Artisanal & Small-Scale Mining – Reducing Risks in Rapid Response Swing Producers of Climate-Critical Minerals

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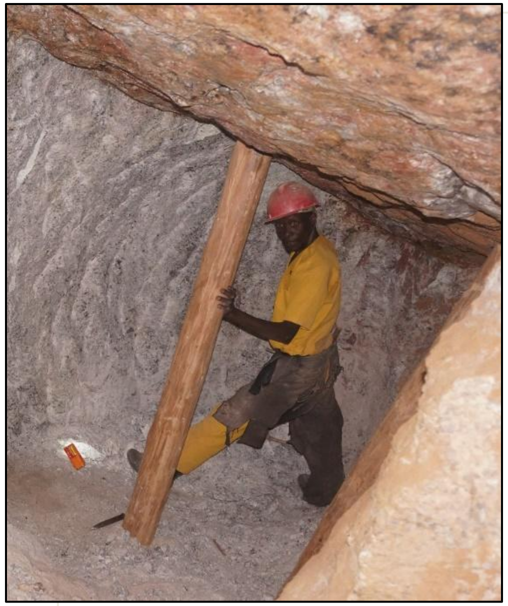
Key Questions

- Can ASM be a swing producer of CRMs in a way that avoids introducing non-responsible minerals and metals into the supply chain?
- Can responsible ASM production of CRMs be scaled-up?

ASM gold production in Ghana

ASM



ASM 3T mining in Rwanda

10 M in Africa

44.7 Million directly employed globally (up from 6 M in the 1990s)

130 Million livelihoods supported globally

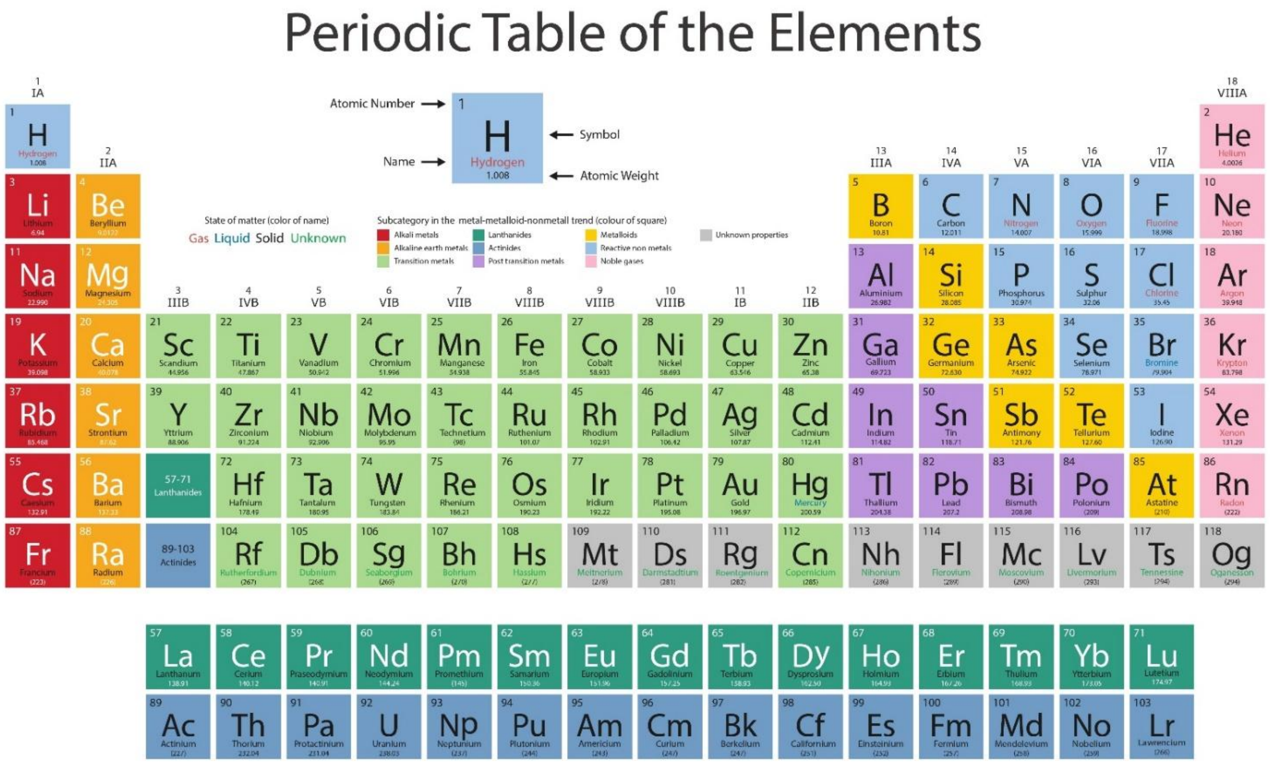
Data: Bansah et al. (2023); Delve Database (2024); Sauerwein (2023)

What are CRMs?

CRM stands for **Critical Raw Material**, which could be a **mineral**, **metal** or **non-metal**

Different countries have different definitions, but generally:

- Important for key industries such as renewable energy, electric vehicles and batteries, defence, electronics
- Economically important
- Often imported and vulnerable to supply disruptions
- Limited options to substitute



CRMs

- Climate change is driving the conversion to RE, away from fossil fuels. These low-carbon technologies require unprecedented amounts of metals such as Co and Li
- Low carbon technologies increase the demand for aluminium, chromium, cobalt, copper, graphite, indium, iron, lead, lithium, manganese, molybdenum, neodymium, nickel, silver, titanium, vanadium and zinc. Impossible to maintain the required supply through a circular economy alone

Landrigan et al. (2022); Domingo et al. (2024)

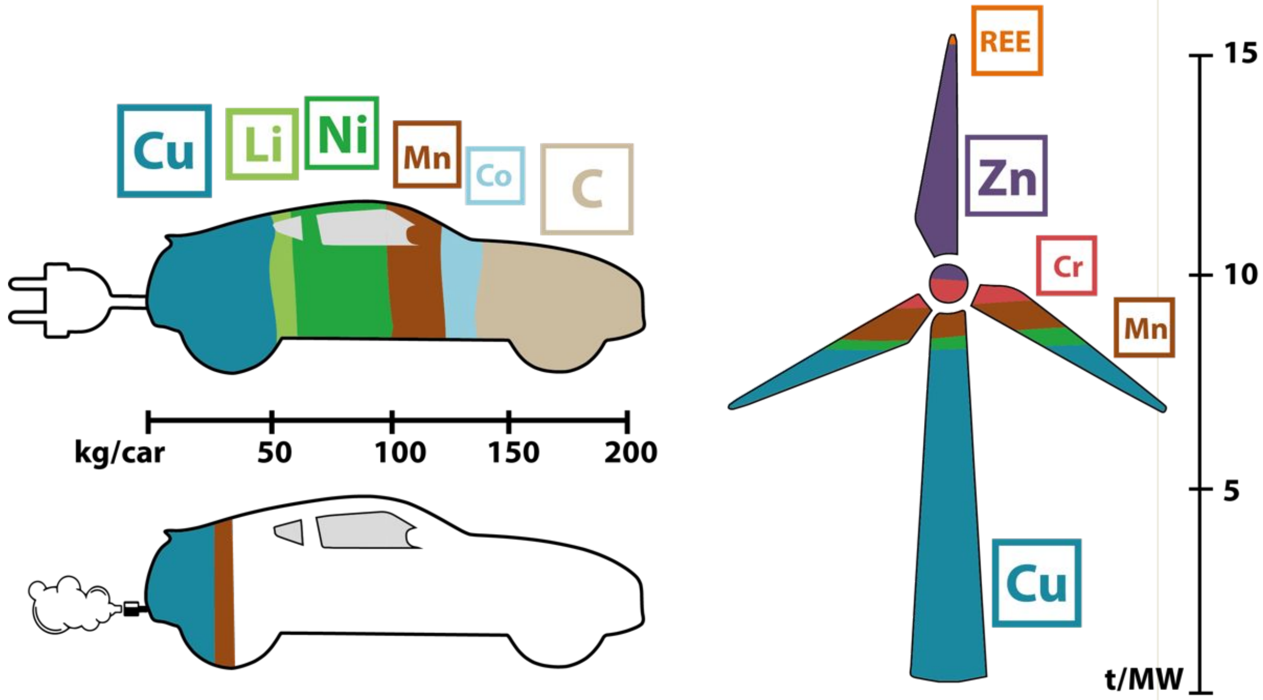
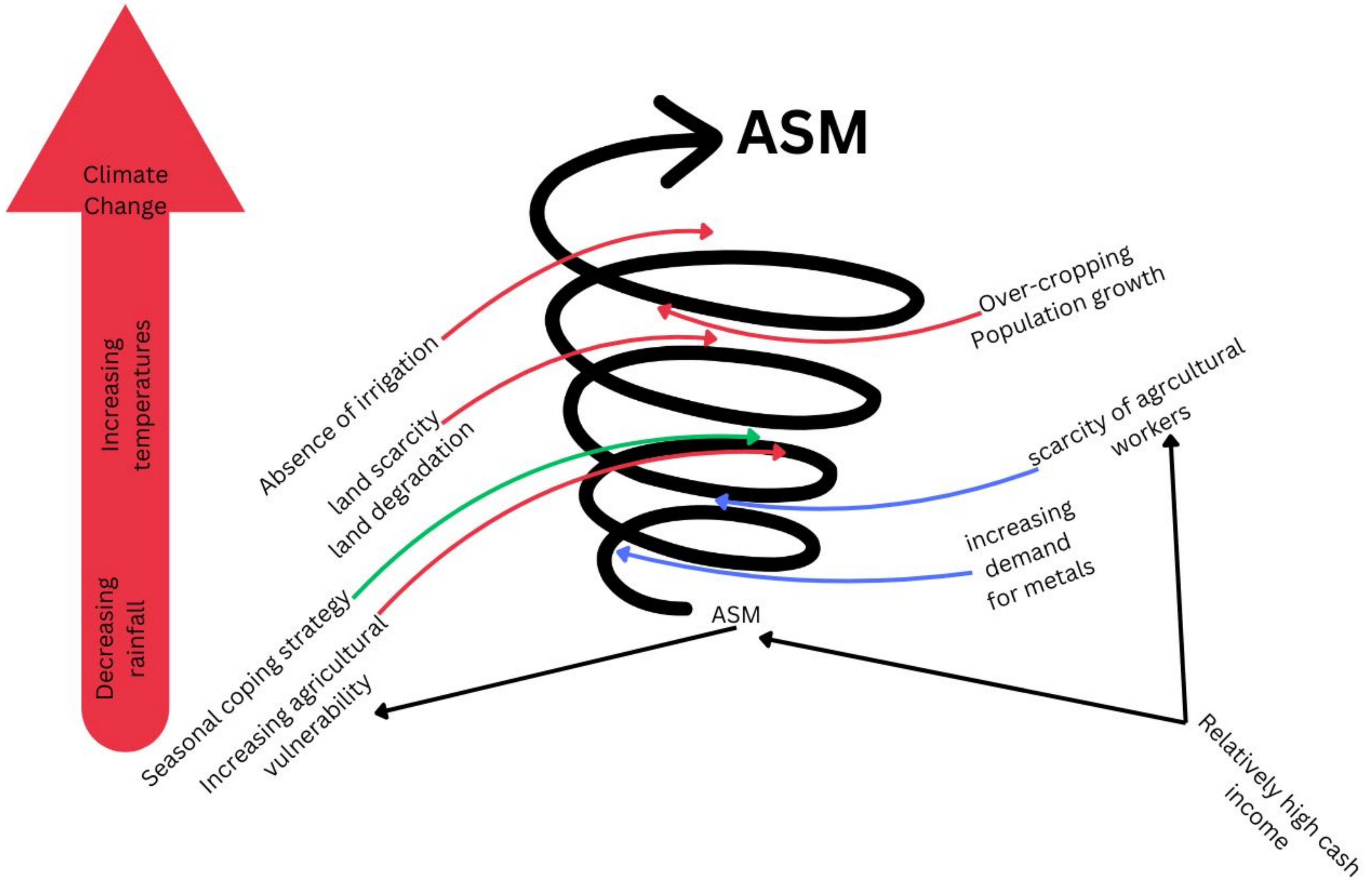


Illustration of the increasing need for CRM to support the transition to renewable energies and electric vehicles

Data from https://www.iea.org/reports/the-role-of-critical-minerals-in-clean-energy-transitions.
(Source: Ch. Kusebauch, GFZ)

Drivers of ASM Growth in Africa



ASM pit in Rwanda

Bansah et al. (2023); Brugger & Zongo (2023); Landrigan et al. (2022); Pokorny et al. (2019)

What are Swing Producers?

- Producers that:
  - control deposits and have significant spare production capacity
  - can increase or decrease supply at a minimal additional cost. This acts to artificially regulate markets, keeping prices stable
- ASM is a reactive swing producer – ASM tends to roll with the punches rather than having control over external factors
- Is it possible to organise ASM so it can be a proactive producer – responding in an agile way to changes in demand?


ASM material handling in Rwanda

ASM as Reactive Swing Producers

"Illegal" gravel washers in Zambia

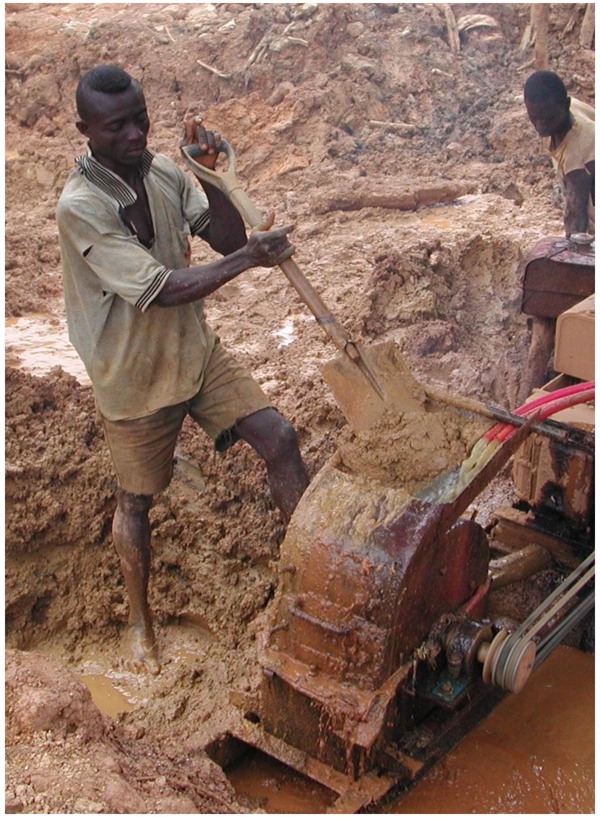
- Highly mobile:
  - Artisanal mines are frequently "illegal" and are resettled from higher grade orebodies as these come under the control of LSM. This may result in a semi-nomadic existence where miners are continuously on the move, looking for the next accessible deposit
- Employment of last resort:
  - in Burkina Faso, for example, severe droughts in the 1980s resulted in mining being a dry-season activity for farmers and a full-time activity for itinerant diggers who include out of work labourers, school drop-outs and ex-convicts

Pokorny et al. (2019); Sauerwein (2023)

ASM as Reactive Swing Producers

- Specialised and Organised:
  - miners have defined structures and are highly organised: watchmen – the elderly; manual grinding/ore sorted – women; crushing/ore and water hauling – young boys; picking/sorting waste heaps – young girls; young men at the rock face share the ore and the risks according to pre-agreed arrangements
  - labour contraction due to technological improvements in LSM has led to an outflow of skilled workers in many countries, providing a ready-made ASM labour force
  - low costs and short lead time: due to low investment costs

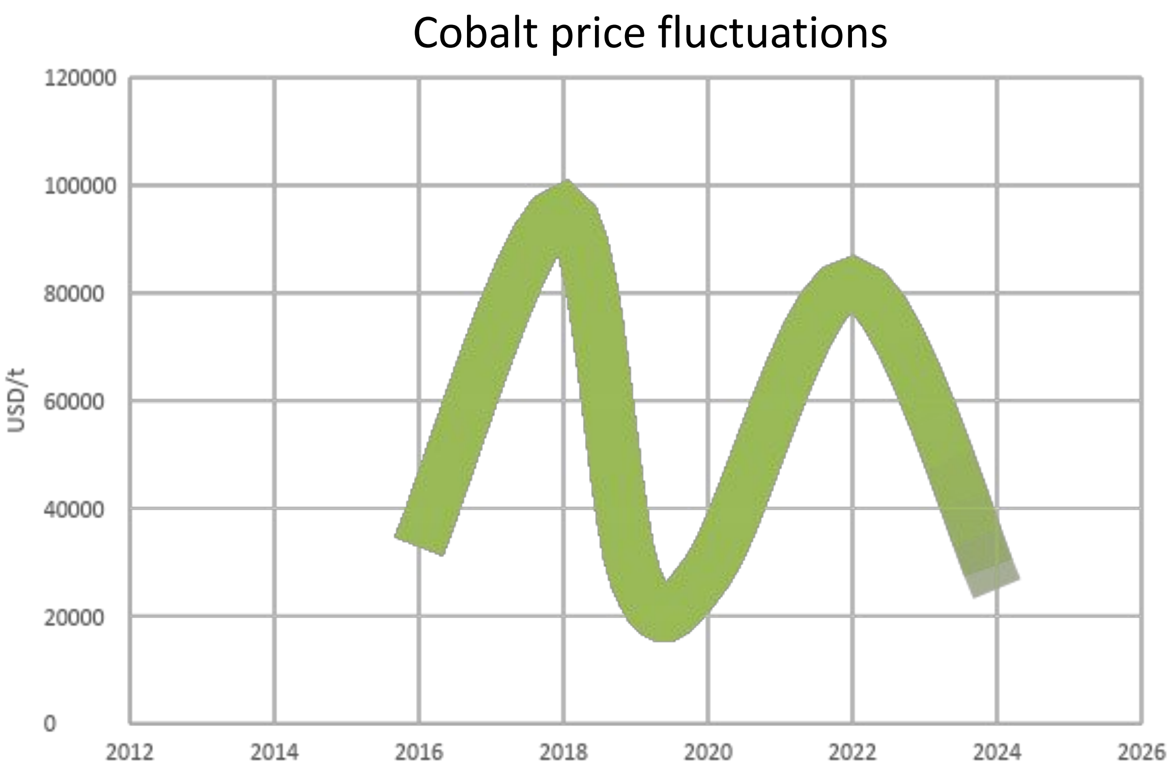
Pokorny et al. (2019); Sauerwein (2023)



ASM gold production in Ghana

Lessons Learnt from Cobalt

- ASM production helped reduce the shortfall in industrial supply in the middle of the last decade and dramatically reduced prices following the 2017-18 boom



Mining.com (2020); Reuters (2019) Ycharts.com (2024)

Lessons Learnt from Cobalt

- The human cost of Co production (for example the KOV tunnel collapse) has lead companies like Tesla to attempt to engineer Co out of their battery supply chain
- While the most significant impacts associated with LSM include climate change and biodiversity loss through GHG emissions, deforestation, use of chemicals, water source pollution, soil degradation, these all apply to ASM, with the possible exception of direct GHG emissions due to the low levels of mechanisation
- ASM sites are prone to erosion, physical and chemical extraction residues render farm lands infertile post mining; such sites may revert to low-grade forest with lowered water tables; revisiting of old sites as metal prices increase also pose a risk to long-term rehab

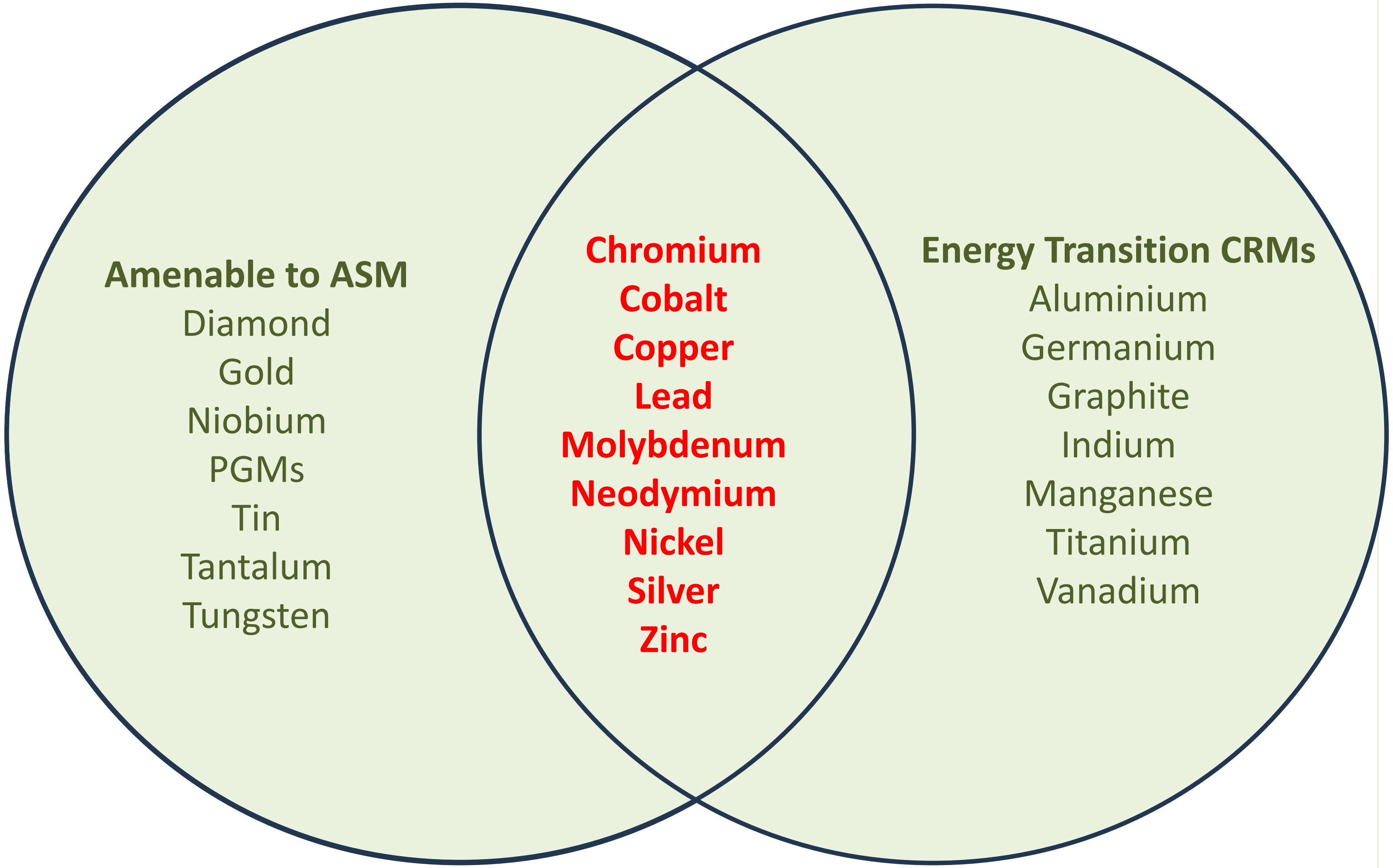
Pokorny et al. (2019); Reuters (2019)

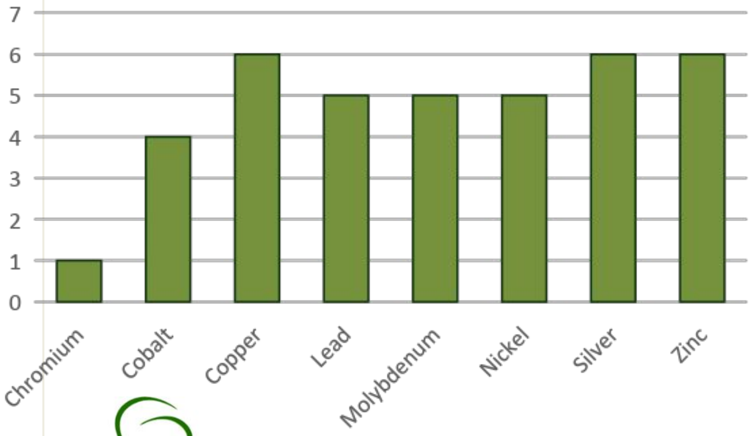
ASM and CRMs

- Commodities that are high value, not dependant on extensive infrastructure for production and transport; including:
    - Metals: nonferrous metals (lead, copper, zinc, tin), steel additives and refractory metals (chromium, nickel, tungsten, niobium, tantalum and molybdenum), and the precious metals (gold, silver and platinum)
    - Non-metals: gemstones, diamonds and industrial minerals as well as abrasive and refractory minerals
- Deposits that are amenable to mechanisation and scale are unfavourable for ASM: uniformity of deposit, width of ore bodies, depth, overburden, low grade); Irregular orebodies, steep dip, small volumes are favourable for ASM

Dorner et al. (2012)

ASM emerald production in Zambia





ASM and CRMs

Dorner et al. (2012); USGS (2024)

Conclusions – Changing the Landscape

- A form of extension service is needed, legalise ASM and require it to meet minimum ESG standards, but with support provided by the State (training, advice, lab services, PPE, sales & marketing); all required to register, low entrance costs, but enforcement to ensure that no illegal mining occurs
- Complex relationships between pastoralists, farmers, ASM and LSM require state guarantees of security and law enforcement in rural areas
- More land to be set aside? Sauerwein (2023) reports that 18.8% of the surface area of Cote d'Ivoire was reserved for LSM (mainly exploration) between 2015 and 2018 while 1% was set aside for ASM – limited land availability encourages actors to stay informal; also problematic that ASM and LSM cannot co-exist on the same land parcel
- LSM should be able to set up systems where ASM producers are licensed to work waste rock or tailings to extract additional minerals / metals
- Downstream companies (manufacturers) invest in ASM producers (c.f. Tesla getting involved with mining)
- LSM using ASM as contractors (there is some of this going on in Indonesian tin production)
- Integrated / streamlined approach by responsible ASM initiatives

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