DECEMBER 2024

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

To reduce harmful air pollution and greenhouse gas emissions from road transport, the Government of India has set targets for increased adoption of battery electric vehicles (BEVs). As a signatory of the Glasgow Zero Emission Vehicles Declaration, India committed to work towards achieving a 100% share of BEV sales for light-duty vehicles by 2040, with an intermediate target of a 30% sales share by 2030. The government has also announced an 80% BEV sales target for two- and three-wheelers by 2030. In parallel, several state-level policies aim to increase the BEV share in the light-duty and heavy-duty vehicle segments by 2030. These targets entail a rapid increase in demand for BEV batteries—and the materials used to produce them.

A new ICCT study projects the demand for battery cells and raw materials for BEVs and plug-in hybrid electric vehicles (PHEVs) resulting from adopted and announced policies and targets in India and globally. The projected demand is compared with announced cell production and mineral supply capacities. The study evaluates all segments of road transport, including two- and three-wheelers, passenger cars, and heavy-duty vehicles.

In a second step, this analysis explores how the development of an efficient battery recycling ecosystem, a reduction in the average battery size of passenger BEVs, and a reduction in vehicle sales through transport demand avoidance and modal shift strategies could reduce the demand for raw materials in India while maintaining a rate of vehicle electrification aligned with the announced policies and targets.

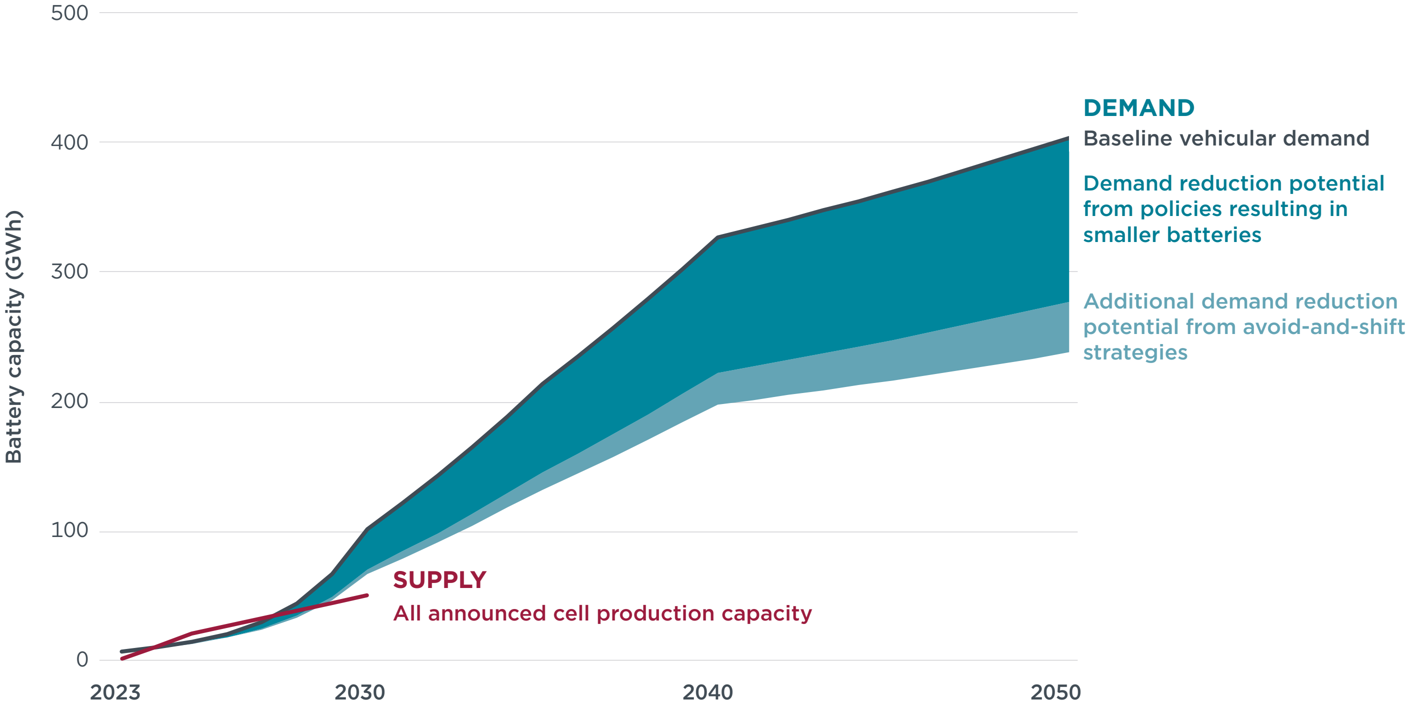
Key results include the following:

Announced battery cell production capacities in India are growing, but do not yet meet projected demand in 2030, considering transport electrification targets. As displayed in Figure 1, in 2030, announced battery cell production capacities in India (as of July 2024) would make up 49% of the domestic demand resulting from India's BEV sales share targets. On a global level, in contrast, total announced cell production capacity is nearly double the 2030 demand. These findings indicate that more investments would be needed to fully meet India's future battery demand from domestic production, while the remaining battery demand can be met from international battery production capacities.

icct
THE INTERNATIONAL COUNCIL ON CLEAN TRANSPORTATION

Figure 1

Battery demand in India 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**

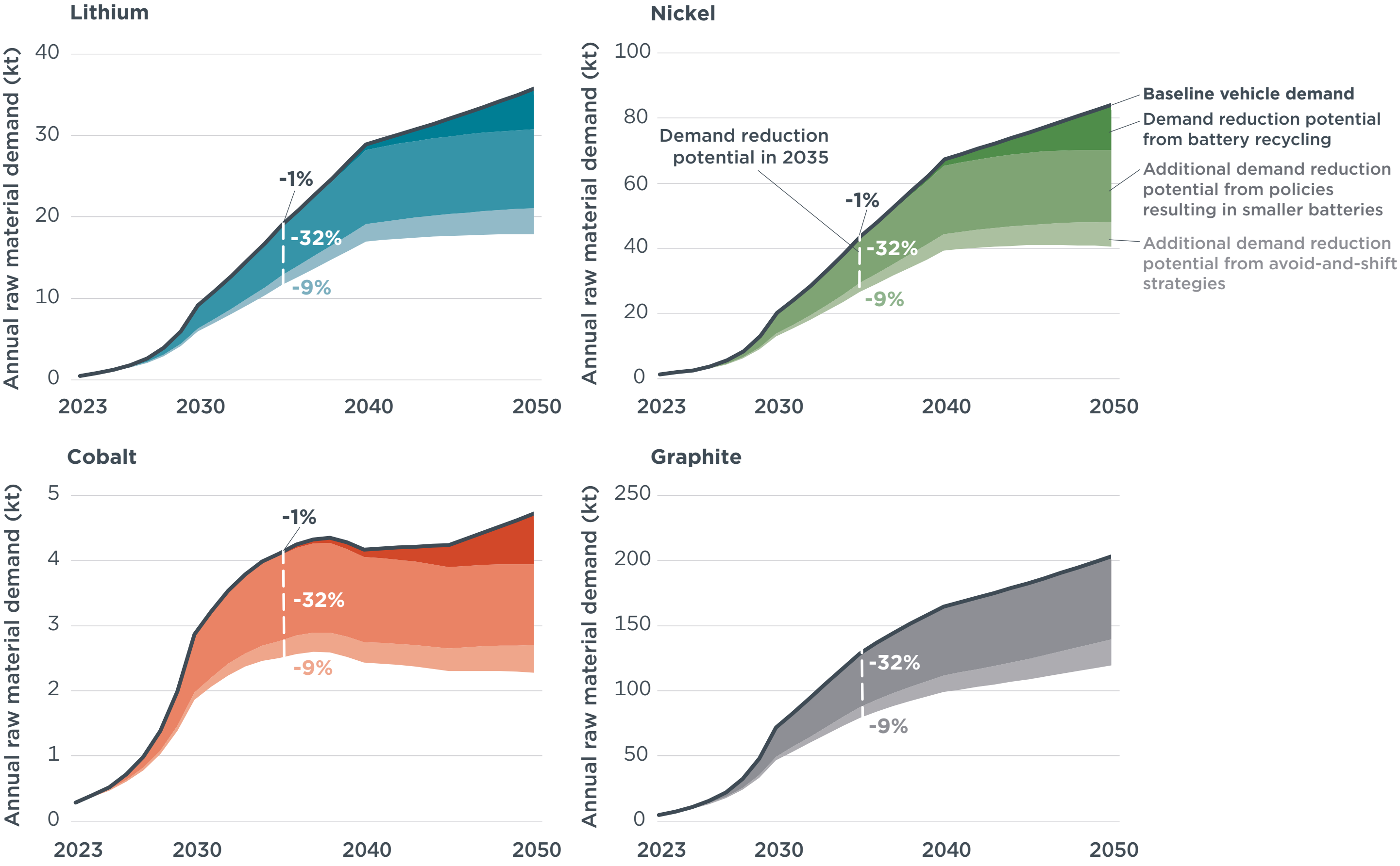
Material demand is impacted by the development of battery technology market shares. Figure 2 presents how projected battery demand in India under a Baseline battery technology mix scenario translates to an increase in raw material demand for lithium, nickel, cobalt, and graphite. Sensitivity scenarios (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, especially for passenger car BEVs, can significantly reduce battery and 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 global trend of increasing battery sizes of passenger car BEVs could reduce the annual battery demand in India by 32% in 2035 and 31% 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 can reduce battery and raw material demand, with impacts growing significantly after 2040. Establishing a battery recycling ecosystem in India with systematic end-of-life vehicle collection and element-specific recovery rates would create a domestic source of secondary mineral supply. This supply would grow with the number of retired vehicles to make up 14% of lithium demand and 17% of nickel and cobalt demand for BEVs in 2050. A change in vehicle sales due to transport demand avoidance and modal shift policies could reduce battery demand from road transport by an additional 9% in 2035 and 14% in 2050, with similar reductions in mineral demand.

Figure 2

Annual raw material demand for lithium, nickel, cobalt, and graphite in India under the Baseline and demand reduction scenarios



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

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 in 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 reliance on global material supply chains, India's domestic reserves can meet demand for certain minerals. The exploitation of India's vast reserves of manganese and natural graphite could allow it to meet the cumulative demand for these minerals for vehicle electrification beyond 2050. Recently discovered lithium deposits in Jammu and Kashmir also are promising but have not yet been classified as reserves pending a determination of the extent to which they are economically recoverable.

POLICY RECOMMENDATIONS

The findings of this analysis highlight that global battery manufacturing and mineral supply chains are not limiting the implementation of vehicle electrification policies and targets in India. Further, growing announced cell production capacity in India and vast reserves of some of the key minerals used in electric vehicle batteries can enable the fulfillment of an increasing share of demand with domestic supply.

Reliable transport electrification policies, incentives for domestic supply chain activities, and trade agreements with resource-producing countries can help expand battery production capacities and secure mineral supply chains. Implementing regulations and incentives that set India's vehicle fleets on a pathway to achieving their vehicle electrification targets, such as the PM E-DRIVE scheme, would send a signal to the private sector to invest in mineral supply chains. Bolstering public funding for projects in the raw material and battery supply chains can also help attract private investment. Accelerated permitting for suitable raw material mining and refining projects can support the scale up of domestic mineral production. Lastly, to secure a supply of materials not covered by domestic reserves, India can establish strategic partnerships with other mineral-producing countries.

Policies reducing the average battery sizes of passenger car 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. Measures such as BEV energy efficiency standards can promote 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. Expanding existing battery recycling policies to support the systematic collection of end-of-life vehicles and setting mandatory mineral recovery rates can spur the development of a domestic battery recycling industry and the growth of a domestic secondary mineral supply. Transport avoidance and modal shift strategies include expanding public transport services and building out safe walking and cycling 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

www.theicct.org

communications@theicct.org

@theicct

icct
THE INTERNATIONAL COUNCIL ON CLEAN TRANSPORTATION