

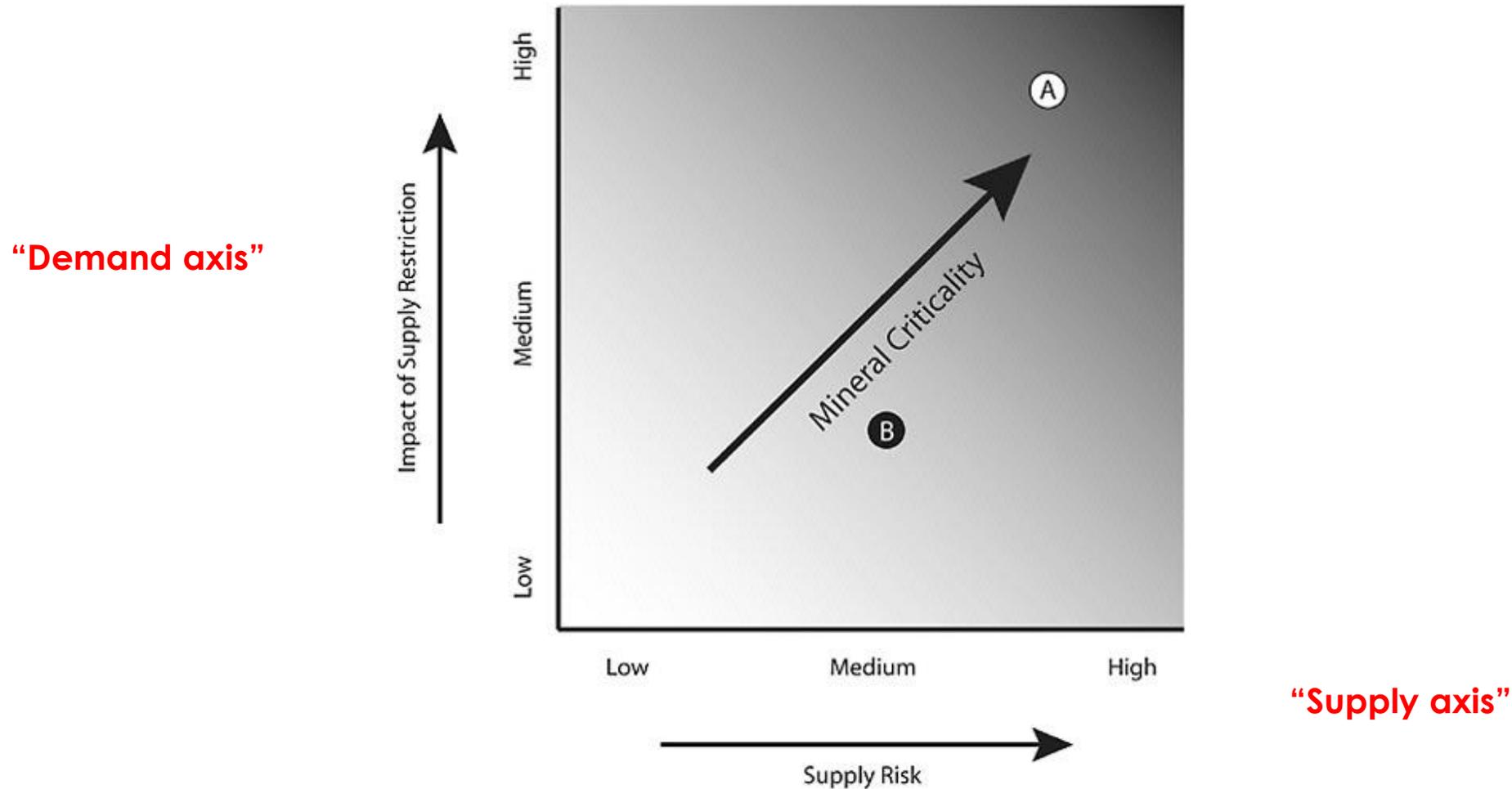
Facilitating the energy revolution through sustainable access to critical raw materials

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*UNECE Committee on Sustainable Energy, 28th Session
Geneva, 25-27 September 2019*

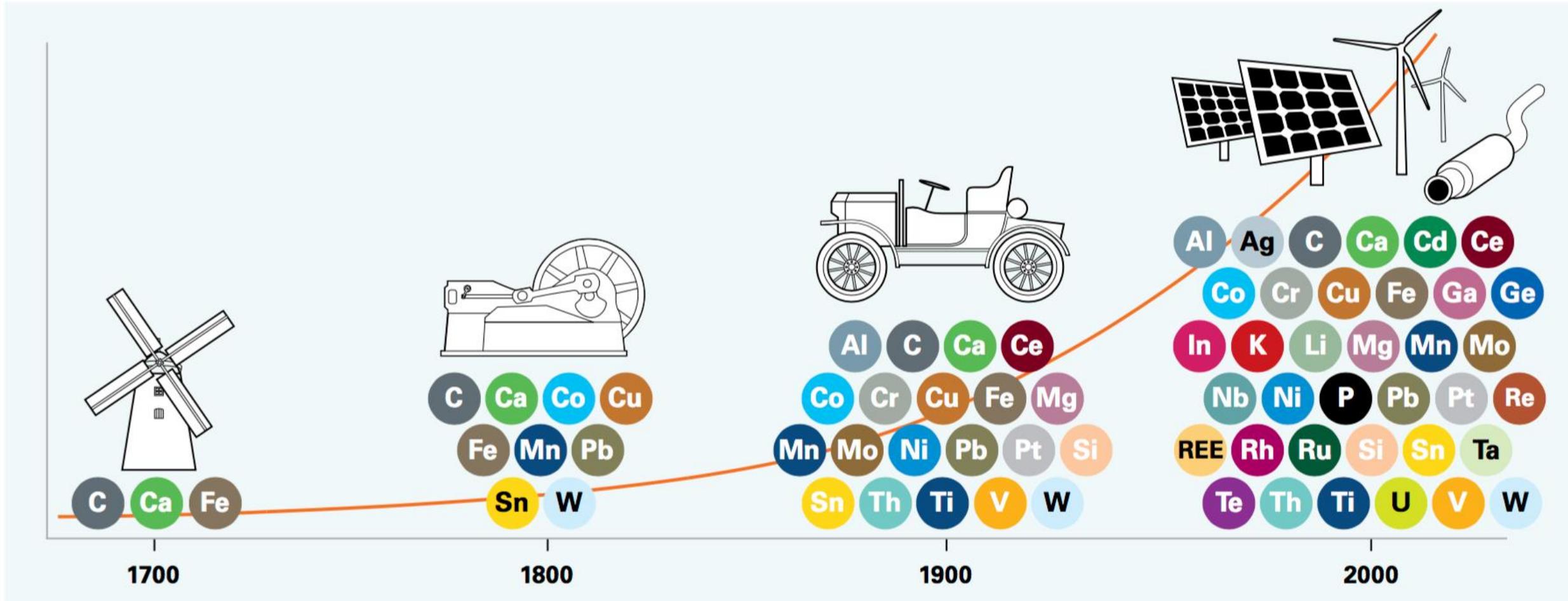


What are critical raw materials?



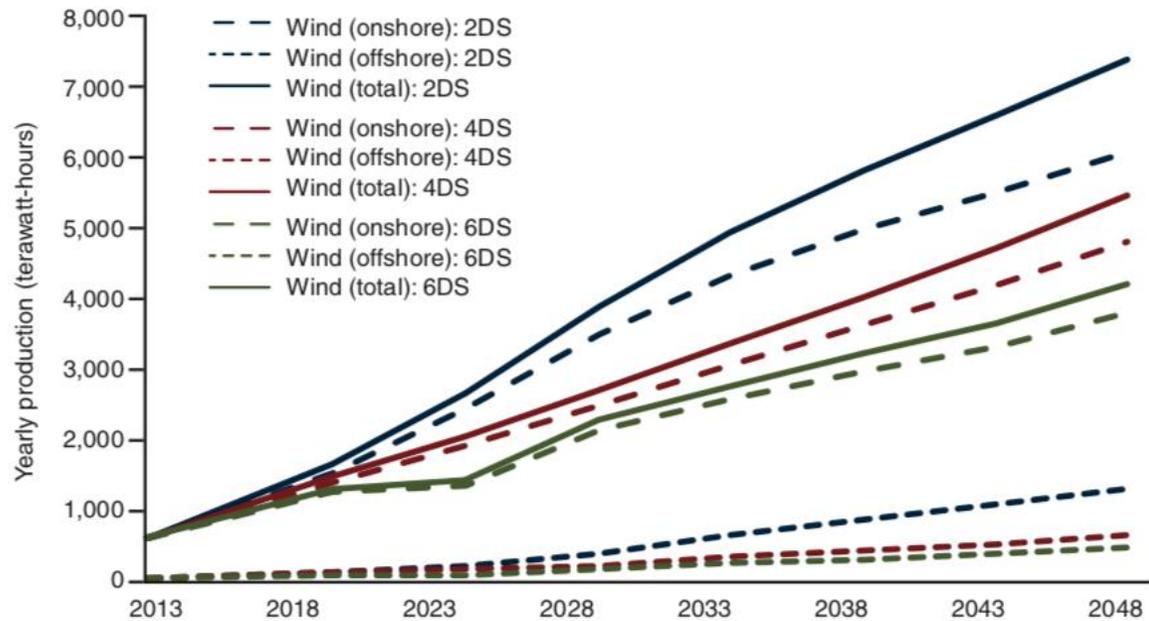
Source: US National Research Council (2008)

Raw materials used for energy technologies

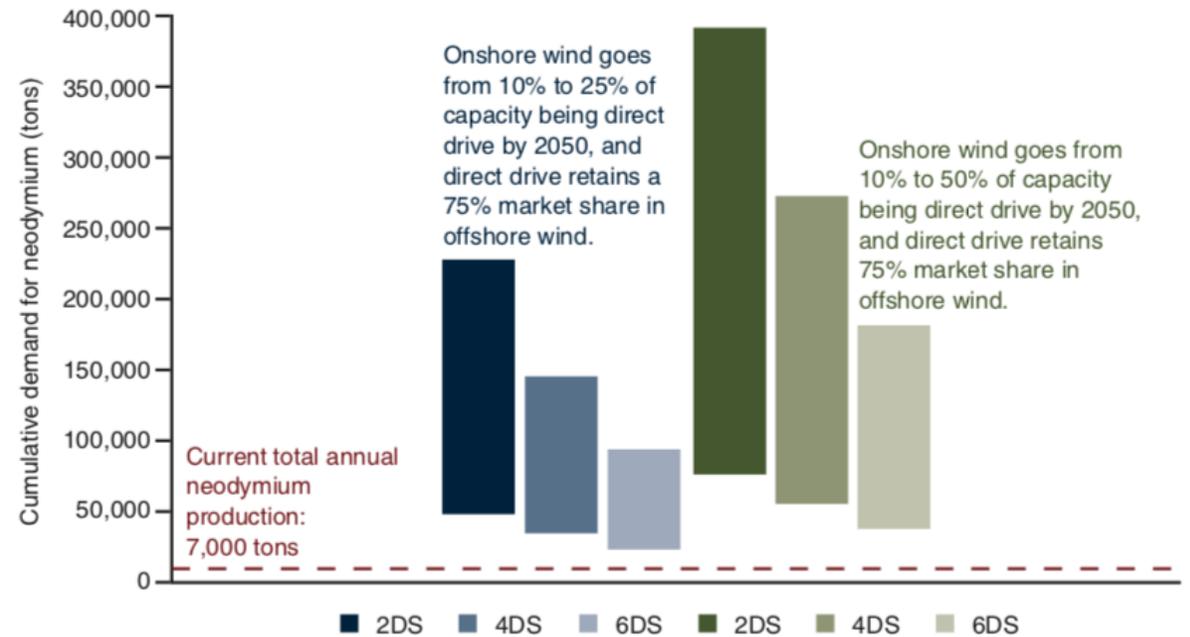


Source: Armin Reller and Volker Zepf,
University of Augsburg

Wind power, climate targets and Nd demand

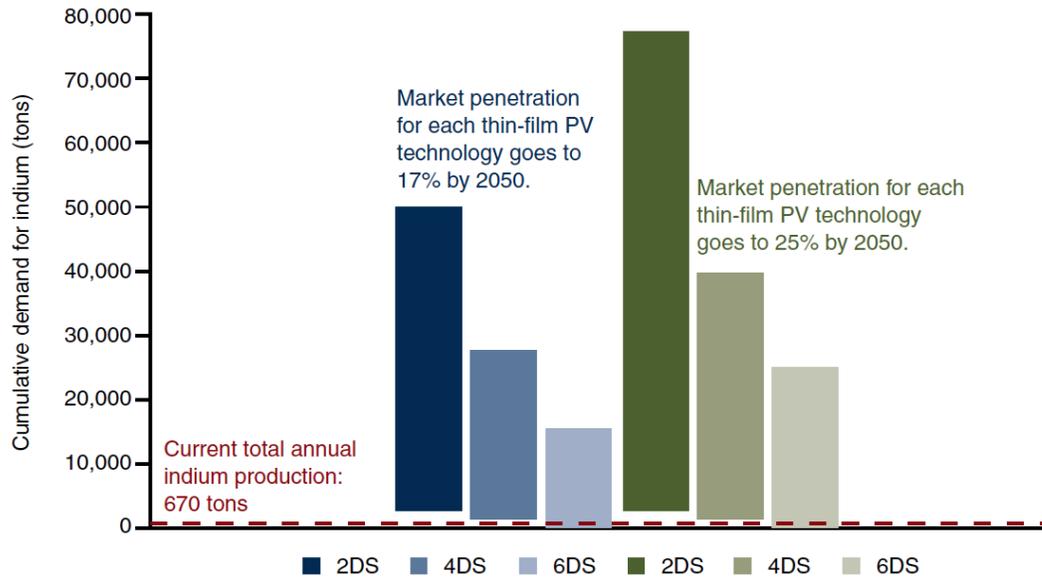


Note: 2DS = 2 degree scenario; 4DS = 4 degree scenario; 6DS = 6 degree scenario.



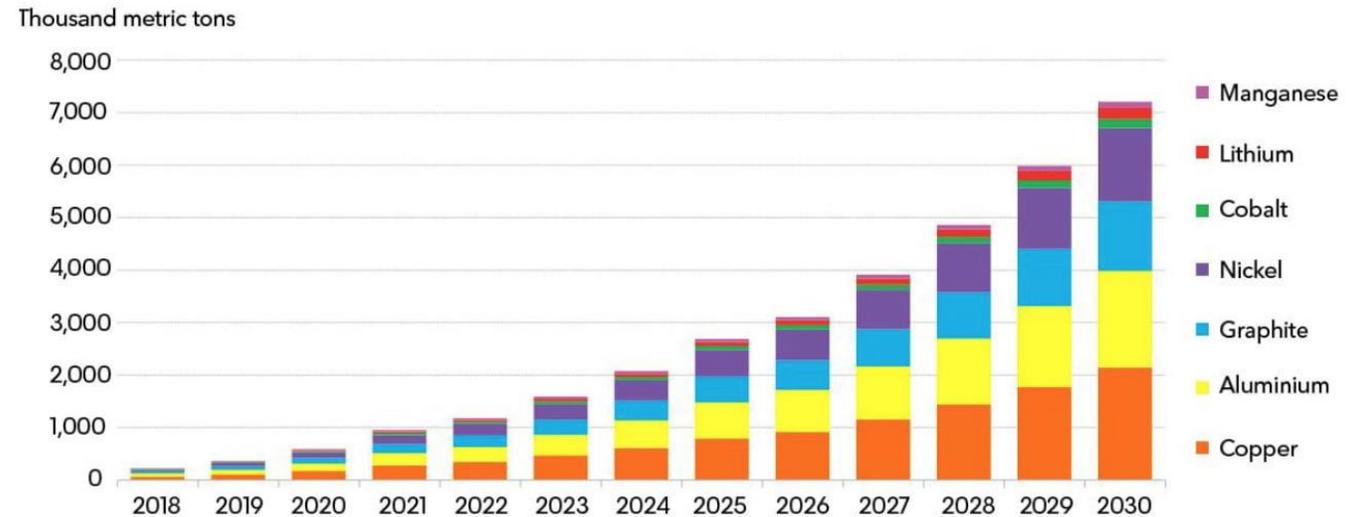
Source: World Bank (2017)

Indium demand for photovoltaics



Source: World Bank (2017)

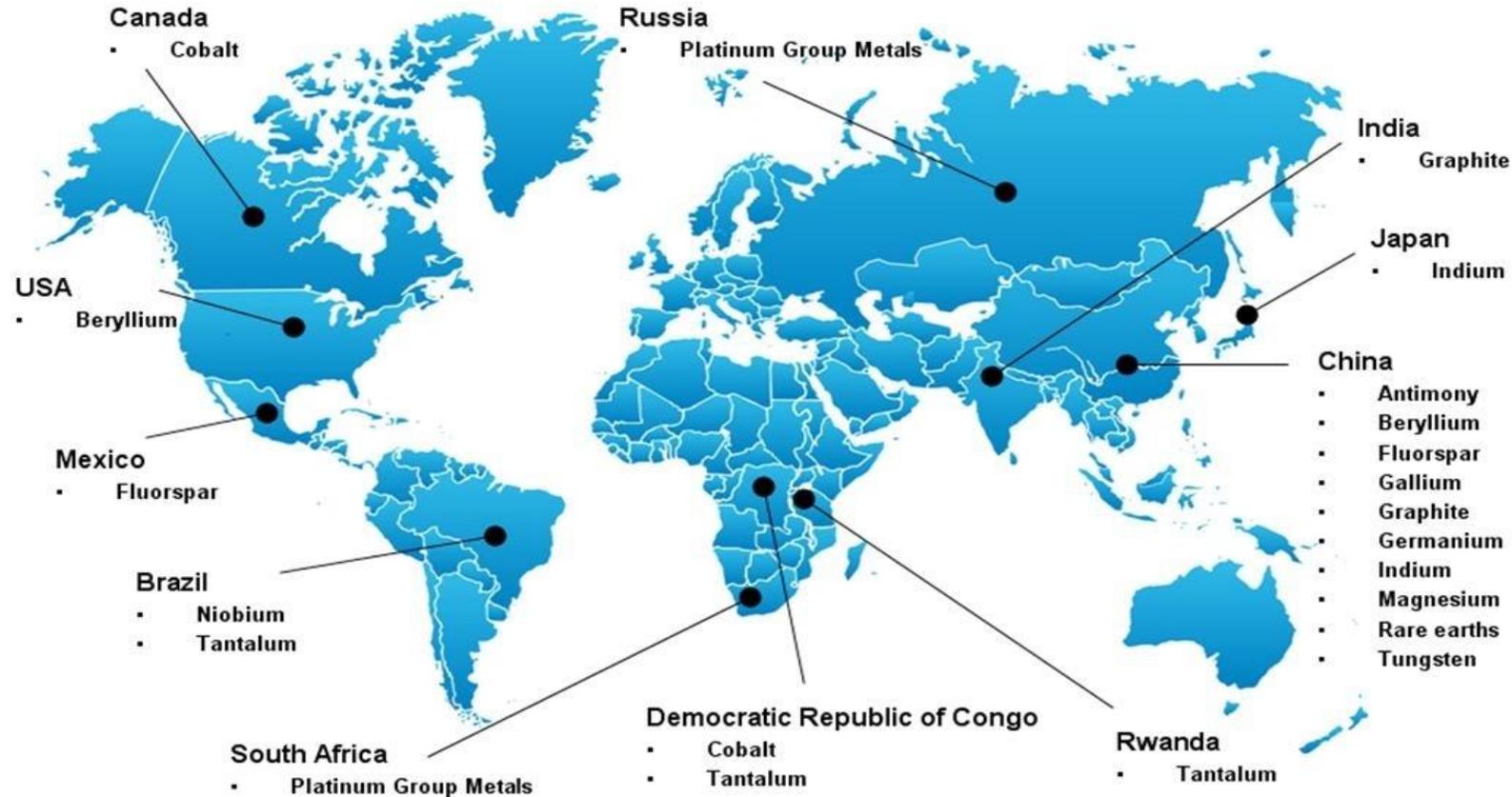
Metal demand for electric mobility



Source: Bloomberg (2018)

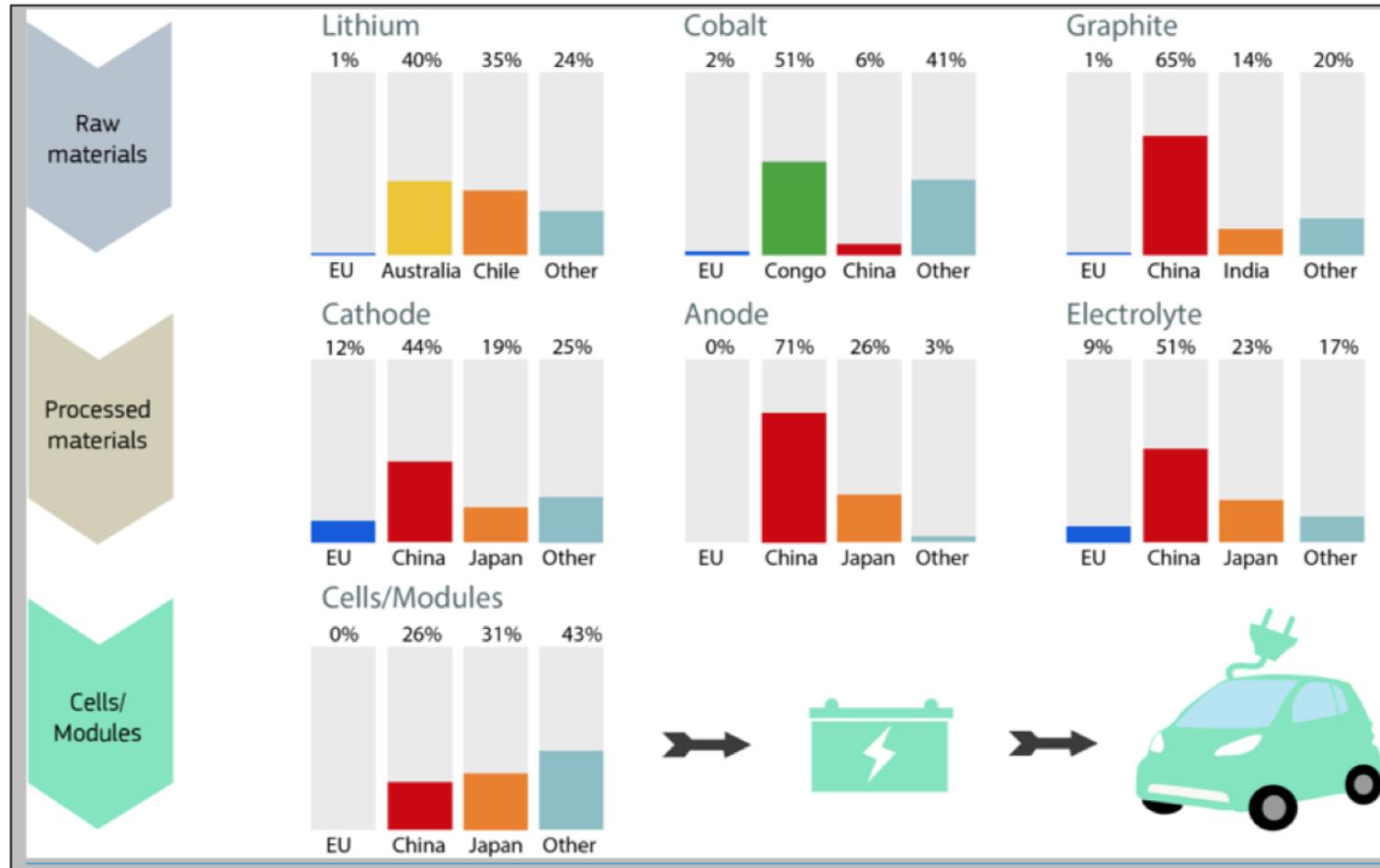
-> A secure raw materials supply base is the prerequisite to ensure global access to clean energy

Production concentration of CRMs



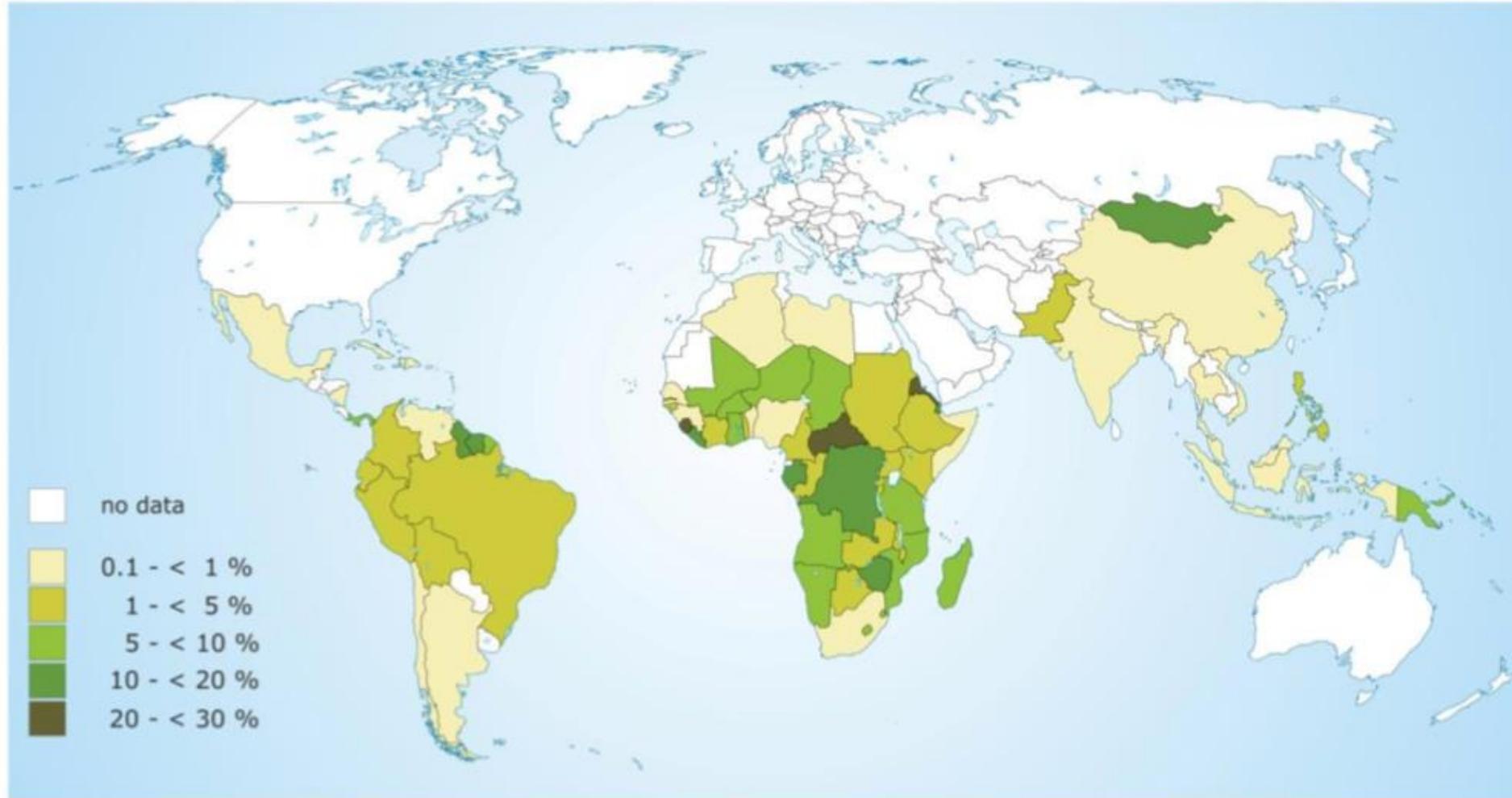
Source: European Commission

Supply dependency of materials along the EV batteries value chain



Source: Implementation report on strategic action plan for batteries (April 9, 2019)

Social: example artisanal and small-scale mining



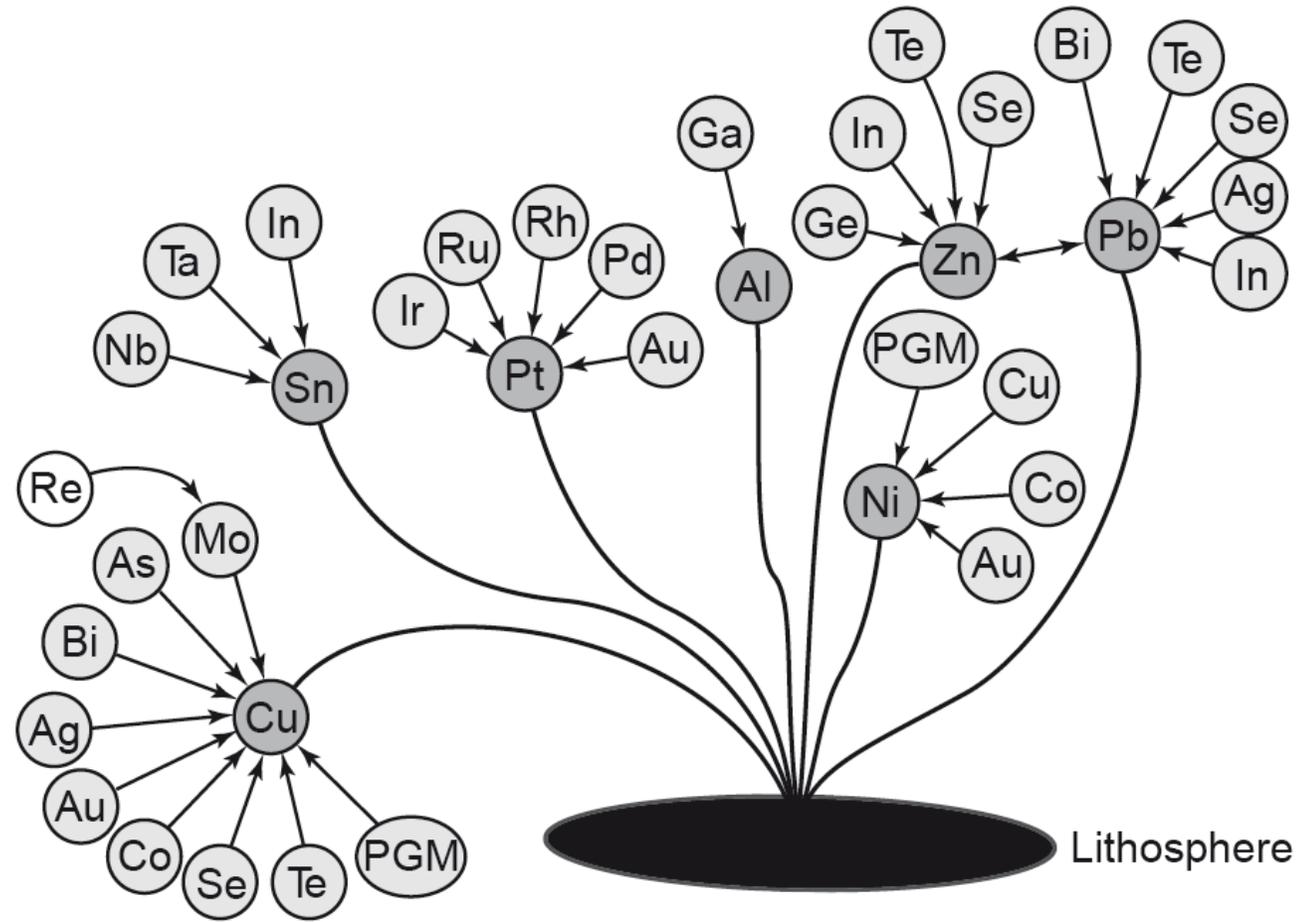
Source: UNEP (2019)

Ecological: Example energy and water use

Metal	Energy use in metal extraction (MJ/kg)		Water use (m ³ /ton)	
	Scrap	Ores	Scrap	Ores
Iron	6	20–100	12–16	50–600
Aluminium	10	238–925	2	11–320
Magnesium	10	165–230	2	2–15
Copper	14	31–2,040	15	40–200
Zinc	11	32–63	20	75–100
Lead	9	32–45	40	50–75
Chromium	6	22–51	12	52–92
Nickel	20	130–370	20	60–320
Cobalt	20–140	140–2100	30–100	40–2,000
PGM	1,400–3,400	18,860–254,860	3,000–6,000	100,000–1,200,000
Zirconium	230	1,320–1,500	260	12,600–13,000
Gold	140–230	13,300–52,300	30	120,000–420,000
Silver	80–180	480–4,280	20–40	60–200
Tin	15	480–2,180	5	75–130
Rare Earths	1,000–5,000	5,500–7,200	250–1,250	1,275–1,800

Source: Sverdrup (2016)

Economic: example co-production



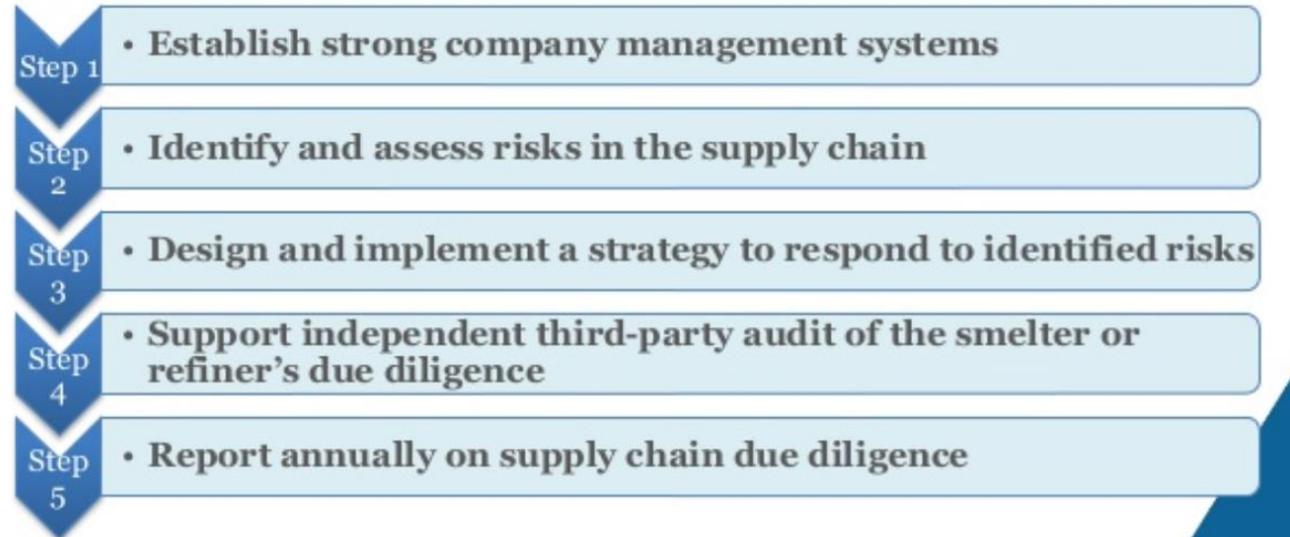
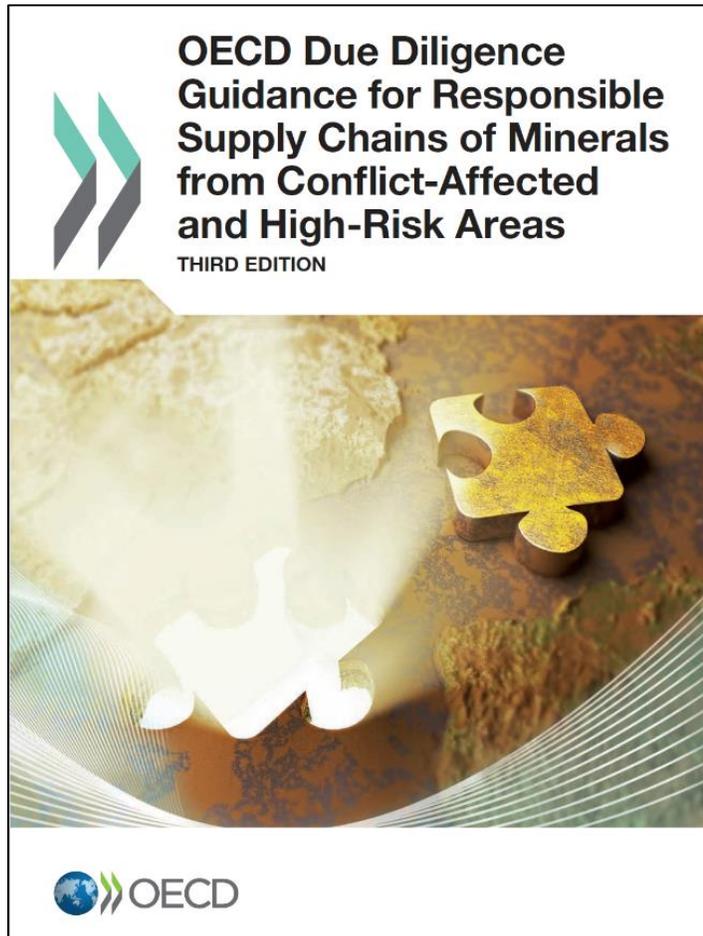
Source: Hagelüken and Meskers (2010)

-> Understanding CRM supply chains and interdependent risks are crucial to secure supply bases for world-wide demand of materials for sustainable energy.

Conflict minerals: Dodd-Frank Act



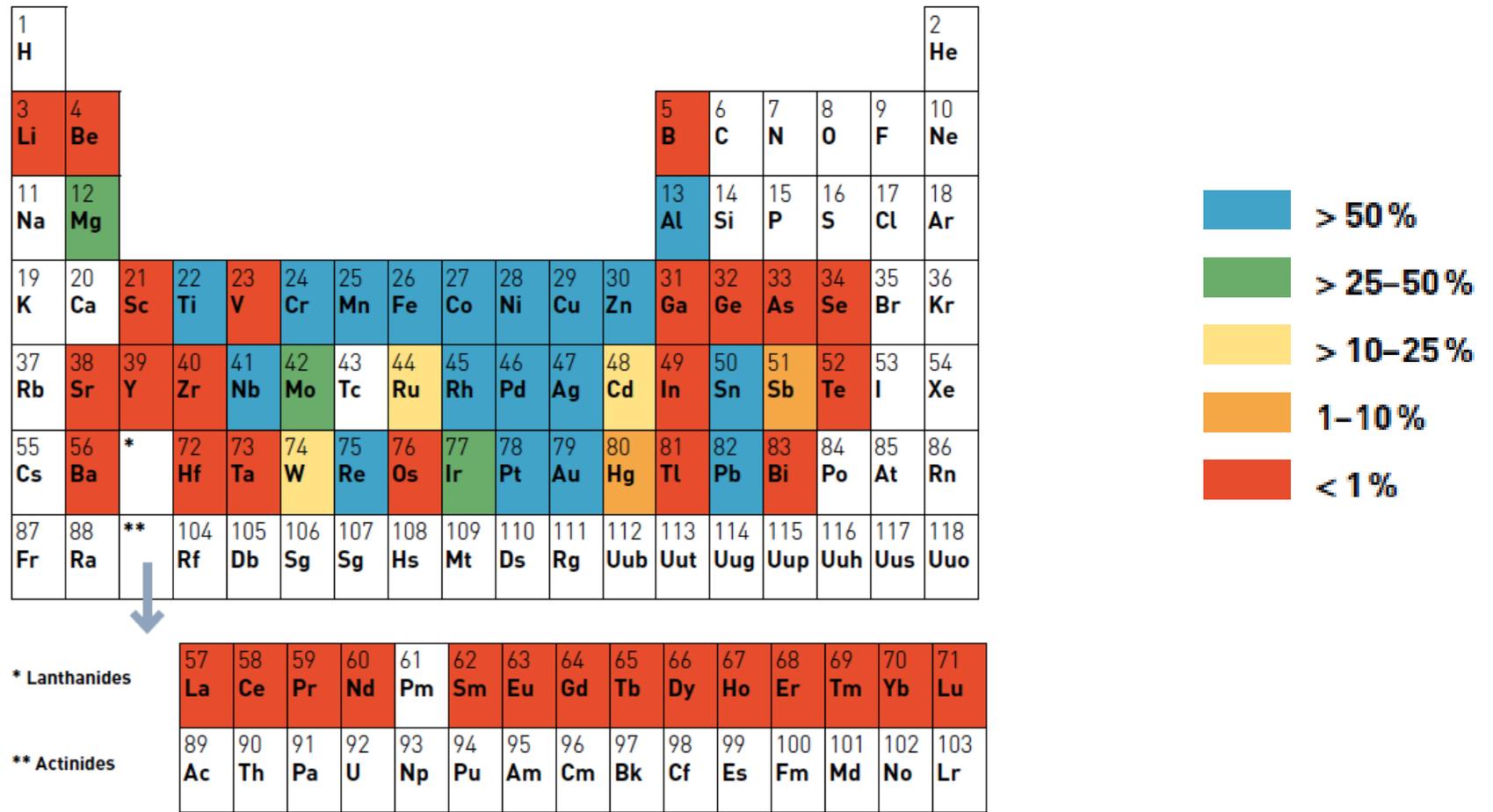
OECD guidance on minerals from conflict-affected and high-risk areas



Business initiatives - examples

- Responsible Minerals Initiative
 - Conflict minerals, since 2018 +Cobalt
- Drive Sustainability
 - Materials for the automotive sector
- Responsible Cobalt Initiative
 - Cobalt
- Global Battery Alliance
 - Battery materials

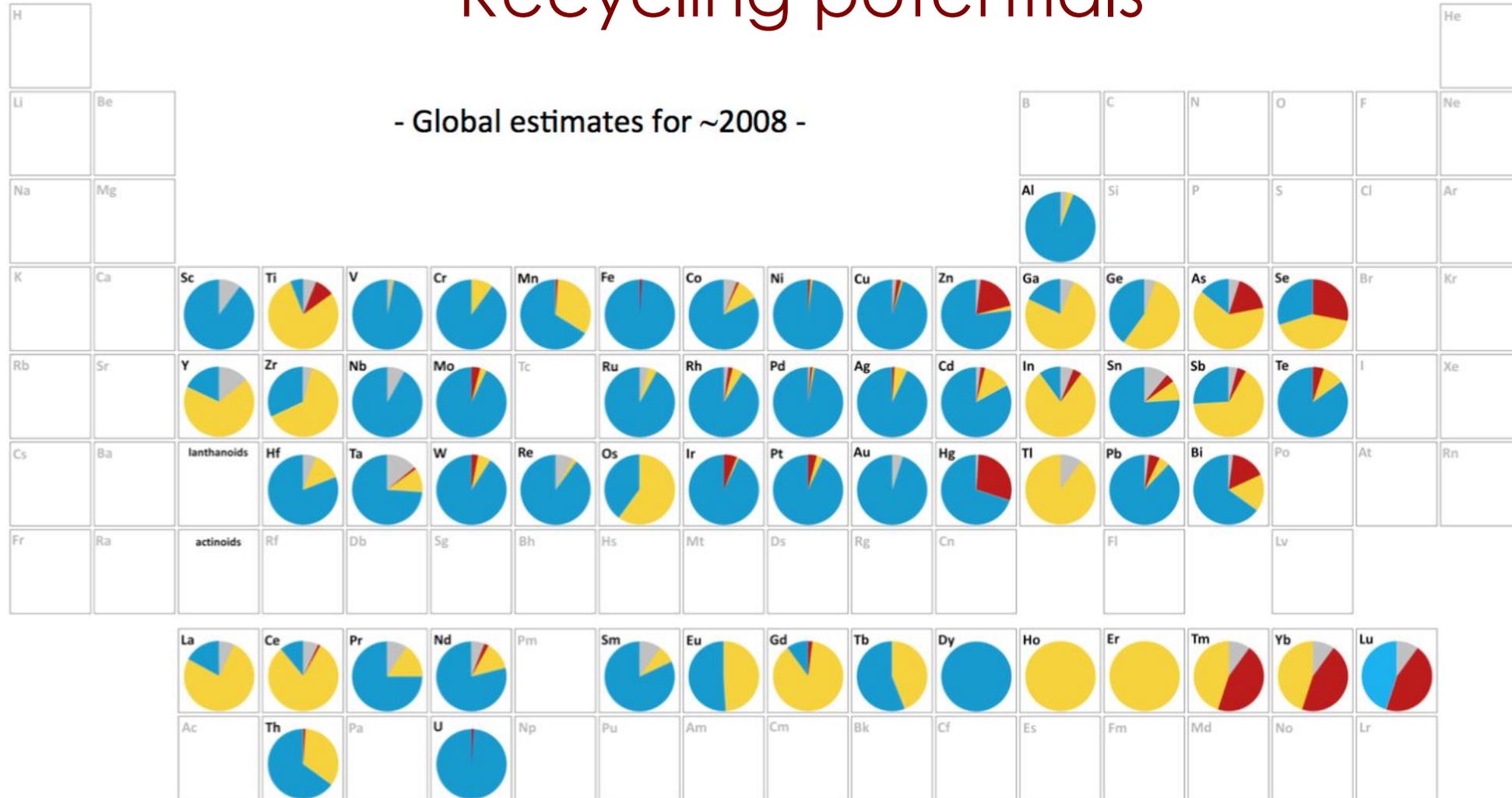
CRM End-of-Life Recycling Rates



Source: UNEP (2012)

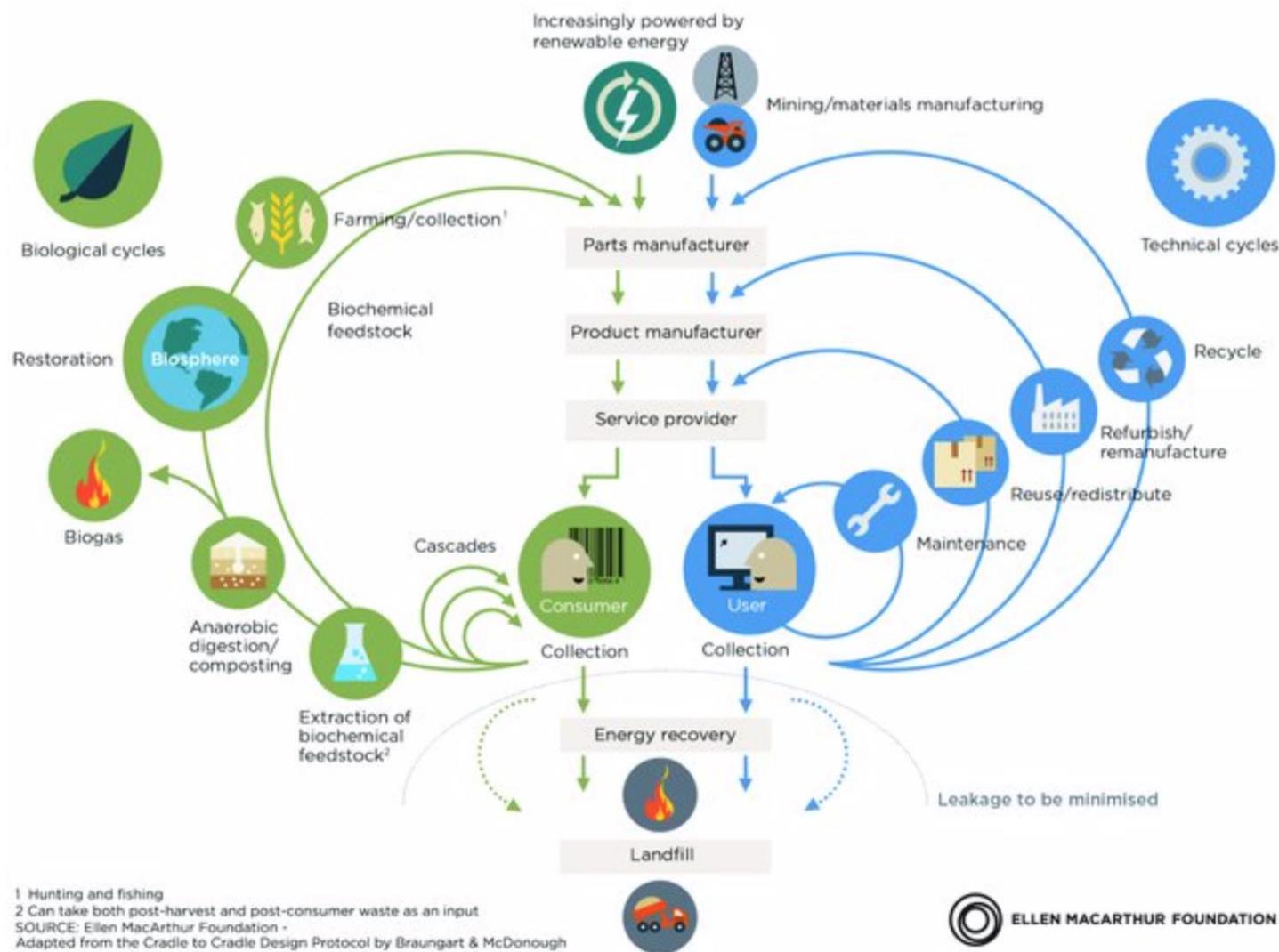
Recycling potentials

- Global estimates for ~2008 -



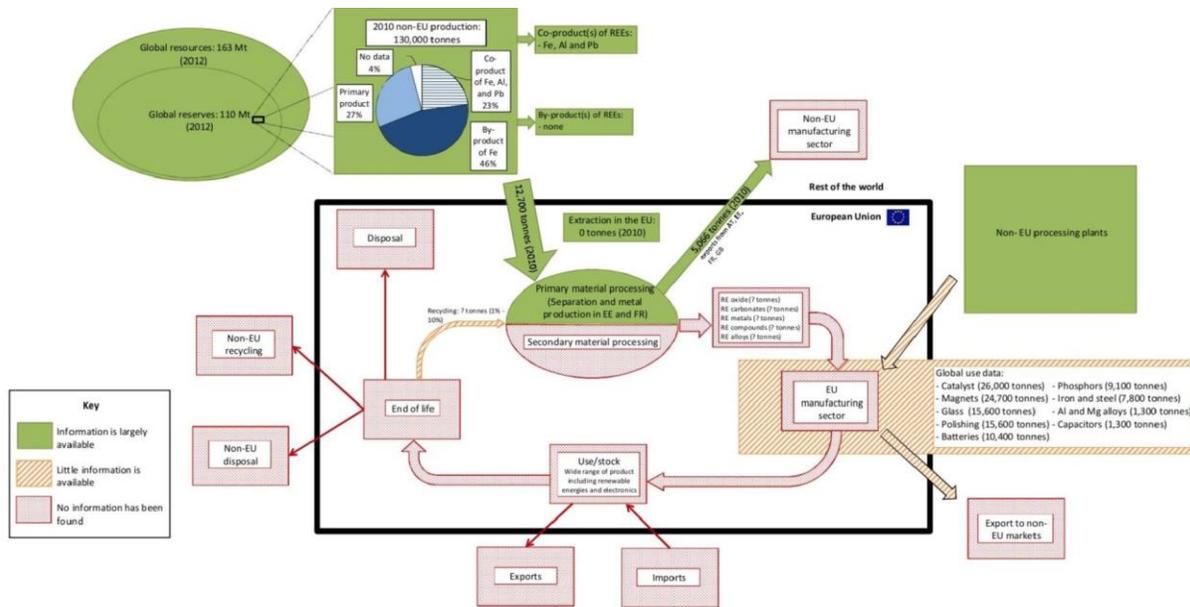
● **In-use dissipated**
 ● **Currently unrecyclable**
 ● **Potentially recyclable**
 ● **Unspecified**

Source: Ciacci et al. (2015)



Source: Ellen MacArthur Foundation

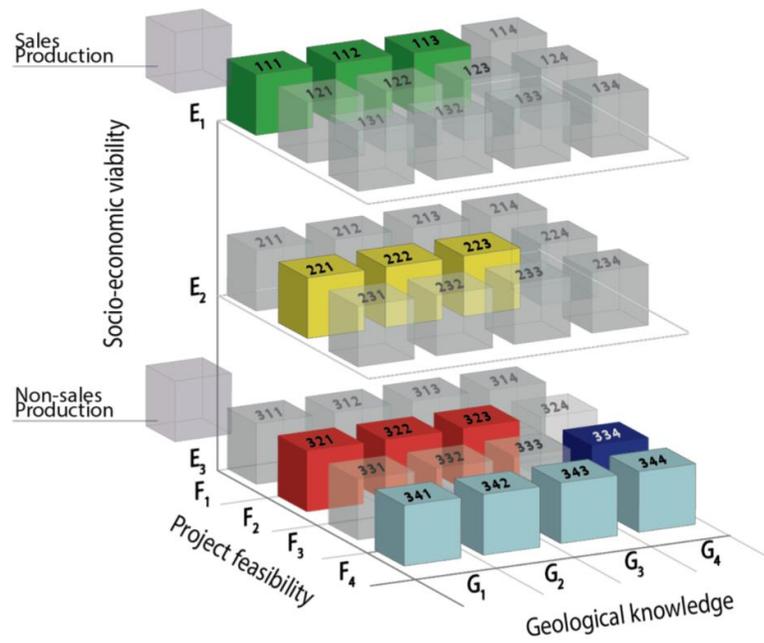
EU study on data needs for a full Raw Materials Flow Analysis (2012)



- There is insufficient data on the flows of materials to and from EU countries.
- There is a lack of systematic and comprehensive research into data on exploration undertakings and investment.
- Data on the recycling process efficiency rate are available for none of the ten materials analysed in detail.

Source: RPA (2012)

A United Nations Resource Management System?



- Commercial projects
- Potentially commercial projects
- Non-commercial projects
- Exploration projects
- Additional quantities in place
- Other combinations
- Extracted quantities
- 123** Codification (E1;F2;G3)



Conclusions

- Worldwide and secure supply of clean energy is fundamentally linked to the access to critical raw materials.
- Managing raw materials supply competently and responsibly needs consideration of impacts along the whole value chain, considering people, planet and prosperity.
- Prerequisites for this are transparent data bases, solid certification schemes, and investigation of circularity potentials on all levels.

Reliable data and effective policy interventions can only be developed in a defined framework and require improved collaboration of all involved actors on an international level.

Thank you.

ESM

ENTWICKLUNGSFONDS SELTENE METALLE

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