Comparing the Supply Chain Dynamics of Grid Flexibility Technologies in the EU's Renewable Energy Transition

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- Key players like Siemens, General Electric, and Hitachi have worked to build a strong regional supply chain for GETs with strategic manufacturing facilities in Germany, France, and Sweden.
- The HVDC technology supply chain in Europe has been robust historically, anchored by major global OEMs based in the region.

The European Union is transitioning towards a more sustainable energy ecosystem by integrating renewable energy into the power grid. As renewable energy sources like wind and solar are intermittent in nature, there is a need for innovative solutions for grid stability and flexibility. Multiple technologies that offer grid flexibility include Battery Energy Storage Systems (BESS), Grid Enhancing Technologies (GETs), High Voltage Direct Current (HVDC) systems, and Distributed Energy Resources Management Systems (DERMS). The article discusses the supply chain status of these four grid flexibility technologies and highlights key developments and efforts undertaken in the EU countries towards a greener future.

Battery Energy Storage Systems (BESS)

BESS has emerged as a crucial grid flexibility technology as it can store excess energy during high supply periods and release the energy when either demand rises, or there is a shortage of renewable energy production.

The demand for efficient energy storage solutions has surged in Europe. The EU has taken significant steps to stabilize its BESS supply chain in response to the growing demand for clean energy technologies. Multiple funding initiatives like the European Raw Materials Alliance, Horizon Europe's funding program, and increased investments from the European Investment Bank have contributed to providing a sustainable supply of electricity when deploying renewable sources. Moreover, OEMs had raised prices for energy storage solutions in 2022, which reflects heightened market demand. Consequently, as an alternative, second-life batteries have also gained traction, including utilizing end-of-life EV batteries, propelled by Enel's 2019 project in Spain.

The EU has opened nine gigawatt-scale battery manufacturing plants, strengthening the regional supply chain of BESS. Recent developments, such as the Critical Raw Materials Act and the proposed European Sovereignty Fund, increased the roles of public banks and emphasized the importance of securing raw materials. For instance, the upcoming 5MW/10MWh second-life battery project of Enel X in Rome and authorizing over 40 gigawatt-scale battery manufacturing facilities place the EU at the forefront of battery innovation and supply. As these projects are in the pipeline, the market is expected to grow at a higher rate in the short term, and the prices will decrease as the supply chain becomes more secure in the energy storage sector.

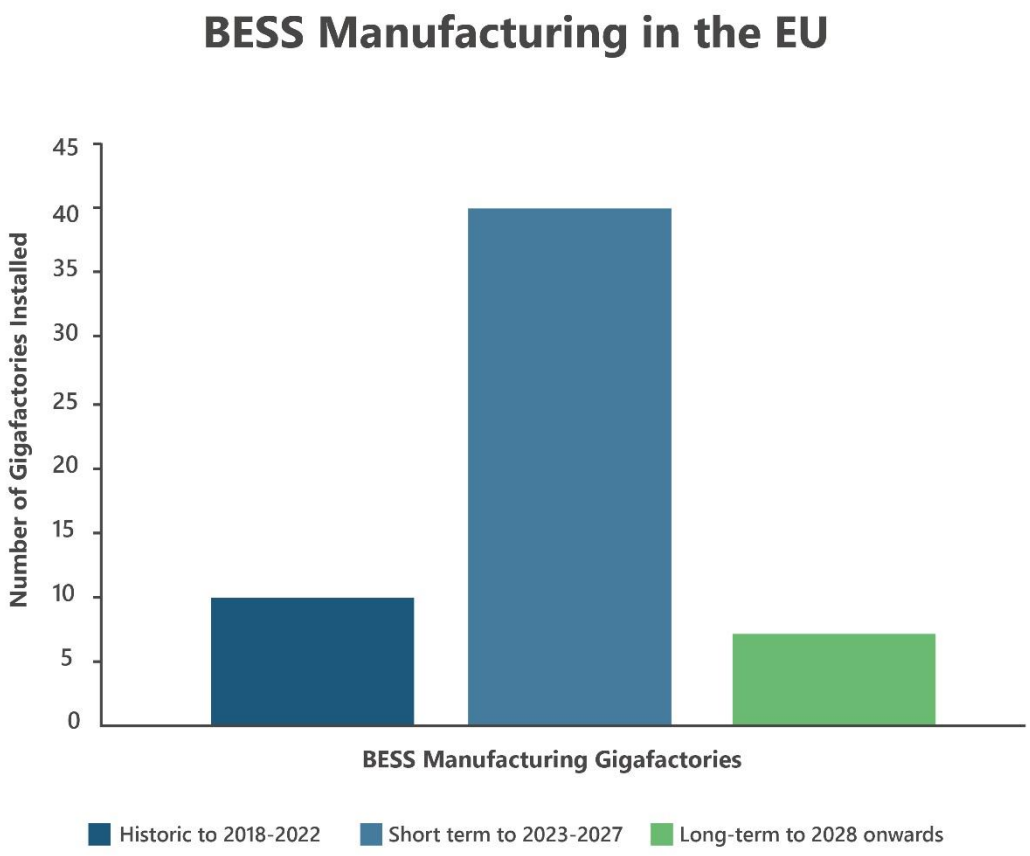

Figure 1: Overview of BESS Gigafactory Installations in the EU.

Source: PTR Inc.

Grid Enhancing Technologies (GETs)

Another solution for grid flexibility that emerged is grid-enhancing technologies (GETs). Integration of GETs signifies a leap toward a more resilient energy infrastructure. This category covers a spectrum of advanced devices, ranging from static synchronous compensators (STATCOMs) to synchronous condensers.

STATCOM prices have dropped due to increased deployment, growing demand, and technology maturation. Key players like Siemens, General Electric, and Hitachi have worked to build a strong regional supply chain with strategic manufacturing facilities in Germany, France, and Sweden. Moreover, increasing short-term projects lead to a surge in adopting FACTS devices, enabling real-time monitoring and predictive maintenance. In the long term, the EU's substantial investment in the semiconductor industry is aimed to attain self-sufficiency, which can positively impact the adoption of GETs devices. Semi-conductors are important components in GETs devices that ensure long-term availability of GETs devices. Although there are limitations due to Chinese suppliers present in the market, the European semiconductor industry will grow, especially in Spain, Germany, France, and Italy, leading to securing the supply chain for GETs devices in the next decade.

High Voltage Direct Current (HVDC) System

HVDC has been one of the most prominent solutions for grid flexibility. As the EU strives for an integrated and interconnected power grid, HVDC systems facilitate the efficient and low-loss transmission of electricity over extended distances. The HVDC technology supply chain in Europe has been robust historically, anchored by major global OEMs based in the region. Recent expansions, such as Hitachi Energy's facility in Sweden and NKT's investments in Germany and Sweden, have further secured the HVDC supply chain. In the short term, Nexans has locked a frame agreement of USD 1.8 billion for HVDC projects, demonstrating market growth. In the long term, the HVDC cable supply chain will further strengthen as European and Asian manufacturers expand their production capacities in the region.

Distributed Energy Resource Management Systems (DERMS)

DERMS is an innovative technology aimed at ensuring grid flexibility. DERMS provides real-time control and optimization of diverse energy resources, improving the reliability and resilience of the grid. European suppliers like Siemens and Schneider Electric have historically been key players in the DERMS sector. However, the EU market faces less competition than the US due to a scarcity of startups. In the short term, the DERMS supply chain will strengthen with the European Chips Act, fostering a competitive market with the entry of innovative startups like Open System International (OSI). Moreover, the presence of key suppliers, coupled with potential startup entries, is expected to drive down DERMS technology costs in the future. The EU aims to fortify the DERMs supply chain as it aims to fulfill 20% of global chip demand by 2030.

Comparative Ranking

After an evaluation of supply chain robustness of various grid flexibility technologies, PTR indicates that HVDC has the most robust supply chain followed by BESS, GETs and DERMS, as shown in Figure 2.

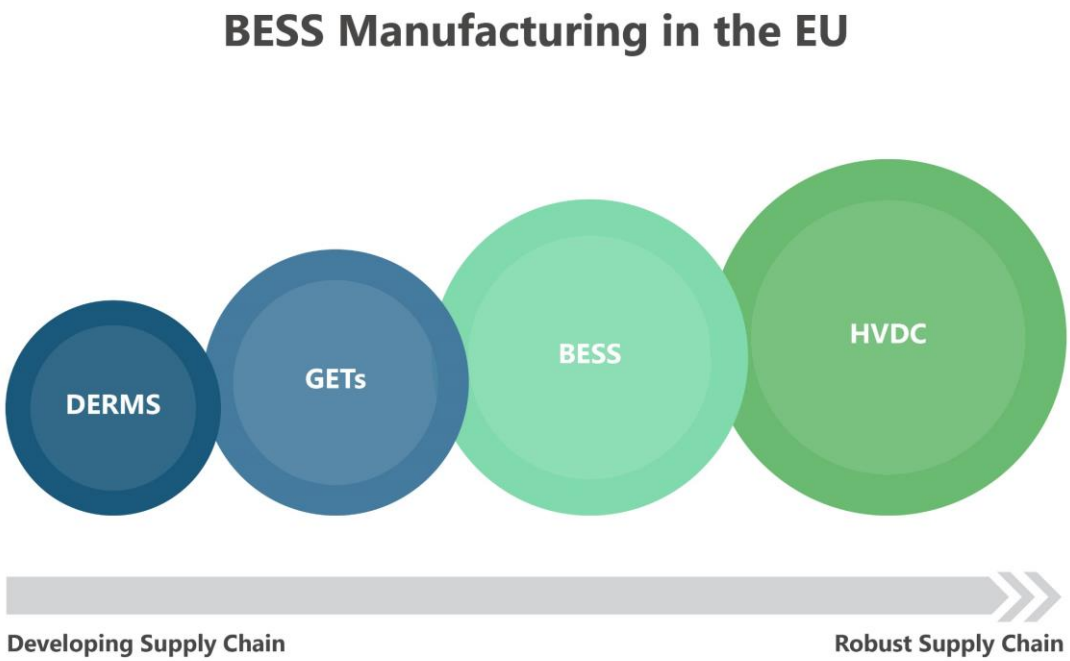

Figure 2: Overview of Supply Chain Robustness Among Various Grid Flexibility Technologies in the EU.

Source: PTR Inc.

Way Ahead

The supply chain dynamics for various grid flexibility technologies in the EU reveal a strategic shift evident from proactive measures and industry responsiveness. Investments in the supply chain of grid flexibility technologies aim to provide flexibility to integrate more renewable energy sources in the EU grid. As the region continues to invest, innovate, and integrate cutting-edge technologies into the grid, the supply chain emerges as a crucial enabler of the energy transition, shaping a sustainable and competitive future for the EU in the global energy landscape.

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