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Strategic Drivers for Battery Development: measures to mitigate critical raw material supply risks

Abstract

Demand for batteries continues to increase due to the expansion of electric mobility and energy storage systems, while battery manufacturing remains heavily concentrated in Asia, creating competitive and supply-chain challenges for European industries. The European Battery Alliance was launched to strengthen Europe's battery ecosystem and support the development of domestic production capabilities.

A central theme is the growing importance of critical raw materials (CRMs), such as lithium, cobalt, nickel and natural graphite. These materials account for a large share of battery costs and are often concentrated in a limited number of countries, creating geopolitical and economic vulnerabilities. Since the same raw materials are also required by many other clean energy technologies, supply security is becoming a key issue for the energy transition. There is a risk of a future "raw materials crisis" comparable in impact to the recent gas supply crisis.

To address these concerns, the European Union has introduced major regulatory initiatives. The Critical Raw Materials Act (CRMA) sets ambitious targets for domestic extraction, transformation, recycling and diversification of supply sources by 2030. In parallel, the new Battery Regulation adopts a life-cycle approach, establishing requirements for collection, recycling efficiency, lithium recovery, recycled content, safety, sustainability and traceability. New instruments such as the Battery Passport and digital product information systems are intended to improve transparency and support the circular economy.

Several strategies to mitigate CRM risks are discussed, including recycling, urban mining, diversification of supply chains, technological innovation, and battery reuse. Among emerging technologies, sodium-ion batteries are identified as the most promising post-lithium solution. They rely on more abundant resources, reduce dependence on critical materials and are approaching industrial-scale deployment, although important technical challenges remain.

Another opportunity is the second-life application for electric vehicle batteries. Once batteries no longer meet vehicle performance requirements, they can still be reused in stationary energy storage systems, extending their useful life by several years. This approach can reduce environmental impacts, lower material consumption and improve resource efficiency. However, challenges remain in assessing battery health, disassembly and economic viability.

It is important to develop a national (or European) value chain for sodium ion technology and for battery reuse and recycling, supporting both industrial competitiveness and the transition toward a more circular and sustainable energy system.