de l'Impératrice, 66 – bte 2 - 1000 Brussels, Belgium
Tel: + 32 2 515 10 00 - VAT: BE 0462 679 112 • www.eurelectric.org
EU Transparency Register number: 4271427696-87