FLOW BATTERIES EUROPE

A united voice for flow batteries

POWER SYSTEM CAPACITY AND THE ROLE OF FLOW BATTERIES

POSITION PAPER 2023

MARCH 2023

FLOW BATTERIES EUROPE

A united voice for flow batteries

The need for system capacity and the role of flow batteries

Position Paper

Flow Batteries Europe, the sole body representing flow battery stakeholders in the European Union, advocates for the deployment of flow batteries as capacity providers. To achieve climate neutrality targets, the European Union must ensure resource adequacy alongside decarbonisation. Flow batteries are a valuable capacity resource: they are a cost-effective energy storage solution that offers the benefits of scalability, long-duration discharge and high round-trip efficiency. By enhancing the reliability and resilience of power systems based on renewable generation, flow batteries can support and accelerate the transition away from fossil fuels. We encourage the European Commission to support flow battery deployment.

I. Introduction

Power systems are designed to generate, distribute and transmit electrical energy from one place to another. They involve a number of electrical components that work together to convert primary energy sources into electrical energy used to power homes and businesses. To generate electricity, power systems use a combination of generating plants that convert primary energy sources into electrical energy. Generating plants can use a combination of primary energy sources: fossil fuels, nuclear power, hydroelectric power and renewable energy. The choice of which primary energy sources are used depends on various commercial, environmental, political and societal parameters.

Until recently, electricity supply in most countries was based on operating the power system at the lowest marginal cost possible. States with abundant coal reserves thus gave preference to coal-fired generating plants, while states that invested in nuclear power prioritised nuclear generation. More recently, political and societal pressures have encouraged a shift to sustainable renewable energy generation. Wind, including offshore wind, and solar photovoltaic (PV) energy have therefore grown considerably. As direct and indirect support have led to cost reductions, priority has been given to renewable generation. The EU's political agreement to become carbon-neutral by 2050 has further incentivised the use of renewables as a primary energy source.

The switch from fossil fuels to renewables puts upward pressure on electricity generation for household applications such as heating and cooling. Daily electricity demand continues to grow despite ongoing efforts to improve energy efficiency. Demand is compounded further by a growing preference for electric vehicles and is increasing across longer time periods, leading to two or more daily peaks. Electricity

demand is simultaneously driven by industry: the European electricity sector will have to decarbonise before 2050 to allow sufficient time for the decarbonisation of hard-to-abate sectors like steel, cement and chemical production.

II. The need for capacity markets

It was previously accepted that constant electricity supply from coal, gas or nuclear generating plants could sufficiently meet the daily minimum electricity load. This meant that additional electricity requirements were covered by resources such as peaking gas turbines, hydro storage or diesel engines. However, conventional power plants that generated both base load and peaking power have been shut down or are approaching retirement. New technologies and strategies are therefore needed to balance the demand and supply of electricity.

Variation causes instability in the power grid and makes it challenging for grid operators to balance supply and demand. Sudden changes in the output of wind and solar PV due to weather conditions can create imbalances in the grid, leading to power outages or other issues. Similarly, offshore wind production can provide almost entirely predictable power over long periods of time, but may nonetheless experience some fluctuations. **The road to net-zero is thus a double-edged sword: the use of renewable energy negatively impacts power systems by destabilising the grid and increasing the intermittency of generation.** Stored capacity is needed to stabilise the electricity flow generated from renewable resources.

Capacity markets play a crucial role in ensuring the reliability and stability of power systems, especially those that rely on renewable generation. To avoid shortages in delivery, energy supply must equal demand as well as any additional losses incurred by a power system. Capacity markets are a type of capacity mechanism that helps do this: they provide a mechanism for energy providers to plan for the future and secure necessary generating capacity.

In a capacity market, energy providers bid to sell their generating capacity to grid operators. Providers that can guarantee a consistent and reliable supply of electricity can offer a higher bid, while those with less reliable capacity offer a lower bid. In short, capacity markets provide financial compensation to generation resources that commit to providing electricity during periods of high demand. This guarantees that there is enough generating capacity available to meet projected demand, including during periods of high demand and unexpected fluctuations in renewable energy output.

III. What about flow batteries?

Long duration energy storage (LDES) systems can play a role in capacity markets by providing backup power during periods of high demand. LDES store excess solar PV or wind power when demand is low and production is high, which can later be released

when demand is high and production is low. This balances fluctuations in supply and demand of renewable generation, thereby increasing the stability and reliability of power systems.

Flow batteries possess sustainability advantages over similar LDES systems. They can store energy for extended periods of time and can be discharged over long time periods, from 4 hours up to 6 or 8 hours. Some flow batteries have a long operational life of 20 000 cycles, roughly equivalent to 20 years.[1] Moreover, the vanadium electrolytes used as storage materials in certain flow batteries can be recovered by as much as 97%, contributing to the circular economic model.[2] Similarly, flow batteries that use organic chemistries are synthesised from abundantly available materials, thus are highly sustainable. Flow batteries have low whole life costs and can be built in a range of sizes to suit location or operating profile.

Flow batteries contribute to climate change mitigation and adaptation efforts through the reduction of carbon emissions. As a LDES technology, flow batteries improve the use of renewable components and allow for intermittent delivery with a 24/7 sustainable baseload. For example, a solar PV plant paired with a flow battery can deliver over 18 hours of power a day as opposed to only a solar PV plant, which would typically deliver less than 10 hours a day. In terms of investments, flow batteries conform to the EU Taxonomy for sustainable finance, the framework for identifying investments that positively contribute to environmental goals.

Flow batteries are particularly well-suited to participate in capacity markets. The capacity provided by flow batteries would ensure that providers and operators are able to match the daily peak requirements. This is true even if a peak is delayed or extended. Furthermore, flow batteries are financially feasible contenders to provide capacity. The revenue generated from participating in capacity markets can help offset the upfront costs associated with building and installing such energy storage systems. This means it is more economically viable to deploy flow batteries, as well as other LDES technologies, as capacity providers. Capacity markets can create a positive feedback loop that encourages further investment in flow batteries, building confidence in the technology while supporting the energy transition.

IV. What we ask of policymakers

The European Association for Storage of Energy (EASE) reported that, to meet EU climate targets, approximately 200 GW of energy storage is needed by 2030.[3] However, market forecasts show that only around 100 GW of energy storage will be deployed without strong investment signals and effective market design. EASE consequently suggests developing long-term mechanisms, such as contracts for difference and

[1] Solving the Technical and Economic Challenges to Reprocessing VRFB Electrolyte | U.S. VANADIUM
[2] It's time to get serious about recycling lithium-ion batteries | cen.acs.org
[3] Energy Storage Targets 2030 and 2050 | EASE

specific auctions, to lower capital costs, ensure decarbonisation targets are met and bring visibility to investors.

The capacity mechanisms at EU level are technology neutral to ensure that sufficient generating capacity is available at specific peak times. The only exception is the limitation of the 550 g/kWh emission threshold that excludes coal power plants from participating in auctions.[4] Setting stricter emission limits on the type of power plant used will facilitate the integration of renewable energy into power systems. Encouraging the participation of carbon-neutral technologies is crucial when deciding to implement a capacity mechanism. Indeed, EASE recommends progressively reducing the carbon cap to 250 g/kWh, increasing flexibility services' remuneration, and incentivising the deployment of energy storage as capacity providers.[5]

The inclusion of flow batteries in capacity markets can help reduce dependence on gas imports and support the transition to net zero. We therefore call on the European Commission to advocate for policies that support the deployment of flow batteries as capacity providers. The EU must develop a long-term investment plan that provides strong signals to invest in flow batteries as a key technology. We encourage policymakers to promote the deployment of flow batteries further by implementing policies that offer financial incentives for the long-term revenue mechanisms, as well as direct technology enabling measures such as defining energy storage as its own asset class. Only by taking such steps can the EU increase energy security, reduce dependence on fossil fuel imports and accelerate the transition to a low-carbon economy.

V. Conclusion

The integration of renewable energy sources into power systems creates the need for new technologies and strategies to stabilise the grid. LDES solutions like flow batteries are an efficient and sustainable way to achieve this. Moreover, the participation of carbon-neutral technologies in capacity mechanisms is crucial. To this effect, flow batteries offer unique benefits, including scalability, long-duration discharge, high round-trip efficiency and sustainability advantages. Such features make flow batteries particularly suitable to provide reliable and flexible capacity in power systems that rely on renewable generation.

We therefore advocate for the use of flow batteries in capacity markets. It is important that the European Commission supports the uptake of flow batteries as capacity providers to ensure sufficient generation adequacy. By providing reliable and flexible capacity to the grid, flow batteries contribute to a stable electricity supply. Successful flow battery projects around the world have already demonstrated the benefits of these batteries, and the potential for application in Europe is immense.

[4] REGULATION (EU) 2019/ 943 - Internal Market for Electricity | Official Journal of the European Union
[5] The Electricity Market Design Revision | EASE

‘

FOR FURTHER INFORMATION

Beata Viršumirska
Policy Officer
b.virsumirska@flowbatterieseurope.eu

ABOUT FLOW BATTERIES EUROPE (FBE)

Flow Batteries Europe (FBE) represents flow battery stakeholders with a united voice to shape a long-term strategy for the flow battery sector. We aim to provide help to shape the legal framework for flow batteries at the EU level, contribute to the EU decision-making process as well as help to define R&D priorities. Flow Batteries Europe is working to create and reinforce networks between key stakeholders in the flow battery industry.

www.flowbatterieseurope.eu