**Cobalt for the energy transition**

**Outlook to 2030 and key challenges**

**Demand**
- Cobalt demand from EVs could increase six-fold by 2030, driving a *increasing total cobalt demand* 2–3x.
- Strong potential to reduce future material requirements with *battery innovation*: chemistries are already shifting rapidly away from high-cobalt nickel-manganese-cobalt (NMC) batteries (e.g., to low-cobalt NMC or to lithium-iron-phosphate (LFP)).

**Supply**
- *Uncertainty in supply* from Democratic Republic of Congo (DRC) due to instability and local conflict.
- Large recent *expansions in supply* from Indonesia.
- Potential to unlock future supply from re-processing of copper tailings.

**Key challenges**
- Cobalt is mined as a *by-product* of copper and nickel, meaning supply is often dictated by prices of those metals.
- Major *human rights and child labour concerns* for supply from the DRC, especially in artisanal and small-scale mining sector.
- Refining of cobalt sulphate is dominated by China (75% of production).

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**Cumulative demand 2022–50 from clean energy technologies**
*Thousand metric tonnes*

- Cobalt: 6,400
- Commercial EV Batteries: 1,400
- Passenger EV Batteries: 4,900
- Stationary Batteries: 100

**Demand and primary supply in 2030**
*Thousand metric tonnes*

- Supply:
  - 2022: 170
  - 2030 Primary demand – upper bound: 420
  - 2030 Primary demand – lower bound: 260
  - 2030 Supply: 245

- Non-energy transition demand:
  - Energy transition drives fast, large increase in demand.
  - New battery chemistries and scaling recycling can reduce primary demand for cobalt by up to 40% this decade.
  - Supply gap would still remain in 2030 – further substitution or supply expansion may be needed.

**Efficiency and recycling could lower primary cobalt requirements by 75% through to 2050**

**Cumulative primary demand 2022–50, reductions due to efficiency and recycling levers, and resources and reserves**

- High Efficiency: 11.3
- High Recycling: 8.3

**Potential for substitution**
- 80% of material demand could be met by recycling by 2050

**Potential for recycling to meet supply**
- Shifting away from cobalt-rich batteries and scaling recycling can reduce total demand to below existing reserves.

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**Sources:** Systemiq analysis for the ETC, US Geological Survey (2023), Mineral commodity summaries, IEA (2021), The Role of Critical Minerals in Clean Energy Transitions; BNEF (2022), 2H Battery metals outlook; IEA (2023), Energy Technology Perspectives.

**Note:** The upper bound demand is the ETC’s Baseline Decarbonisation scenario, which assumes an aggressive deployment of clean energy technologies for global decarbonisation by mid-century, but materials intensity and recycling trends follow recent patterns. The lower bound demand is the ETC’s Maximum Efficiency and Recycling scenario, which assumes accelerated progress in material and technology efficiency, and recycling clean energy technologies, thereby reducing requirements for the primary supply (i.e., mined supply) of materials. “Resources” is an estimate of material supply available in sufficient concentration to make exploitation an economic interest at some time. “Reserves” are the currently economically and technically extractable subset of resources. It is important to note that even these estimates tend to increase over time. Calculated assuming average 2022 price of around $65,000 per tonne of cobalt metal. L = Low, M= Medium, H = High.