International Energy Agency

The Role of Critical Minerals in Clean Energy Transitions

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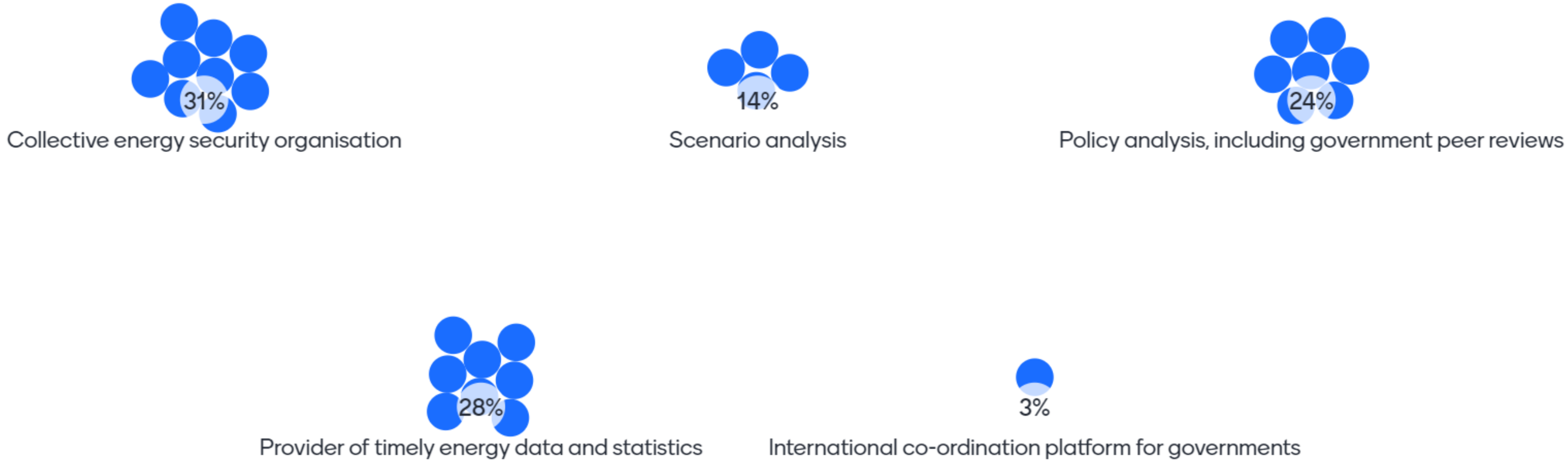
What is the IEA most well-known for?



What is the IEA – a ‘NATO’ for energy security

- Treaty-based energy security mechanism
  - Collective assistance
    - Each Member has agreed to assist each other in times of energy supply disruption
  - Associated obligations
    - disclose and cooperate on energy data
    - consult with industry
    - peer-review Members’ national policies/legislations at regular intervals

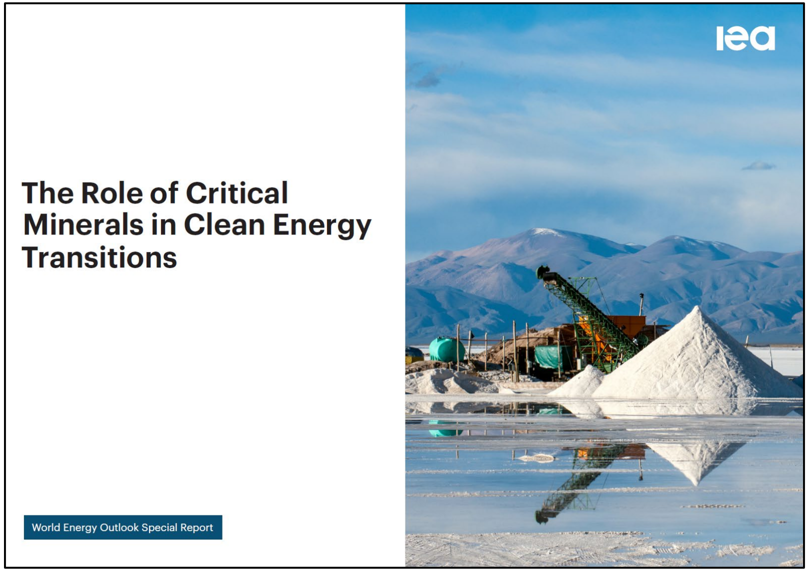
- Concept of energy security has shifted over time
  - In addition to strategic oil stocks, IEA activities now encompass **gas security**, **electricity security**, and **clean energy transitions**

IEA Special Report on critical minerals

- Mandate from IEA Members

  “[to] pay closer attention to the security of supplies of the critical mineral resources that will be needed to support the acceleration of clean energy transitions"

- Key highlights
  - Estimates of demand for critical minerals in clean energy transitions
  - Outlook for supply
  - Exploration of energy security implications
  - Need for sustainable and responsible development of minerals



https://www.iea.org/reports/the-role-of-critical-minerals-in-clean-energy-transitions

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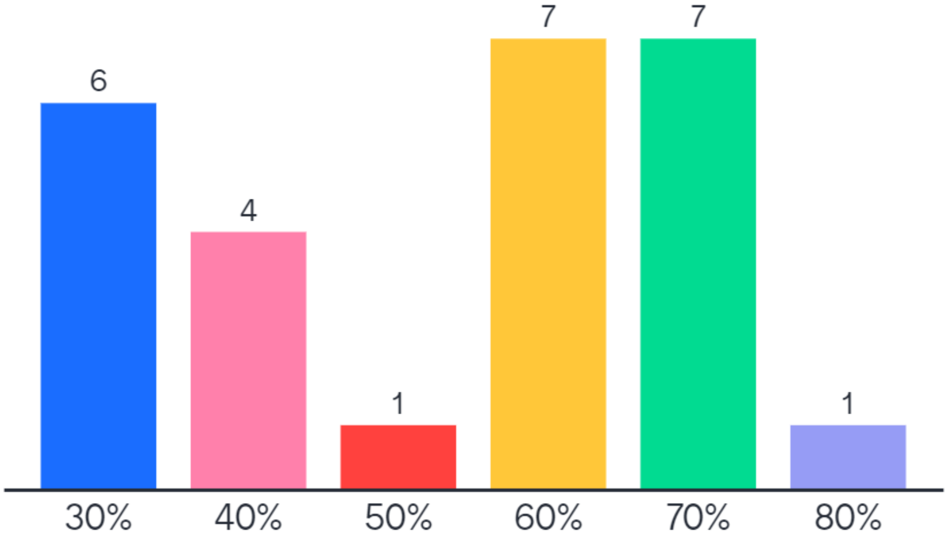
Countries with net-zero commitments account for what percentage of today's total GDP and emissions?



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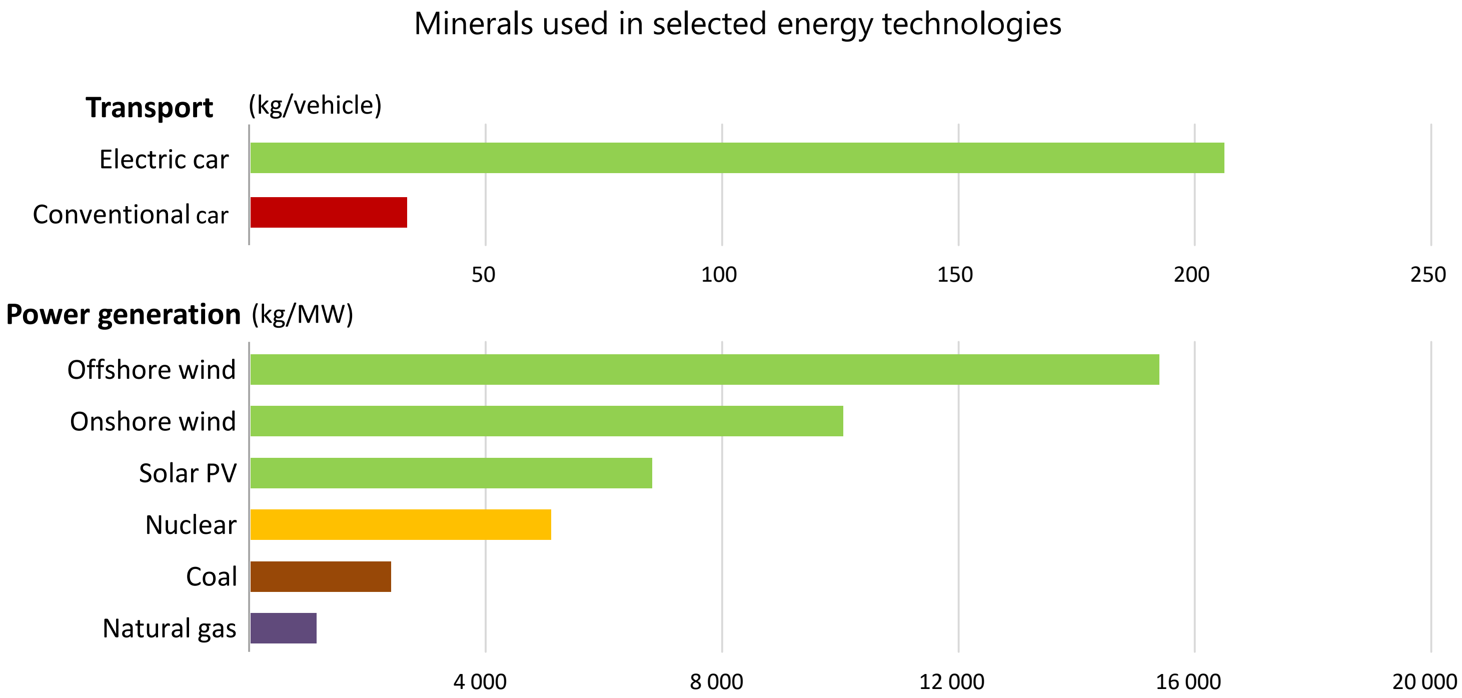
Context

- 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

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

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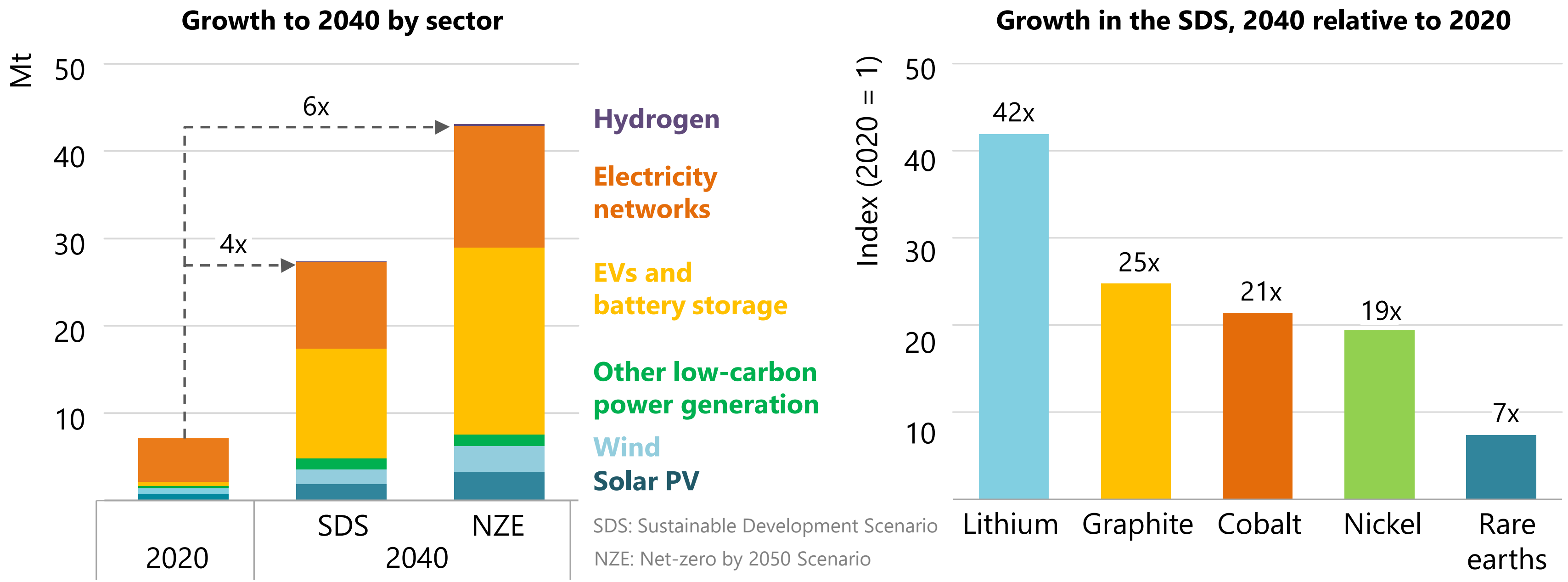
- There is no shortage of mineral resources, but recent price rises for cobalt, copper, lithium and nickel highlight how supply could struggle to keep pace with the world's climate ambitions

- 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

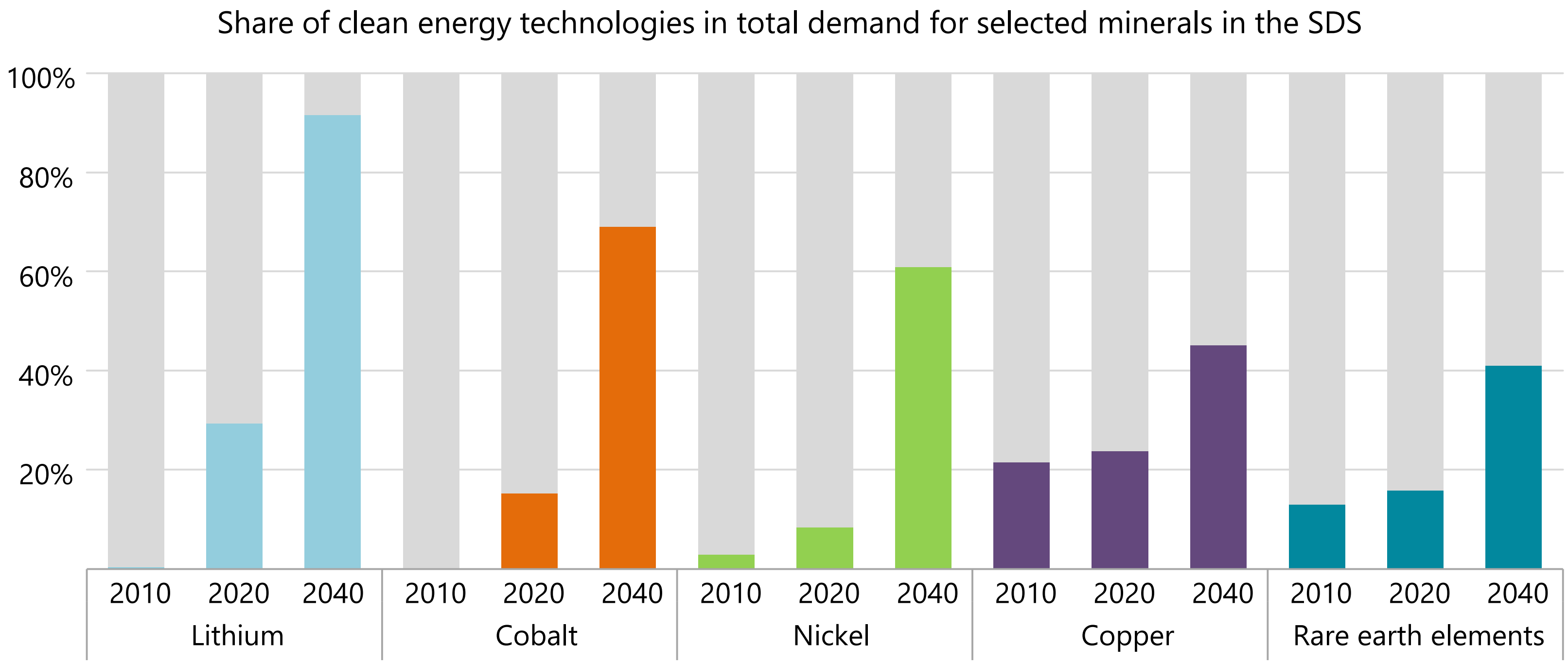
Meeting climate goals will turbo-charge demand for minerals

Mineral demand for clean energy technologies by scenario



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

Clean energy in the driving seat for mineral demand growth



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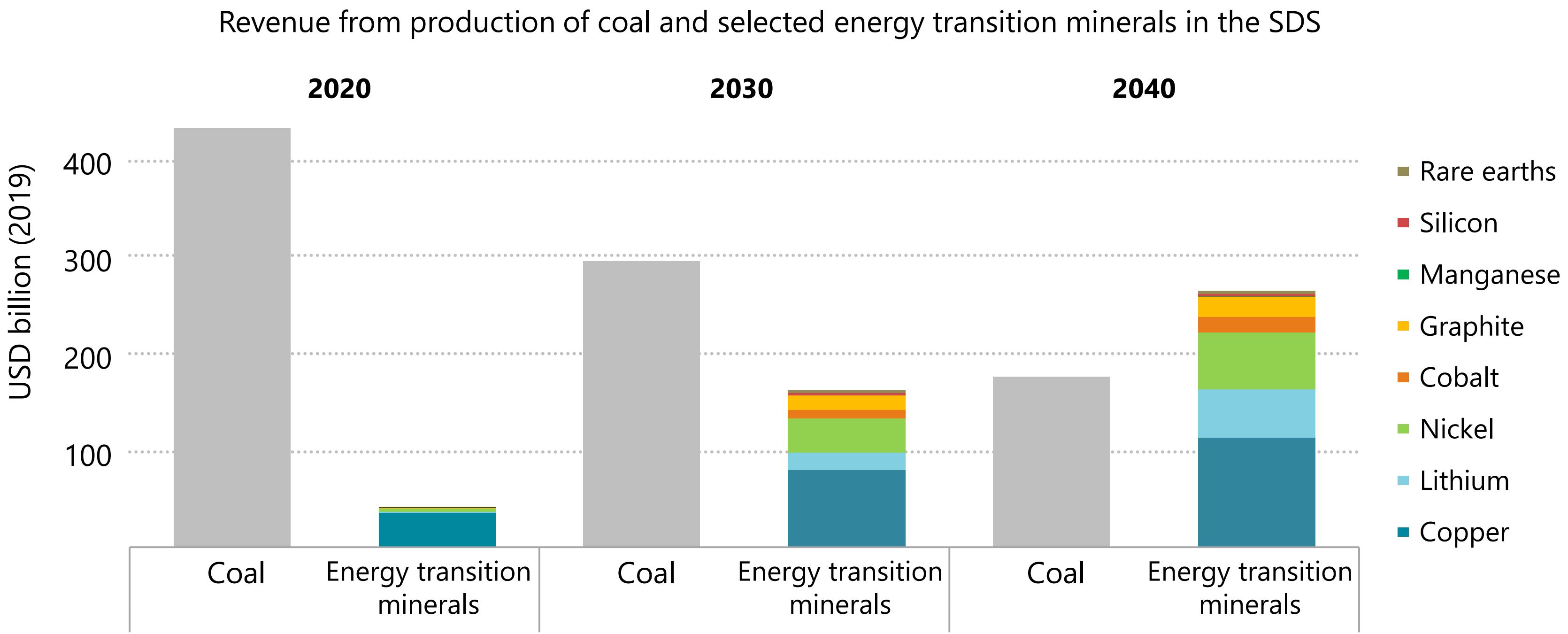
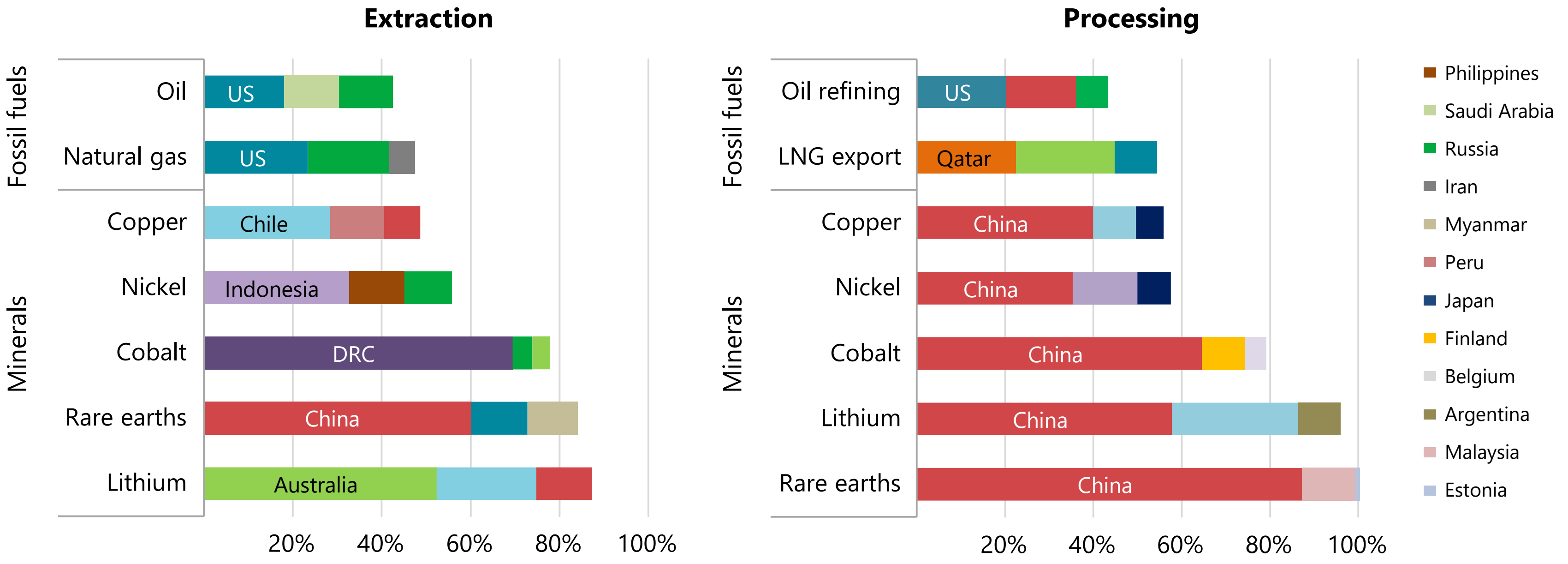
New reasons to go underground



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

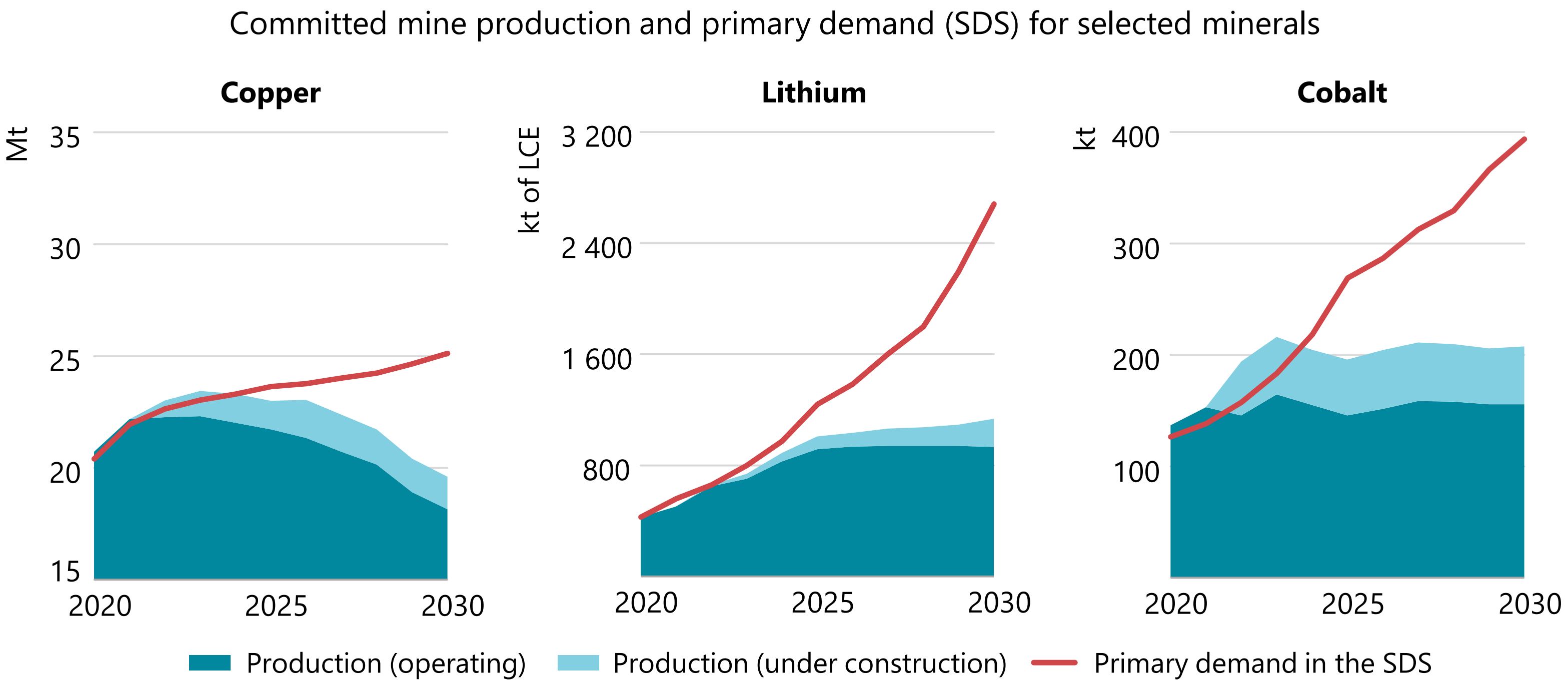
Many mineral supply chains lack diversity

Share of top three producing countries in production of selected minerals and fossil fuels, 2019



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

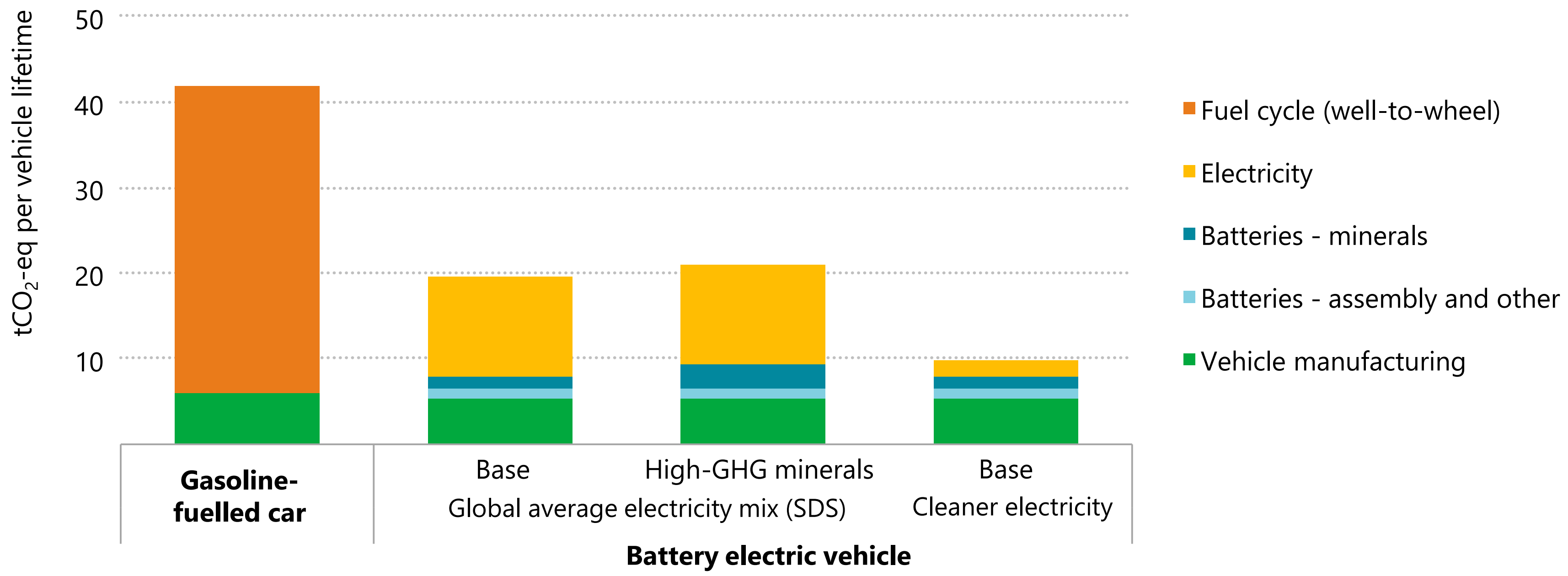
A looming mismatch between mineral supply and climate ambition



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

Critical minerals do not undermine the case for clean energy

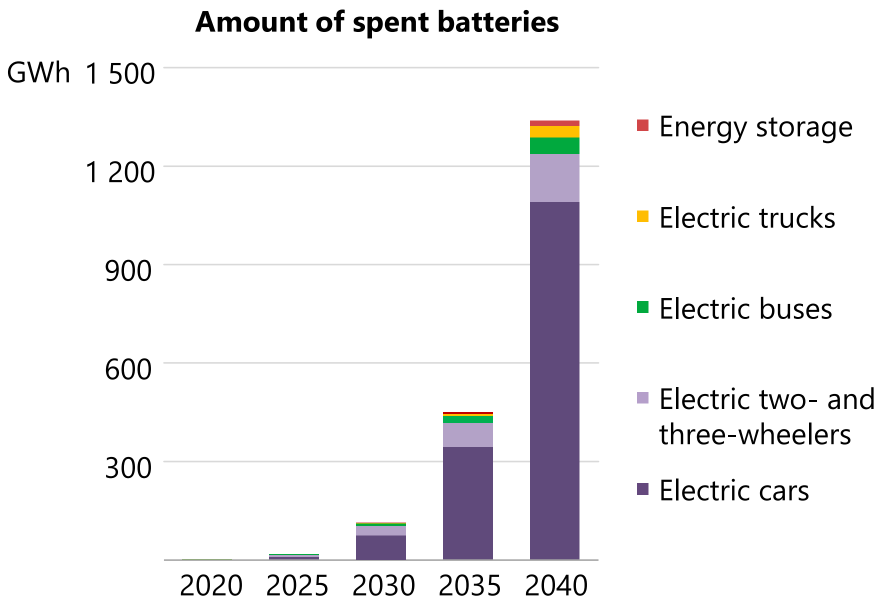
Comparative life-cycle GHG emissions of a mid-size battery electric versus a conventional car

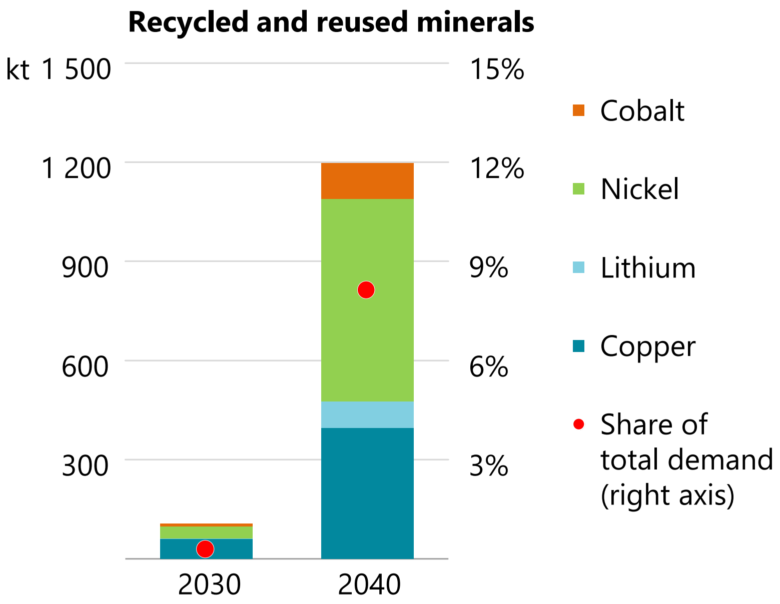


Even though mineral extraction is relatively emissions-intensive, on average the full lifecycle emissions of an EV bought today are around half those of a conventional car

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%

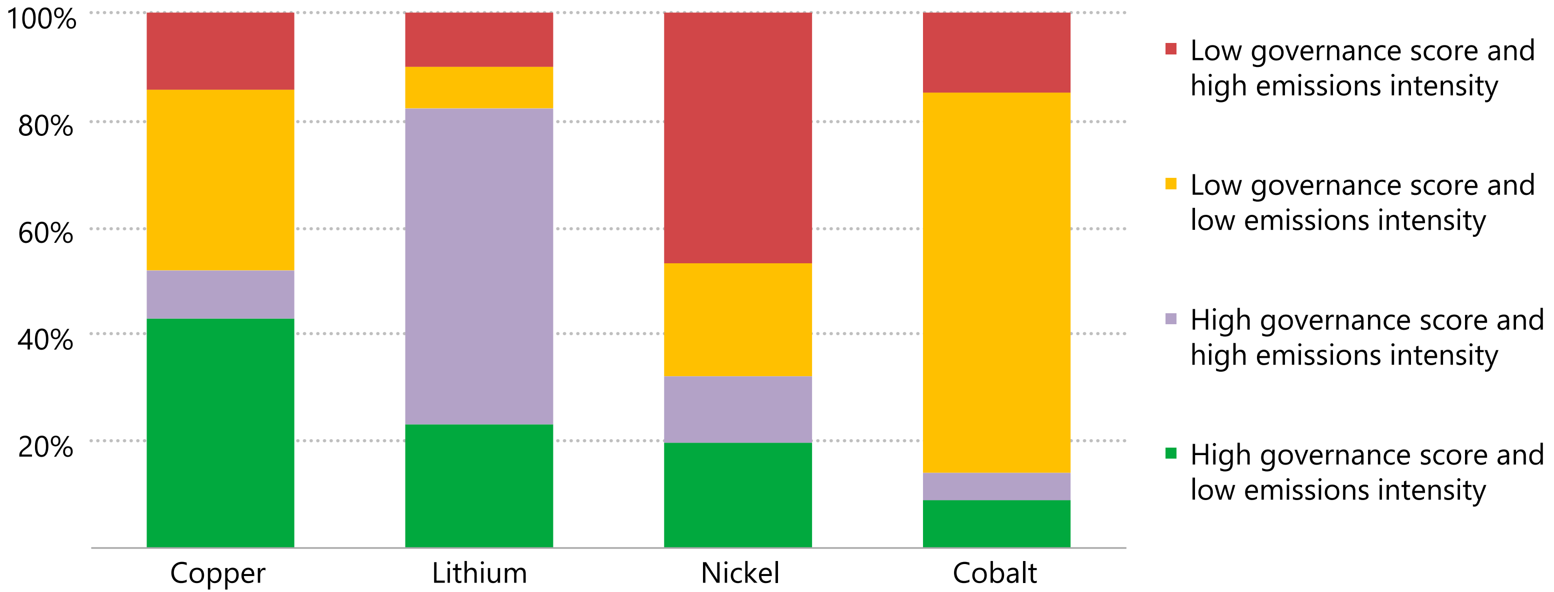
IEA plan of action: a comprehensive approach to mineral security

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**

Strong linkage between ESG and supply security

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



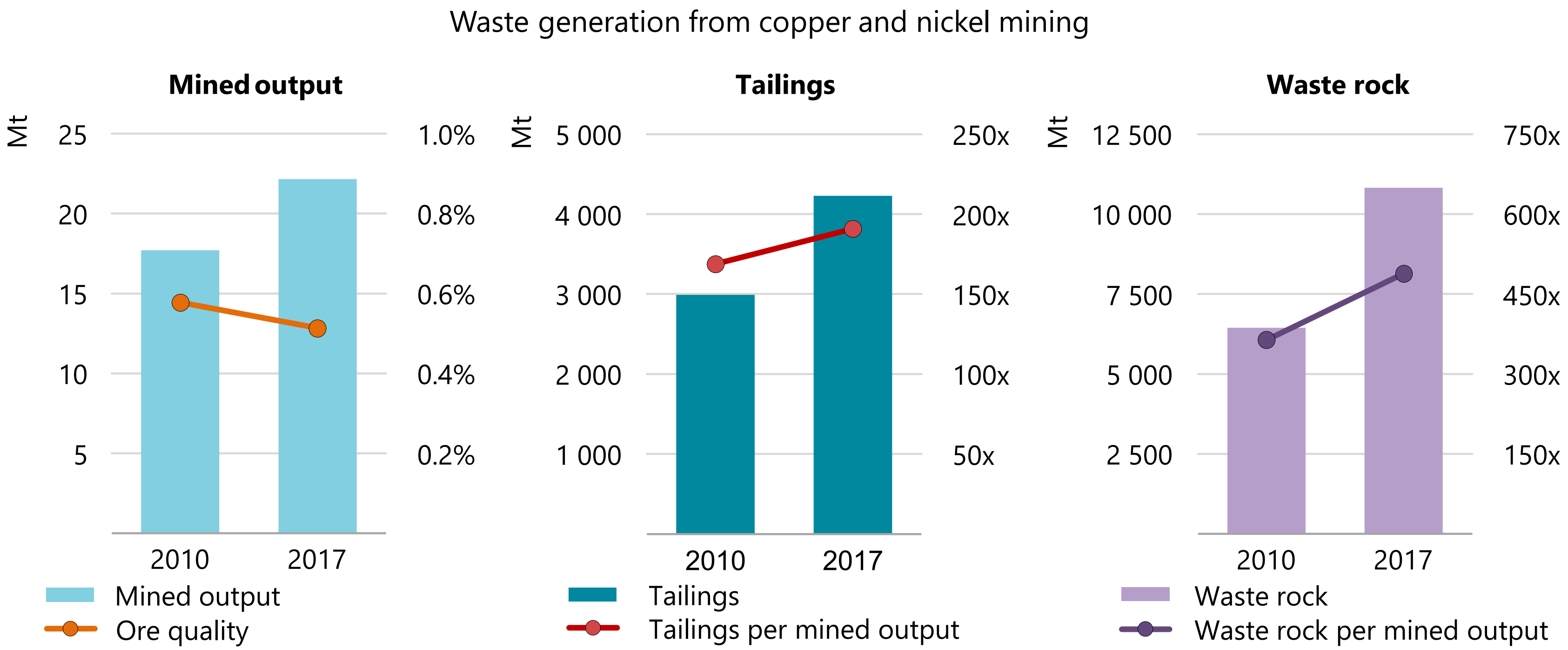
The majority of current production volumes come from regions with low governance scores or high emissions intensity

Environmental and social impacts must be carefully managed

Selected environmental and social challenges related to energy transition minerals

Areas of risks	Description
Climate change	With higher greenhouse gas emission intensities than bulk metals, production of energy transition minerals can be a significant source of emissions as demand rises
Land use	Mining brings major changes in land cover that can have adverse impacts on biodiversity and communities
Water management	Mining and mineral processing require large volumes of water for their operations, and pose contamination risks through acid mine drainage, wastewater discharge or the disposal of tailings
Waste	Declining ore quality can lead to a major increase in mining waste (e.g. tailings, waste rocks); tailings dam failure can cause large-scale environmental disasters (e.g. Brumadinho dam collapse in Brazil)
Governance	Mineral revenues in resource-rich countries have not always been used to support economic and industrial growth and are often diverted to finance armed conflict or for private gain
Health and safety	Workers face poor working conditions and workplace hazards (e.g. accidents, exposure to toxic chemicals)
Human rights	Mineral exploitation may lead to adverse impacts on the local population such as child or forced labour

Mineral development is generating increasing volumes of residues



As ore grades decline and volumes increase, policies and industry standards will be increasingly important to ensure that waste is managed sustainably

Artisanal and small-scale mining (ASM) poses special challenges

- Regulatory protections at ASM sites are often ineffective or non-existent
  - Unsafe working conditions
  - Lack of personal protective equipment
  - Inadequate safeguards against the worst forms of child labour

- Efforts to formalise ASM activities may improve health and safety conditions and reduce human rights concerns, particularly for child labour
  - Despite promising results, long-term viability of this model remains unclear

- Stronger commitment to formalisation needed both from industry and from governments

The role for international and regional coordination

- International co-ordination already plays a vital role in encouraging companies to identify and address risks across their entire supply chains

- Multilateral efforts to enhance capacity building and knowledge sharing can be particularly effective at addressing key resource gaps between countries
  - Intergovernmental Forum on Mining, Minerals, Metals and Sustainable Development (IGF)
  - Energy Resource Governance Initiative (ERGI)
  - Extractives Industries Transparency Initiative (EITI)

- Despite many success stories, the proliferation of international initiatives increases the risk of duplication and inconsistency
  - A high-level forum for co-ordination could play a key role in standardising environmental and social standards while ensuring security of supply

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In what areas is international co-operation most needed? (i.e. technology R&D, regulatory policy, due diligence etc.)

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