DECEMBER 2024

Electrifying road transport with less mining: A global and regional battery material outlook

To mitigate global warming and reduce harmful air pollution, the European Union has adopted legislation requiring a 100% reduction of tailpipe CO_2 emissions from new cars and vans by 2035 and a 90% reduction from new trucks and buses by 2040. These policies are expected to significantly increase the region's demand for battery electric vehicle (BEV) and plug-in hybrid vehicle (PHEV) batteries—and the materials used to produce them.

A new ICCT study projects future demand for batteries and battery materials considering policies and targets that have been adopted or announced in the European Union and globally. This demand is compared with announced battery cell production and mineral mining capacities to determine whether battery supply chains are prepared to meet demand. The study covers all segments of road transport, including light-duty, heavy-duty, and two- and three-wheeled vehicles, as well as non-vehicular demand.

In a second step, this analysis explores how policies to reduce the average battery size of passenger BEVs and decrease vehicle sales through transport demand avoidance and modal shifts could lower the demand for raw materials in the European Union while maintaining a rate of vehicle electrification that aligns with announced policies and targets.

Key results include the following:

Announced battery production capacities in the European Union could meet projected domestic demand, if a large share of announced projects can be realized. As displayed in Figure 1, total announced cell production capacities in the European Union could meet 99% of projected road transport and non-vehicular battery capacity demand in 2030 if all projects are realized, while the proportion of these facilities that are already operational or considered highly probable to reach planned output meet 72% of demand in 2030. This indicates that additional efforts are needed to ensure that a large share of the announced capacity will be realized and maintained on schedule. On a global level, total announced cell production capacity is nearly double the estimated 2030 demand, and the proportion of this capacity that is considered highly probable also significantly exceeds projected demand.

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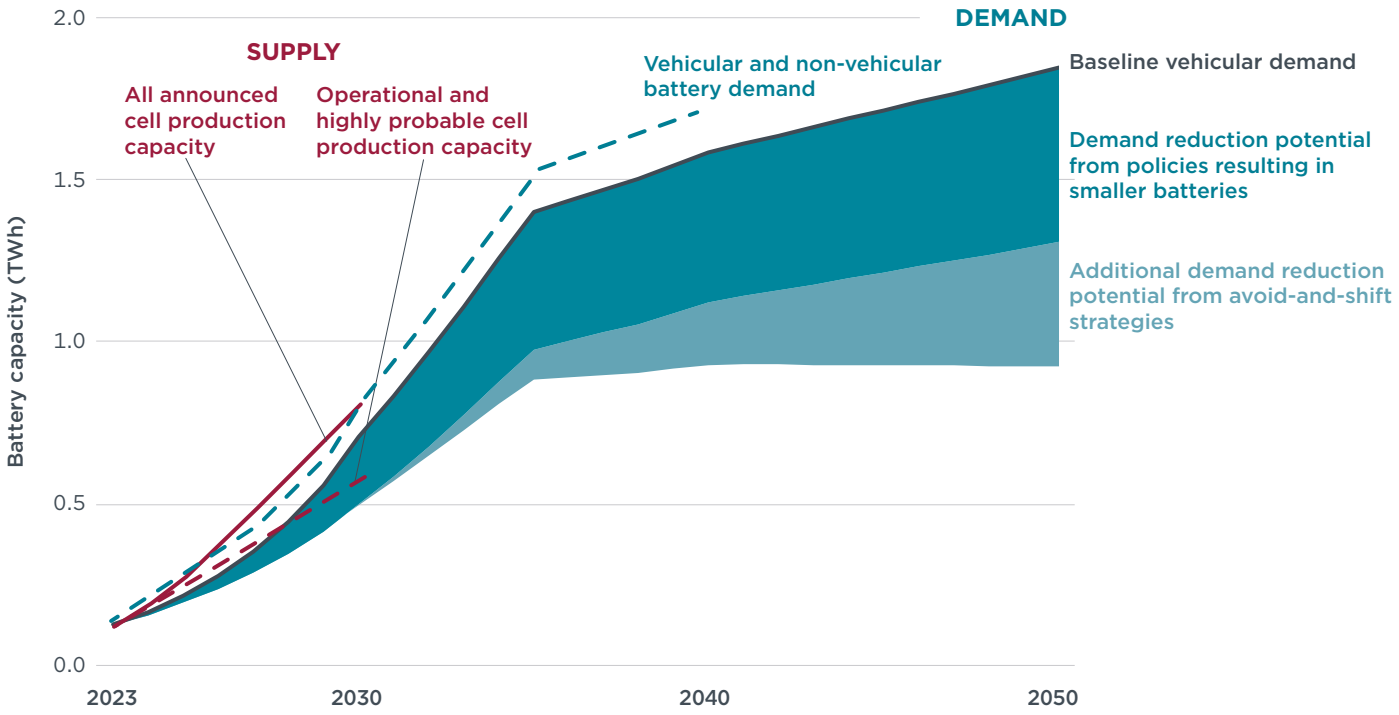
Figure 1

Battery demand in the European Union by policy scenario compared with announced cell production capacity



Notes: This demand projection excludes lead acid batteries. Cell supply data are sourced from Benchmark Mineral Intelligence.

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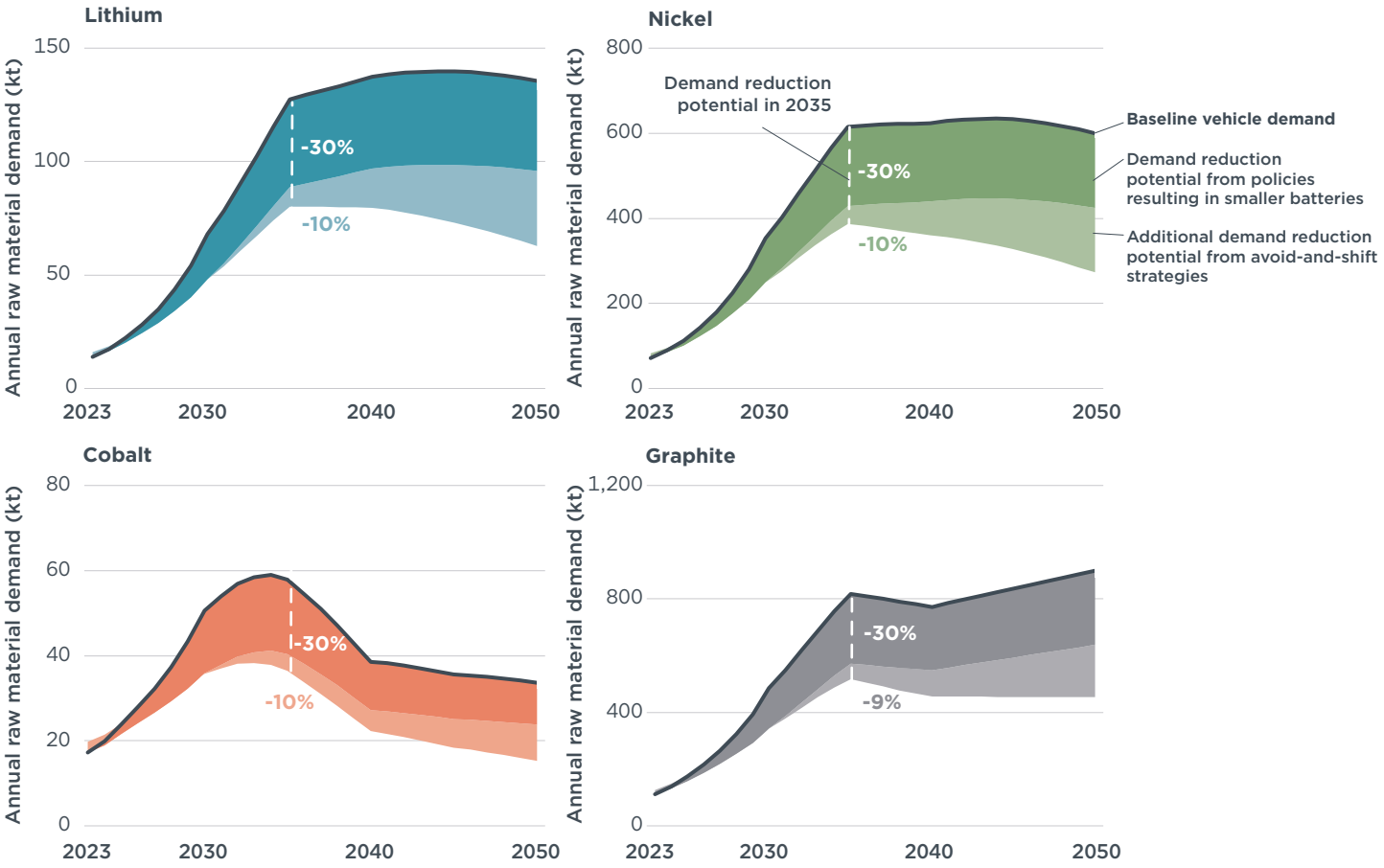
Material demand is impacted by the development of battery technology market shares. Figure 2 displays how projected battery demand in the Baseline technology mix scenario, which assumes a continuation of current market trends, translates into an increase in raw material demand for lithium, nickel, cobalt, and graphite in the European Union. Sensitivity scenarios (not displayed) show that a faster increase in the market share of LFP batteries reduces the demand for nickel and cobalt, while the large-scale application of sodium-ion batteries would reduce the demand for lithium, cobalt, and graphite.

Smaller average battery sizes, especially for light-duty BEVs, can significantly reduce battery and related mineral demand in the near term. Improvements in vehicle energy efficiency and the deployment of more charging facilities can lower the demand for BEVs with large batteries. Reversing the trend of increasing battery sizes of light-duty BEVs could reduce the annual battery demand in the European Union by 30% in 2035 and 29% in 2050. Demand for lithium, nickel, cobalt, manganese, and graphite would decrease by the same amounts in both years.

Reduced vehicle sales as a result of less vehicle-dependent transportation systems can reduce battery and raw material demand, with impacts growing significantly after 2040. A change in vehicle sales due to avoided transport demand and modal shift policies could reduce battery demand from road transport by an additional 9% in 2035 and 29% in 2050. Mineral demand would be reduced by an additional 9%–10% in 2035 and 29%–36% in 2050, depending on the mineral.

Figure 2

Annual raw material demand for lithium, nickel, cobalt, and graphite in the European Union under the Baseline and demand reduction scenarios, all with Baseline battery technology shares



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In the near term, the scaling-up of battery mineral supply on a global level is projected to keep pace with growing demand. For the Baseline scenario, the analysis finds that mining capacities anticipated for 2030 would meet 101% of the annual global demand for lithium, 97% of the demand for nickel, and 85% of the demand for cobalt, including the projected demand for these minerals in non-vehicle applications. When considering a scenario with higher market shares of LFP batteries, the capacities would meet a slightly higher 102% of lithium demand, along with 108% of nickel demand and 103% of cobalt demand. These scenarios highlight that the market can continue to react to high prices of individual materials by optimizing market shares of battery technologies.

In the long term, global mineral reserves are sufficient to meet battery demand. Even for the Baseline scenario in which battery demand through 2050 is met only with lithium-ion battery technologies already commercialized in 2024, cumulative material demand would correspond to less than half of land-based lithium, cobalt, and nickel reserves.

Despite a general reliance on global material supply chains, the European Union's domestic reserves can partially meet the demand for certain minerals. Aside from considerable nickel reserves in the French overseas territory of New Caledonia and lithium reserves in Portugal, the European Union has few domestic resources of battery minerals that are listed as reserves by the U.S. Geological Survey. In addition

to the deposits listed as reserves, Germany, Czech Republic, Spain, Finland, and Austria have significant lithium resources. In close proximity to the European Union, Norway has natural graphite reserves and Serbia has lithium resources.

POLICY RECOMMENDATIONS

The findings of this analysis highlight that the European Union's battery manufacturing and global mineral supply chains are not limiting the implementation of the adopted light-duty and heavy-duty vehicle CO_2 emission standards. Rather, announced domestic cell production and global mineral supply chains are keeping pace with projected demand. Nonetheless, EU policymakers could consider implementing measures to ensure that a high share of announced cell production projects will be realized and to secure a reliable supply of raw materials. In parallel, policy measures can help to reduce the aggregate demand for raw materials and thereby reduce the environmental impacts and social risks associated with raw material mining and refining.

Reliable transport electrification policies, incentives for domestic supply chain activities, and trade agreements with resource-producing countries can help to build resilient supply chains. Maintaining the timeline and stringency of the light-duty and heavy-duty CO_2 performance standards would send a clear signal to the private sector to invest in and build up mineral supply chains. Beyond that, the European Union could prioritize domestic battery production and supply chain capacities within the announced Clean Industrial Deal. Expanding public funding for suitable projects from sources such as the European Union's announced Battery Fund and similar initiatives in Germany, France, and Italy can help attract private investment. A rapid implementation of the accelerated permitting processes prescribed under the Critical Raw Materials Act and the Net-Zero Industry Act can support the scale up of domestic manufacturing.

Policies reducing the average battery sizes of light-duty BEVs, implementing avoid-and-shift strategies, and ensuring efficient battery recycling can help to reduce the demand for new mining. Measures such as BEV energy efficiency standards can incentivize a shift to vehicles with smaller batteries. In addition to reducing the demand for raw material mining, these policies also translate into consumer benefits of more affordable BEVs with lower operational costs. Transport demand avoidance and modal shift strategies include planning higher density urban areas, developing cities centered around well-connected public transport, and building out safe walking and biking infrastructure. Lastly, maintaining a robust regional battery recycling ecosystem, including by supporting the implementation of the EU Battery Regulation's recycling mandates and efforts to meet the domestic recycling capacity targets set out in the Critical Raw Materials Act, can further reduce raw material mining.

PUBLICATION DETAILS

Title: Electrifying road transport with less mining: A global and regional battery material outlook

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Download: theicct.org/publication/EV-battery-materials-demand-supply-dec24

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