



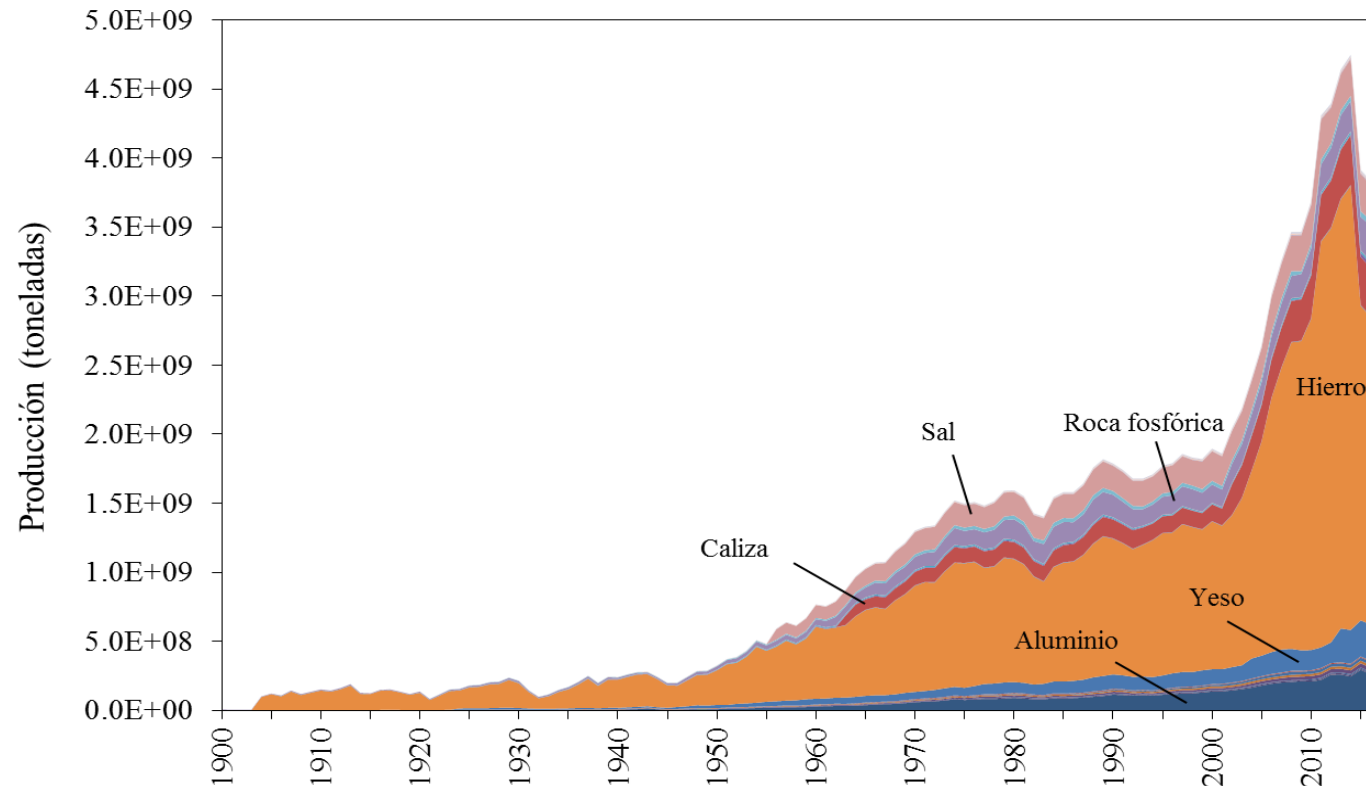
Instituto Universitario de Investigación Mixto de la  
**Energía y Eficiencia de los  
Recursos de Aragón**  
**Universidad Zaragoza**

**LASER Talks in Ispra: Entanglement of Desert Water: on the  
water conflict between demands for energy transition and  
rights of a fragile ecosystem**

Alicia Valero Delgado

**energaia**

# Exponential extraction of raw materials



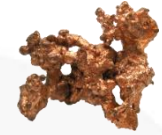
**Total world cumulative production of 48 minerals and elements from 1900 to 2016. Only the names of those minerals with the greatest weight are shown in the figure.** Source: Valero, A.; Valero A.; Calvo, G. (2021). *Thanatia: Límites materiales de la transición energética*. Prensas de la Universidad de Zaragoza.

# Exponential demand of raw materials

**Nature's depredation is growing at a rate of 2.8% per year. In one generation we will consume twice as much as we do today and in 25 years we will have consumed as much as in the entire history of mankind.**

## Exponential extraction of raw materials 21<sup>st</sup> century

**During the 21st century we have extracted as much copper as in the whole history!**



**Gold (electronics, jewellery...): 0,5 times**

**Silver (solar energy, electronics, jewellery...): 0,6 times**

**Zinc (steel, metallic parts,...): 0,8 times**

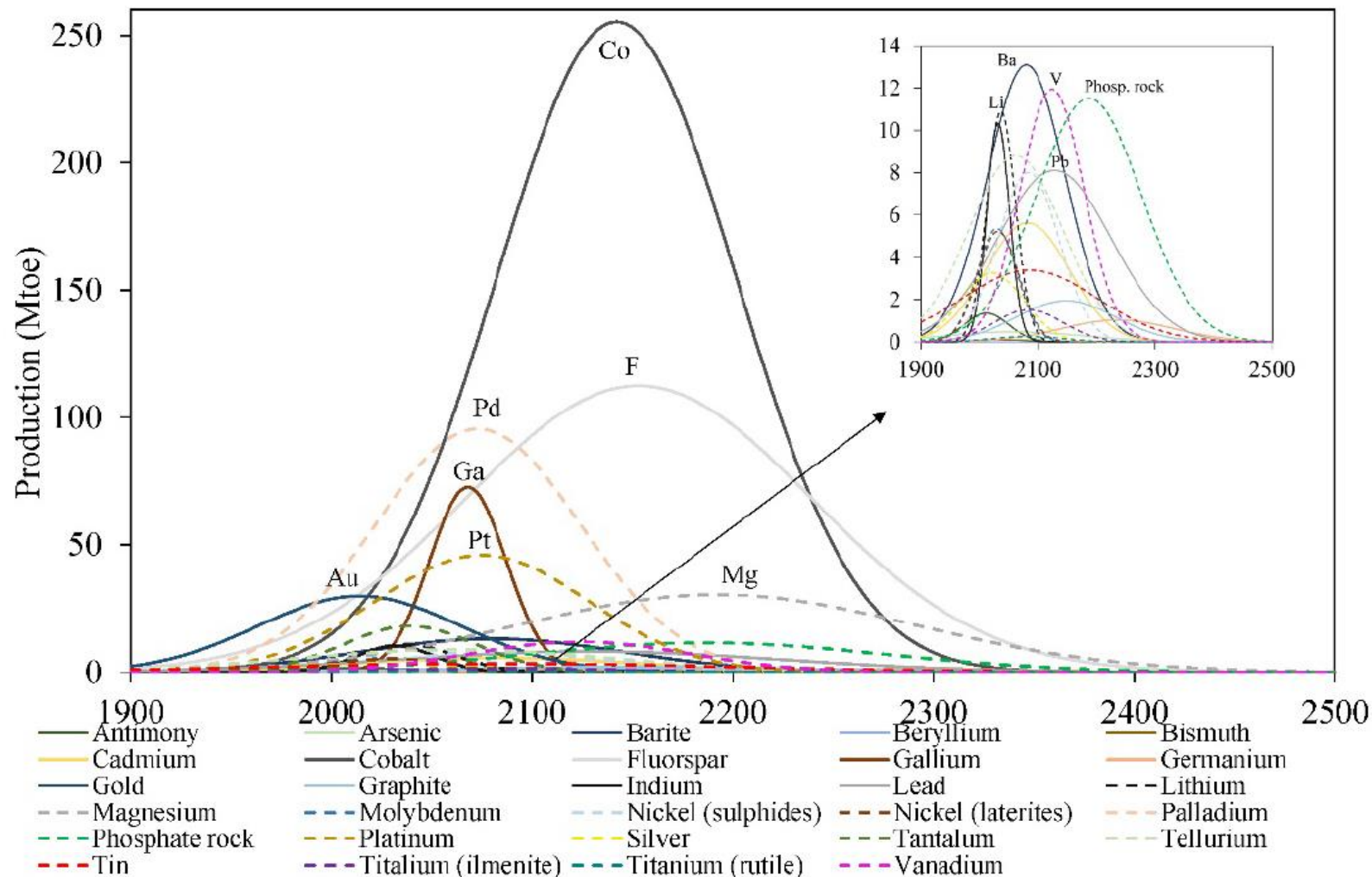
**Nickel (steel, batteries,...): 1,2 times!**

**Cobalt (batteries, paintings, engines...): 1,56 times!**

**Lithium (batteries,...): 1,93 times!**

**The shortage of raw materials and supply disruption is not a one-off issue, it is a structural problem.**

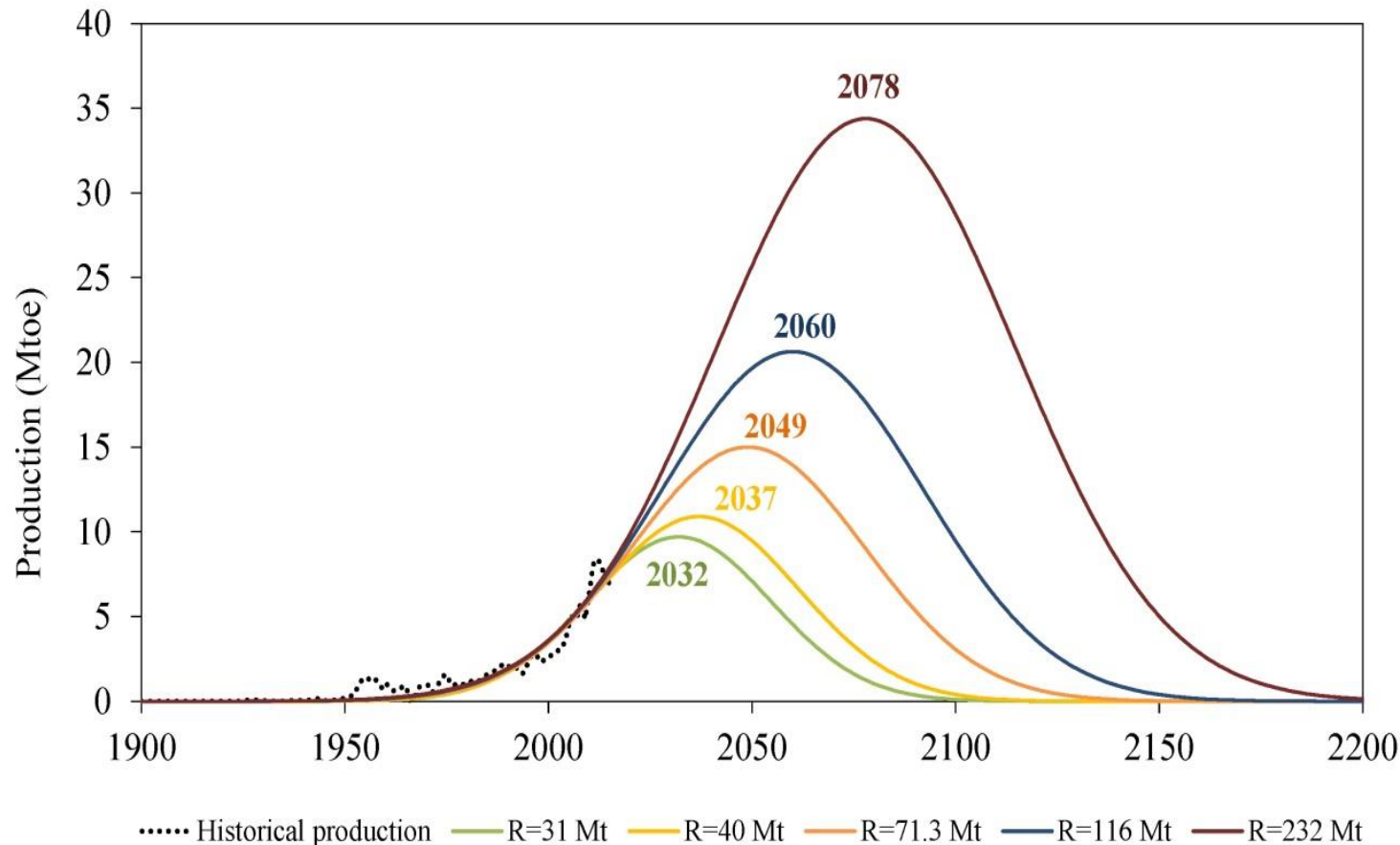
# Mineral deposits get exhausted



The production peak of most essential minerals could be reached before the end of the 21st century

Source: Calvo, Valero and Valero. Assessing maximum production peak and resource availability of non-fuel mineral resources: Analyzing the influence of extractable global resources. <http://dx.doi.org/10.1016/j.resconrec.2017.06.009>

# Example: lithium – future availability projections



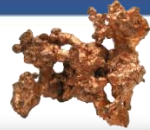
**Lithium maximum production peak with different resources estimations**

Source: Calvo, Valero and Valero. Assessing maximum production peak and resource availability of non-fuel mineral resources: Analyzing the influence of extractable global resources.  
<http://dx.doi.org/10.1016/j.resconrec.2017.06.009>



# Total energy consumption (GJ/t vs. ore grade)

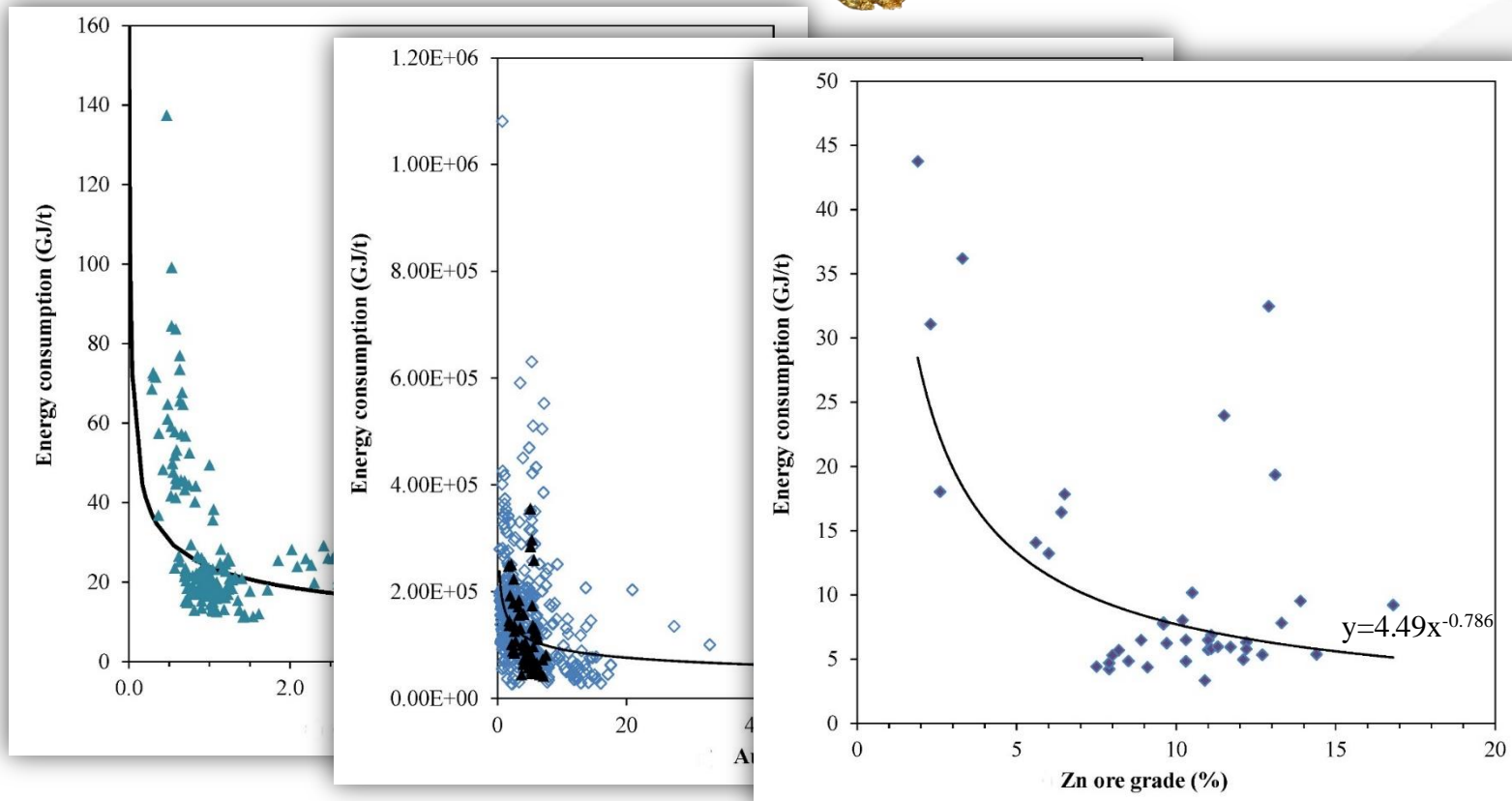
Copper



Gold

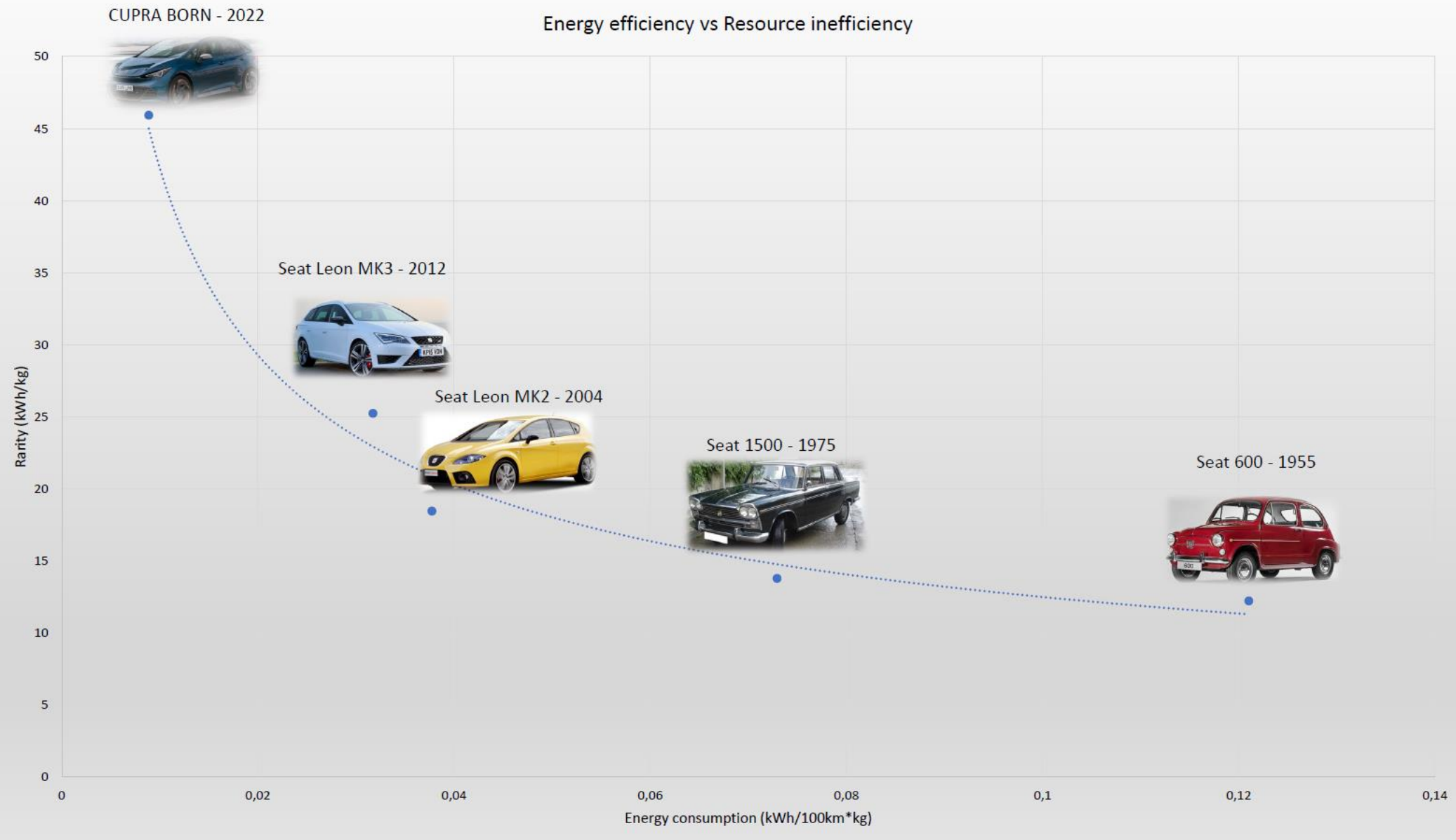


Zinc



Energy for mining is mostly based on fossil fuels. This means that global GhG emissions associated to mining will increase.

### Energy efficiency vs Resource inefficiency



Source: own elaboration (CIRCE Institute)



How can humans deal more fairly with contested resources such as groundwater, and in particular in this case where there is such an urgent human demand, and such a unique ecology?

The age of abundance is over. Raw materials supply decline. It is not only a matter of the economy, it is the ecology, it is physics, it is the **SECOND LAW**

# BACK TO THE ROOTS, BACK TO THE FUTURE

## TOWARDS A “BOTIJO” ENGINEERING

### Efficiency in products



Clay jug

- Keeps water cool (energy efficient)
- Simple design
- Local and cheap materials
- Robust
- Easy to repair and recycle (just 1 material)
- Creates a sense of community (Sharing)

# DIS-FACTORY

## Efficiency in processes

Example of the automotive industry:

- A car factory produces a car every 2 minutes
- Yet the same factory is unable to dismantle a single car!



**In the design of products, make sure your production line is able to dismantle that same product**

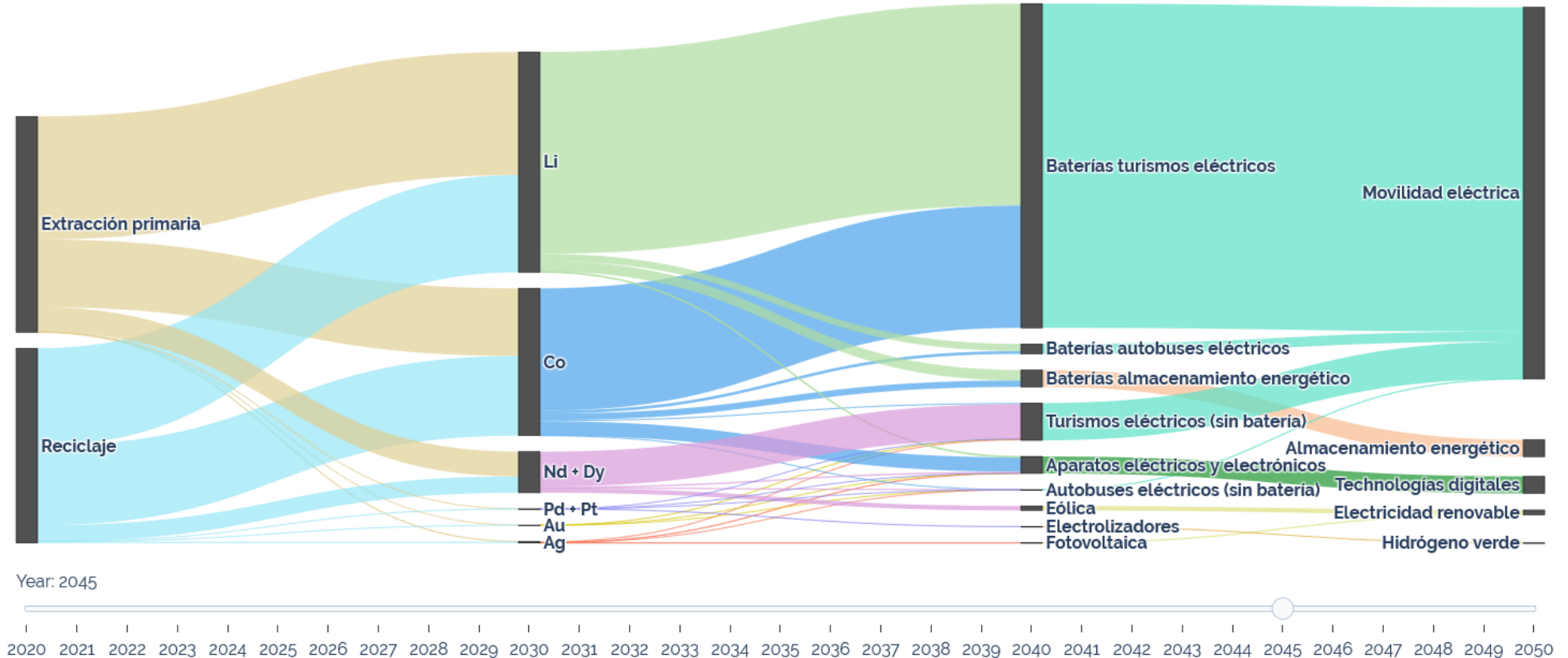
**Part to part strategy: For a true circular-spiral economy, a product should not be a source of materials but a source of spare parts!!!**

# Recycling is not sufficient

**For the case of Spain, recycling could cover ~57% of CRM demand of clean transition technologies by 2050**

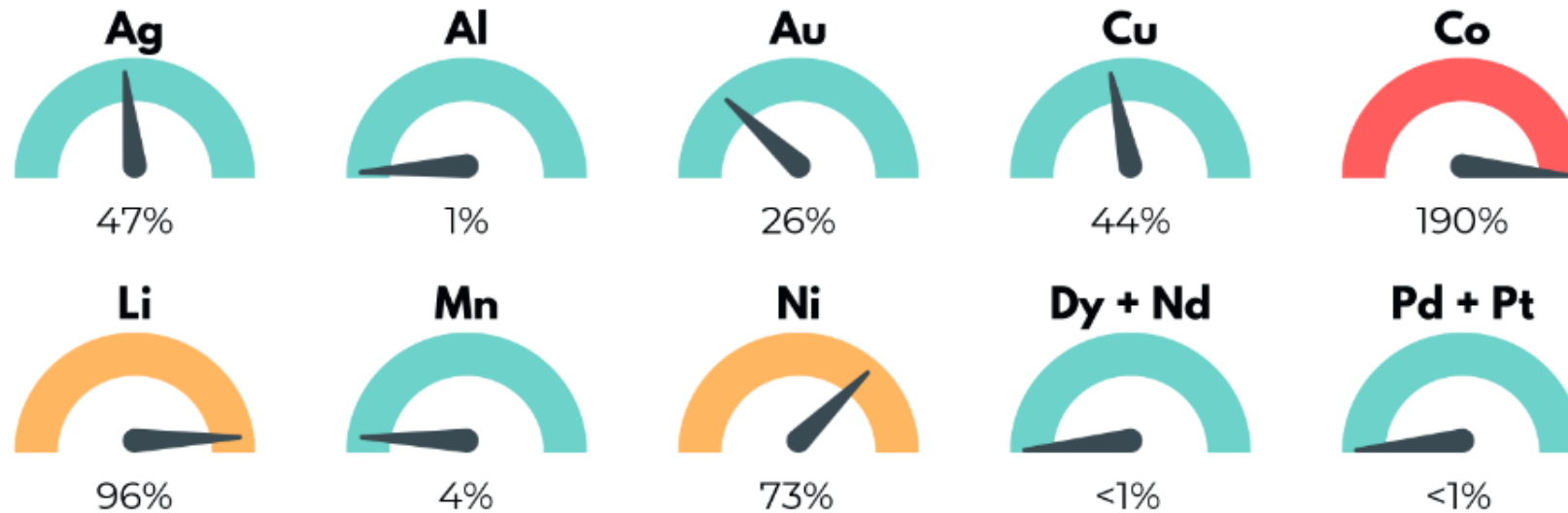
Demanda anual [t]

Lallana, Torrubia & Valero (2023). Metals for energy & digital transition in Spain: demand, recycling and sufficiency alternatives



# Demand exceeds supply and the equitable fraction of global reserves

Distribution by technologies of the cumulative metal demand 2020-2050 considering high recycling rate



Spanish population:  
 0,6% world  
 population → **Equitable  
 fraction of global  
 reserves: 0,6% global  
 reserves(USGS, 2022)**



# Selling Nature's cathedrals for the price of bricks

- **GDP and other economic indicators do not take the effort by Nature to produce resources and future generations into account. The scarcer, the greater the debt to Nature.**



Source: wikimedia commons



- **Natural capital is a natural heritage of those who live today but also of those who will be born. It must be valued fairly in order to create a true sense of conservation and intergenerational justice!**

# How can humans deal more fairly with contested resources?

- ✓ From efficiency to sufficiency:
  - Rethink human needs → reduce consumption.
- ✓ From extraction to regeneration:
  - Adequately value nature's goods: Responsibility to future generations → what resources will be left?
- ✓ From accumulation to distribution:
  - Social justice