Electrifying Global Road Transport with Less Mining

Policy Insights for the EU and U.S.

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THE INTERNATIONAL COUNCIL ON CLEAN TRANSPORTATION

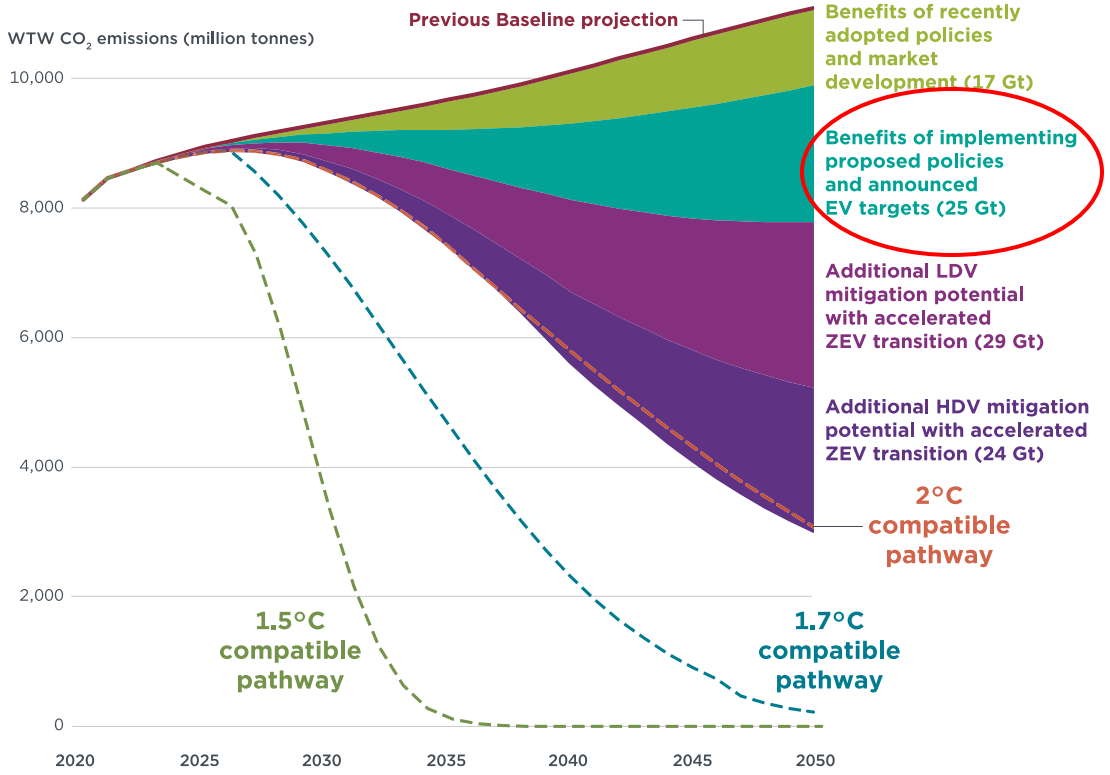
Outline

- Introduction
- Battery demand and production capacities
- Material demand and supply
- Summary and policy implications

Link to the paper:
www.theicct.org/publication/EV-battery-materials-demand-supply-dec24

Objective

- Project demand for global battery cell production capacity and mineral supply required to implement adopted vehicle electrification policies and targets and those under consideration
- Compare demand with anticipated cell production capacity and mineral supply



(Sen and Miller, 2023)

Study Design

- Global demand and supply analysis and analysis for focus regions: **China, the European Union, India, Indonesia, the United States**
- Covers all on-road transport segments: light-duty, heavy-duty, and two- and three-wheeler vehicles, as well as non-vehicle applications
- Scenarios for future market shares of battery technologies:
  - Continuation of current trends, considering technologies on the market in 2024
  - Two alternate scenarios: **Higher LFP share and sodium-ion batteries**

- **Evaluates how three policy interventions would reduce battery demand:**
  - **Battery recycling**
  - **Smaller batteries**
  - **Transport demand reduction and modal shift strategies**

Key takeaways

1) On a global level, **announced domestic cell production and global mineral supply capacities are keeping pace with, and partly exceed, projected demand** from road transport electrification policies.

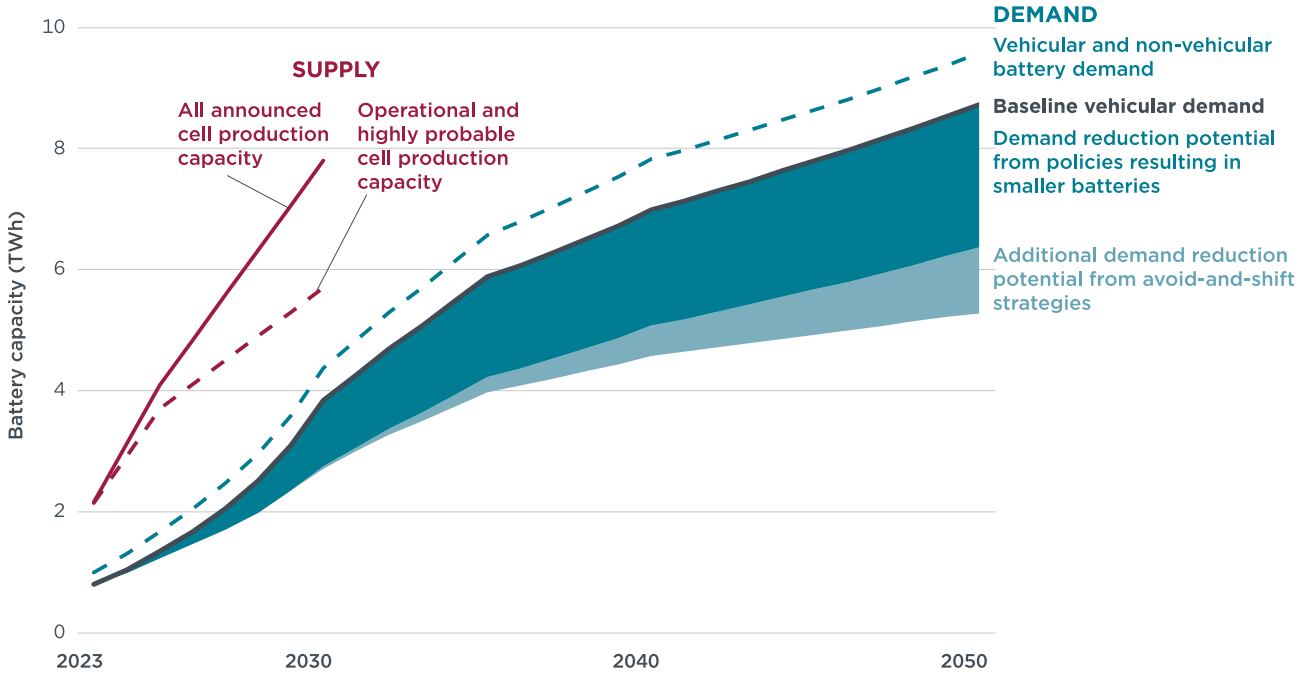
2) Even though there likely will be enough mineral supply, that doesn't mean we need to do all that additional mining. **Right-sizing of EV batteries, battery recycling, and reducing vehicle demand through avoid and shift transportation policies can reduce the demand for new mining**, and thereby lower the environmental impacts of EVs.

Battery demand and production capacities

Global battery cell demand and anticipated production capacity

- All announced cell production capacities globally are nearly twice as high as projected demand from all sectors in 2030.

Global projection of battery demand from all sectors compared with announced cell production capacity

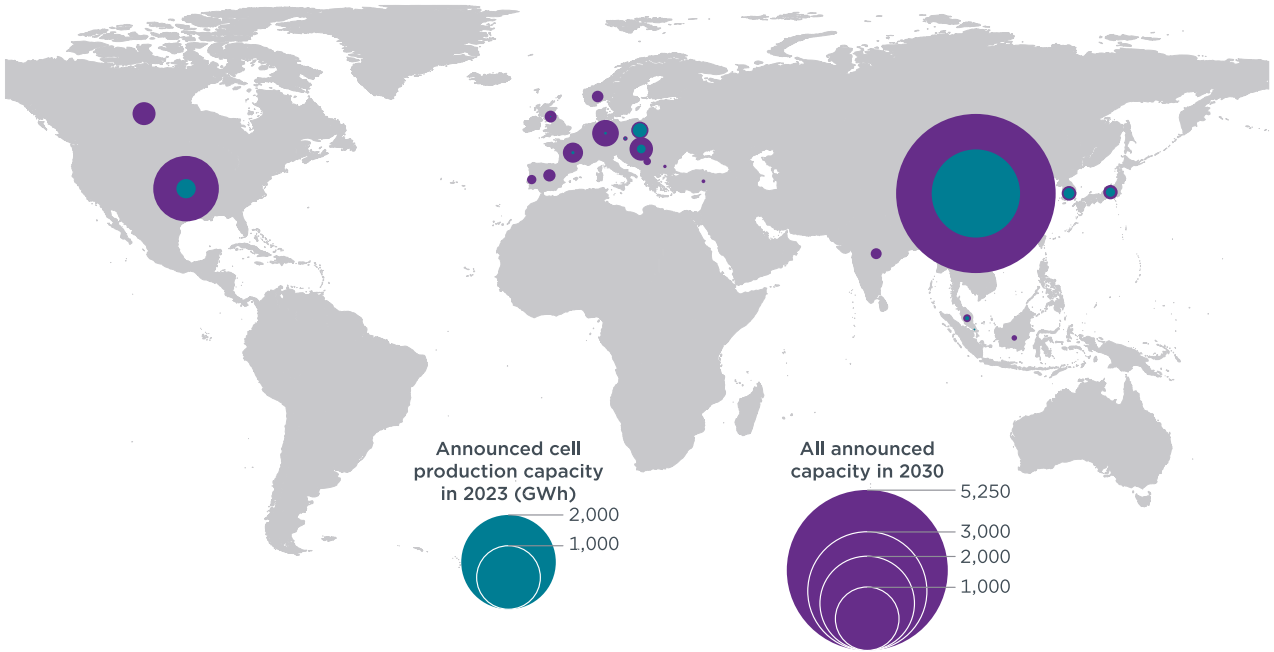


Announced cell production capacities from Benchmark Mineral Intelligence

Location of announced cell production capacity

- A large share of the battery production capacities today and those expected in 2030 are located in China.
- Capacities in the US and the EU are expected to grow by 2030.

Announced cell production capacity in 2023 and 2030 by country

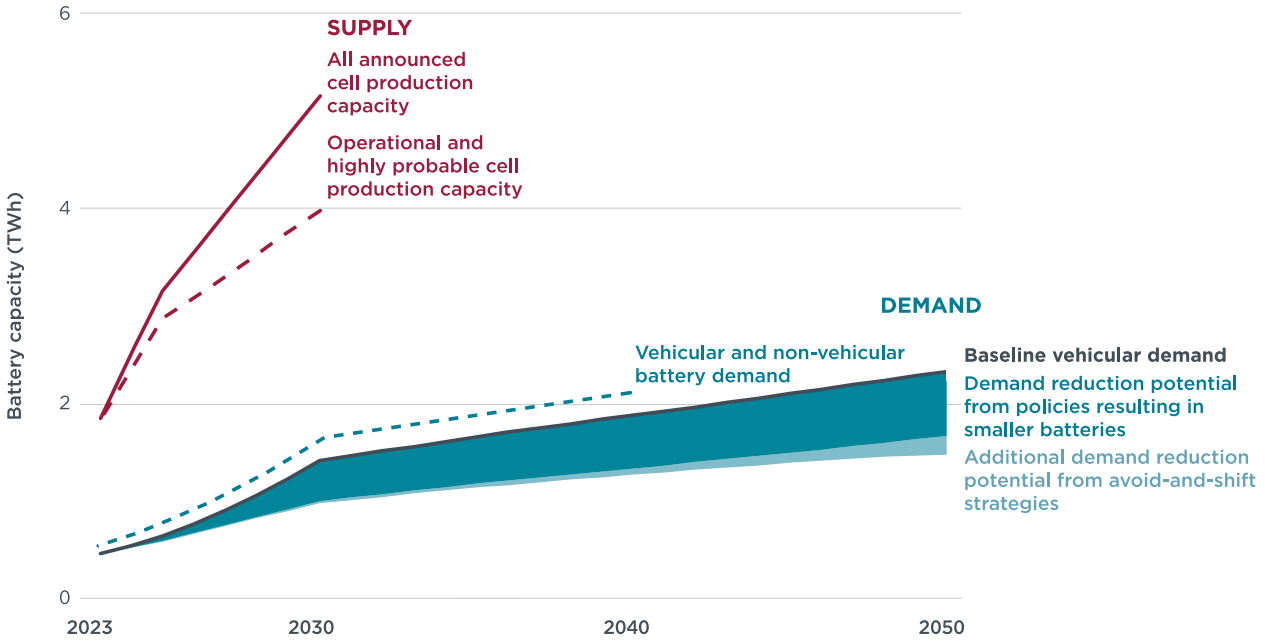


Announced cell production capacities from Benchmark Mineral Intelligence

Battery cell demand and anticipated production capacity in China

- All announced cell production capacities in China in 2030 are **3 times higher** than domestic demand.
- Operational and highly probable capacities are more than twice demand in 2030.

Projection of battery demand from all sectors compared with announced cell production capacity in China

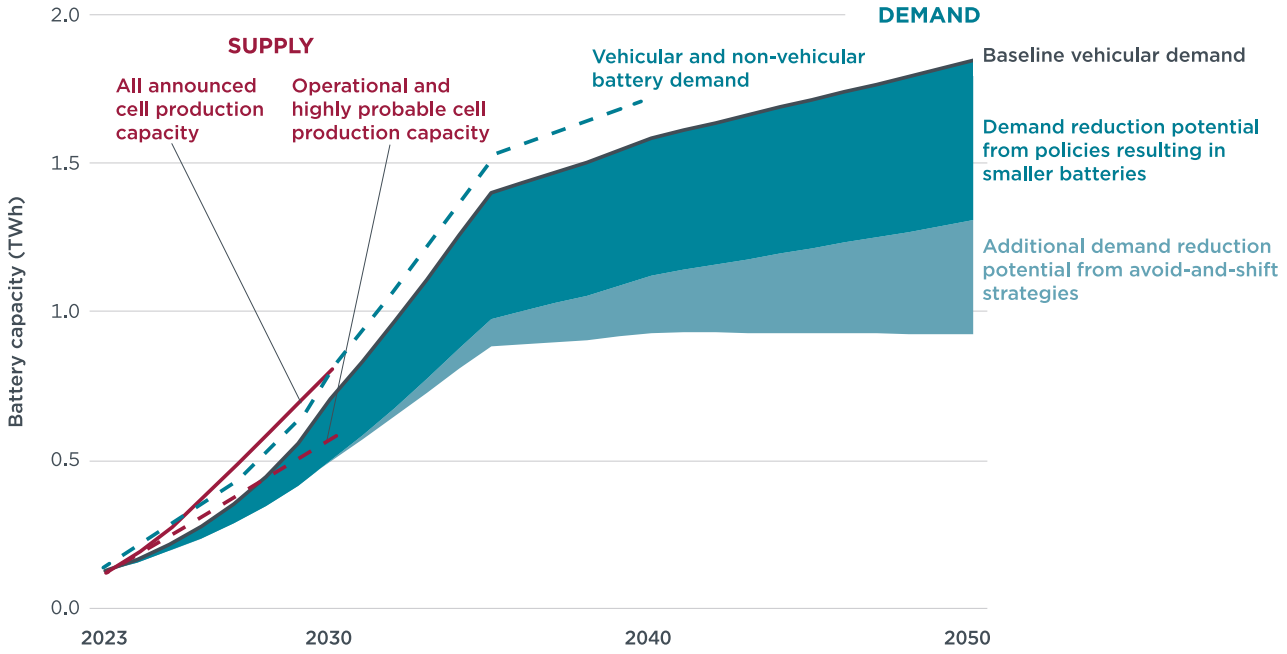


Announced cell production capacities from Benchmark Mineral Intelligence

Battery cell demand and anticipated production capacity in the EU

- All announced cell production capacities in the EU correspond to **99% of domestic demand** from all sectors in 2030.
- Operational and highly probable capacities correspond to **72% of demand**.

Projection of battery demand from all sectors compared with announced cell production capacity in the European Union

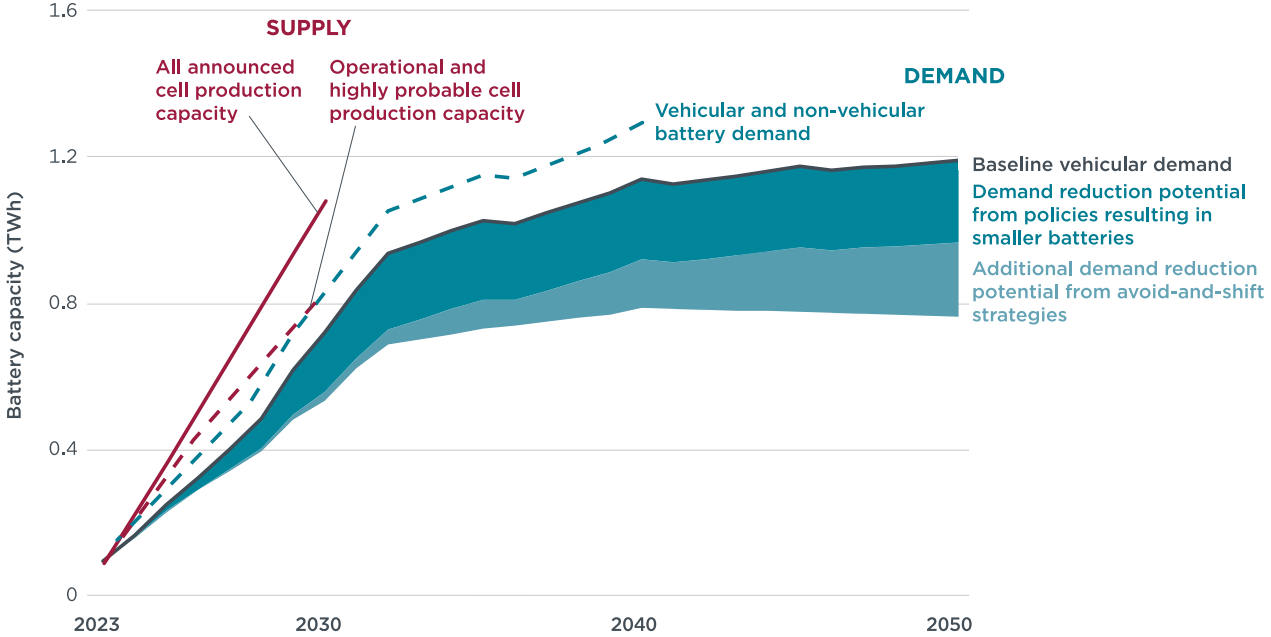


Announced cell production capacities from Benchmark Mineral Intelligence

Battery cell demand and anticipated production capacity in the US

- All announced cell production capacities in the US correspond to **130% of domestic demand** from all sectors by 2030.
- Operational and highly probable capacities correspond to **103% of demand**.

Projection of battery demand from all sectors compared with announced cell production capacity in the United States

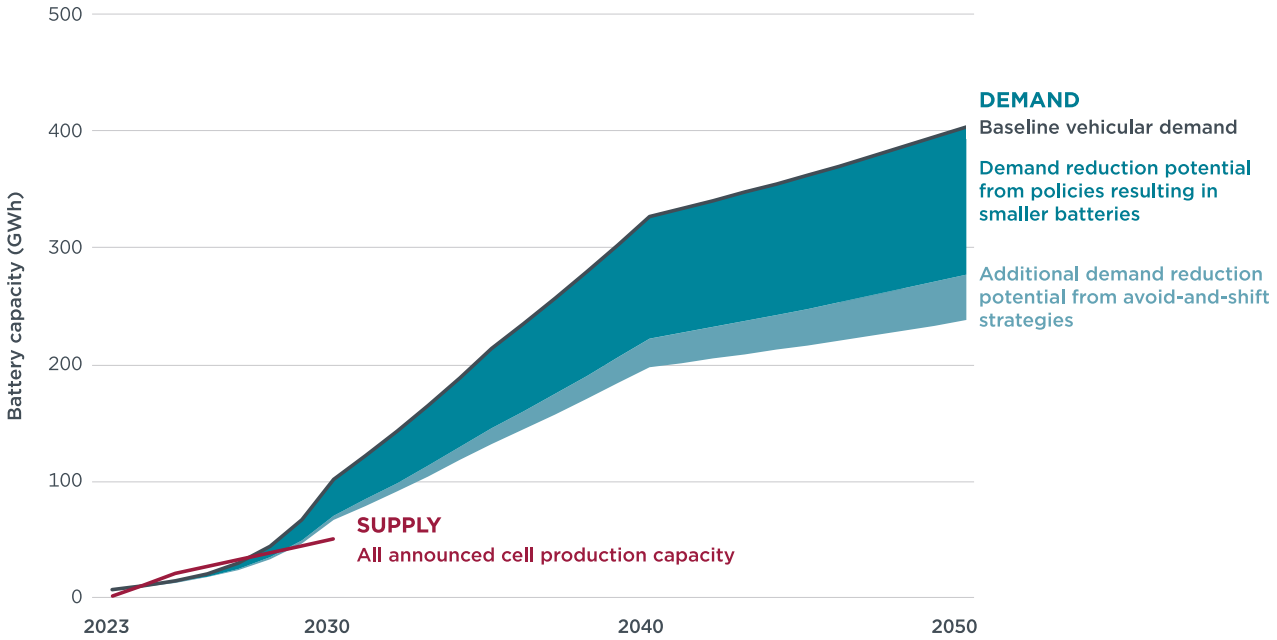


Announced cell production capacities from Benchmark Mineral Intelligence

Battery cell demand and anticipated production capacity in India

- All announced cell production capacities in India correspond to **49% of domestic vehicular battery demand** in 2030.

Projection of battery demand from all sectors compared with announced cell production capacity in India

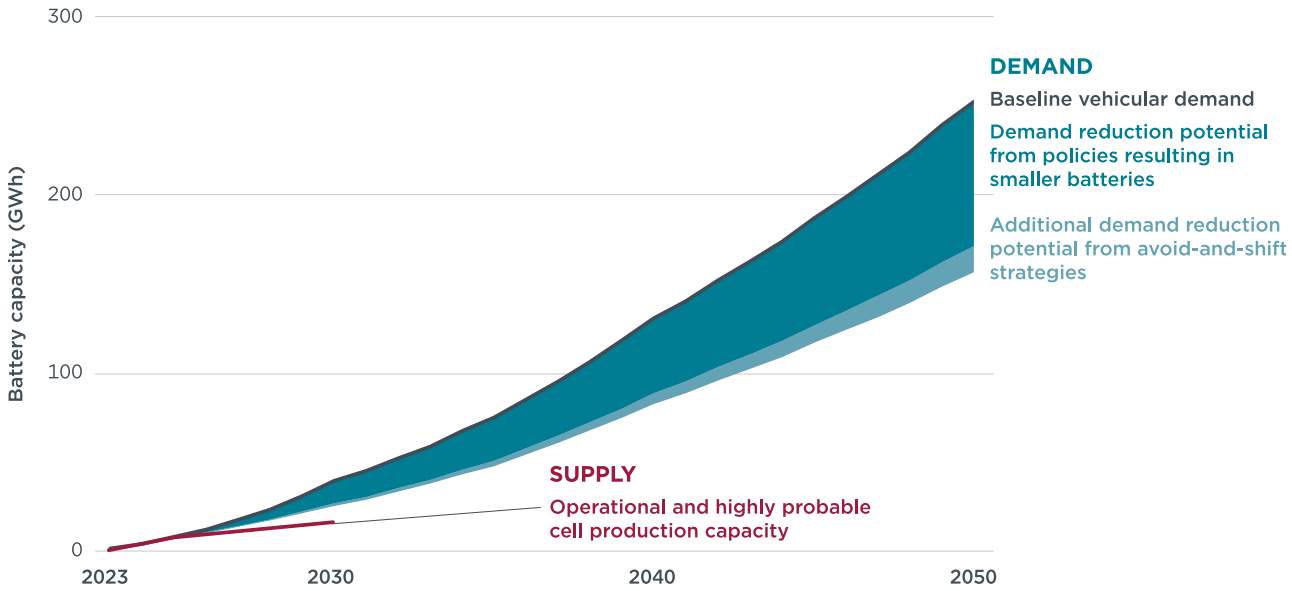


Announced cell production capacities from Benchmark Mineral Intelligence

Battery cell demand and anticipated production capacity in Indonesia

- All announced cell production capacities in Indonesia are **44% of domestic vehicular battery** demand in 2030.

Projection of battery demand from all sectors compared with announced cell production capacity in Indonesia

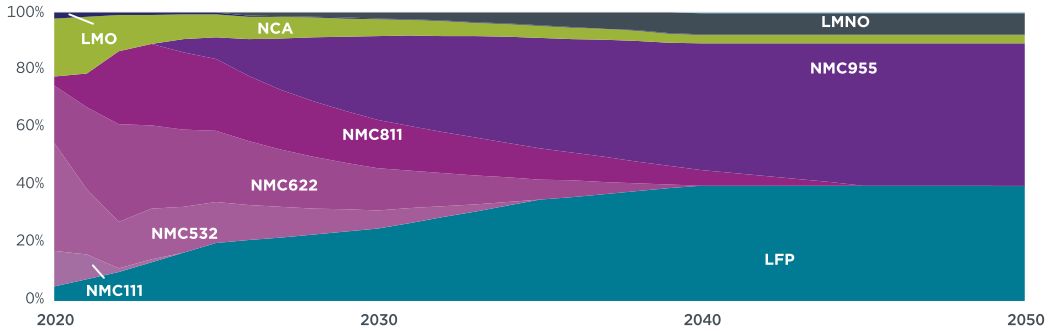


Announced cell production capacities from Benchmark Mineral Intelligence

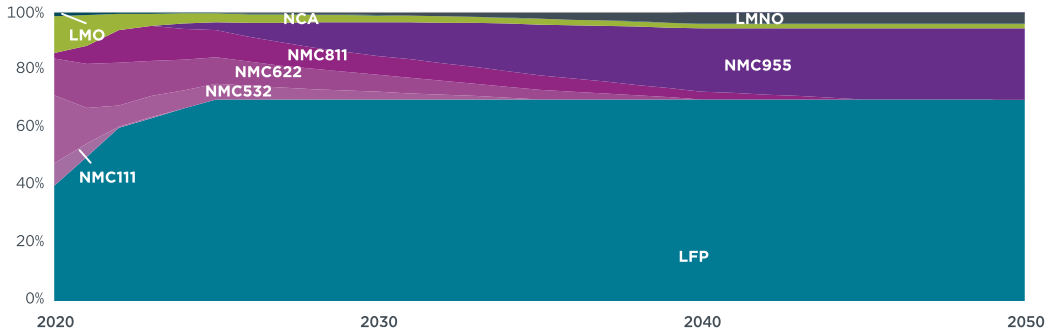
Material demand and supply

Study Design – Battery Technology Mix

NMC-leaning countries, e.g., EU and U.S.



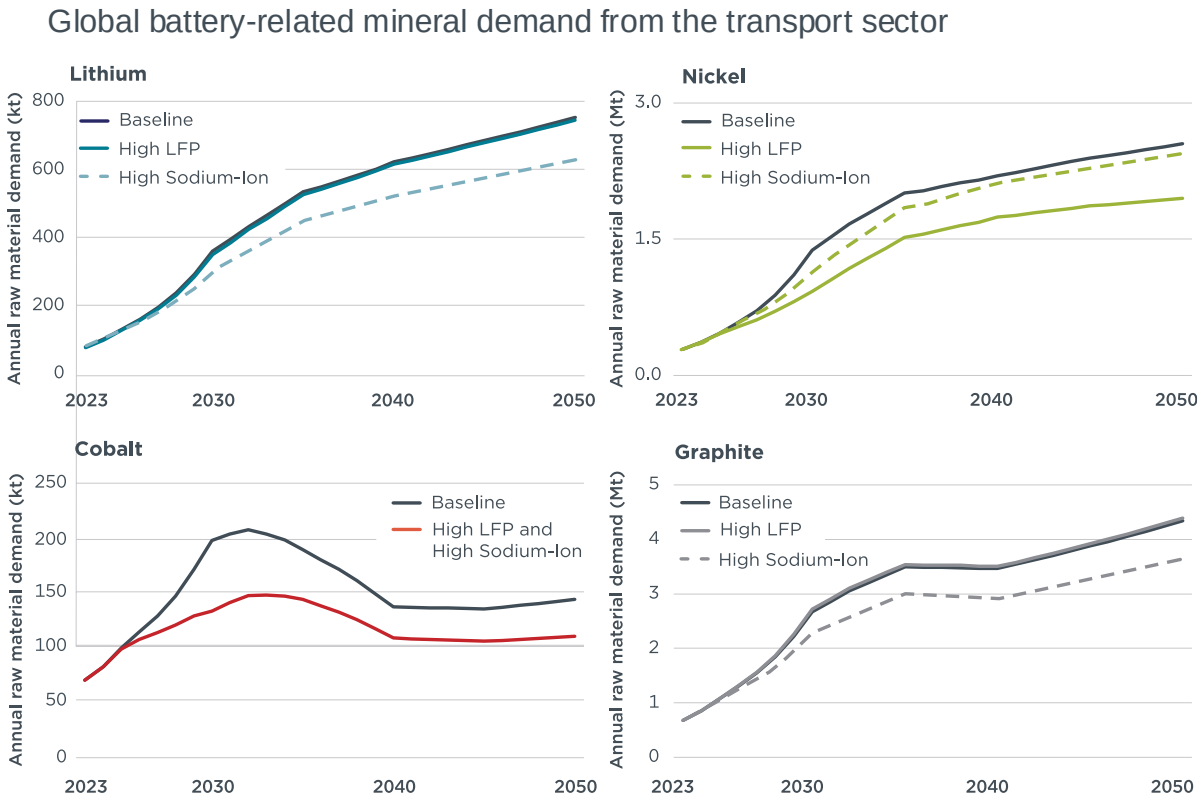
LFP-leaning countries, e.g., China and India



- **Baseline scenario** (presented) assumes a continuation of observed trends
- **Sensitivity scenarios** evaluate higher share of LFP and sodium-ion batteries

Global material demand under Baseline, High LFP Share, and High Sodium-Ion Share battery technology mix scenarios

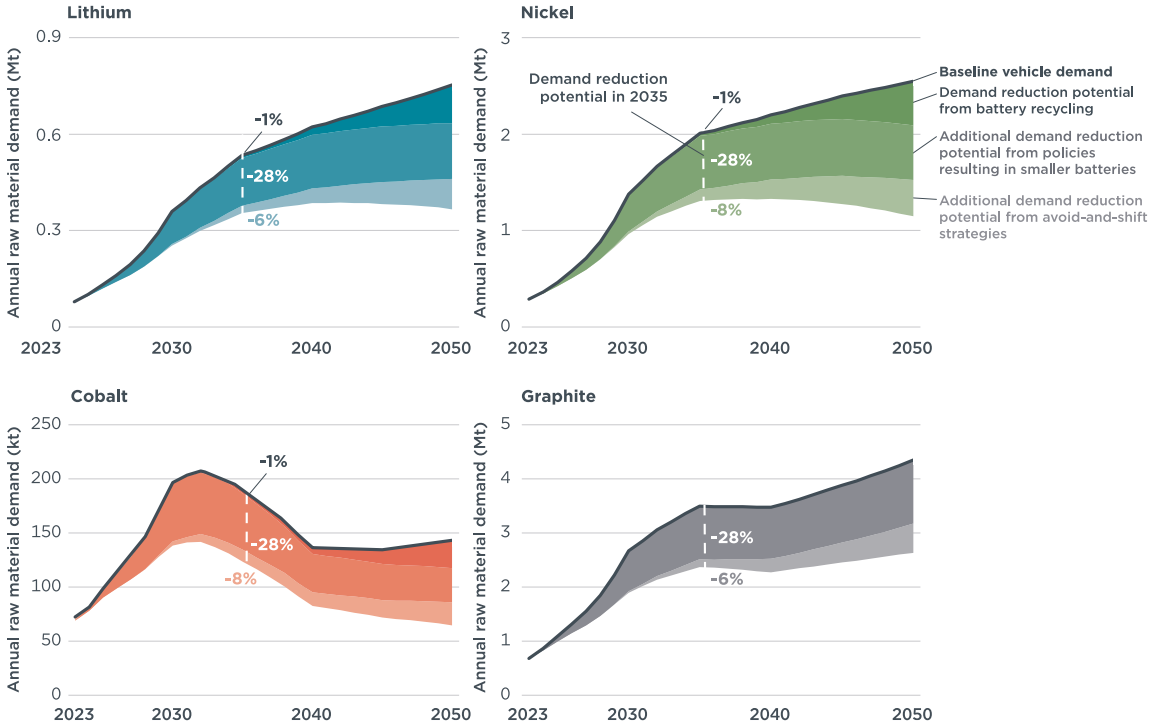
- Demand for all materials increases until 2030.
- Cobalt demand decreases after 2032 in Baseline
- Nickel & cobalt demand decrease in High LFP scenario
- Lithium demand decreases in High-Sodium-Ion scenario



Global material demand under Baseline and demand reduction scenarios

- Reversing the trend of increasing battery sizes for light-duty BEVs is the most immediate way to reduce battery and raw material demand.
- Battery recycling and avoid-and-shift policies show their full potential in the longer term.

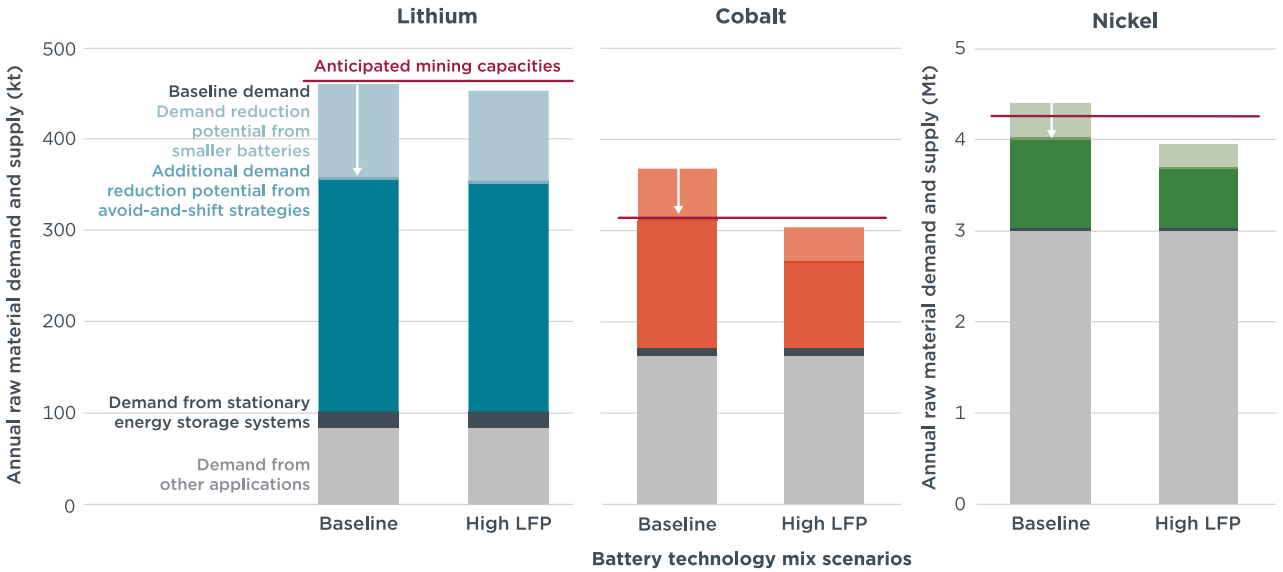
Global battery-related mineral demand from the transport sector



How do these mineral demand projections compare with anticipated supply?

Projected **mineral demand** in 2030 with anticipated **mining capacities**

- The scaling up of material supply is expected to keep pace with growing demand in 2030.
- Limitations in nickel and cobalt mining capacities could accelerate the trend to a higher market share of LFP batteries.

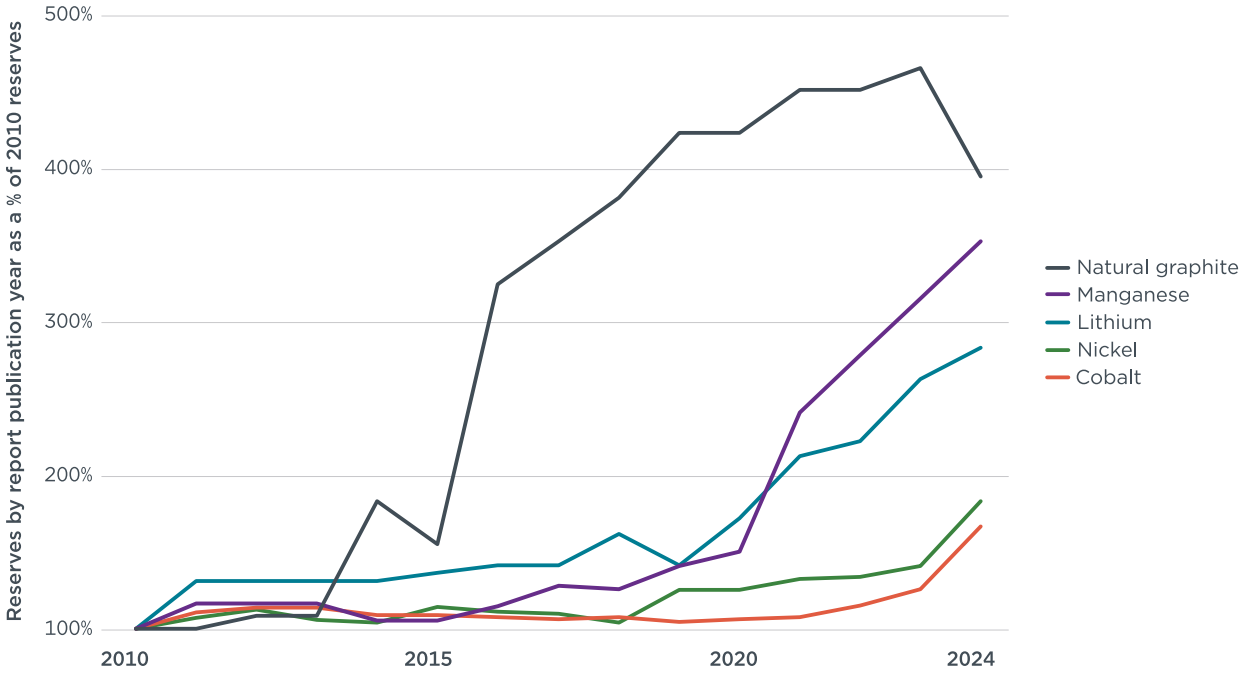


Anticipated mining capacities and non-vehicle mineral demand from International Energy Agency

How do these ranges of mineral demand compare with global mineral reserves?

- Global land-based mineral reserves have grown continually over the last decade.
- Higher demand for minerals leads to more exploration of deposits and to the development of novel extraction technologies

Global reserves by publication year of report as a percentage of 2010 reserves

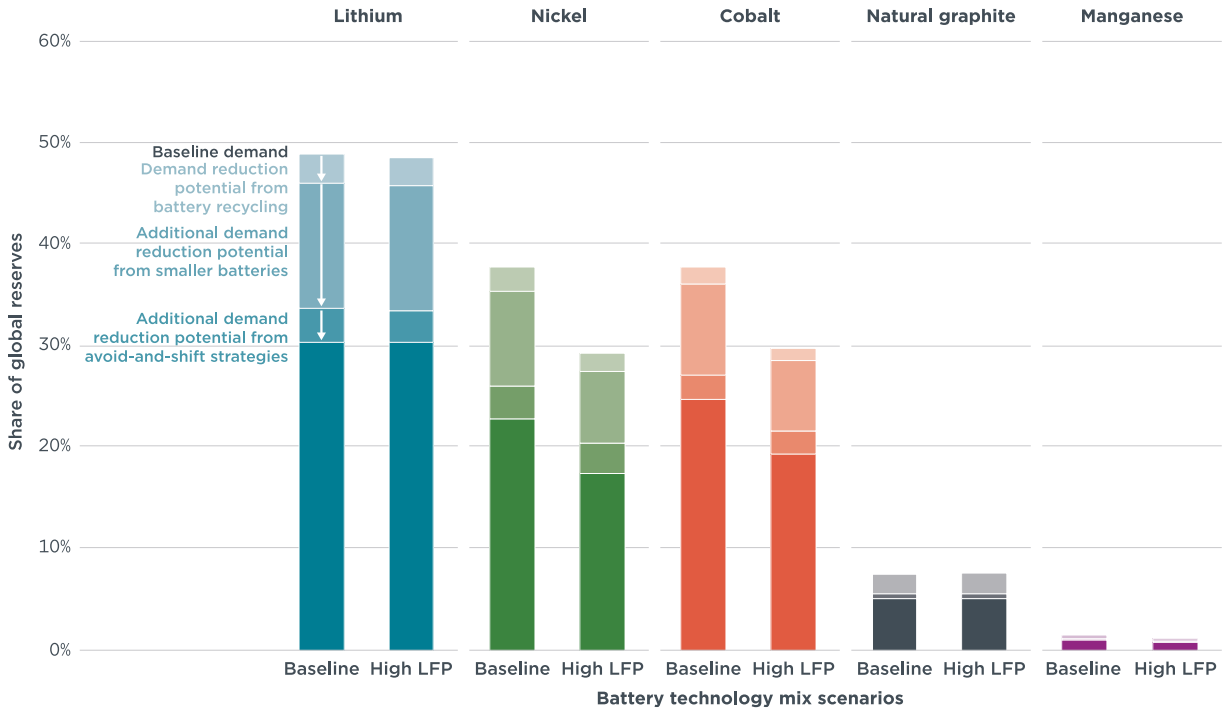


Mineral reserves data from U.S. Geological Survey , 2024

How do these ranges of mineral demand compare with global mineral reserves?

- Global mineral reserves are more than sufficient to meet cumulative battery material demand in the long term.
- Cumulative vehicular demand for lithium, nickel, and cobalt are less than half of reserves identified as of 2024.

Cumulative raw material demand between **2023 and 2050** as a share of global reserves



Mineral reserves data from USGS, 2024

Summary of findings

Summary of findings

- **Global mineral reserves are more than sufficient to meet battery material demand** in the long-term.
- Despite a general reliance on global material supply chains, **domestic reserves in each of the focus regions can help to meet future demand.**
- Scaling-up of **cell production and material supply keep pace with and partly exceed growing demand.**
- **Reversing the trend of an ever-growing increase in the battery sizes for light-duty EVs is the most immediate way to reduce battery and raw material demand.**
- Battery recycling and avoid-and-shift policies show their full potential only in the longer term (2040 and beyond).
  - Developing battery recycling capacity can increase the domestic supply of recovered minerals, lowering dependence on mineral imports in markets where few domestic reserves are located.

Summary of findings: EU and U.S.

- **All announced battery cell production capacities exceed demand in the US and keep up with demand in the EU in 2030.** The capacities of operational and highly probably facilities correspond to 72% of demand in the EU and 103% of demand in the U.S. in 2030.
- **A decrease in passenger car BEV battery sizes would decrease battery and mineral demand in 2035 by 30% in the EU and 21% in the U.S.**
- Battery recycling and avoid-and-shift strategies can help to reduce mineral demand in both regions with impacts growing after 2040.
- The EU and the U.S. have some mineral reserves that if exploited, could help to meet domestic battery demand:
  - The EU has sizeable nickel reserves and minor lithium reserves.
  - The US has sizeable lithium and manganese reserves and minor nickel and cobalt reserves.

Policy Implications

Policies to support the battery supply chain

Scaling up supply capacities:

- Adopting and maintaining **policies that set a clear timeline for BEV adoption** send a signal to industry to invest in upstream supply chain projects.
- **Regulatory and financial incentives** for mineral mining and refining, as well as cell production facilities can help supply chains scale up and boost domestic production.
- **Strategic trade agreements** with mineral-rich countries help secure supply.

Responsible supply chains:

- Supporting local **social and environmental regulations** at home and in mineral producing regions improve mining and refining practices.
- Strong **due diligence standards** on social and environmental risks in the supply chain require to track and improve social and environmental impacts.
- Targeting incentives to projects with high standards for social and environmental impacts support best practices.

Policies to reduce mining demand

Smaller batteries

- More affordable BEVs and most immediate impact on battery and mineral demand:
  - Informing consumers on battery right-sizing for their travel behavior
  - Charging infrastructure
  - Improving BEV energy efficiency

Battery recycling

- Reduces raw material demand and increases domestic mineral supply.
- Effective battery recycling regulations include **extended producer responsibility** rules for a comprehensive the collection of end-of-life vehicles and **high recovery rate for key battery minerals**.

Transport avoidance and mode shift

- Higher density urban areas, developing cities centered around well-connected public transport, and building out safe walking and biking infrastructure.
- Discourage private motorized vehicles, e.g., by congestion charges or parking management.

Thank you!
Questions?

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