DECEMBER 2024

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

Federal emissions regulations, consumer incentives, and supply chain investments are marshalling billions of dollars for the U.S. clean energy and transportation industries. Such initiatives aim to support economic growth and resilience, reduce dependence on foreign supply chains, create jobs, and involve workers and communities in the transition to zero emissions. These policies and targets are expected to result in a large increase in the 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 the demand for battery cells and raw materials for BEVs and PHEVs resulting from adopted and announced policies and targets in the United States and globally. The analysis compares projected demand with announced battery production and mineral supply capacities. It evaluates all segments of road transport, including sales in the light-duty, heavy-duty, and two- and three-wheeler vehicle segments, as well as non-vehicular demand.

In a second step, the study evaluates how the implementation of a comprehensive battery recycling program, a reduction in the average battery size of passenger BEVs, and a reduction in vehicle sales through demand avoidance and modal shift strategies could reduce raw material demand while maintaining a rate of electrification aligned with announced policies and targets.

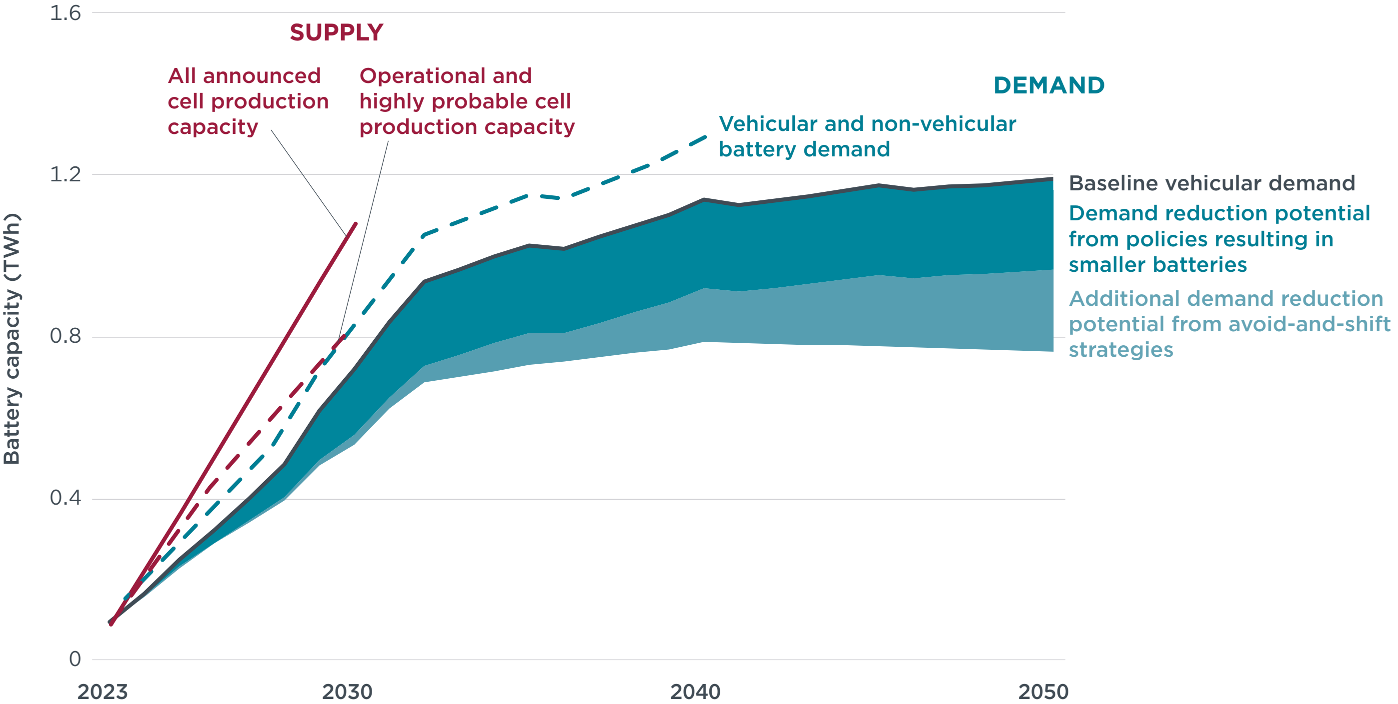
Key results include the following:

The capacities of announced battery production plants in the United States exceed the projected domestic demand from all sectors. As shown in Figure 1, the total capacity of announced cell production facilities in the United States exceeds projected demand from all sectors by 30% in 2030. The proportion of announced capacity coming from plants that are already operational or considered highly probable to meet planned output exceeds total demand by 3%. On a global level, total announced cell production capacity is nearly double the projected demand in 2030, with operational and highly probable capacity also exceeding demand.

icct
THE INTERNATIONAL COUNCIL ON CLEAN TRANSPORTATION

Figure 1

U.S. battery demand 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.

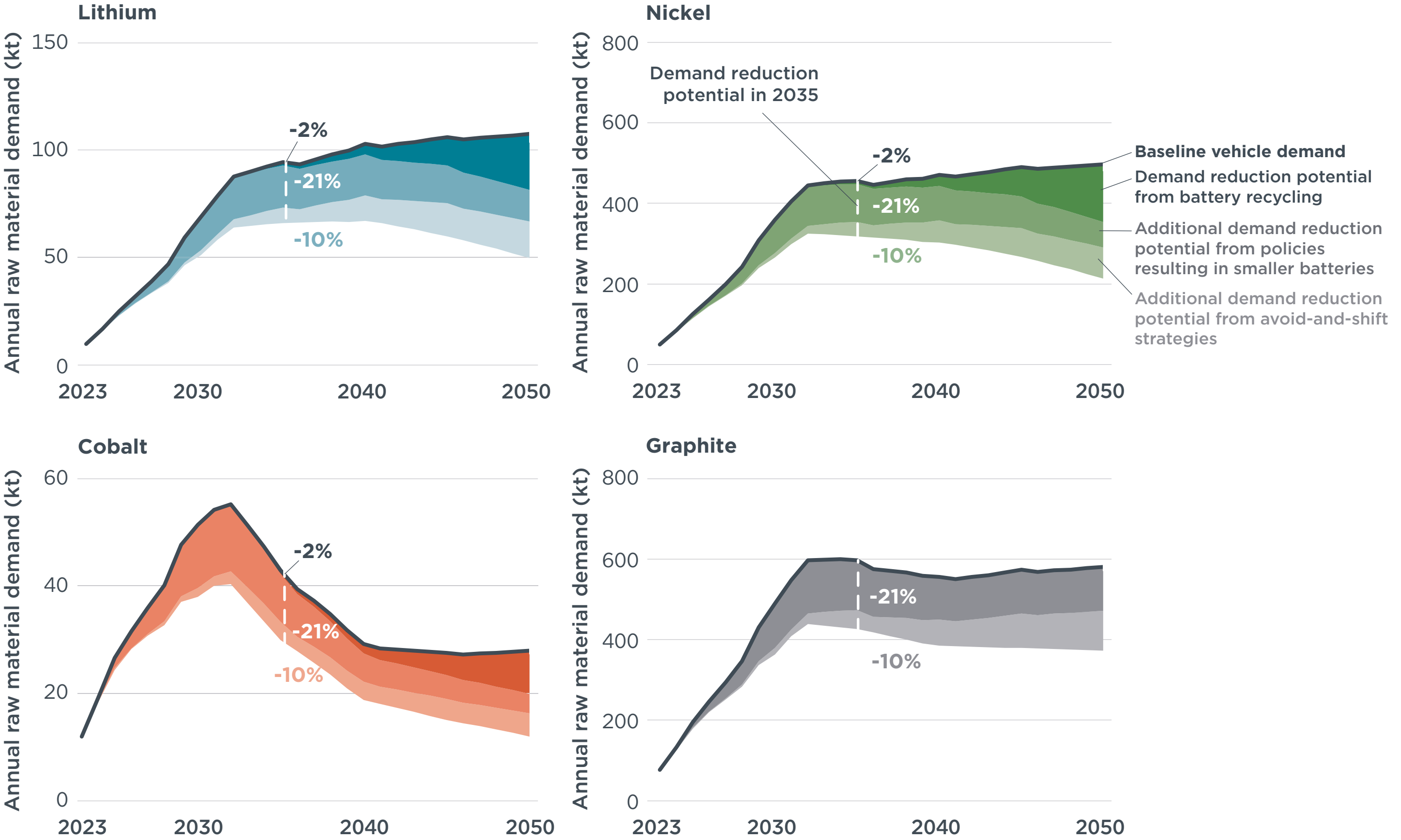
THE INTERNATIONAL COUNCIL ON CLEAN TRANSPORTATION **THEICCT.ORG**

Material demand is impacted by the development of battery technology market shares. Figure 2 displays how the projected battery demand in the United States under a baseline battery technology mix scenario corresponds to an increase in demand for lithium, nickel, cobalt, and graphite. 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 for passenger BEVs can significantly reduce the growth in battery cell and mineral demand in the near term. Improving energy efficiency and reducing the average battery sizes of light-duty BEVs could lower the annual battery demand in the United States by 21% in 2035 and 19% in 2050. Demand for lithium, nickel, cobalt, manganese, and graphite would decrease by the same amounts in both years.

Battery recycling and reduced vehicle sales as a result of a less vehicle-dependent transportation system in the United States can reduce battery and raw material demand, with impacts growing significantly after 2040. The development of a battery recycling ecosystem in the United States with high material recovery rates would help create a domestic source of secondary mineral supply. This supply could make up 24%–29% of projected lithium, nickel, and cobalt demand for BEVs and PHEVs in 2050, depending on the mineral. A change in vehicle sales due to the implementation of transport demand management and modal shift policies could reduce battery demand in the United States by an additional 10% in 2035 and 21% in 2050, with similar reductions in mineral demand.

Figure 2
Annual raw material demand for lithium, nickel, cobalt, and graphite in the United States under the Baseline and demand reduction scenarios, all with Baseline battery technology shares



THE INTERNATIONAL COUNCIL ON CLEAN TRANSPORTATION **THEICCT.ORG**

The scaling-up of battery mineral supply on a global level is projected to keep pace with growing demand in 2030. 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. Battery recycling, a reduction of vehicle battery sizes, and avoid-and-shift strategies could further limit the extraction of mineral reserves.

U.S. reserves can meet the domestic demand for lithium and manganese, while imports from partner countries are needed for other battery minerals. The United States is home to ample manganese and lithium reserves. If exploited, the lithium reserves in the United States would provide enough supply to meet the cumulative domestic demand for lithium from road transport electrification through between 2030 and 2040, while the manganese reserves would be sufficient to meet demand beyond 2050. The United States also has some nickel reserves, but these would not be sufficient to meet the cumulative domestic nickel demand through 2030.

POLICY RECOMMENDATIONS

The results of this study underscore that domestic battery manufacturing and global mineral supply chains are not limiting the transition to electric vehicles in the United States. Rather, announced domestic cell production and global mineral supply capacities are keeping pace with, and partly exceed, projected demand.

Clear long-term emissions regulations, support for domestic supply chain activities, and strategic partnerships with mineral-producing countries can help to build domestic battery production and reliable supply chains. Light-, medium-, and heavy-duty emissions standards send clear signals to the private sector to invest in and build up mineral supply chains. Public support for supply chain projects, such as the domestic battery production-linked incentives in the Inflation Reduction Act, can help attract private investment and maintain the growth of clean jobs in the battery supply chain. For minerals not covered by domestic reserves, policymakers can strengthen strategic partnerships with mineral producing regions to help meet domestic demand.

Implementing policies to reduce the average battery size of light-duty BEVs can curb the demand for raw material mining in the near term, while battery recycling and avoid-and-shift strategies can realize reductions in the long term. Promoting a shift to more energy efficient vehicles can lower the average battery size of passenger BEVs and provide consumer benefits by lowering BEV purchase prices and operational costs. Policy frameworks to support the complete collection and efficient recycling of electric vehicle batteries, can spur the development of a domestic battery recycling industry and secondary mineral supply. Transport demand avoidance and modal shift strategies include transport demand management, planning higher density urban growth around well-connected public transport, and developing safe walking and biking infrastructure.

PUBLICATION DETAILS

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

Authors: Eyal Li, Georg Bieker, Arijit Sen

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

Contact: Georg Bieker, g.bieker@theicct.org