FLOW BATTERIES EUROPE

A united voice for flow batteries

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## Business Cases

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### I. Making the sun shine at night - using flow batteries

The wind doesn't always blow and the sun doesn't always shine. Long duration energy storage (LDES) technologies, such as flow batteries, are needed to securely and reliably incorporate wind and solar energy into the power grids of the future.

#### Best buffer for renewables: flow batteries

**Managing the variability of renewable energy sources** such as wind and solar photovoltaic (PV) power is a major challenge. One key solution lies in energy storage systems that can hold electricity for extended periods of time, typically 6 to 10 hours or more. These systems are crucial to bridge the gaps in energy supply when there is little wind or sunlight. Flow batteries are a promising solution for this challenge. Compared to other energy storage systems, flow batteries are **safe, reliable, long-lasting and potentially more affordable**. Flow batteries are therefore a strong candidate for enabling deeper renewable energy integration.

#### Size: from S to XXL – everything is possible

Flow batteries are a type of energy storage technology that can be scaled to a wide range of sizes, from small systems suitable for individual homes to much larger systems that are appropriate for industrial or commercial applications. This scalability is one of the key advantages of flow batteries over other types of energy storage systems.

**The ability to scale flow batteries makes them a versatile energy storage option** that can be customized to meet the specific needs of different applications. A homeowner might install a small flow battery system in their home to store excess solar power generated during the day for use at night or during times of high demand. Meanwhile, a business might install a much larger flow battery system to provide backup power during outages, manage peak energy demand, or help reduce energy costs.

#### A sample calculation:

- Installation of PV system for 20 years = 365*20 = 7,300 days
- 7,300 cycles are needed for overnight electricity stored during the day
- Cycle life comparison
  - Li-Ion batteries: 3000-4000 cycles
  - Flow batteries: > 10,000 cycles

**Flow batteries have a longer lifespan than comparable storage solutions**, including lithium-ion batteries. This means they can be used for longer periods of time before needing to be replaced, reducing their overall environmental impact. Flow batteries are also more energy efficient than other LDES solutions, resulting in less waste and lower greenhouse gas emissions over the lifetime of the battery. Moreover, flow batteries use liquid electrolytes to store energy and their active storage materials are easily recyclable. This allows for circular production and

reduces the need for new materials, which can be energy-intensive and environmentally damaging to extract and process.

These factors make flow batteries a more sustainable LDES technology compared to other alternatives, which explains why they are increasingly considered a key technology to enable the energy transition.

## II. Sustainable energy infrastructure – a path for the future

Countries and cities are investing trillions of dollars in infrastructure projects. These account for more than half of total carbon emissions globally. Various stages in the infrastructure lifecycle are to blame: emissions arise from the manufacturing of construction materials, the energy needed to transport materials and workers to building sites, as well as the operation of the asset itself. Addressing the energy needs of infrastructure projects is therefore vital to transition away from fossil fuels.

### Why flow batteries?

**Flow batteries are an attractive solution for medium and large-scale applications due to their scalability**. They can connect solar and wind power plants securely and at low costs, allowing for maximum use and quality of renewable electricity in infrastructure applications. For infrastructure like tunnels, critical infrastructure and highly efficient buildings, safety and circularity are often the most important selection criteria.

Sustainable and resilient infrastructure must integrate environmental, social and governance aspects into planning, building and operating. Electrification can help; however, it needs to be significantly ramped up to enable decarbonisation. This requires going beyond the construction of renewable generation capacity to meet the increased demand for renewable electricity. Modernised infrastructure is needed, including **expanded electricity grids and demand-side flexibility sources, such as energy storage systems**.

Flow batteries meet the requirements needed to supply medium and large-scale infrastructure power needs because they:

- Are highly scalable;
- Are environmentally conscious and suitable for circularity;
- Ensure a stable supply of high-quality power;
- Are cost-effective over their lifetime;
- Are safe and efficient;
- Have a long lifetime of over 20 years.

In summary, flow batteries are versatile, durable, sustainable and cost-effective, making them well-suited for a range of infrastructure projects.

## III. Flow batteries as the solution to high-cycle applications

Flow batteries have the advantage of being able **to discharge and recharge for extended periods without losing capacity or degrading performance**, making them an ideal solution for energy storage applications that require frequent cycling.

### The German case

Germany offers an interesting case study of flow batteries for high-cycle applications due to a unique legal context. For example, German regulations that require grid operators to maintain a precise level of system stability have created a unique legal context that incentivises the deployment of LDES solutions.

In Germany, interconnection fees – charges applied to the transfer of electricity between different grid systems – are discounted for companies with a constant high demand for power. These companies qualify for the discount when their annual energy demand divided by peak power is greater than 7 000 hours. If the result is above 6 000 hours but below 7 000, an energy management system combined with an energy storage system can help customers qualify for the discount. The discount on interconnection fees stands at approximately 80% and varies depending on local fees, leading to short payback periods. Flow batteries are suited to such applications, particularly given the load profile. A flow battery can provide a long storage capability (6-10 hours), a **high overload capability and a high life cycle to secure a steady demand.**

### High-cycle applications

Many industries use batch processes when manufacturing their products, meaning that a set quantity is produced at a time. This is particularly the case with high energy-demanding industries such as chemical, food and beverage industry, petroleum refining and metal manufacturing. If a batch is energy-intensive or is conducted multiple times a day, it can lead to high peak loads on the grid. A high peak load can strain electrical grid infrastructure, potentially leading to blackouts or brownouts.

Energy storage systems can smooth out energy demand and reduce costs. When combined with renewable generation, power or heat generation, battery systems can further increase the usage of self-generated power. Flow batteries in particular are suitable for industries that use batch processes with high energy demand. This is because flow batteries offer high-power discharge capabilities and long-duration energy storage. Flow batteries also have short payback periods depending on the load profile. By using flow batteries, the industry can reduce the amount of energy it needs to drawback up power for sensitive industries from the grid during peak periods, leading to significant cost savings.

Flow batteries' applications are extensive, they are particularly prevalent for grid-scale energy storage and for the storage of renewable energy. They are important to the stability of expanding electricity networks, notably through frequency regulation. Additionally, they can reduce grid extension measures and backup power for sensitive industries such as telecommunications or provide energy storage for EVs.

## IV. Conclusion

Flow batteries are safe, reliable, long-lasting and potentially more affordable than comparable LDES systems. Flow batteries can easily be scaled to a wide range of sizes, have a long lifespan and can easily be recycled. Moreover, their ability to charge and discharge over extended periods

without experiencing degradation makes them ideally suited for high-cycle applications. As the world transitions away from fossil fuels, flow batteries promise a solution to the challenges posed by renewable energy.

## FOR FURTHER INFORMATION

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## ABOUT FLOW BATTERIES EUROPE

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.

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