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DES RESSOURCES MINÉRALES
POUR LES FILIÈRES INDUSTRIELLES

Resources to achieve a just transition: levers and limits

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Géosciences pour une Terre durable
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ADEME
AGENCE DE LA TRANSITION ÉCOLOGIQUE

le cnam

ifri
institut français des relations internationales
1979 2019

conseil national de l'industrie
CSF Mine & Métallurgie

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Energy transition Geology

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Existence of the resources - quantities

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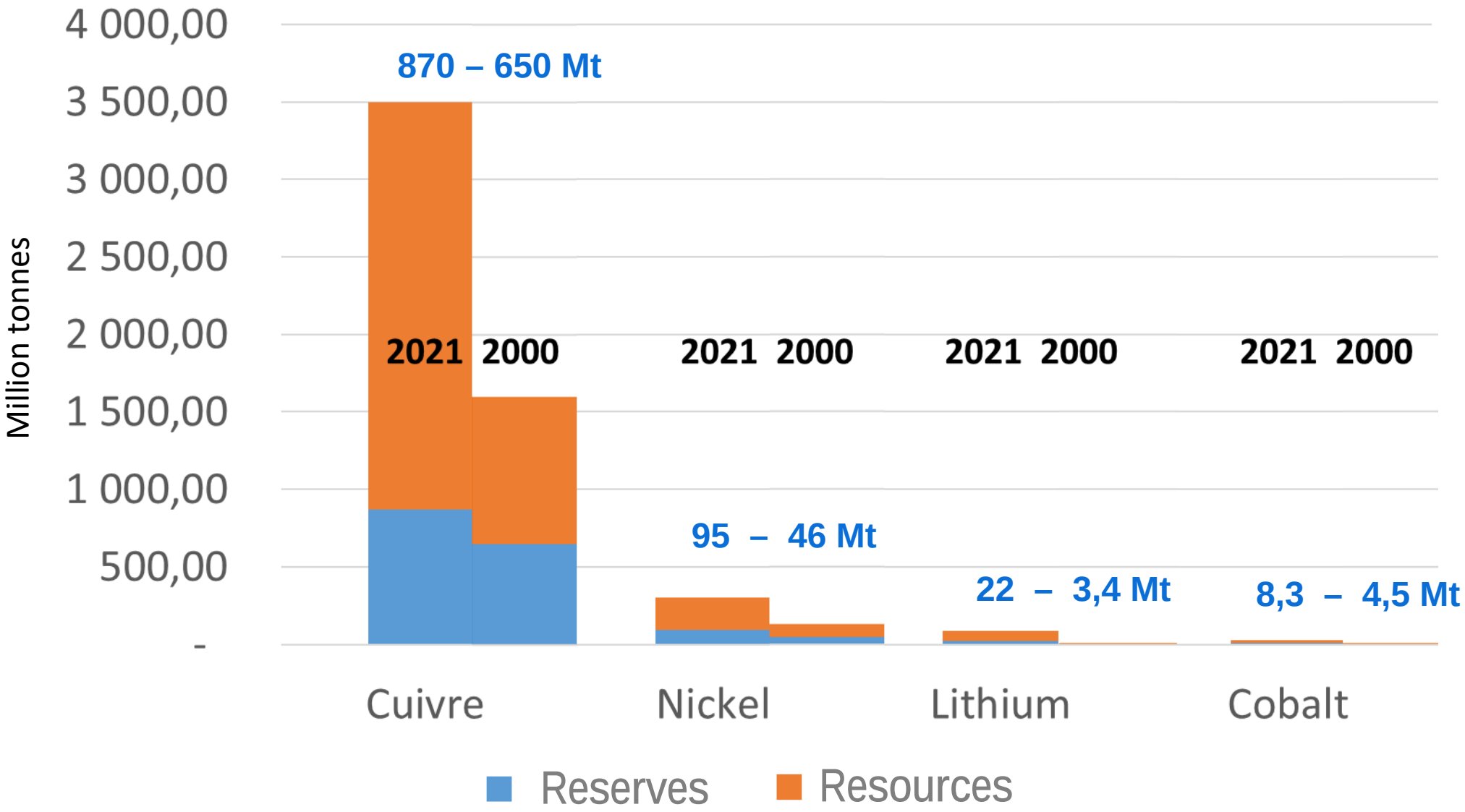

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Existence of the resources – years of consumption

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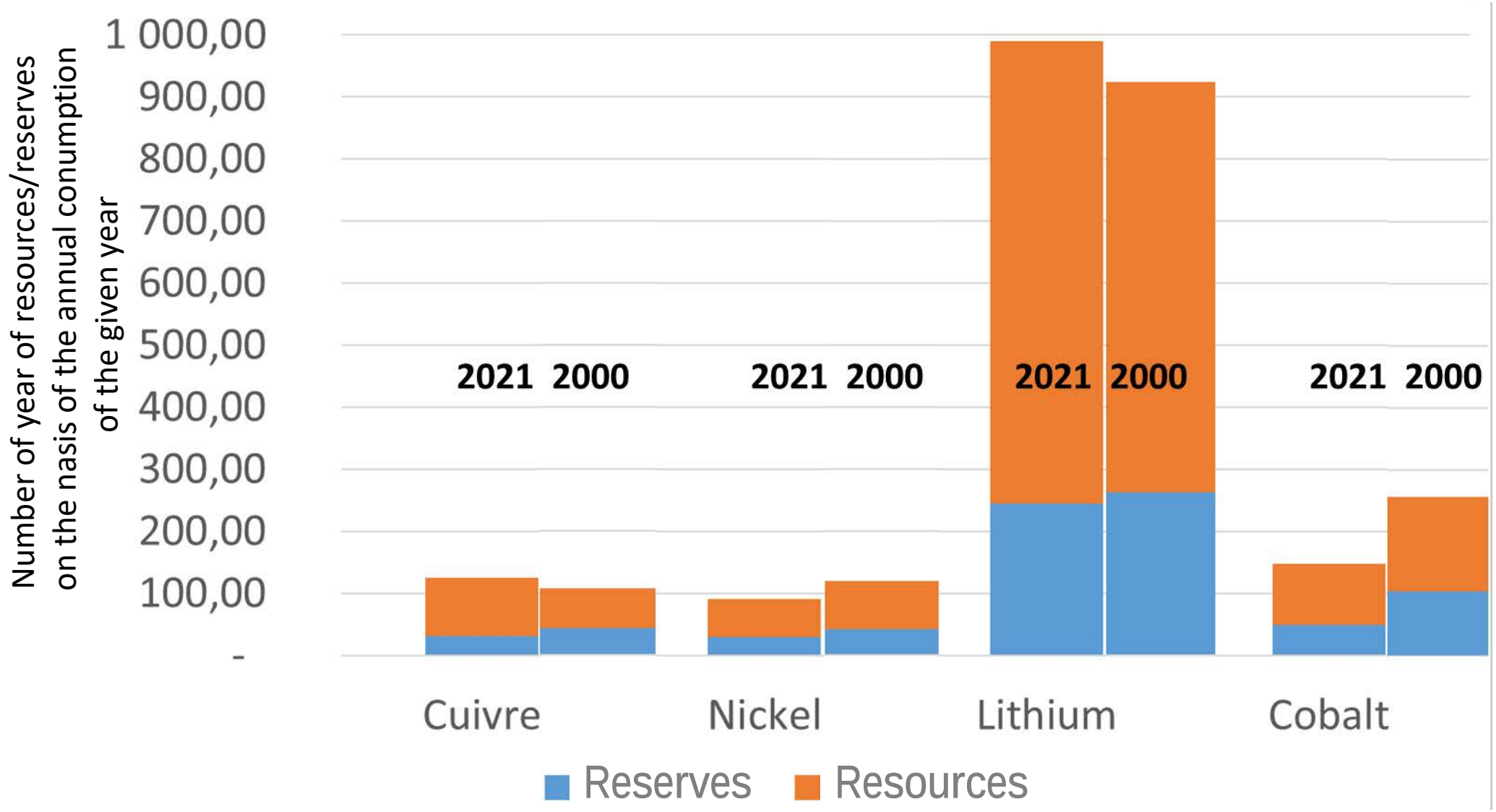

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Energy transition Limits

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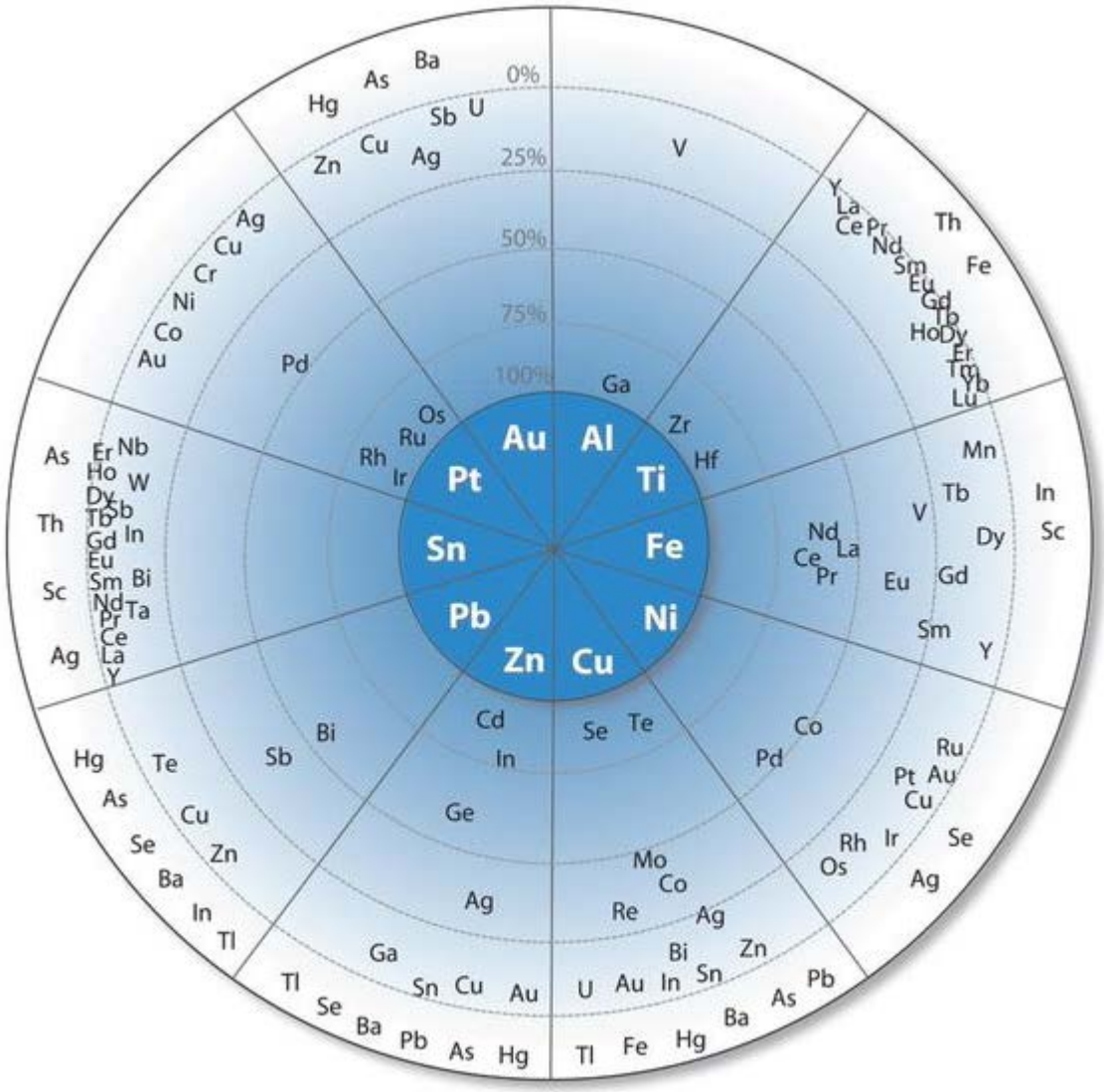
Limit 1 – In their majority, critical metals are not extracted for themselves



N. T. Nassar et al. Sci Adv 2015;1:e1400180

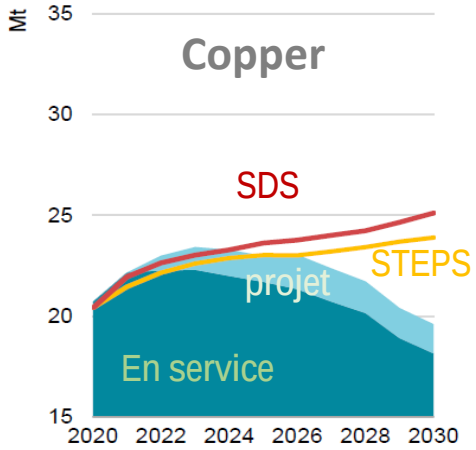
« Small » metals depend on the production of a « carrier metal » from geological or metallurgical sources

- Cobalt and copper, cobalt and nickel
- Gallium and Aluminium
- Platinum and Palladium, Rhodium, **Iridium**

➔**inelasticity of supply and complexity of markets**

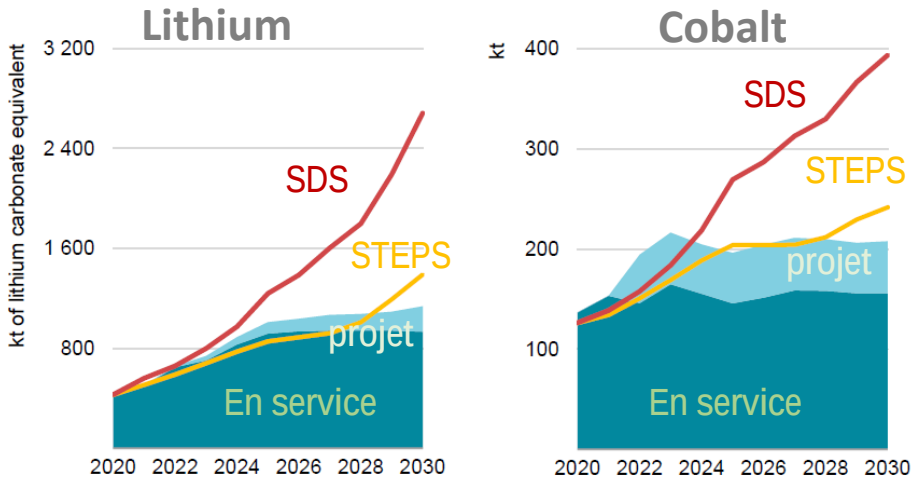
Limit 2 – Resource availability in due time

- Demand very much higher than production capacities by 2030



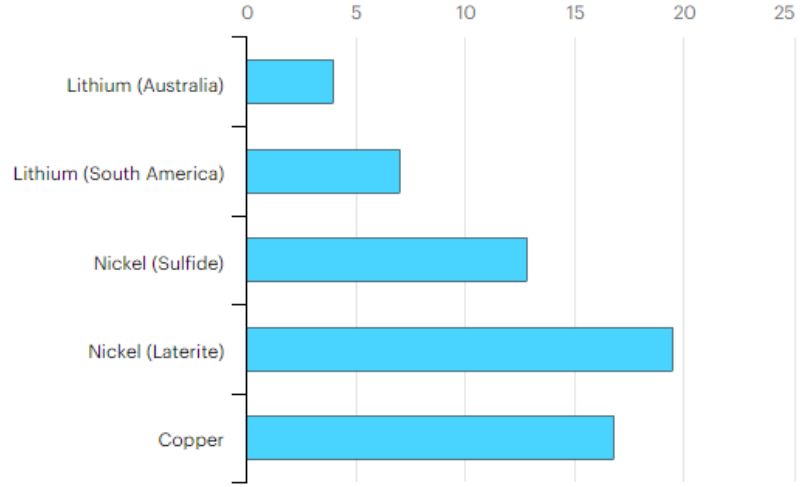
STEPS: stated policies scenarios

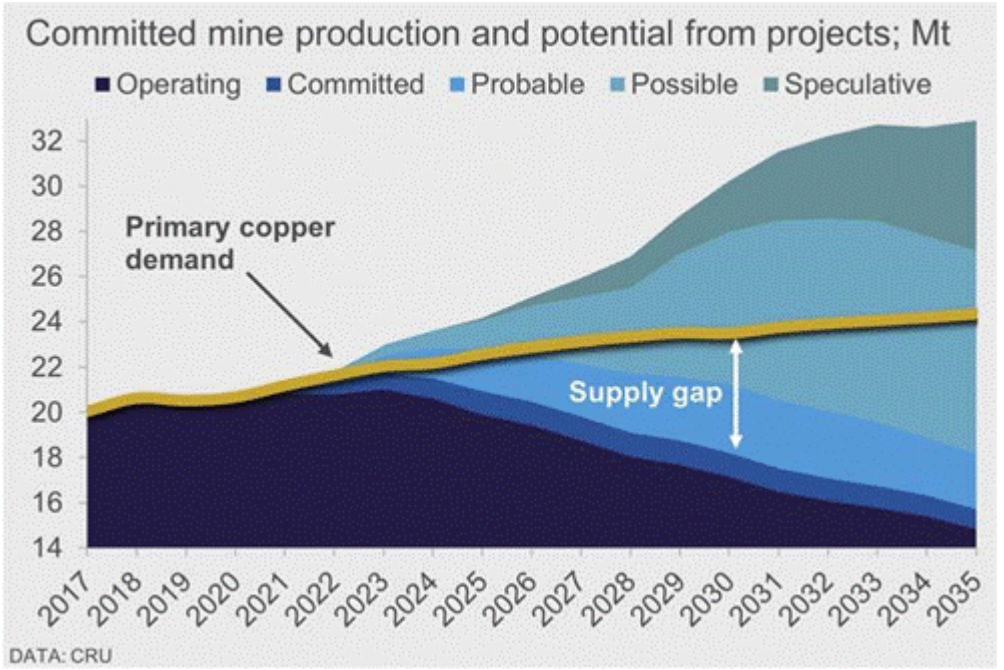
SDS : Sustainable development scenario (1,5°C)



IEA. Licence: CC BY 4.0

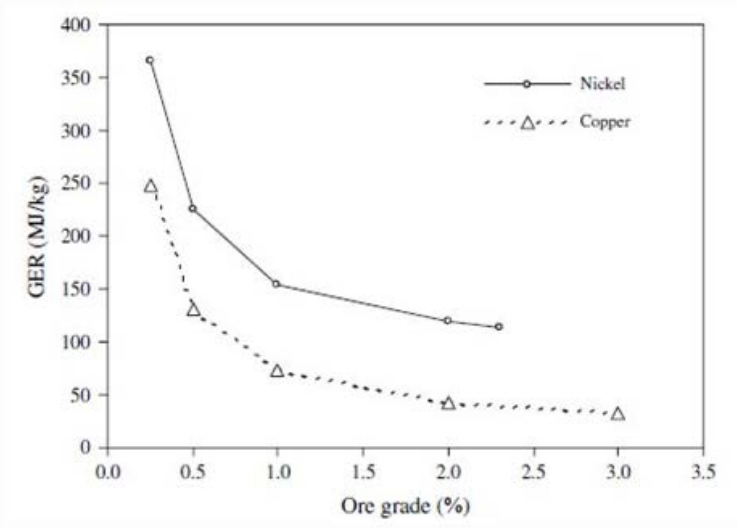
Average time to open a mine from the discovery to the first production

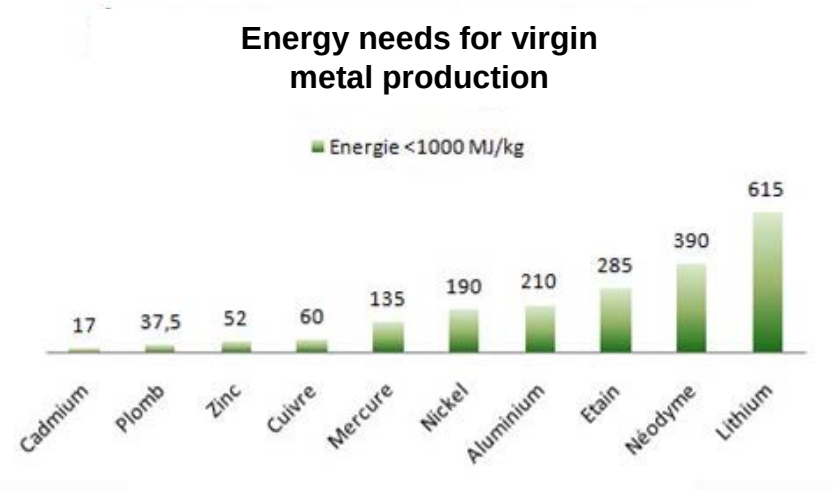


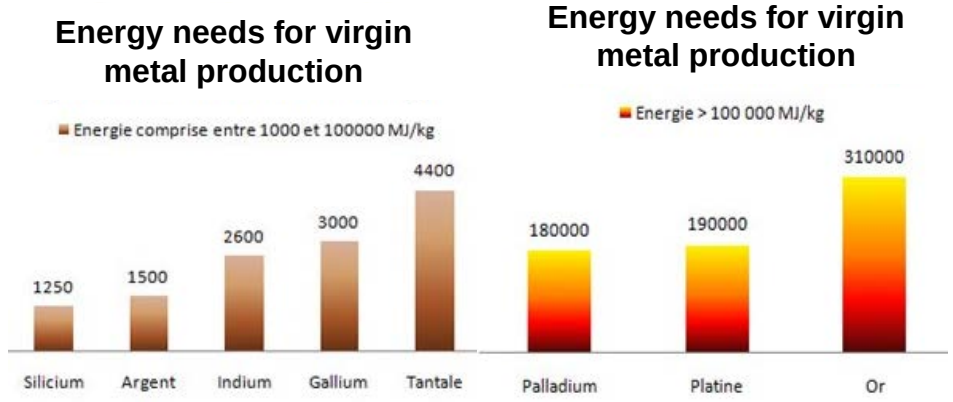


Limit 3 – Accessibility to resources at sustainable energetic and economic costs

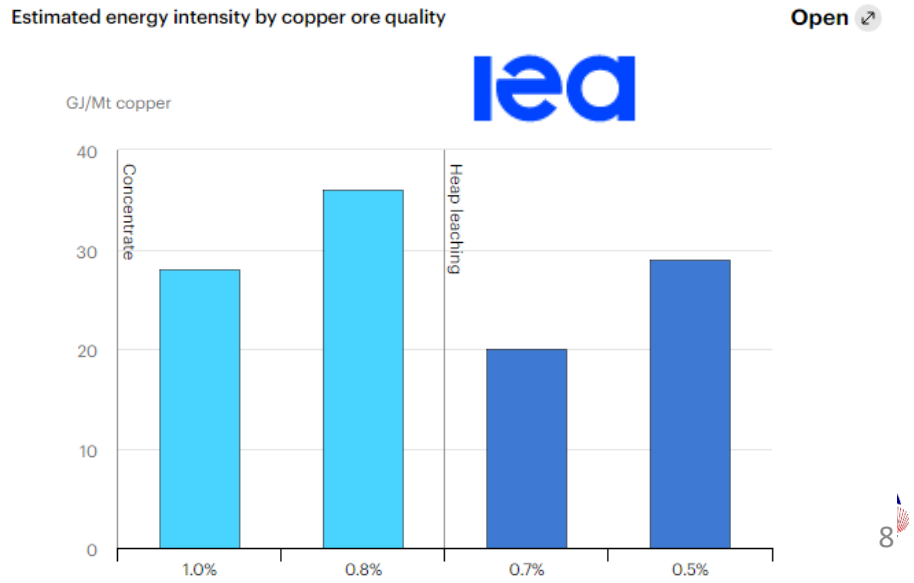
10% the global primary energy is used to extract and refine raw materials







The cost…
But also the impacts!
Environmental
Social
Governance
Reputational issue!



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Limit 4 – Localisation of the supply chains

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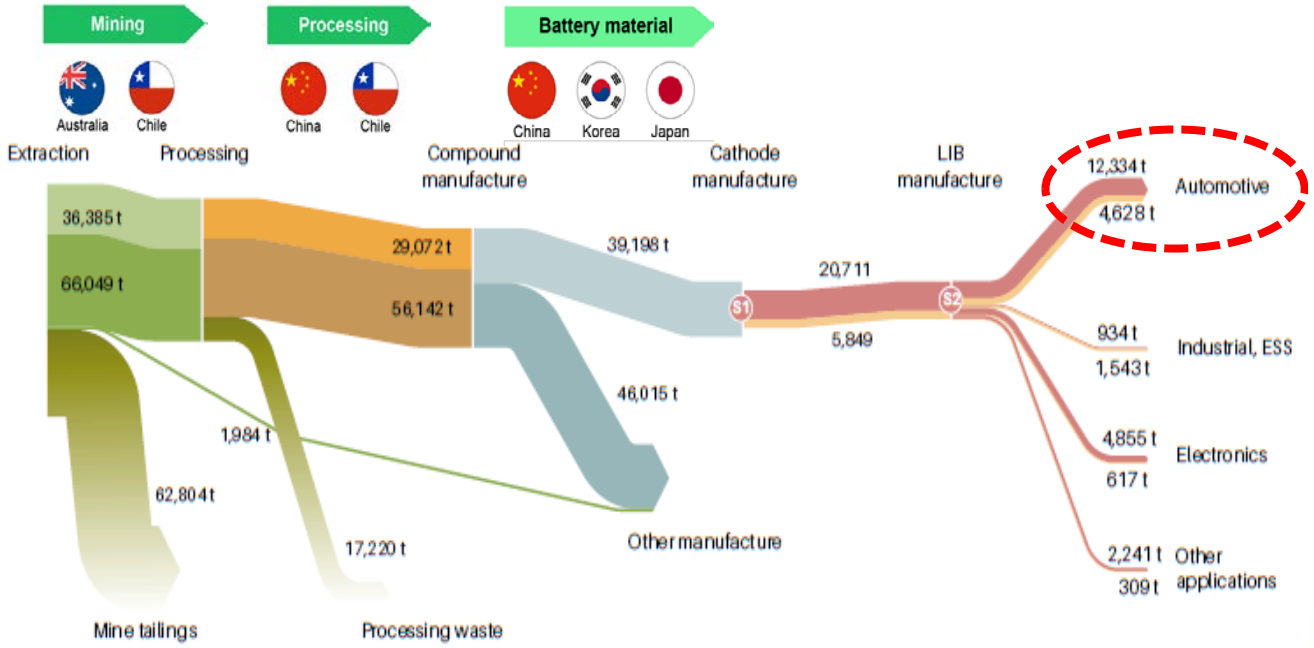
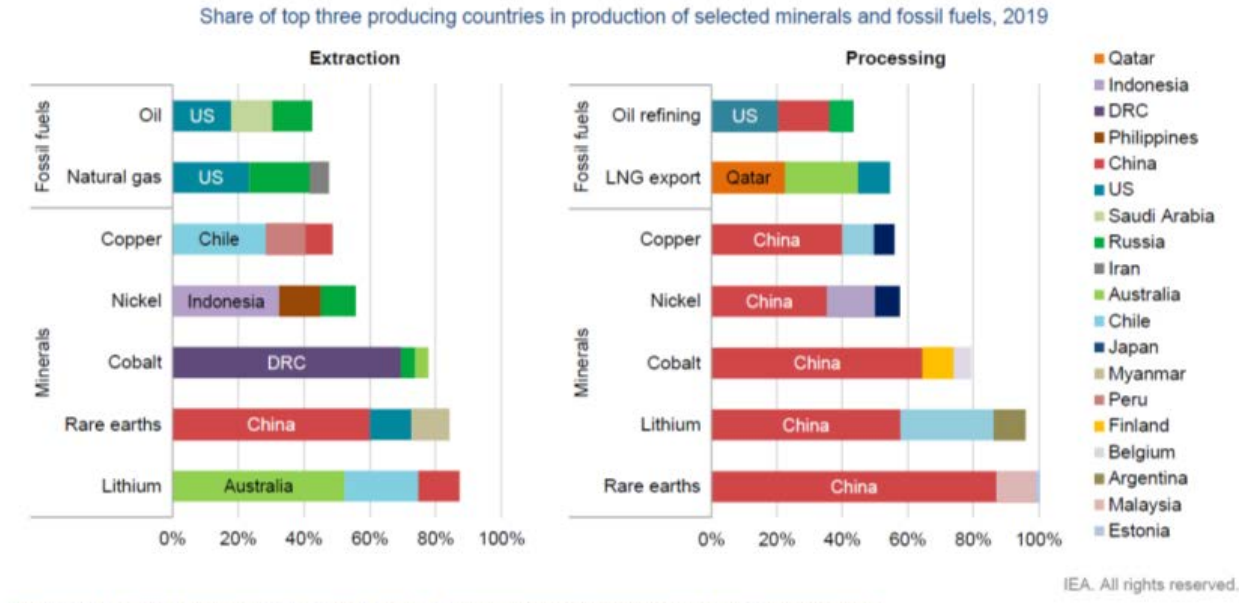


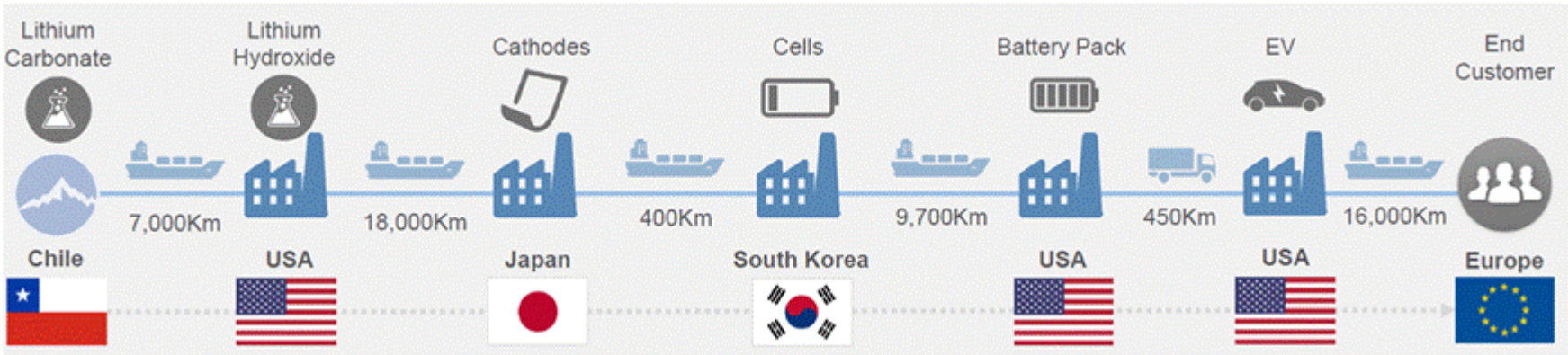


Notes: LNG = liquefied natural gas; US = United States. The values for copper processing are for refining operations.
Sources: IEA (2020a); USGS (2021), World Bureau of Metal Statistics (2020); Adamas Intelligence (2020).

Legend
- Li brine
- Li hard rock mineral production
- Waste
- Li carbonate_brine
- Li carbonate_spodumene
- Li compounds_battery grade
- Li compounds_other grade
- LIB cathodes/batteries
- LFP cathodes/batteries

S1 18,000 t
S2 S2: 6,750 t

The lithium inside you car travels more than **50,000km** before you even start driving*



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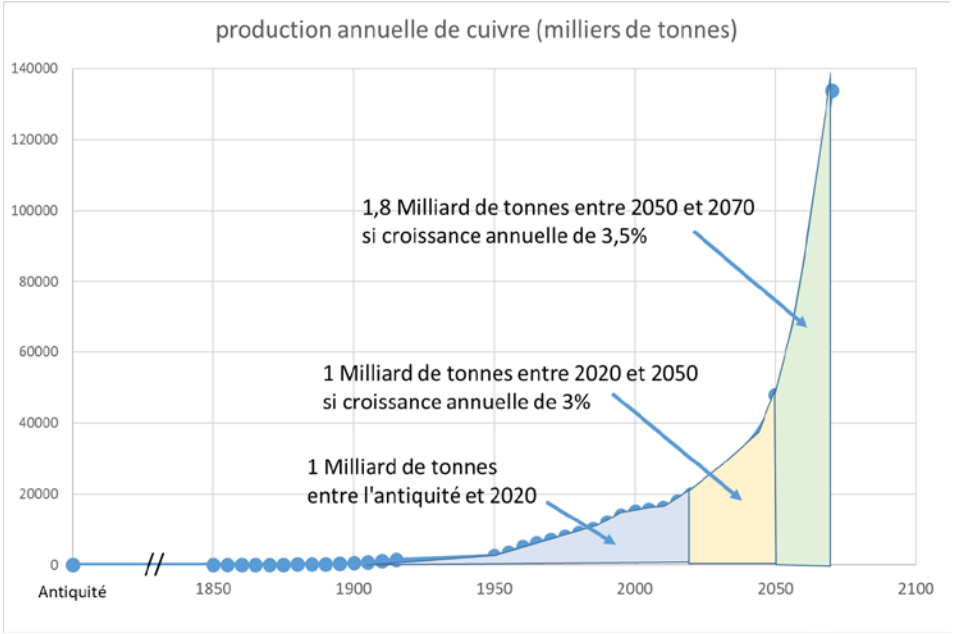
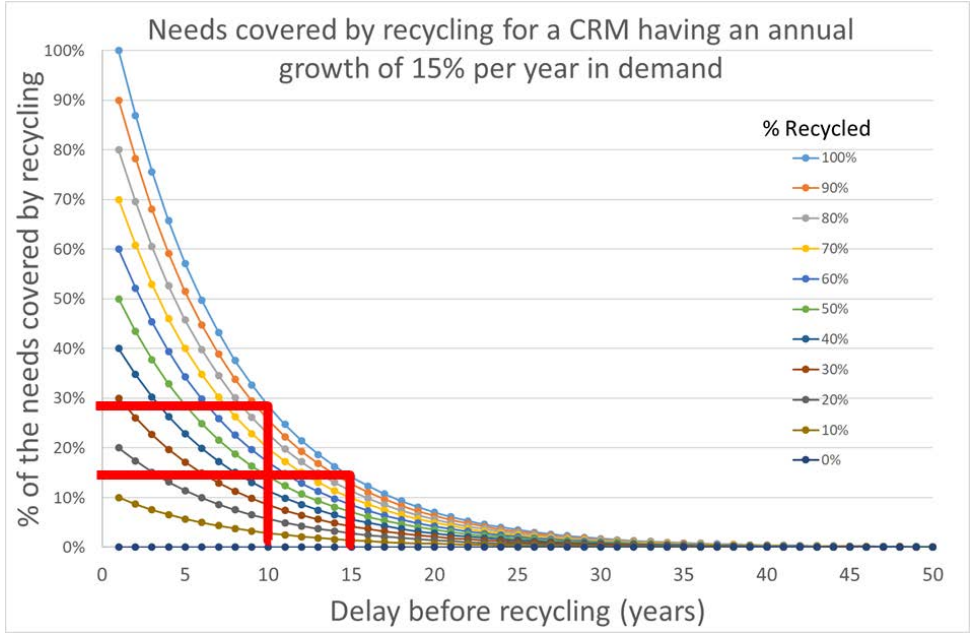
Limit 5 – Overestimation of the role of recycling for sovereignty and resilience

Copper



Recycling all the copper produced from the Antiquity to 2020 would not be enough to answer our needs between 2020 and 2050

Metals for energy transition



In a growing market about 15% per year, reycling of end of life products made 15 years earlier would only cover 12,5% of the needs

Mine = stock

Known, characterized, anticipated,
Production according to demand

Recycling = flux

Variable, evolving, random,
Production 10, 15 or even 20 years before demand

Recycling is compulsory for a sustainable use of resources

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Energy transition
Make it reality

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Levers (illustration)

Think in terms of (sustainable) use and not in terms of technological solution

- inter modal mobility offer, car sharing, car pooling…
- mobility adapted to the territorial situation

Use the right technology for the right use (“right-tech”, “just tech” or “fair tech”)

- city-car ➔ < 100km/day ➔ 20 kWh battery ➔ LFP or Na-ion
- long distance driver (eg taxi) ➔ 600km/day ➔ 100kWh battery ➔ NMC811

Innovation

- R&D&I: in materials sciences: soon, less rare earth per kg of magnet for the same efficiency and performance (/3)
- Invest in breakthrough technologies but in a global value chain approach
(not exotic, realistic, scalable, and cost-effective) ➔ informed and trained researchers
- New business models to promote new value chains (vertical integration, concept of insurance based on the cost of inaction approach)

But be careful of

Rebound effects
Competition of uses
Technologies relying on (exotic) metals (where we do not/cannot control the production)
Do not forget the digital transition…

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