Critical materials for the energy transition

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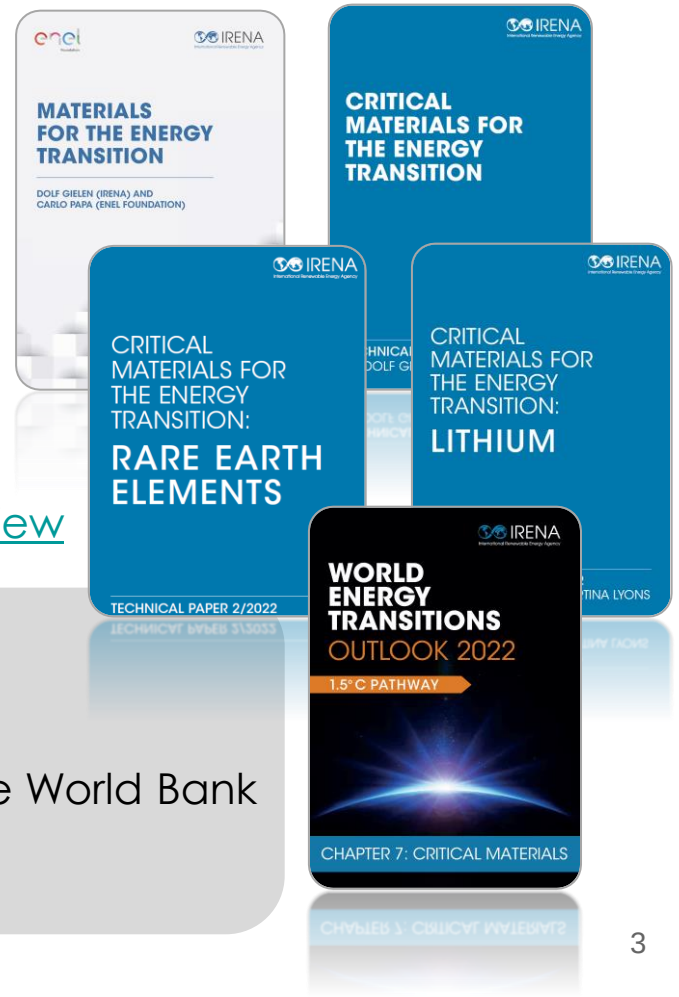
Innovation for Cool Earth Forum (ICEF) 9th Annual Meeting
4-5 October 2022

The problem

- Energy transition with today's technology **requires rapid growth** of critical materials **supply**
- The **resources are available**
- **Rising prices** indicate scarcity
- However the development of new mines faces opposition
  - Environmental
  - Social
  - Unconventional resources are unclear
- Pr**oduct quality** can be a problem
- Typical **mine development and growth** is not commensurate with the foreseen demand growth
- Can **innovation** mitigate demand growth?

IRENA work to date

- IRENA Assembly January 2022 provided a mandate for Agency work on critical materials
- Launch Collaborative Framework Critical Materials February 2022
  - Around 40 countries participate actively
- To date:
  - Scoping paper – together with ENEL Foundation – October 2021
  - Technical paper critical materials – November 2021
  - Deep dive lithium – February 2022
  - Deep dive rare earth elements – March 2022
  - Chapter 7 World Energy Transitions Outlook 2022 – March 2022
  - Nickel editorial
  - Editorials on critical materials in energy-post , smart-energy and mining review



- **Upcoming**:
  - Deep dive into **EV battery manufacturing**
  - Deep dive **sustainable critical materials supply in Southern Africa** – with the World Bank
  - Overview of **supply chain** of energy-related critical materials and minerals

Collaborative Framework & working groups

Aim: develop a set of activities to:

- support a better **understanding** of the role and market dynamics of critical materials to sustain the energy transition,
- facilitate **discussion** among the different groups,
- Establish a **list of experts** across Members and stakeholders, and
- assist in systematizing and disseminating **knowledge**.

Observatory

Collect data that help **understand scarcity and potential supply shortages** that may affect the energy transition in the coming decade

De-risking supply

Develop and apply **strategies to de-risk supply**

ESG & mining

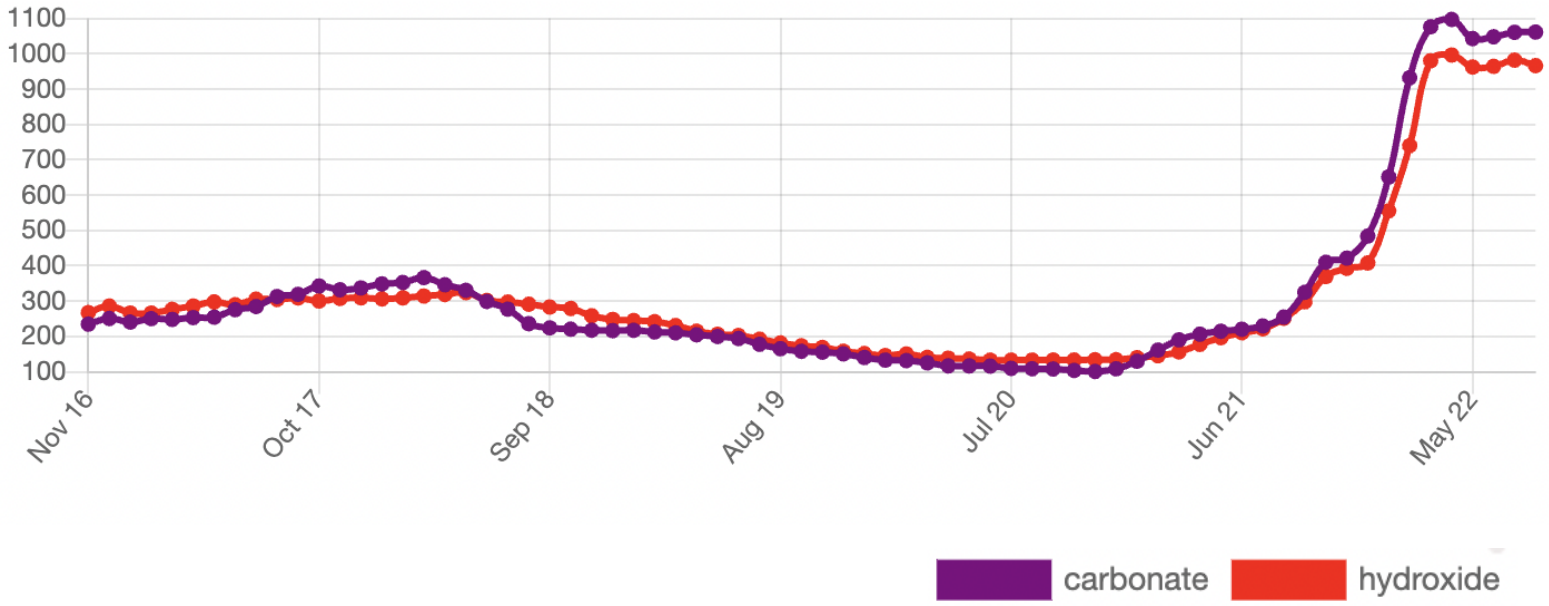
Develop strategies to **raise acceptance for new mining projects**

Example: Lithium Market

The price of lithium, often expressed in LCE, has experienced **steep changes in recent years**.

Since early 2021, prices have seen a **450%-480% increase**, with lithium **hydroxide** prices reaching **USD 76/kg** and lithium **carbonate** prices **USD 60/kg** in September 2022

Lithium Price Index Sep 2019 – Sep 2022



Lithium supply and demand in 2021

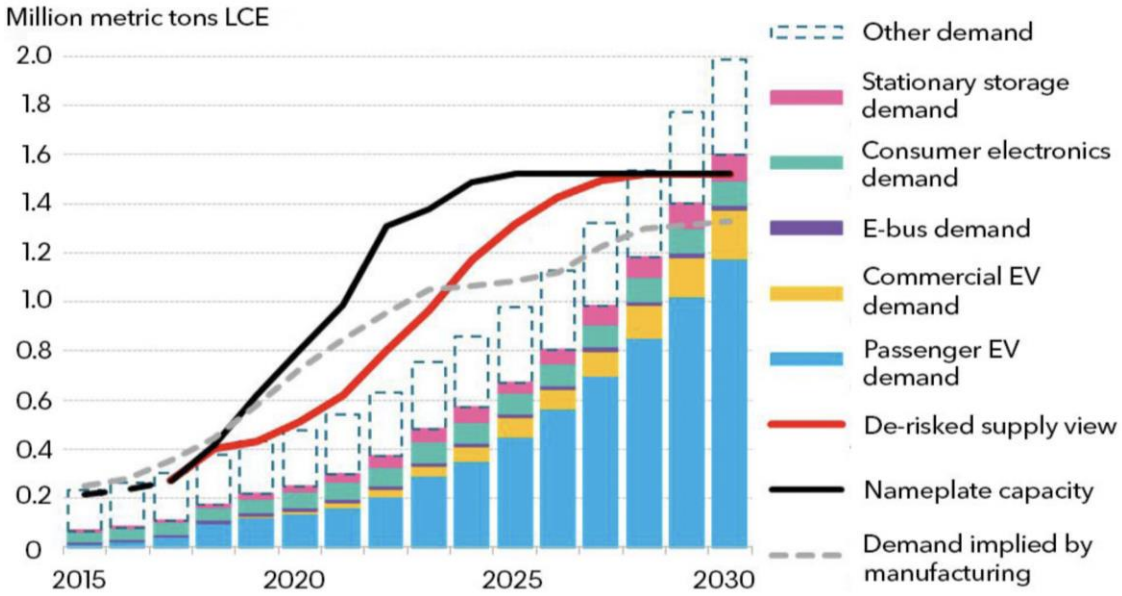
Lithium production reached 0.10 Mt, or ~0.532 Mt LCE, **21% higher than 2020**.

Lithium demand reached 0.09 Mt, **33% higher than 2020.**

Lithium supply and demand forecasts

Demand

Lithium Demand Forecast towards 2030



Source: BNEF

- Significant demand uncertainty – BNEF and S&P expect lithium **demand** to reach **2 Mt LCE by 2030 (x4)**, McKinsey expects **it to surpass 3 Mt (x6) by 2030.**
- **Supply:** primary (from **mining**) and secondary (**recycling**) → not until 2040 (and there at max 40%)

Supply

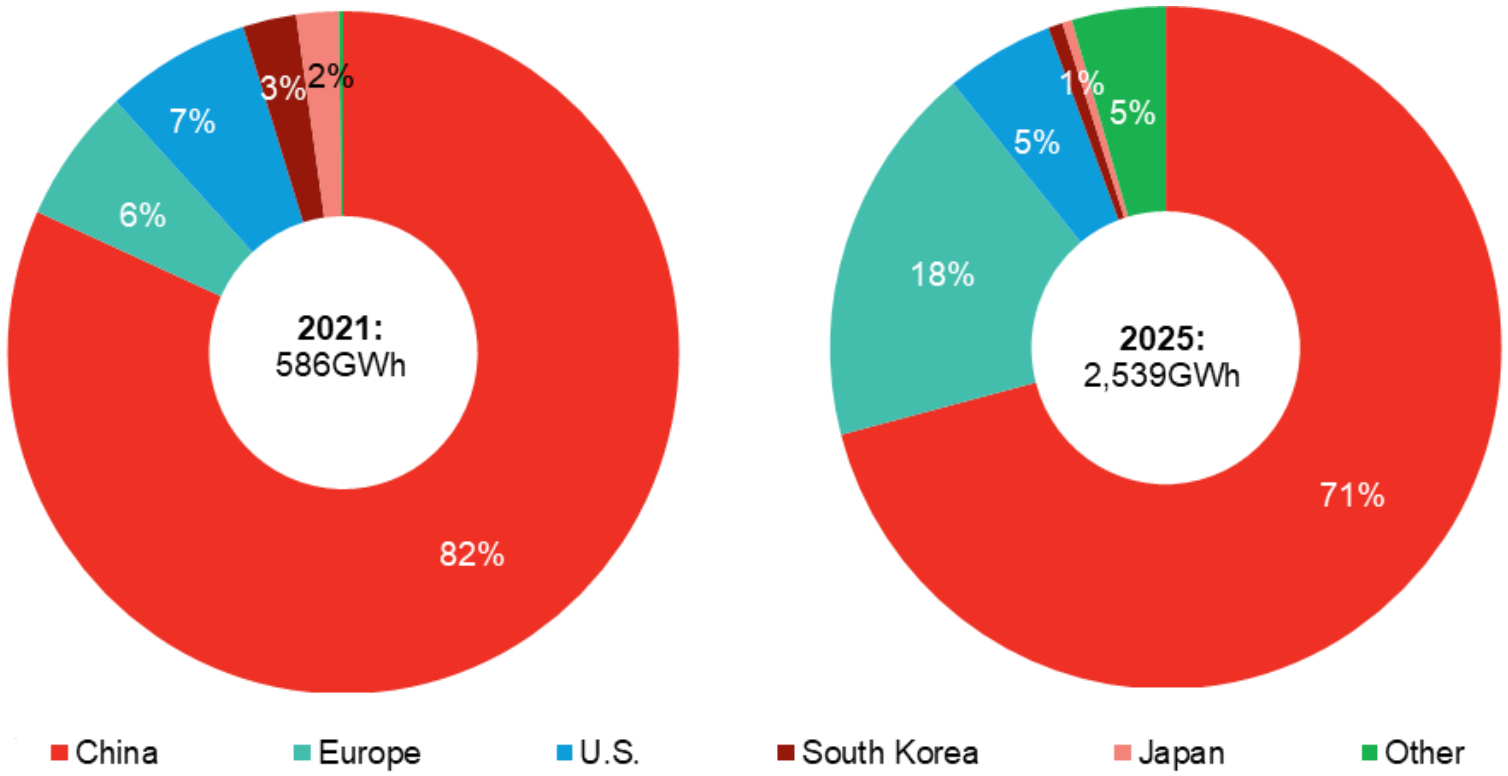
Future mine capacity and their outputs by 2030

Source: S&P

- Lithium supply is expected to **triple by 2025.**
- **Australia** is set to maintain dominance – production is expected to **increase by 139% towards 2025**.
- **South American** production is expected to **increase by 200%** in the same time period.
- Lithium supply can likely switch to deficit if additional projects are not added to the pipeline to meet 2030 demand.
- **China** holding 80% of battery manufacturing capacity

Rapid demand growth this decade: example battery manufacturing

Quadrupling in only 4 years



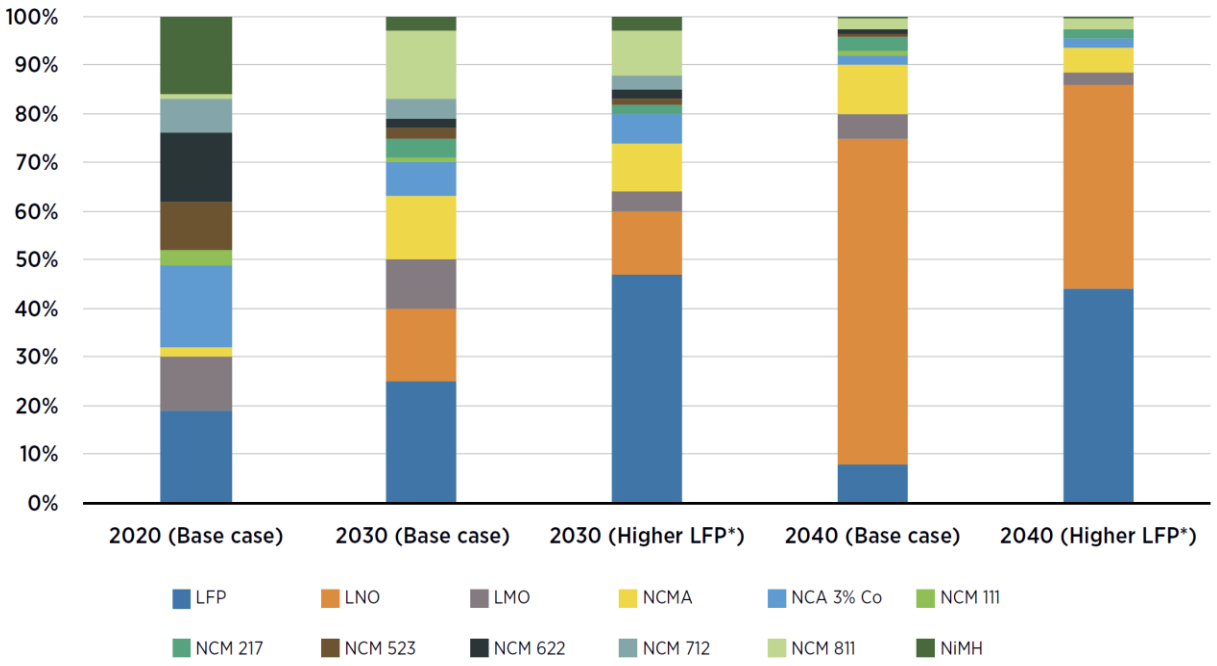
Source: BNEF

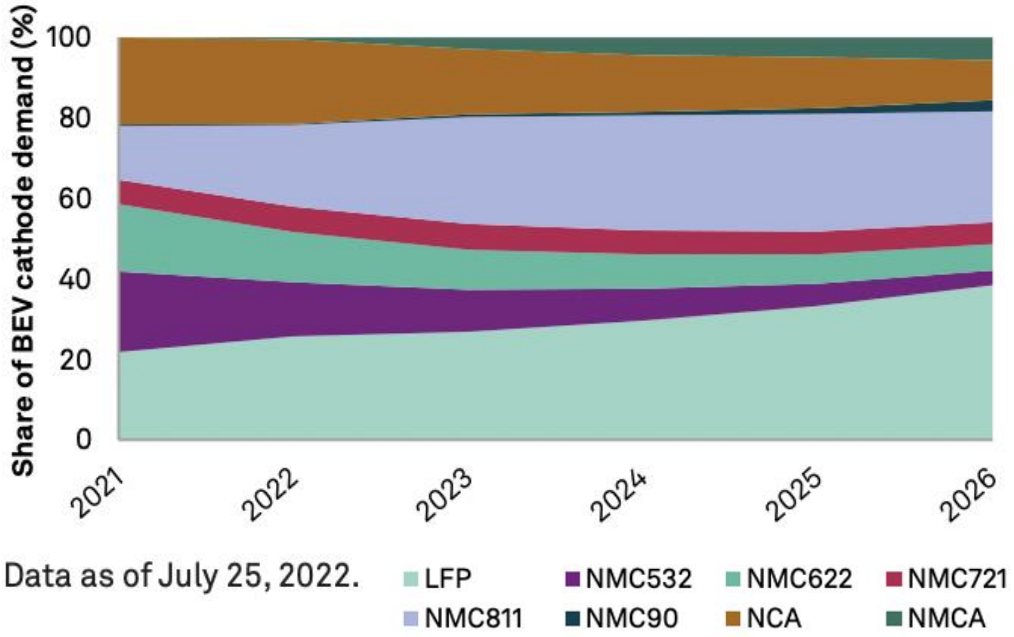
EV battery cathode material scenarios

Nickel-rich NMC or LFP?

Lithium needed in all of them (7-11% of battery mass), but prices and performance and safety differ

At present price nearly 4000 USD nickel in a car battery

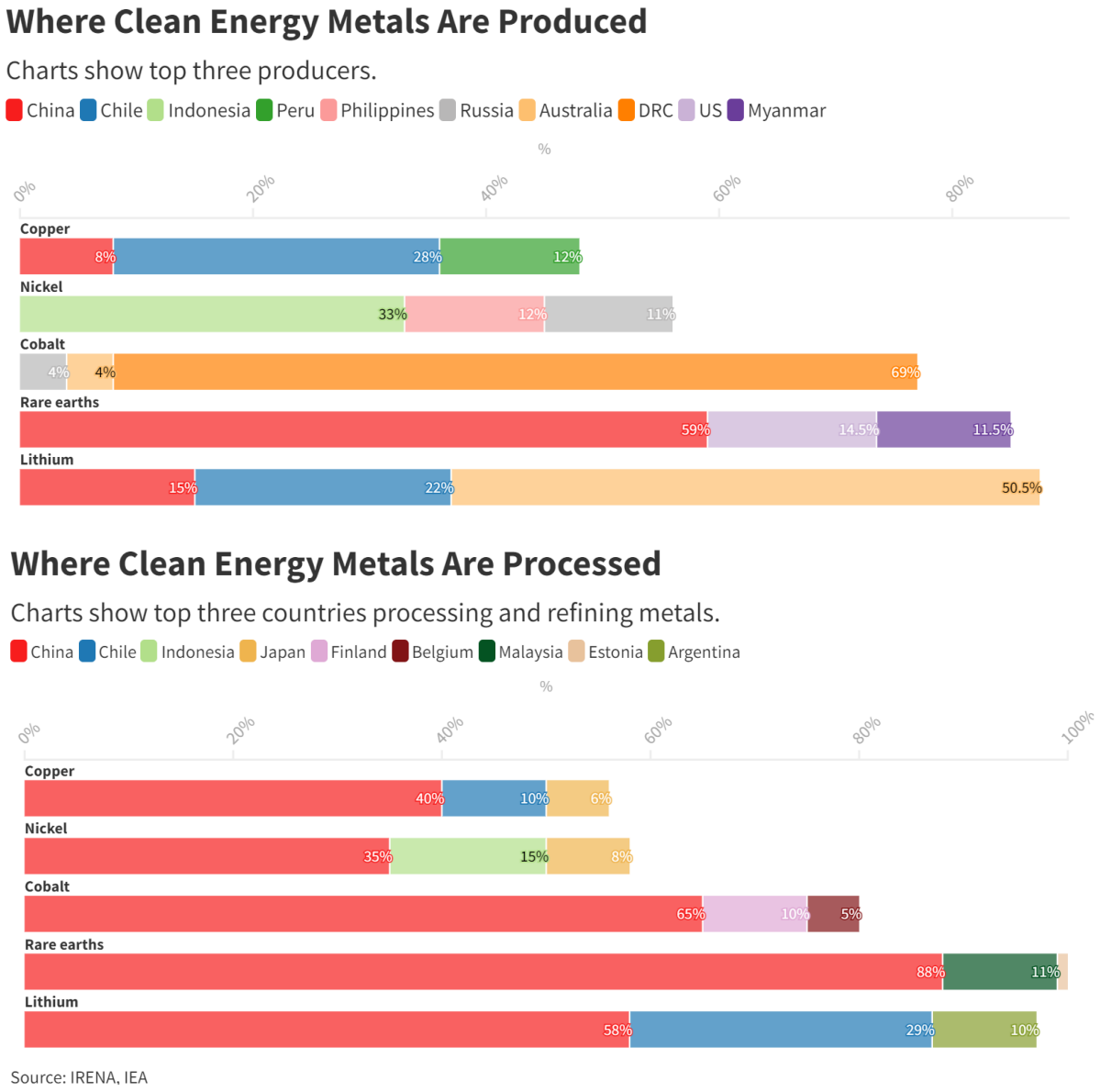




Source: S&P

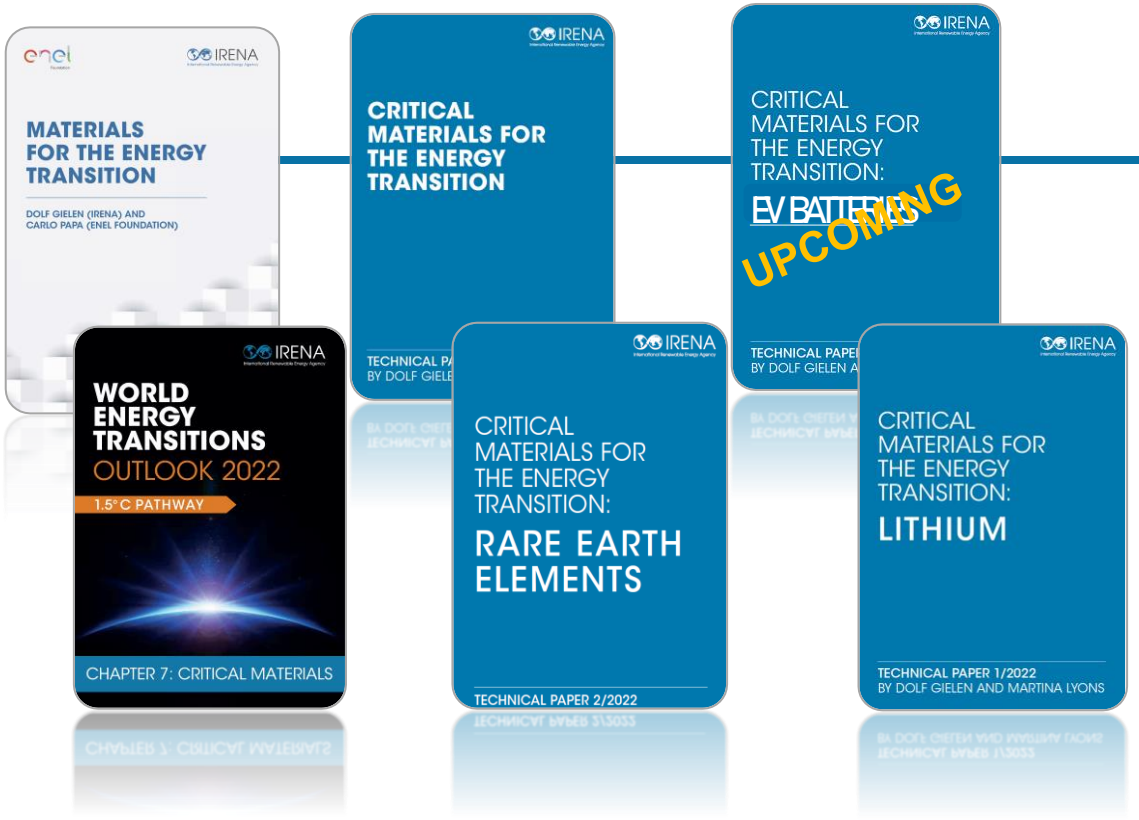
Mitigating supply risks

- Mining sites depend on the resource quality
- **Processing is concentrated in a few countries**, namely China
- China is also the largest consumer of critical materials
- Efforts to **diversify the supply**, processing close to mining sites
- ESG of mining operation still not a given
- Need for environmentally and socially sustainable supply structures
- An opportunity to use renewable energy



Conclusion

- There are enough critical material resources to drive the energy transition
- However, there are **risks that need to be mitigated**:
  - The ability to **increase supply quickly enough** to meet growing demand
  - The availability of **high-quality products**
  - The capacity to **diversify mining and processing** of materials
  - Diversify supply: increase **mining and recycling**
- **Product innovation** can alleviate these risks through **reducing** demand and **substituting** critical materials with more abundant elements.
- **Leveraging existing initiatives** and **increasing cooperation** among governments, academia, and the private sector needed to boost innovation



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International Renewable Energy Agency

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