



FLOW
BATTERIES
EUROPE

A united voice for flow batteries

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Accelerating Europe's Green Transition: The Crucial Role of Flow Batteries



Dear EU Policymakers,

In this Manifesto, we highlight 4 key EU policy goals and present opportunities for a seamless transition to climate neutrality. Our objective is to demonstrate how flow battery technology can bolster the achievement of the EU's environmental objectives while safeguarding Europe's competitiveness and security.

We propose solutions and outline 10 pivotal steps to facilitate the green transition. FBE stands prepared to support your efforts and facilitate collaboration between industry stakeholders and policymakers.

We are eager to hear your perspective!

Flow Batteries Europe



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There are four pillars of strategic importance for the EU:

1. EU decarbonisation targets

At the heart of the European Green Deal is the EU's aim to become climate-neutral by 2050 – a legally binding target under the EU Climate Law. To achieve this, policies aim to reduce net greenhouse gas emissions by at least 55% by 2030 compared to 1990 levels. Energy is a central pillar in this transition as the production and use of energy account for more than three-quarters of the EU's greenhouse gas emissions. To reach its climate targets, Europe requires a greater share of renewable energy sources (RES), higher energy efficiency, and reduced energy consumption.

Reliable energy storage is essential for a successful energy transition. It allows intermittent renewables to replace fossil fuels by maintaining a stable energy supply. Storage systems store excess energy for later use, ensuring consistent power, supporting peak demand periods, balancing the grid, and preventing wastage of renewable energy. With the rise of cost-effective renewables in Europe, the demand for energy storage is increasing, becoming crucial for the electricity grid and energy system.

While many batteries have been installed with just one or two hours of storage capacity, there is a need to focus more on energy storage solutions that cater to both short- and long-duration needs (i.e., 4 hours or more). The rise of RES of 45 to 60 percent market share poses significant challenges to grid stability and balance between supply and demand. Here, flow batteries emerge as a crucial solution, offering sustainable energy storage with unique advantages. Flow battery technology is designed with sustainability in mind, and it can be used for both short- and long-duration energy storage applications. **The ability to decouple power and energy capacity provides the advantage of tailoring the storage system to the needs of the specific application.** Furthermore, **flow batteries have a long operational life**, with certain models exceeding 20,000 cycles and decades of operation with no degradation. Flow batteries as sustainable technology for energy storage are ultimately able to contribute to the EU's decarbonisation targets for the coming decades.

2. Energy security and grid stability

Energy security has become a top priority for the EU following the Russian invasion of Ukraine, primarily due to Europe's dependence on Russian fossil fuel imports. The EU's response to Russia's weaponisation of its natural gas exports was the REPowerEU plan, launched in May 2022, which aims to bolster Europe's energy security by accelerating the energy transition, diversifying energy import sources, and saving energy. With the long-term goal of achieving full decarbonisation and a shift toward RES, **energy storage capacities are expected to expand significantly in the**

coming years: to more than 200 GW by 2030 and 600 GW by 2050. Grids are encountering numerous challenges due to the growing complexity of energy systems, evolving consumer demands, and the integration of renewable energy sources. For instance, Europe faces a substantial backlog of solar energy projects awaiting grid connection. However, once connected, the fluctuation of RES requires complex balancing services and the restructuring of coordination processes among transmission and distribution system operators.

Energy storage technologies, especially long-duration energy storage sources (LDES) are essential for mitigating the intermittency of renewable energy generation, stabilising the grid, and optimising the utilisation of RES. **Flow batteries offer significant value to the grid, especially due to their capacity to store energy for extended periods, ranging from hours to days, and their rapid response times.** This enables them to promptly charge or discharge energy to accommodate fluctuating demand or offset abrupt shifts in renewable energy output, which increases flexibility in the power grid. The advantages of flow batteries align with the EU's new Action Plan, which targets shortcomings in the energy transition, especially those related to the stability and efficiency of electricity transmission and distribution grids.

3. Energy affordability and consumer protection

The global energy crisis has led to a sharp increase in prices, affecting consumers the most. In 2022, energy prices in Europe hit all-time highs, with a 35% increase in consumer electricity prices compared to the previous year. This has exposed more Europeans to the risk of energy poverty. Although prices have since decreased, vulnerable consumers continue to struggle with paying electricity bills, which is accompanied by high costs of living. Moreover, the challenges extend beyond mere price hikes. The expansion of grids, a crucial component in addressing energy needs and integrating renewable sources, presents its own set of hurdles. Grid expansion projects entail substantial investment, often translating to high charges for consumers. This burden is unequally distributed across the population. Especially underserved and low-income households without access to RES. These households face especially high costs, frequent power outages, and exposure to polluting energy generation facilities.

Flow batteries can bring several benefits related to energy affordability and consumer protection. **Since LDES facilitates grid stability, electricity is continuously available, reliable, and therefore remains affordable.** Additionally, underserved communities have increased access to clean energy and become less dependent on fossil fuels, which reduces pollution overall. EU efforts tackling energy affordability, such as the new electricity market reform, seek to enhance the integration of renewables in the energy system while protecting users from price spikes.

The deployment of flow batteries serves as a bridge in achieving both objectives. By shifting stored energy from renewable sources from low-price to high-price periods, overall electricity costs are reduced. This contributes to price stabilisation by replacing expensive power sources with lower-cost renewable alternatives. Moreover, **the technology's modular design facilitates easy scaling up or down**, enhancing adaptability to the existing grid requirements and enabling the

gradual expansion of renewables. In summary, flow batteries play a crucial role in addressing the 'Energy Trilemma,' balancing energy security, equity, and environmental sustainability.

4. Diversification and safety of energy storage

It is crucial to diversify the energy storage supply chain. A diverse range of storage technologies mitigates the risk of relying solely on one battery type manufacturing buildout for achieving net-zero goals, and it also enhances the potential availability of materials for the automotive sector. Lithium-ion batteries are absolutely essential to electric vehicles (EV), because of its density, weight and expectations of cars to last for years, not decades like a utility asset. By using an alternate set of resources for an application where size and weight are not a constraint, flow batteries enable a future of EVs powered by renewables, stored in flow batteries. It should be taken into account that the swift growth of EV could cause the potential emergence of supply chain limitations. Should these supply chain hurdles persist and impede scalability, lithium-ion batteries may not achieve the anticipated cost reductions, leading to prioritisation of production for automotive industry clients over the energy sector. According to the JRC, **while the EU is making swift strides in the lithium battery value chain, progress has been too slow in the realm of stationary battery technologies based on abundant raw materials, such as flow batteries.** If the current funding trends don't shift, the EU risks on missing out being competitive in the field of stationary battery market. Therefore, ensuring diversity within the energy storage supply chain is of utmost importance.

Flow batteries offer significant advantages over competing technologies in terms of **material availability and safety**. Metal-based chemistries include iron/chromium, zinc/iron, and vanadium flow batteries. Processed iron, zinc, and chromium are massively available and have reserves located in every continent and throughout Europe. Untapped reserves of vanadium mineral deposits in Norway and Finland are set to enhance European supplies in the coming decade. Meanwhile, organic flow batteries, free from metals and PFAS, are also advancing rapidly. Flow batteries are safe, as the key component of the non-flammable electrolyte is water. The technology poses no explosion risks because it operates with liquids at near-atmospheric pressure and stores the active materials apart from the reactive point source.

We call on EU leaders to:

1. Support local manufacturing of flow batteries and the formation of the supply chain

Supporting local manufacturing of flow battery technology in Europe goes beyond industry growth and sustainability; it has the potential to significantly bolster the EU's energy security and economic prosperity. By producing key critical raw materials, components and systems within the region, the EU can reduce its reliance on international suppliers and mitigate risks associated

with supply chain disruptions. However, the formation of the supply chain must be strategically arranged prior to the expected rapid expansion to fulfil market demands by 2030.

Moreover, improvements in manufacturing and supply chain will lead to cost reductions, and a more consistent and predictable project pipeline will result in improved manufacturing efficiency. The EU has the opportunity to become a leader in the stationary battery market.

2. Increase financial support for the R&D of flow batteries

Europe should awaken to and support battery technologies that utilise abundant and readily available base materials. Under the Horizon 2020 framework, half of battery R&D funding was allocated to projects on lithium batteries, with only 3% dedicated to the advancement of flow battery technologies. By 2030, flow battery deployment could cover at least 10% of the energy storage needs. However, to achieve this goal, significantly more support is needed. We advocate for increasing financial support for the R&D of flow batteries to 20% of the whole battery projects funding under the Horizon Europe framework and offering targeted financial support, such as grants or loans, for individual projects.

R&D efforts are the main factor behind the improvement of performance, efficiency, and cost-effectiveness. The costs of technology and its manufacturing decrease through refining design and improving production efficiency. Increasing financial support for flow battery R&D is essential for unlocking the full potential of this technology and advancing towards a more sustainable and resilient energy future.

3. Increase the bankability of the Long Duration Energy Storage (LDES) technologies, including flow batteries

The bankability of LDES technologies, like flow batteries, cannot depend solely on short-term price signals for investment. While LDES investments often become profitable within a decade, it's crucial to begin capacity building now. To incentivise investments in flow battery projects, we need policy support that acknowledges the inherent value of flow batteries.

Additionally, we propose the implementation of a long-term compensation mechanism to reflect the economic and reliability benefits of LDES technology deployment, which are not fully compensated by current market conditions. Flow Battery energy storage could be treated as strategic energy reserves, as it is done with the emergency stockpiles of petroleum that is held by private industry and governments to safeguard the economy and maintain industrial or national security during energy crises.

What is more, the capacity market should establish 15-to-20-year length contracts for new-build energy storage. Intervention from both the EU and Member States is necessary. This could involve providing direct revenues from market participation or offering indirect support by including LDES in resource planning outside competitive energy markets.

4. Recognise the need for energy storage and endorse flow battery deployment targets

Decarbonising entire energy systems requires storage solutions capable of ensuring the long-term security of supply. It is estimated that by 2030, a regional deployment of 200 GW of energy storage is required to meet the ambitious renewable energy targets outlined in the Green Deal. More than 30% of this target should be allocated to LDES solutions in order to meet EU decarbonisation goals.

By endorsing deployment targets for flow batteries – 20 GW by 2030 – policymakers can send a clear signal to the market about the importance of investing in and developing energy storage infrastructure. These targets serve as benchmarks to guide the expansion of energy storage capacity, thereby facilitating long-term planning and investment decisions.

5. Enable the deployment of flow batteries and establish fair energy market rules

To foster the growth of any technology into a self-sustaining market, it must progress through three key phases of commercialisation: demonstrations, scaling, and deployment. Flow batteries, as a promising energy storage solution, require a number of significant large-scale projects in Europe, such as a utility-scale deployment. Demonstrating the efficacy of flow batteries at grid-scale projects would validate business models, paving the way for the evolution of standalone, bankable businesses. Such a project would not only serve as a proof for the viability and reliability of flow battery technology but also provide data and insights into its performance in real-world grid applications. Additionally, it would attract investment and encourage further R&D, fostering innovation and driving down costs.

Linked to this, it is vital to establish fair market rules, which involves reevaluating capacity payments, infrastructure investments, and pricing mechanisms to prioritise renewables over fossil fuels and ensure a level playing field for all energy technologies, including flow batteries. By promoting the deployment of flow batteries, the EU can accelerate its transition towards a more resilient, sustainable, and decarbonised energy system, in line with its climate and energy targets.

6. Incentivise the efficient connection of renewables and energy storage to the grid

The EU should work towards removing barriers and encouraging investments in grid infrastructure that can accommodate the growing share of renewables and facilitate the optimal use of energy storage to enhance grid stability and reliability. This also involves establishing optimal regulatory frameworks, defining efficient operational procedures, establishing remuneration schemes and transmission planning, enhancing information exchange, transparency in all TSOs and DSOs investment plans, and current grid capacities.

The expansion of renewable energy necessitates the promotion and broadening of flexibility resources. This involves providing incentives for hybrid renewable energy projects, such as integrating solar, wind, and flow battery technologies.

However, it is crucial to note that in some EU countries, incentives for renewable energy sources, such as fixed feed-in tariffs, may not align with incentives for energy storage installation. If operators of wind and solar receive fixed feed-in tariffs, it does not incentivise energy storage utilisation and may even hinder it. This discrepancy presents a challenge that needs to be addressed to fully realise the potential of energy storage in conjunction with renewables. Strategically deploying energy storage systems in areas with high demand growth or grid constraints can defer the need for costly grid expansion projects. By addressing localised capacity needs, energy storage can postpone or even eliminate the need for new transmission lines or substations.

A potential solution could involve reconsidering incentive structures to ensure coherence between incentives for renewable energy sources and energy storage installation. By aligning incentives, policymakers can encourage the simultaneous deployment of renewables and energy storage, thus maximising the efficiency and reliability of the grid while facilitating the transition to a sustainable energy system.

7. Enhance regulatory coherence for Critical Raw Materials used in flow battery technology

Certain materials crucial for flow batteries, such as vanadium, are designated as CRMs due to their high importance to the EU economy and associated supply risks. The absence of a harmonised legislative approach to CRMs may result in multiple and disparate regulatory frameworks, creating barriers that hinder material supply, EU industry competitiveness, and investment access.

It is therefore necessary to eliminate unnecessary complexity in existing EU legislation, ensuring consistency and compatibility with the concept of "critical raw materials". This paves the way to align policy developments on chemicals, products, and industry, which is essential to prevent conflicting requirements, confusion, and uncertainty, particularly for materials vital to the low carbon economy and future technologies. Future legislation concerning CRMs must further ensure the inclusion of a socio-economic analysis of potential impacts on CRM producers and supply chains, serving as a foundational step in the regulatory process.

8. Incentivise the development of LDES systems that contain zero critical raw materials and are PFAS-free

In light of new legislation targeting Critical Raw Materials (CRMs) and hazardous substances (i.e., the CRM Act and the PFAS restriction proposal, respectively), the development and

increased deployment of sustainable LDES solutions must become a priority. Decision-makers can incentivise innovation and investment in alternative technologies that mitigate environmental risks and safeguard public health, ultimately accelerating the transition towards a more sustainable energy landscape. Currently, leading storage technologies frequently rely on CRMs or PFAS substances, such as lithium-ion batteries, while non-toxic and CRM-free systems like organic flow batteries are often not yet market-ready. Additional incentives for their development and deployment boost the EU's independence from third countries regarding materials selection on the one hand, and on the other, bring us closer to becoming the first climate-neutral continent.

9. Foster skills development along the flow battery value chain

The energetic and green transition with ambitious decarbonisation goals is causing rapid growth in the EU battery sector. 3 to 4 million jobs are expected to be created directly and indirectly by 2025 through the battery industry. However, skills shortage already poses a problem as about 800,000 workers will need to be reskilled by the next year.

Due to flow batteries' unique design, engineers and technicians require a specific skill-set related to the flow battery production (e.g., electrochemistry, material science, cell and module design, assembly, recycling) and its industrialisation (comprising industrial design and application, planning and logistics, maintenance). Tailored courses at academic, professional and vocational levels are strongly needed to scale up the flow battery deployment in Europe. Skills development efforts should be based on a coherent exchange between industry and academia in order to adapt trainings and courses appropriately.

10. Boost information dissemination about flow batteries and their market readiness

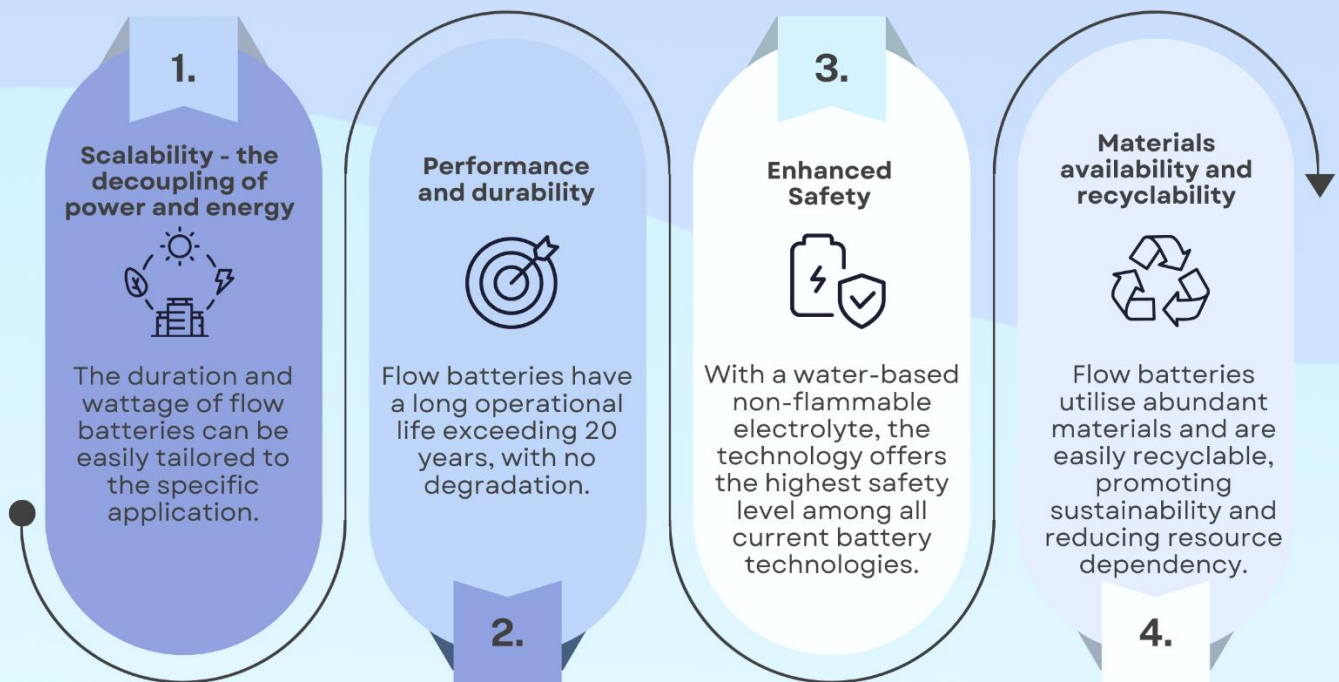
Flow batteries are one of the most promising storage technologies as RES are going to be the greatest share in Europe's energy mix. By effectively communicating the advantages, capabilities, and readiness of flow batteries, a swift adoption and implementation across various sectors can be catalysed.

Demonstration projects showcasing the technology would be the most effective means of dissemination. The flow battery sector thus requires comprehensive and accessible information regarding flow batteries and their current readiness for market integration. This entails the development of targeted educational campaigns aimed at diverse stakeholders, including consumers, businesses, policymakers, and investors. By proactively promoting awareness and understanding of flow battery technology, we can accelerate its market penetration and contribute to the transition towards sustainable energy solutions.

Executive Summary

The EU faces significant hurdles in achieving its decarbonisation targets outlined in the European Green Deal. Reliable energy storage, particularly LDES, is crucial for maintaining a stable energy supply and enhancing grid stability in the light of the increasing share of renewables. Flow batteries emerge as a crucial solution due to its sustainability, long operational life, and capability to store energy for both short and long durations. By addressing obstacles related to energy security, grid stability, energy affordability, and supply chain diversification, flow batteries offer numerous benefits in facilitating the EU's transition to a sustainable energy system while ensuring coherence with its decarbonisation targets.

Advantages of Flow Batteries



About Flow Batteries Europe

Flow Batteries Europe (FBE) represents flow battery stakeholders with a united voice to develop a long-term strategy for the energy storage sector. Our mission is clear: to accelerate decarbonisation in Europe and globally, fostering the widespread adoption of energy storage and flexibility solutions powered by flow batteries. At FBE, we bring together leading industry experts to advance research, commercialisation and deployment of flow batteries. Together, we're paving the way towards a greener, more resilient energy landscape.

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