International Energy Agency

The Role of Critical Minerals in Clean Energy Transitions

Enerclub webinar

10 June 2021

Context

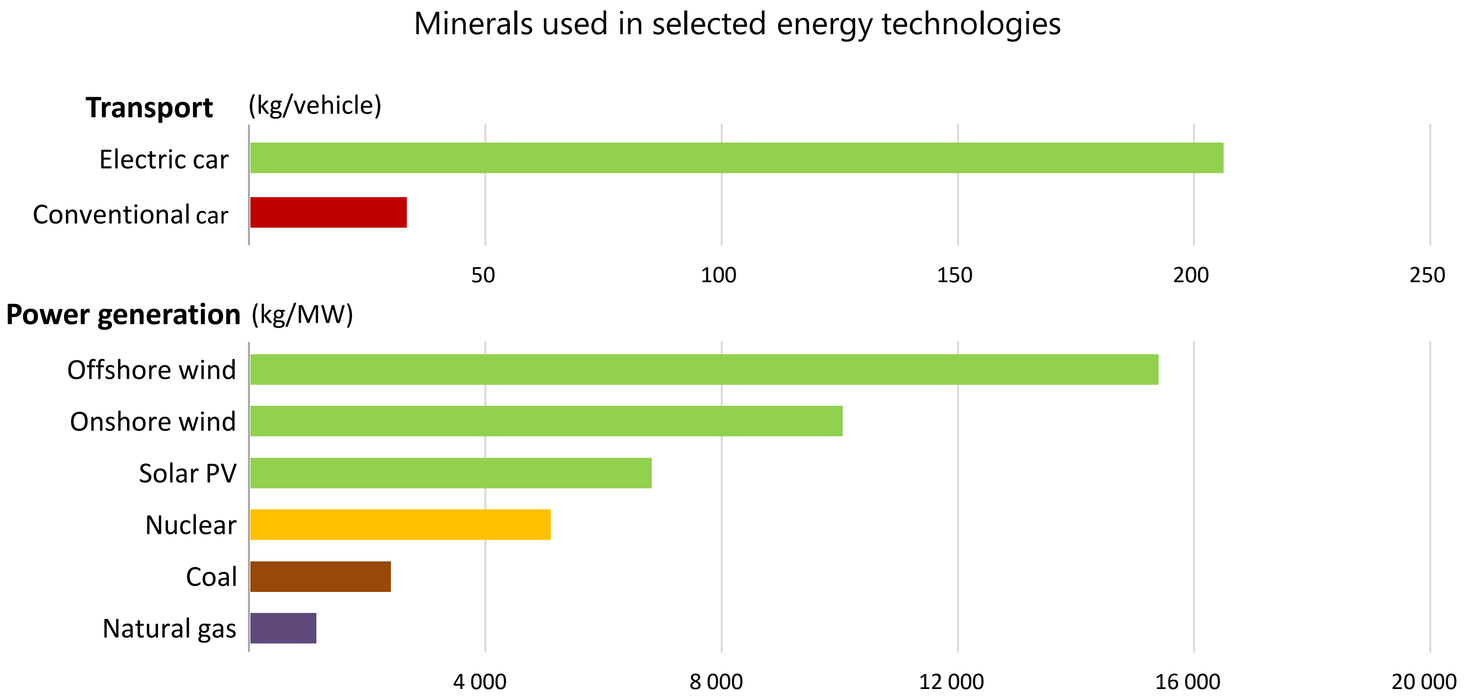
- Countries accounting for more than 70% of today's global GDP and emissions have committed to net-zero emissions, implying a massive acceleration in clean energy deployment

- An energy system powered by clean energy technologies needs significantly more minerals, notably:
    - Lithium, nickel, cobalt, manganese and graphite for batteries
    - Rare earth elements for wind turbines and electric vehicles motors
    - Copper, silicon and silver for solar PV
    - Copper and aluminium for electricity networks

- There is no shortage of mineral resources, but recent price rises for cobalt, copper, lithium and nickel highlight how supply could struggle to keep pace with the world's climate ambitions

- An evolving energy system calls for an evolving approach to energy security; policy makers must expand their horizons and act to reduce the risks of price volatility and supply disruptions

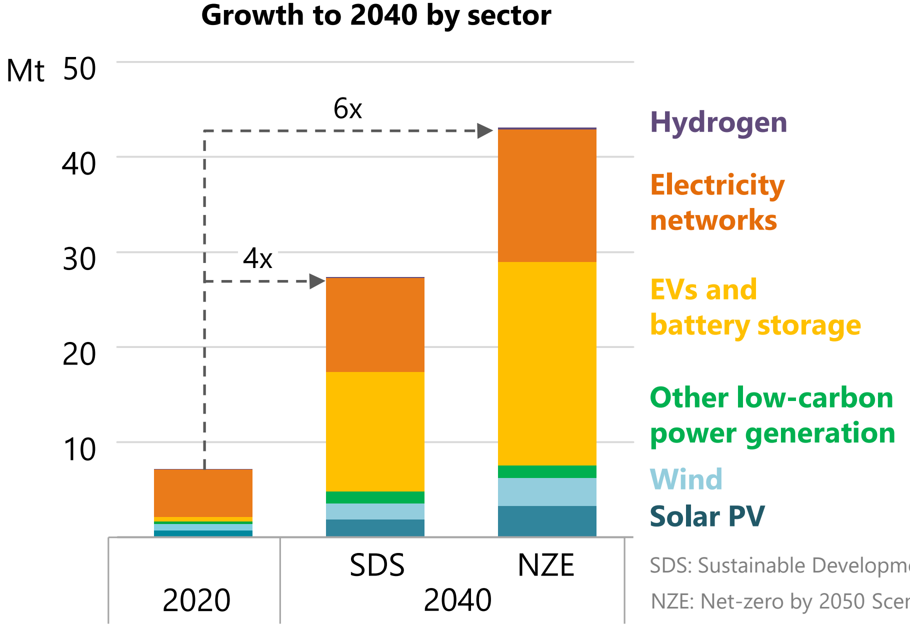
The shift to a more mineral-intensive energy system



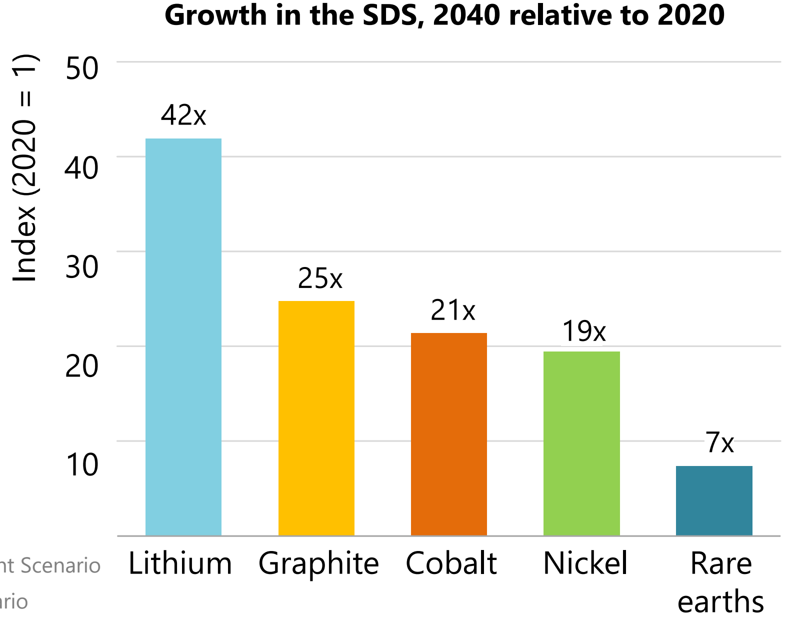
A typical electric car requires six times the mineral inputs of a conventional car, and an offshore wind plant requires thirteen times more mineral resources than a similarly sized gas-fired power plant

Meeting climate goals will turbo-charge demand for minerals

Mineral demand for clean energy technologies by scenario

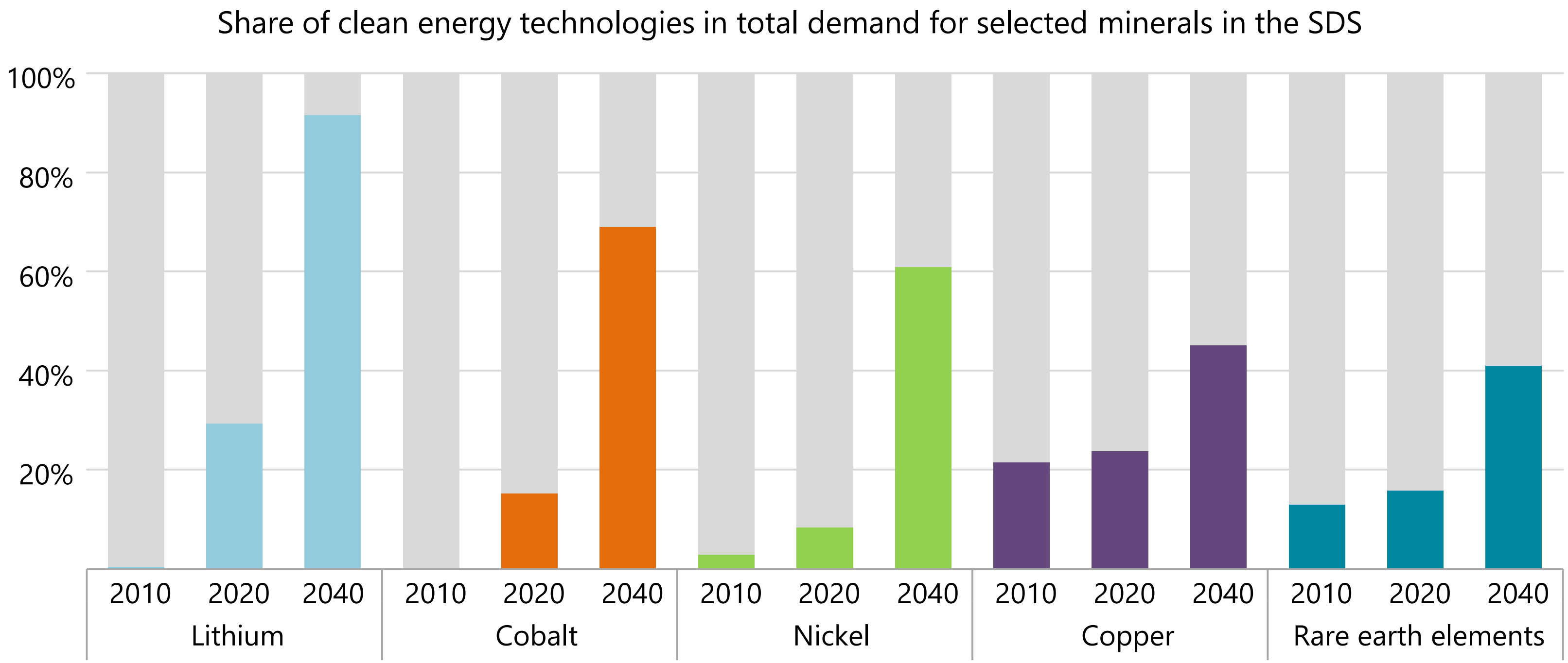


SDS: Sustainable Development Scenario
NZE: Net-zero by 2050 Scenario



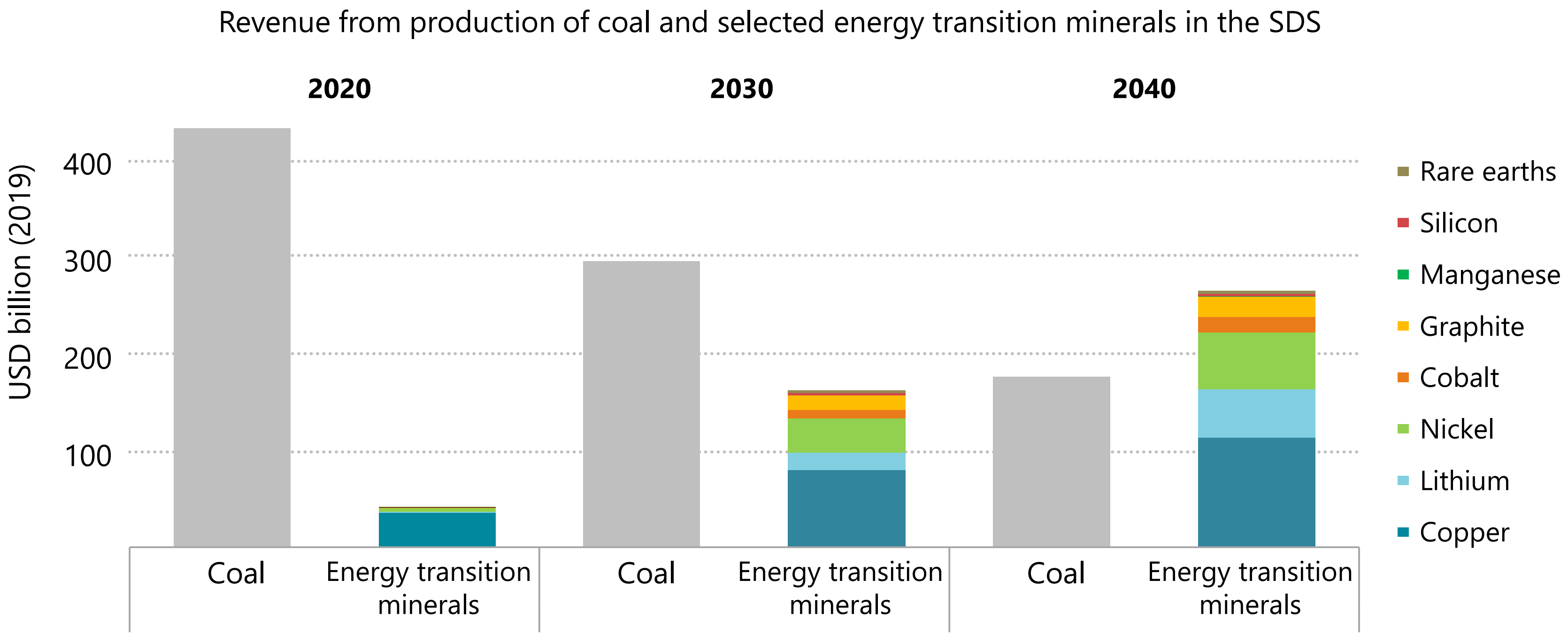
Demand for critical minerals is set to soar over the next two decades as the world pursues net zero goals; overall requirements rise by as much as 6 times, but individual minerals, led by lithium, rise even faster

Clean energy in the driving seat for mineral demand growth



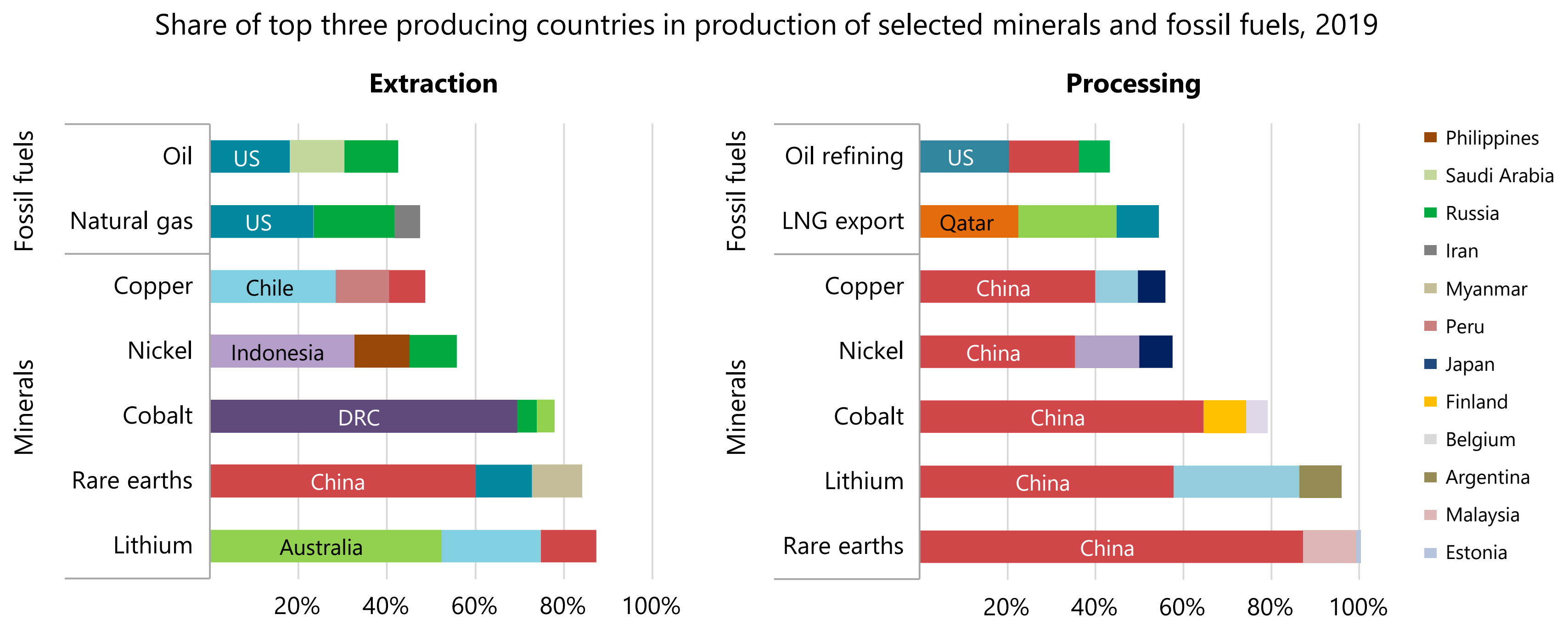
As learning and economies of scale bring down other cost components, mineral inputs also account for an increasingly large share of the total cost of batteries and other key clean energy technologies

New reasons to go underground



Today's revenue from coal production is ten times larger than from energy transition minerals. However, in climate-driven scenarios, these positions are reversed well before 2040

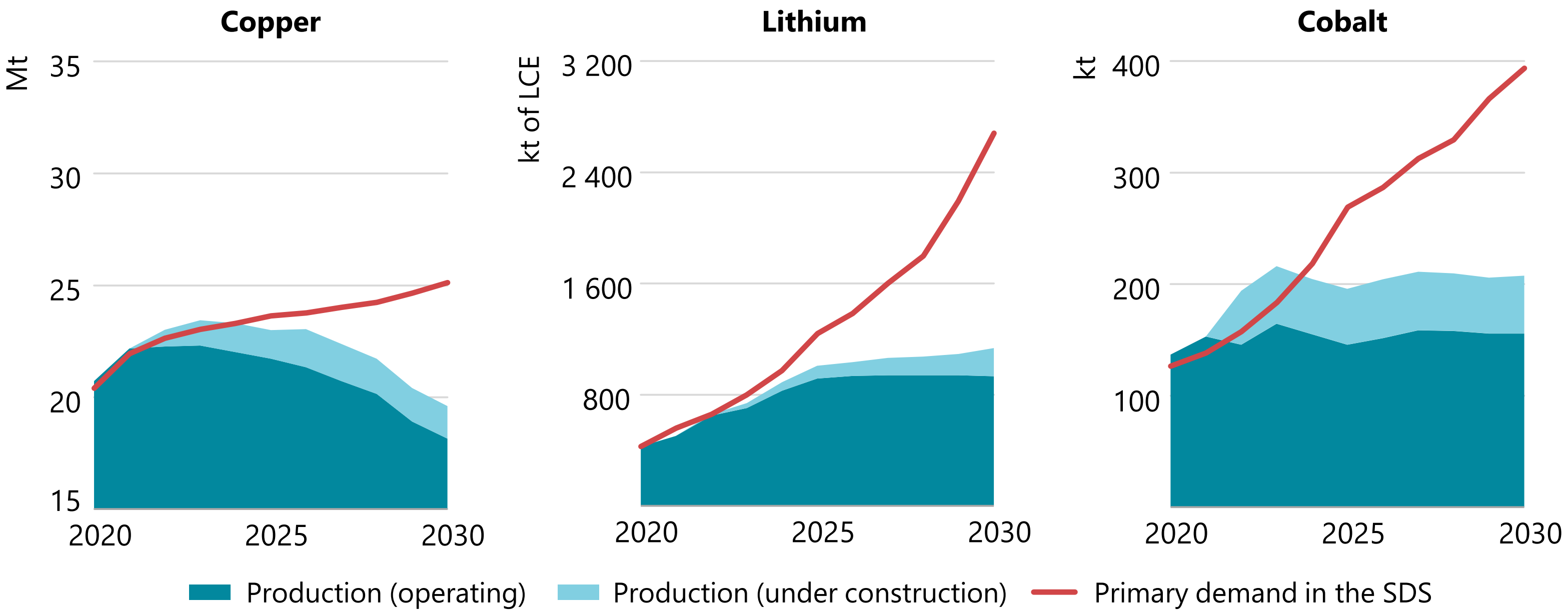
Many mineral supply chains lack diversity



Production and processing of many minerals such as lithium, cobalt and some rare earth elements are geographically concentrated, with the top three producers accounting for more than 75% of supplies

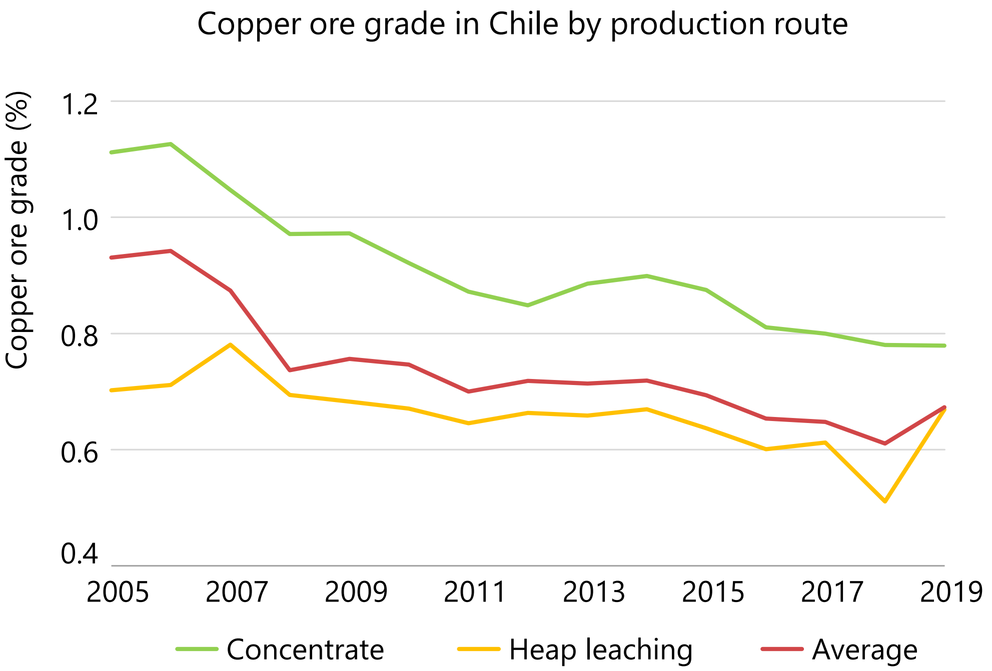
A looming mismatch between mineral supply and climate ambition

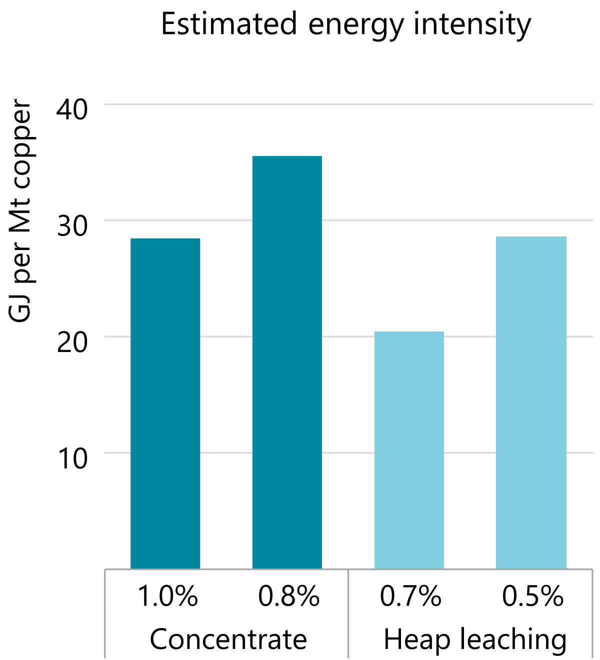
Committed mine production and primary demand (SDS) for selected minerals



Today's investment plans are geared to a world of gradual change; given long leads times for new projects, an accelerated energy transition could quickly see demand running ahead of supply

Resources: not a quantity problem, but a quality problem

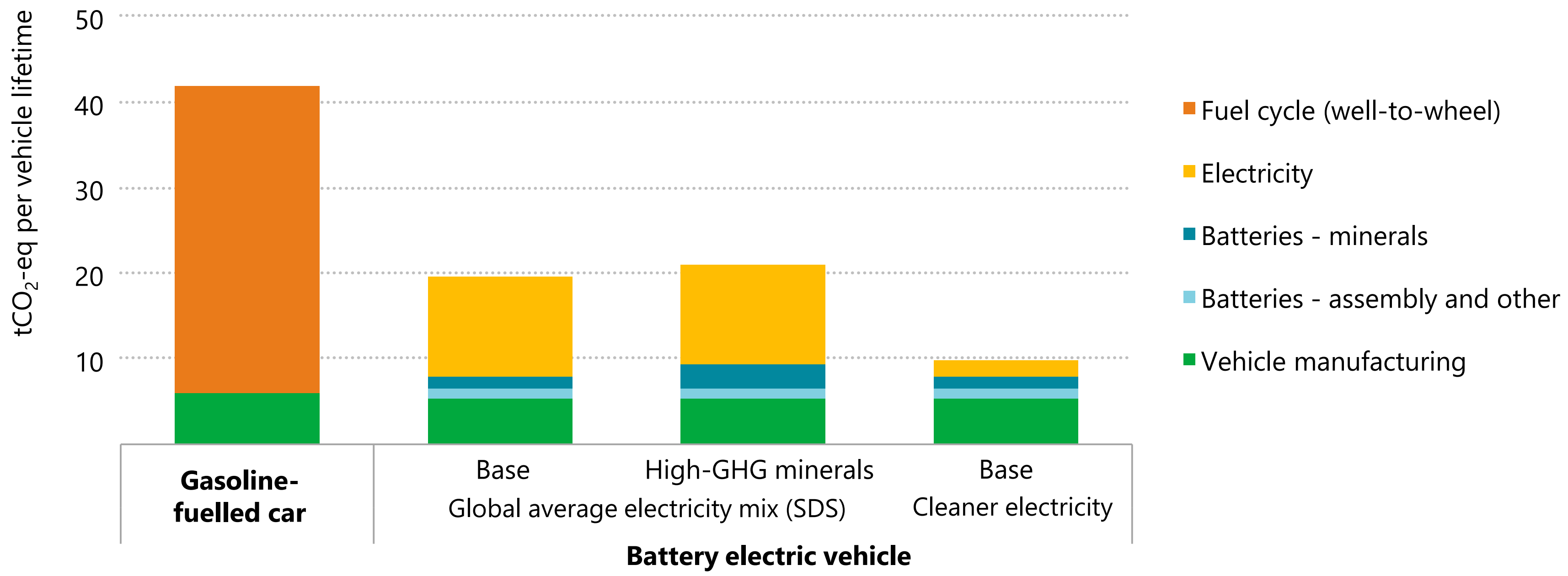




Declining resource quality poses multiple challenges for extraction and processing costs, emissions and waste volumes

Critical minerals do not undermine the case for clean energy

Comparative life-cycle GHG emissions of a mid-size battery electric versus a conventional car



Even though mineral extraction is relatively emissions-intensive, on average the full lifecycle emissions of an EV bought today are around half those of a conventional car

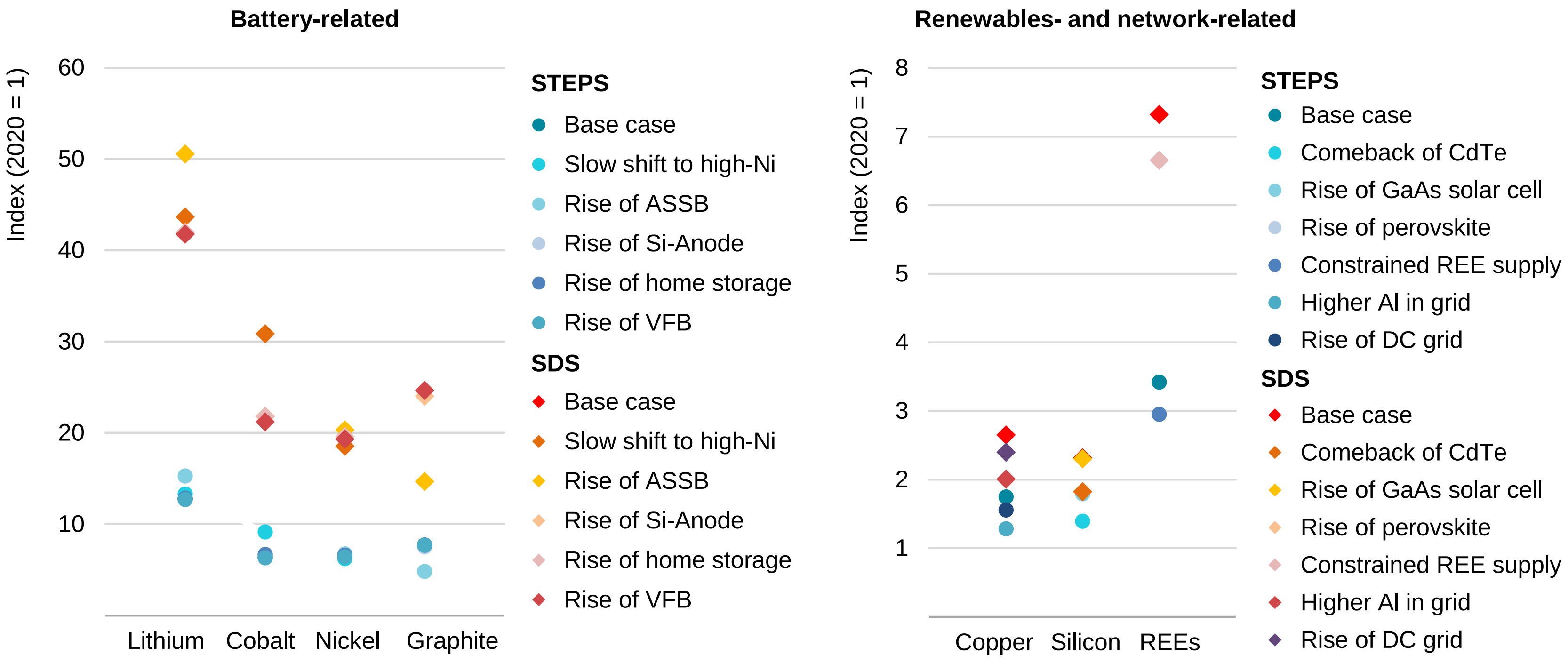
IEA plan of action: a comprehensive approach to mineral security

Building on the IEA's leadership role in energy security, these six key areas of action can ensure that critical minerals enable an accelerated transition to clean energy

1. **Ensure adequate investment in diversified sources of supply**
2. **Promote technology innovation at all points along the value chain**
3. **Scale up recycling**
4. **Enhance supply chain resilience and market transparency**
5. **Mainstream higher environmental, social and governance standards**
6. **Strengthen international collaboration between producers and consumers**

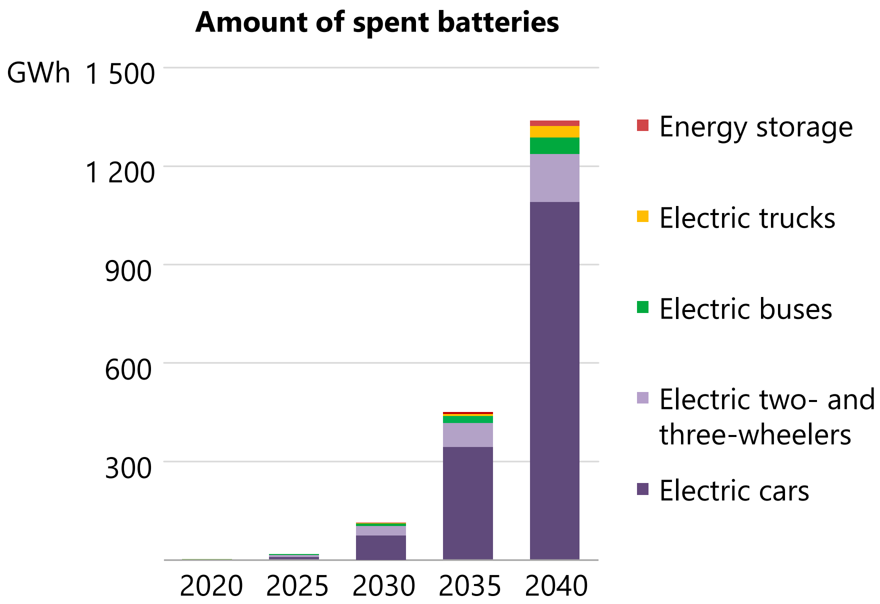
A major source of demand uncertainty: strength of climate policies

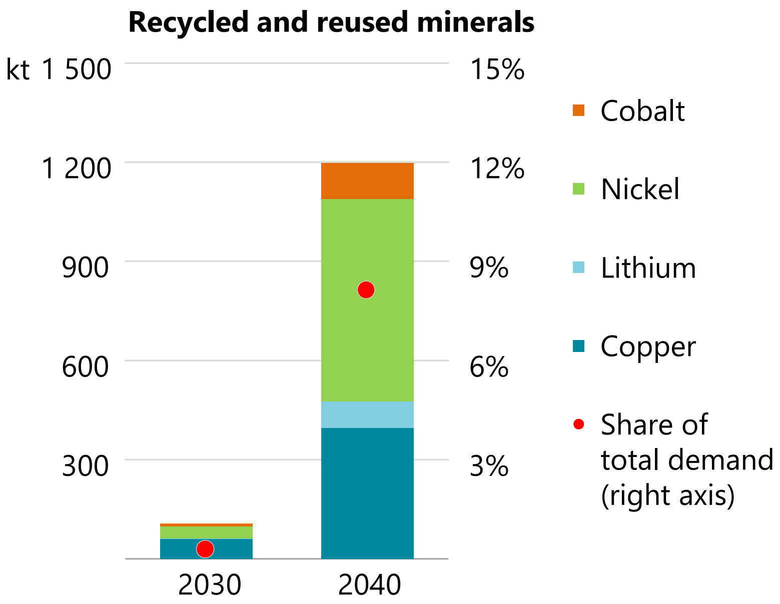
Range of projected demand under different scenarios and varying technology evolution trends, 2040 relative to 2020



Recycling becomes a significant source of supply

Contributions from spent lithium-ion batteries from EVs and storage to reducing primary demand in the SDS

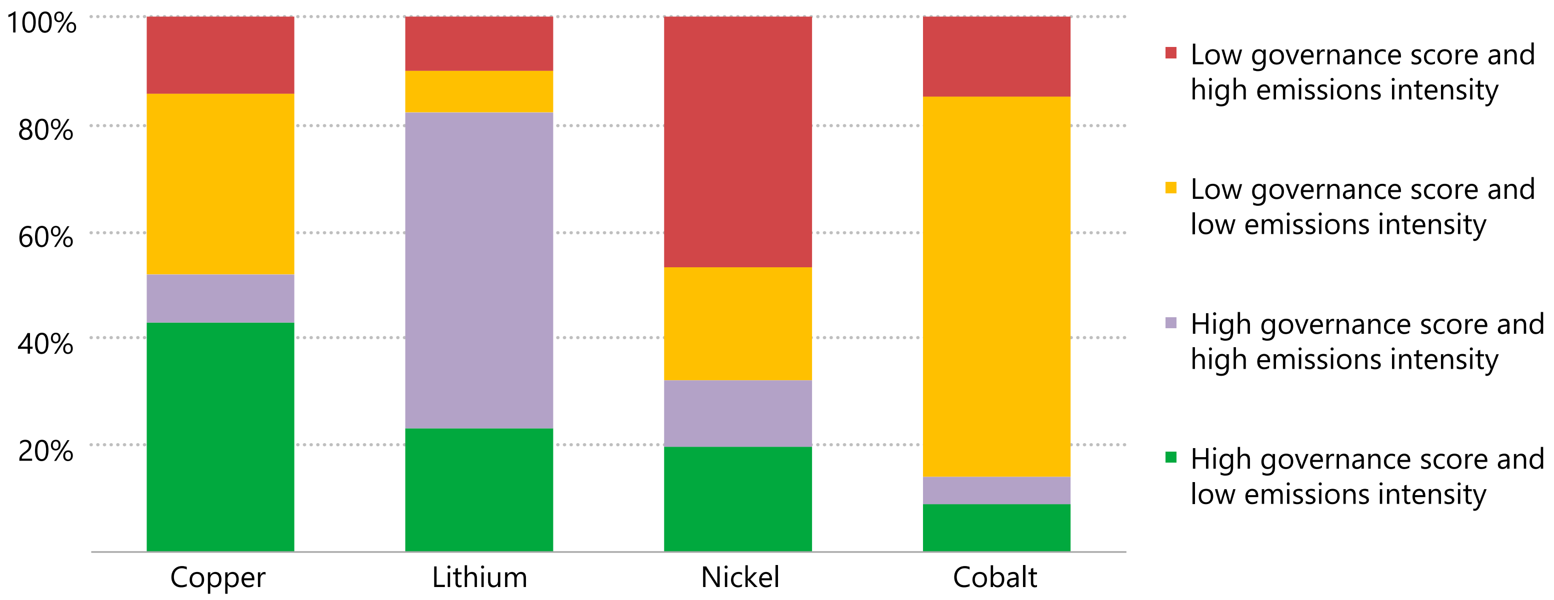




By 2040, recycled quantities of copper, lithium, nickel and cobalt from spent batteries could reduce combined primary supply requirements for these minerals by around 10%

Strong linkage between ESG and supply security

Distribution of production of selected minerals by governance and emissions performance, 2019



The majority of current production volumes come from regions with low governance scores or high emissions intensity