Energy Storage in the EU: unlocking the next step in the energy transition via the electricity market design

Summary of key recommendations

Energy storage plays a key role in the new decentralised and flexible electricity system. Energy storage allows the shifting of electricity from the moment of generation, over time, to the moment of use. But not only that, it is also an inclusive technology that brings the energy markets to potentially millions of consumers while taking great steps into guaranteeing stability of our new emerging decentralised and renewable energy system.

1. ***Move to a service-definition based market.*** *Storage solutions, their technical capabilities and the services they can provide will evolve quickly. The current asset-class centric definition is restrictive by nature, thus hampering the development of new technologies.*
2. ***Foster market-oriented adoption of storage****. Storage has to be allowed for use in market-based scenarios solely, to make the full range of services and benefits available to society.*
3. ***Prevent double taxation of storage****. Storage must be charged in a fair and transparent way, double taxation has to be overcome, to unleash the cost-saving potential of this technology to the public.*
4. ***Allow stacking of services****. To provide a better business case storage must be allowed to offer multiple services from a single or multiple unit(s) to multiple markets.*
5. ***Allow aggregation of storage****.* Storage has to be allowed to be aggregated and bring flexibility to all organised markets by a service provider, independent aggregators or suppliers.

Overall, an open and free market is essential for storage. *Storage solutions will become competitive not only thanks to cost decrease due to technological evolution, but also due to an unrestricted market, which values fairly all services. Missing the chance now for a new framework might hinder the rapid adoption of this technology into our electricity network. Important principles have been put forward in the proposals for the Electricity Market Regulation and Directive. The inclusion of some important amendments tabled by the European Parliament and Council should bring necessary clarifications and improvements to secure a successful development path for energy storage.*

Introduction

The European Union aims to lead the way towards the clean energy transition by adopting some of the most forward-looking climate and energy legislation in the world. This will lay the foundations for energy markets to transform into more competitive, flexible and effective structures where modern energy models can thrive. New scenarios are already shaping up, driven by growing shares of decentralised solutions and variable renewable energy sources. Energy storage, including batteries in electric vehicles, is at the core of this transformation and will play a fundamental role throughout the electricity system of tomorrow. It does so not only by mitigating the variability of renewable energy sources (RES), but also by enabling citizens to play a more active role and become engaged customers – thereby democratising energy markets.

In line with this ambition, the European Commission's proposals on the electricity market design[1] re-write the rules which will govern the electricity markets of tomorrow. In these future markets, new technologies and services such as automation and digitalisation, battery storage, distributed solar and wind power generation and real-time data generation and management will become increasingly common and offer huge benefits in terms of increased system reliability, safety, decreased costs and emissions all the while helping to avoid the need to build new generation capacity. Both the Parliament and Council have recognised the benefits that these technologies bring to the energy sector and have supported, in their respective versions of the text, the creation of a level playing field for all market participants. In this paper, the particular role of energy storage is discussed as a key technology to achieve the necessary flexibility for an efficient energy system.

Depending on its technical characteristics, storage can already provide a wide range of services characterized by being a flexible and efficient technology:

1. **Response**: Storage is able to fully imitate demand response and can act as generation response
2. **Rapid**: Storage is able to respond in milliseconds to provide or take energy from the grid
3. **Resilient**: Storage is able to store and discharge energy only when needed
4. **Redistribution**: Storage can shift energy from lower to higher demand times to moderate prices and stabilize systems states in our energy system.

However, there are still challenges for storage that need to be addressed before it can realise its full potential as a part of the energy system. Double-charging of taxes and levies on storage are still present and distorting investment decisions. Discussions around regulated ownership and operation of storage assets could stunt the development of the storage industry for years to come. And finally, discussions are still ongoing on what services, and especially at what times, storage should be able to provide to the system.

This paper outlines smartEn's positions on these topics, and its recommendations to the three EU co-legislators on how best to proceed in order to unlock the true potential of storage in the energy transition.

[1] Regulation on the internal market for electricity and Directive on common rules for the internal market in electricity

1. Moving to Service-Based Markets

In the new energy landscape, with new technologies and services appearing almost every day, the rigid definition of asset classes should give way to a service-based approach for market participation and pre-qualifications

Storage does not fit in the traditional asset classes. Storage can be classed either as a generation or a consumption asset or both. This issue is particularly problematic since storage does not refer to one single technology. It is difficult to bundle in the same category a home battery, a grid-scale pump hydro scheme and an electric vehicle. An appropriate classification of storage means that storage will be on an equal footing with other technologies when providing services to the electricity grid. Current asset classes limit companies from developing new technologies due to reduced investment signals, induced by the limitations of the current asset classes. It will be more and more challenging to fit new approaches, that combine decentral solutions, into individual asset classes. For example, if an electric vehicle is equipped with a solar panel and participates both in smart charging and vehicle-to-grid solutions, this vehicle could be considered generation, storage, demand response and simple demand. The limits between asset classes are becoming more diffuse, and in the long run strict asset classes won't be able to effectively take into consideration all the different capabilities.

The alternative to asset classes is a service-definition approach. The services required by the grid should be defined by the relevant authorities, with a clear set of technology agnostic requirements. With this approach the specific technologies that provide the service are irrelevant, levelling the playing field for a competition that yields the biggest social benefit. An additional requirement is that resources are allowed to qualify as a pool. Technical capabilities are verified by the TSO on an aggregate level, and not on the individual resources. This approach is not only more cost-effective but also allows various technologies, with different capabilities, to qualify and deliver highly reliable services as an aggregate. This is the case even if certain assets might not be able to provide these services individually. As the energy system is more and more decentralized, the detail of assets can go down to the level of an individual appliance in a home.

A pool-based approach allows for the necessary level of aggregation to provide the system operators - TSOs and DSOs - with the sufficiently detailed data needed for a reliable system operation. This data includes information on the interaction of different assets with the grid and which services can be delivered in which timeframes. At the same time, the pool-based approach would allow for the protection of highly granular personal and commercially sensitive information. In this way, a pool-based approach would enable the use of innovative solutions, increase efficiency and bring down costs.

While the service definition-approach is the ultimate goal, constraints in the current network code design limit its fast adoption. The current network codes are built based on the definitions of asset classes which have to be adapted, which will delay the adoption of the service-definition approach.

smartEn recommends an interim solution until the service-definition approach is implemented. Storage should be allowed to participate in all services to the grid with an update by the relevant authorities of the current network codes. By including addenda to the existing network codes, storage should be able to participate within the current network code design, unrestricted by the less than optimal asset classes it has been assigned to currently. Within this interim solution, storage could be considered a separate asset class or benefit from improved access conditions within each of the existing asset classes. This interim solution should be time constrained and as short as possible.

2. Foster market-oriented ownership and operation of storage

In line with the liberalisation of the European Energy Market, the ownership and operation of storage should be market based.

The market-based ownership of storage is the only way to ensure that flexibility providers can invest in storage solutions based on their competitive value. Market-based operation of storage makes it possible for these units to offer and deliver ancillary and balancing services to Distribution System Operators, Transmission System Operators and other market participants such as Balancing Responsible Parties, depending on where they are most needed at any moment. On the other hand, a general ownership and operation of storage by regulated actors could distort competition and limit the possible usage cases.

The market-based ownership and operation of storage assets is important also to secure the functioning of European electricity markets. Especially in the early phases of storage development, a market offer for storage may appear more expensive than direct investment by DSOs and TSOs. This can be explained by the favourable access to capital for regulated actors and by the current limits on monetization and stacking of all technically feasible services that can be provided by storage. However, allowing regulated players to own and operate storage assets poses the immediate risk of locking out other players from this activity and directly contradicting the European rules on the unbundling of market activities and system operation, by extending the scope of regulated activities.

The European Parliament reached an agreement on the need to provide a level-playing field, without discrimination or barriers for market entry for new technologies and emphasized the need for market-based ownership and operation of storage assets. At smartEn we support these principles on ownership and operation but there is room for improvement. Conditions and exceptions for TSOs and DSOs to own and operate storage facilities should be firm and make sure not to leave the door open to loopholes that can be exploited. Finally, the tendering procedure should be organised by Members States or the System Operators, subject to approval of the national regulatory authorities.

3. Prevent double taxation of storage

The proper taxation of each kWh will make the case for the expansion of storage

With several different revenue streams for storage, the double-charging of taxes and levies adds an unnecessary burden on the viability of a storage installation. Different levies (incl. for the recovery of capacity mechanisms, renewable obligations, feed-in tariffs or contracts for difference) are passed on by suppliers to the consumer. Storage solutions are especially vulnerable to this. In general energy offtake for storage assets is burdened with taxes and charges each time, whether it is used for consumption or only stored for system support and re-injected later. In some countries this same energy is also charged again when fed back into the grid providing services to the system. Regulation should make sure that every kWh can be traced and is only taxed one time and only in the case it is consumed. At the same time, energy losses should not be burdened with taxes or fees, or owners should at least be able to deduct part of it. Energy losses should be considered a cost to run the asset, similar to the untaxed energy spent to run a generation plant. Some

storage assets will be acting as virtual power plants, competing with other sources, and so should be able to do it evenly.

The transitional role of storage in the energy system needs to be addressed and clarified also with a view to network charges. Thanks to their technical specifications, storage technologies can offer different services with the energy stored. Part of that energy will be used to balance out the system, helping the electricity grid to remain stable. It is therefore important that network tariffs do not penalise the use of storage and users should be charged and rewarded for the costs and benefits they generate for the network.

Several possible models for network tariff design are possible, all of them have different implications for storage resources and flexibility services, and the most efficient one for storage might not be the most socially fair. While capacity-based network tariffs might be the best option for storage assets, since they avoid double charging of network tariffs, they act as a de facto subsidy for storage which bring system inefficiency. Connection charges, while a cost-reflective tariff, are deemed unfair, shifting the costs from richer network users to poorer network users. Additionally, connection charges also hinder flexibility by being an incentive for smaller power connections that limit the flexibility potential. Volumetric network tariffs on the other hand, are not well suited in the current market composition, with a higher share of decentralized generation. Sophisticated dynamic network tariffs could be the most appropriate solution technically, but will be challenging to implement, due to certain practical restrictions and possible consumer preference. Currently the system monitoring might not be developed enough to take into account all the variables needed to implement complex dynamic network tariff. Additionally, rapidly changing conditions would provide complex signals, not well suited to all types of consumers, that might prefer more certainty. At the same time, a badly designed Time of Use tariff could even be counterproductive, disincentivising the use of flexibility services and sending out the wrong signals on network congestion. While smartEn recommends the continuous testing and improving of dynamic pricing approaches, for example on critical peak pricing, it may not offer a full solution quickly.

Given that there is no one single adequate network tariff model available today, a combination of volumetric, capacity and fixed network tariffs is recommended. This could be combined with the procurement of flexibility services by DSOs, so as to provide the necessary signals and incentives. With monetisation of flexibility services, the cost of network charges can be recovered, making them less of a barrier. A combination of volumetric, demand-based and connection charges would be starting point for a tariff structure encouraging a flexible use of the network. Demand charges should then be differentiated between on-peak demand charges and non-coincident demand charges. A correct mix of those would reflect the peak periods of the network as well as the customers own peak period, which might not coincide with the networks peak period, hence the name.

Finally, transparency is key for the implementation of any network tariff model and only actual network related costs should be categorized as such, not including in them any other fees and levies, for example RES support schemes. Similarly, a clear bill structure is recommended, where all the components of the network tariff are separately listed.

4. Allow stacking of services

Storage can offer several services making the case for a diversified investment

A storage solution that only provides delayed consumption of energy is a suboptimal use of an asset. Whenever stored energy is not being used for direct consumption, the storage asset can provide different services to the grid, increasing the return on investment of the installation. Measures should be in place to enable the stacking of services from storage, i.e. allowing a single asset to perform and switch between different tasks also for different users. The viability of storage as a profitable business case depends on the variety of services it can provide to the grid, minimising its idle time.

By incentivising different activities, multiple revenue streams will be created that will lower the payback time of storage assets. For example, during a period of 24 hours a battery can provide frequency response to the grid, avoid the triad periods for end consumption and finally charge up when the prices of electricity are the lowest. Besides this, storage assets can provide a wide range of services: Peak shaving when electricity is at its highest price, energy shifting, demand response, ancillary services, support to microgrids and solar self-consumption, guaranteeing power quality and acting as an emergency backup. Finally, it also provides support to the transmission and distribution system.

In addition to the sequential stacking of services, storage can provide certain services simultaneously. Battery storage control systems allow for the 'segmenting' of a battery storage's capacity with incredible precision, enabling, for example, battery storage to bid in 50% of its capacity to deliver frequency control, while increasing self-consumption with the remaining 50%.

Not only is it important that storage can provide these services, but also that it is able to deliver these to all market parties, be it suppliers and Balance Responsible Parties (BRPs) or Distribution and Transmission System Operators (DSOs and TSOs). To achieve this, a streamlining of markets and product definitions needs to be performed (by TSOs, DSOs and wholesale) to enable stacking and switching between markets.

5. Allow aggregation of storage

The aggregation of storage empowers consumers to control their energy cost

For all decentralised assets, including storage, the possibility of aggregation plays a major role in their development. Storage owners who do not have the capacity or desire to offer their flexibility to the market themselves should have the option to work with an aggregator (which can be their supplier or and independent aggregator). Aggregators provide a key service to the market, offering a path to the market for big and small storage owners, and streamlining the process for them. In a decentralised energy system, with an increase of participants whose main occupation may not be related to the energy sector, aggregators will provide an easy way to optimise the wholesale of energy, scheduling and dispatch of services and in general connecting the individual storage assets into the different grid services.

As the complexity of operating storage assets increases and with more decentralised generation, guaranteeing the security of supply will be one of the key issues of the energy transition. There will be a greater need for aggregators that can take over the role of system safeguarding and allowing the owners to access new revenue streams for their storage systems. There is also a need for simply streamlining the

process for smaller distributed systems, whose owners can't or don't want to be involved in the micromanagement of their installations. A streamlined process for aggregators and storage to participate in selling non-frequency ancillary services to DSOs is needed. The importance of providing a harmonized market in the EU to facilitate the creation of new business models and avoid a fragmentation of the market, is undeniable.

To enable a dynamic market for aggregation services that storage solutions can provide, it is important that consumers have the choice to work with aggregators, be it independent aggregators or their suppliers, to increase the offer available. Consumers that decide to work with independent aggregators should not depend on a prior agreement by their supplier.