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The hunt for critical materials: Battery recycling to strengthen the supply security

Global demand for batteries is rising, driven by the shift to electric mobility and the energy transition. For example, demand for Li-ion batteries is expected to grow nearly seven times, reaching 4.7 TWh by 2030.[1]

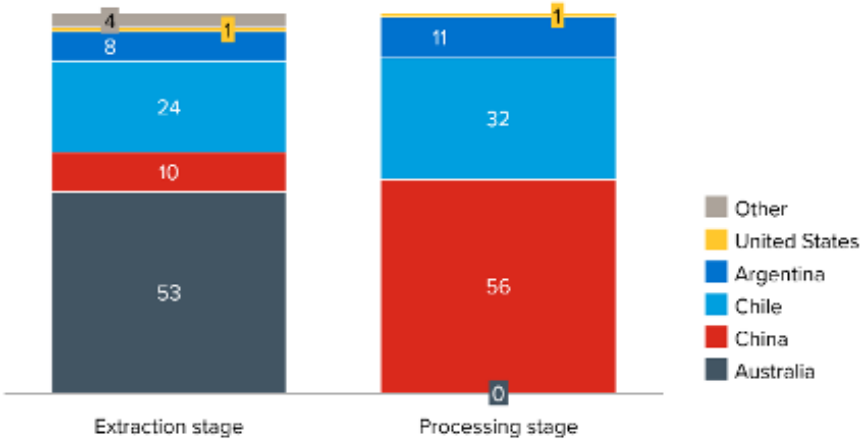
Battery manufacturers face challenges in securing enough raw materials for future production. Demand for these critical materials is expected to grow faster than ever before, with lithium alone projected to see a fivefold increase over the next decade.[2]

Since these resources are scarce in both Europe and North America, most critical raw materials are imported—mainly from Asia.[3],[4] For instance, the EU and the US each contribute less than 1% to global lithium extraction and processing, while China supplies more than 50 percent of the processed lithium globally.[5]

Expanding battery recycling in Europe and North America could reduce supply chain risks and ensure the long-term stability of local battery industries. According to the latest projections for 2040, recycled materials could supply 20-40% of the global demand for key raw materials used in batteries.[6]

Europe is aiming to accelerate battery recycling by establishing clear goals in the EU's Critical Raw Materials Act (CRMA) and Batteries Regulation (EUBR). By 2031, all new batteries intended for the EU market must have a minimum recycled content of 6 percent for lithium (Li) and nickel (Ni) and 16 percent for cobalt (Co). These requirements will rise to 12 percent, 15 percent, and 26 percent, respectively, after 2036.[7]

Global supply of lithium
Percent of supply 2023



Source: Study on the critical raw materials for the EU (2023)

1 https://www.mckinsey.com/industries/automotive-and-assembly/our-insights/battery-2030-resilient-sustainable-and-circular
2 https://www.mckinsey.com/industries/energy-and-materials/our-insights/global-materials-perspective
3 https://op.europa.eu/en/publication-detail/-/publication/57318397-fdd4-11ed-a05c-01aa75ed71a1
4 https://theconversation.com/our-research-reveals-the-scale-of-the-eus-dependency-on-imports-for-critical-minerals-needed-for-the-green-transition-heres-how-that-can-change-230244
5 https://data.europa.eu/doi/10.2873/725585
6 https://www.mckinsey.com/industries/metals-and-mining/our-insights/toward-security-in-sustainable-battery-raw-material-supply
7 https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32023R1542

Current recycling efforts and challenges for ramp-up

Still in its infancy, the worldwide battery recycling industry is projected to grow sevenfold over the next decade, reaching a market size of USD 24 billion by 2033.[8]

Many start-ups, as well as incumbents, are exploring novel recycling technologies, business models, and partnerships. For example:

- The BMW Group and Singapore-based recycling company SK Tes recently formed a partnership to ship high-voltage batteries from the automaker's Europe-based facilities to Singapore for recycling in order to create a circular recycling ecosystem for EoL batteries[9]
- Porsche-backed startup Cylib broke ground last year on a battery recycling plant in Germany that is expected to open in 2026, with a total recycling capacity of about 30,000 t/year[10]
- South Korea's Posco Future M Co. signed a contract with LG in 2023 to supply high-nickel cathode materials worth about USD 1.3 billion.[11]

New projects signal growing collaboration among key players. However, the total planned capacity of the current global pipeline of announced projects covers only about half of the projected demand for recycled materials in 2030[12].

On top of this, almost half of the announced capacity for Europe remains on hold or faces uncertainty about proceeding due to high energy costs and a lack of mature technical expertise or financial support.[13]

For example, in France, a collaboration between utility company Suez and mining and metallurgy player Eramet was expected to create 50,000 t/year of processing capacity in 2025. However, the partners put the venture on hold in 2024,[14] citing a "pending solid and sustainable economic model in Europe" as a reason for their decision.

In contrast, well-established South Korean and Chinese companies benefit from mature recycling processes and lower energy costs. They frequently import black mass (a mix of crushed metals from shredded battery scrap) from Europe. This puts European recyclers at a disadvantage, as they have to compete with established Asian companies for limited local black mass supply.[15]

Key success factors in realizing the full potential of battery recycling

Experts highlight three major success factors in developing a robust recycling value chain:[16]

- Securing local black mass supply for recycling plants: Ensuring a steady feedstock supply can help maximize plant utilization and lower unit costs for operators. Experts propose restricting black mass exports outside the EU and North America to support local recycling efforts.14,15
- Establishing partnerships to secure demand for recycled materials: Strategic partnerships can help recycling plants access downstream markets and strengthen stability across the value chain.
- Investing into technological performance: Advancing recycling technology while aligning with OEM battery design trends can improve material recovery, efficiency, and overall profitability.16

Presently, the profitability of recycling varies significantly on the global level. The total operational expenses of battery recycling in the EU are reported to be 60% higher than the costs in China. Specifically, European recyclers are incurring ~60% higher electricity and ~35% higher labor costs, while utility costs can be 5 times more expensive.13

As a result, Europe and North America face two key challenges: securing long-term local black mass supply and building up a functional battery ecosystem to achieve cost competitiveness vs. Asian competitors. A localized supply of black mass operating at scale would help to decrease the direct costs of battery recycling, while a unified battery ecosystem across the entire value chain (including battery OEMs) would enable the ramp-up of local recycling capacities towards a cost-competitive scale.

8 https://www.statista.com/topics/9962/li-ion-battery-recycling/#topicOverview
9 https://www.automotivedive.com/news/bmw-sk-tes-announce-closed-loop-battery-recycling-partnership/737333/
10 https://rennlist.com/articles/cylib-the-german-startup-backed-by-porsche-builds-new-battery-recycling-facility/
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