RawMaterials
Connecting matters

The Critical Raw Materials.

Dr Laurence Lamm, 2021 Workshop Black-cycle Nov 22nd 2021

Co-funded by the
European Union

AGENDA

1. Definition
2. Trends and situation of supply in Europe
3. Status of recyclability
4. The way to decrease dependency… Circularity
    1. Extend life cycle
    2. Repair
    3. Better design for circularity
    4. Better use of materials
    5. Substitution
    6. Valorising waste
    7. Recycling EoL
    8. Industrial Symbiosis

DEFINITION

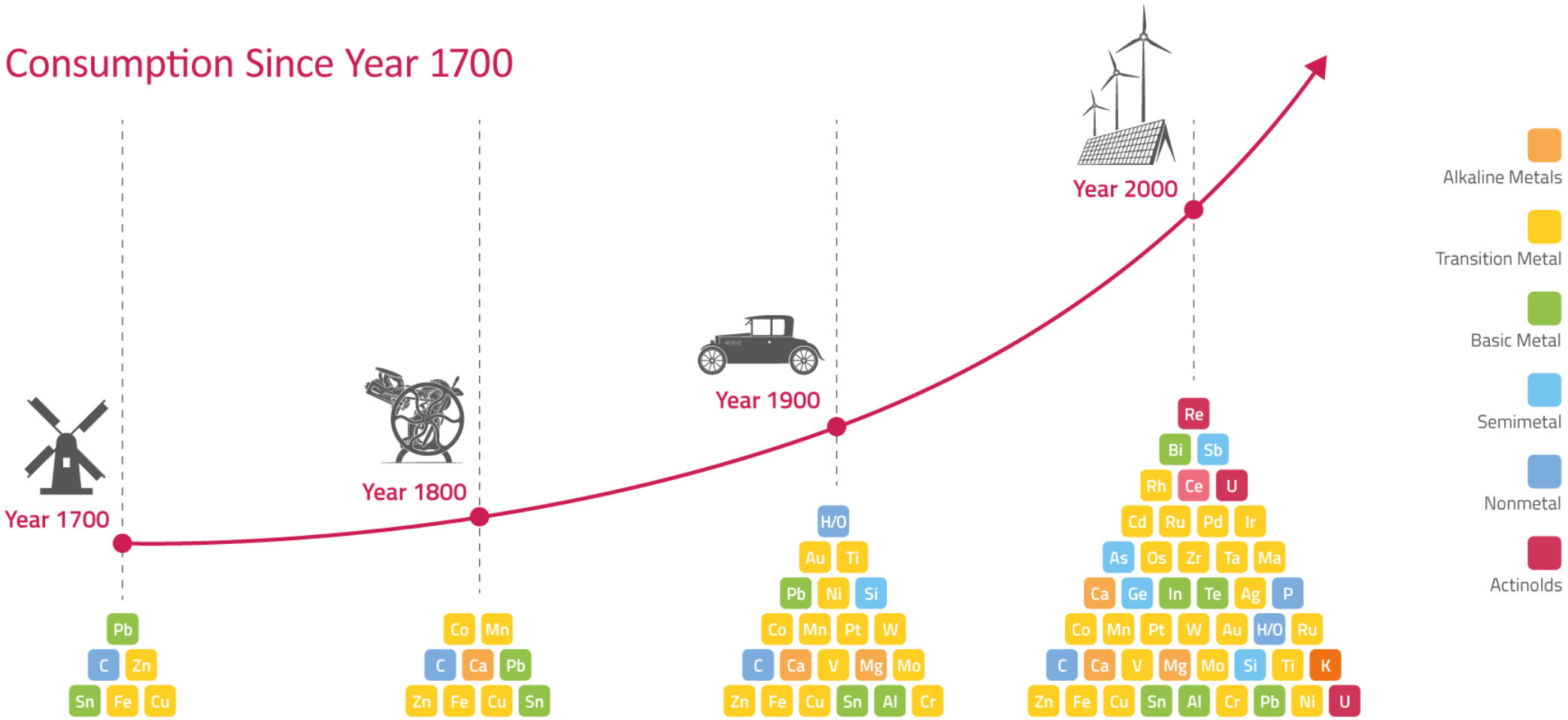
The European Commission publishes the list of CRM every 3 years

- A material is considered critical based on the following criteria :
  - **Economic importance :** importance of a material for the EU economy in terms of end-use applications and the value added
  - **Supply risk :** reflects the risk of a disruption in the EU supply of the material.

EVOLUTION OF THE CRM LIST

2011	2014	2017	2020
Sb	Sb	Sb	Sb
		Barites	Barites
			Bauxite
Be	Be	Be	Be
		Bi	Bi
	Borates	Borates	Borates
	Cr	/	/
Co	Co	Co	Co
	Coaking coal	Coaking coal	Coaking coal
Fluorspar	Fluorspar	Fluorspar	Fluorspar
Ga	Ga	Ga	Ga
Ge	Ge	Ge	Ge
Graphite	Graphite	Graphite	Graphite
		Hf	Hf
		He	/
In	In	In	In
			Li
	Magnesite	/	/
Mg	Mg	Mg	Mg
		Natural rubber	Natural rubber
Nb	Nb	Nb	Nb
PGM	PGM	PGM	PGM
	Phosphate rocks	Phosphate rocks	Phosphate rocks
		P	P
REE	REE	REE	REE
		Sc	Sc
	Si	Si	Si
			Sr
Ta	/	Ta	Ta
			Ti
		V	V
W	W	W	W

CONSUMPTION OF MINERAL RAW MATERIALS

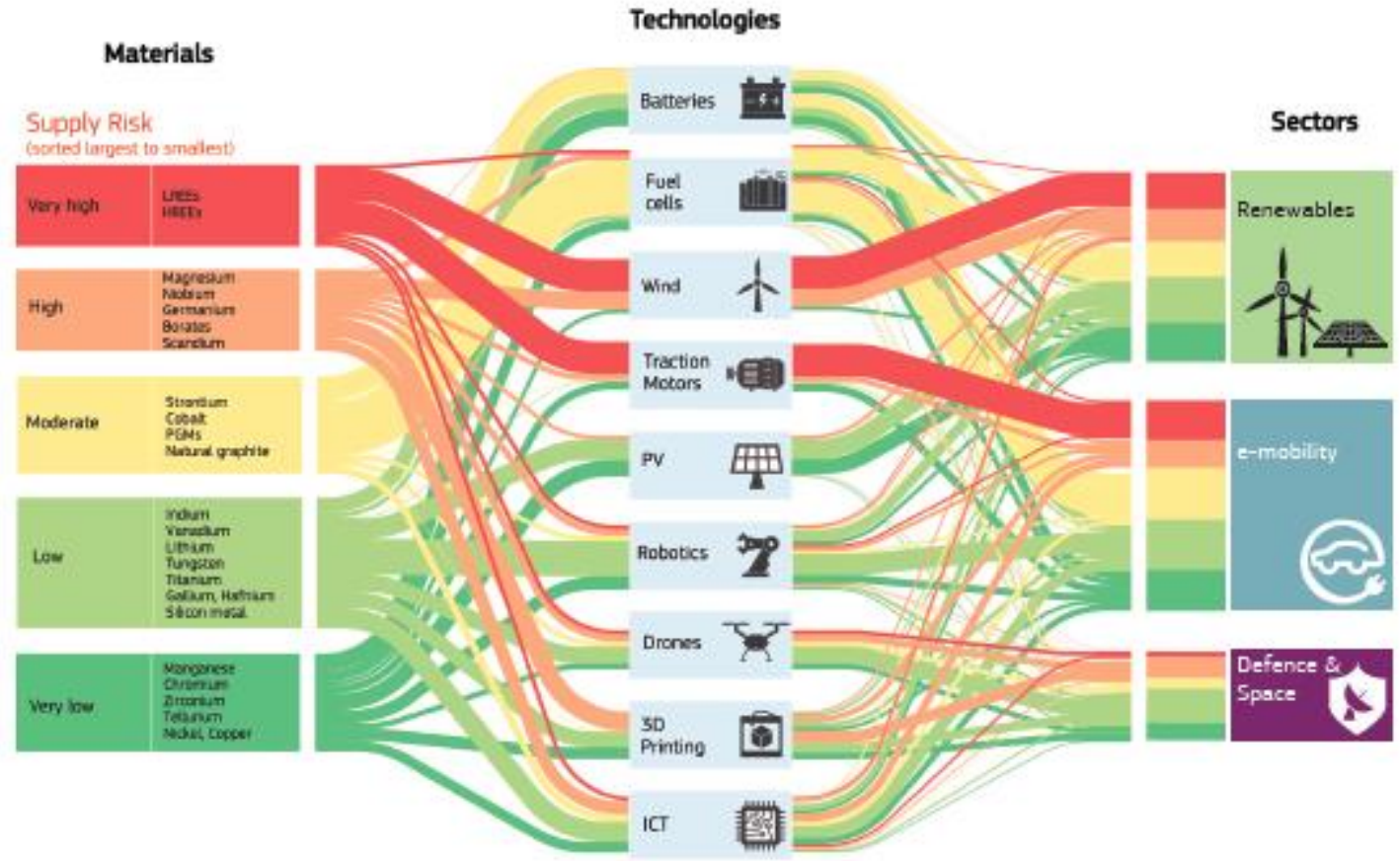


GOING CLIMATE NEUTRAL…TRENDS & CONSEQUENCES

- Industry to be cleaner:
  - more efficient processes to produce AND use Raw Materials
  - better E and W consumption management,
  - CO2 footprint
- Transportation to be less pollutant:
  - E-Vehicles, train, trucks, buses,
  - Fuel Cells, H2 production
- Energy to become renewable:
  - transition to wind, solar…

Each of the actions will require a deep transformation and an increased need for metals and minerals

TRENDS FROM THE CLEAN ENERGY

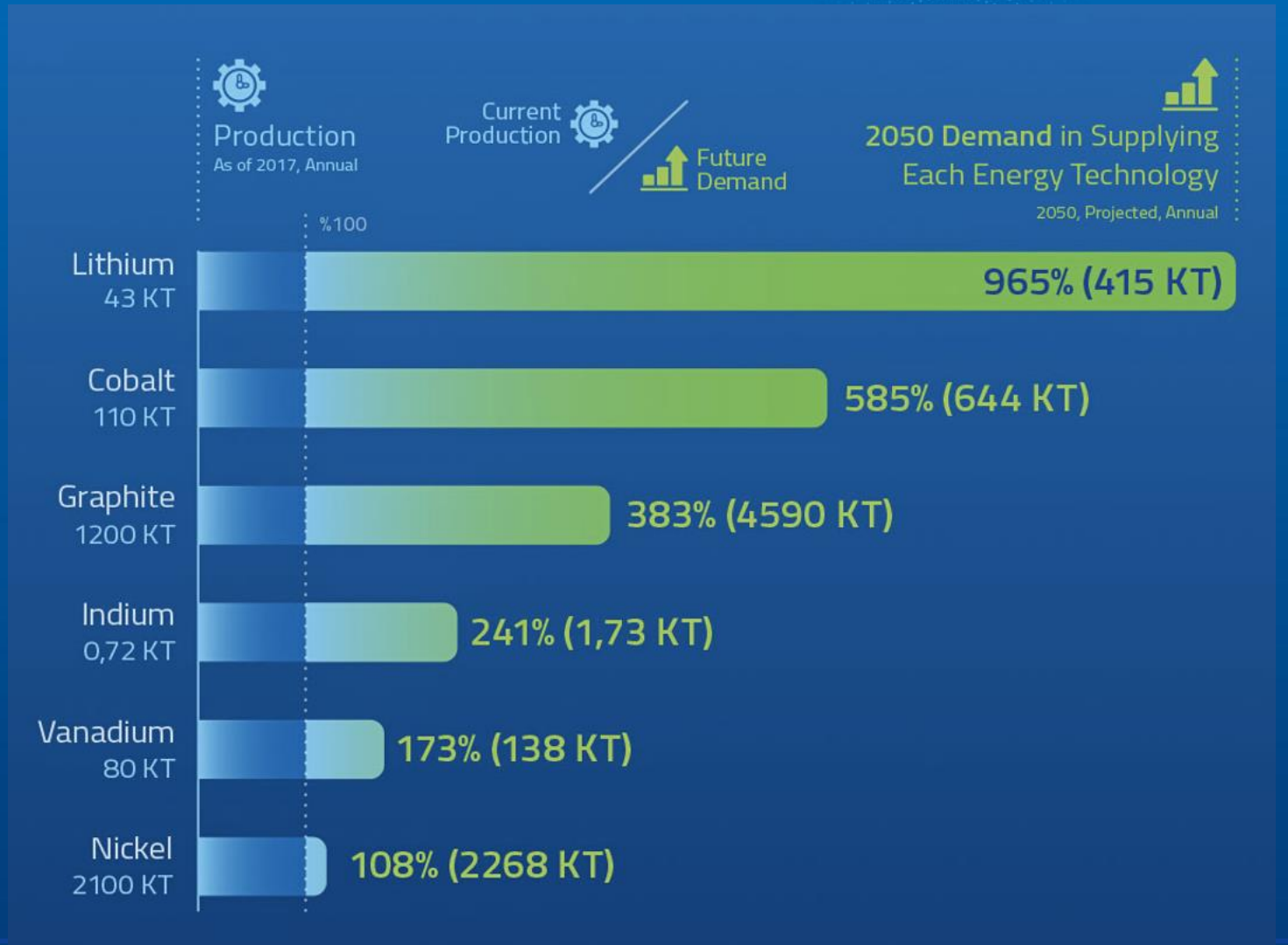


Critical Raw Materials for Strategic Technologies and Sectors in the EU - A Foresight Study (2020)
Rapport JRC

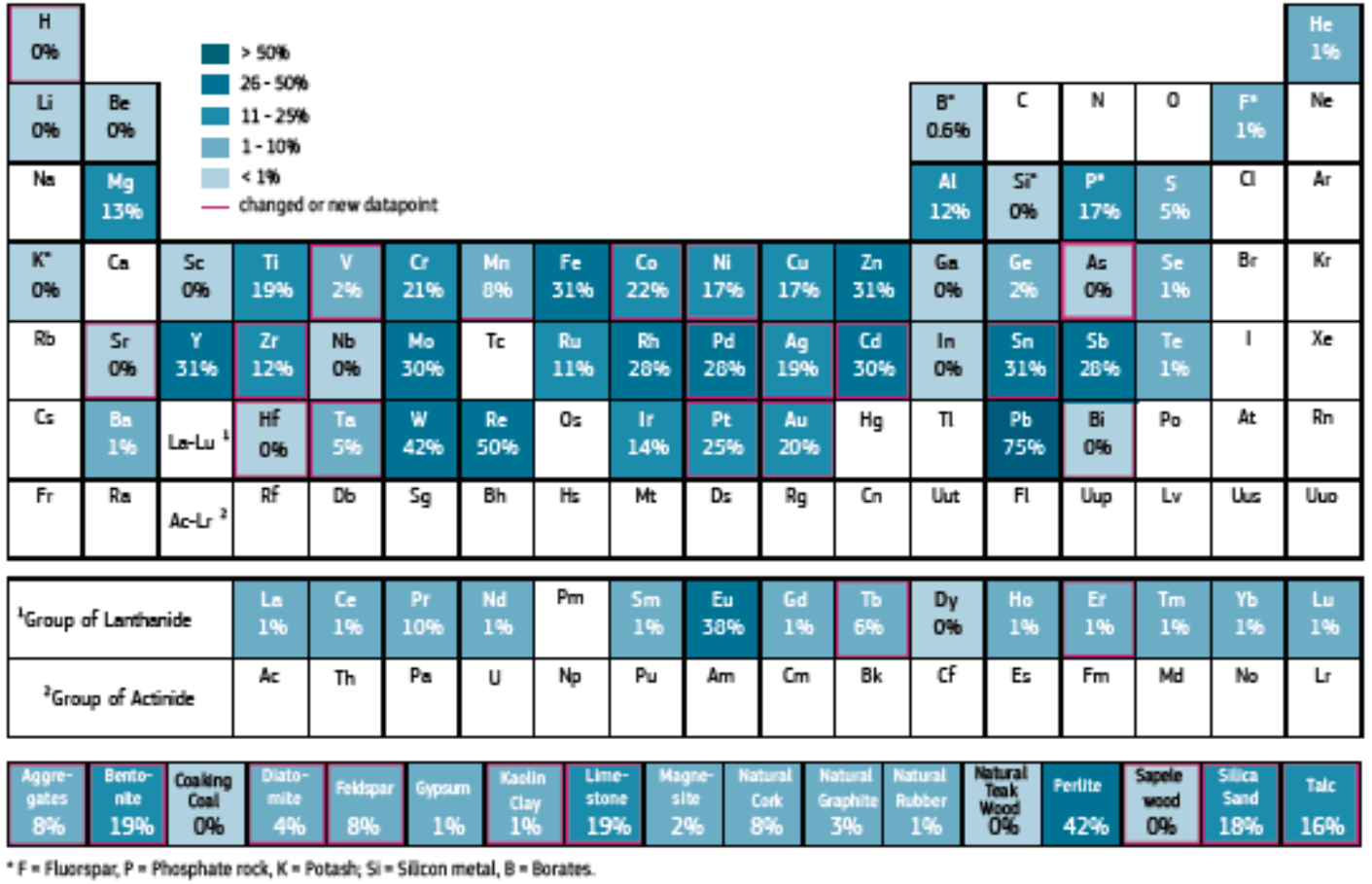
GREEN ENERGY TRANSITION CREATES A GROWING DEMAND FOR MINERALS AND METALS

Wind power, solar energy and batteries are key technologies for Europe's green energy transition toward carbon-neutrality by 2050. These green technologies require large amounts of minerals and metals with a demand that is expected to increase exponentially. Hence, sustainable and reliable production will need to keep up.

Right now, Europe is highly dependent on minerals and metals from non-European countries crucial to the global green energy transition and achieving the UN SDGs. Continuous investment in innovation and technology for sustainable sourcing of raw materials along the entire value chain is key.



RATE OF RECYCLING

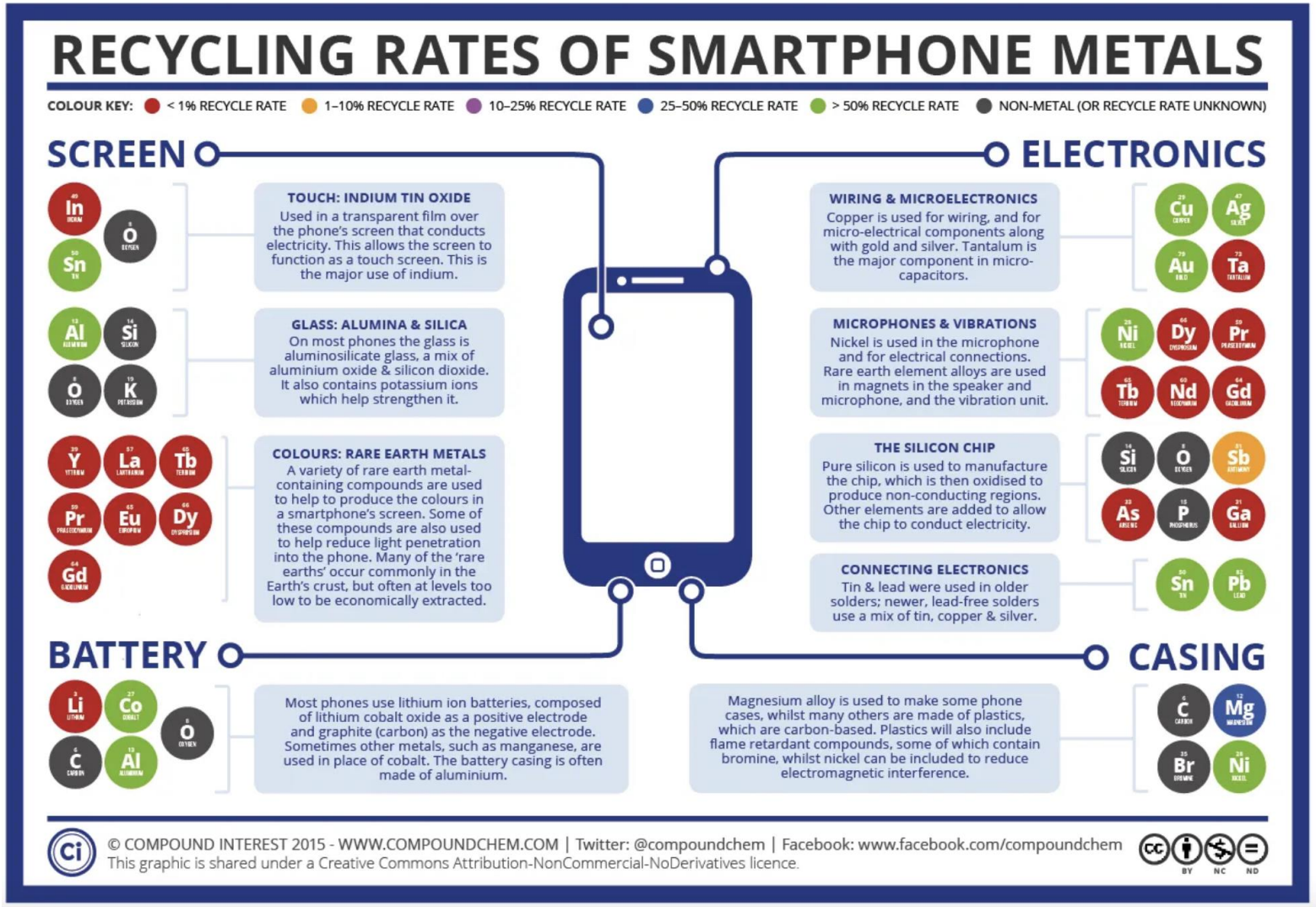


* F = Fluorspar, P = Phosphate rock, K = Potash; Si = Silicon metal, B = Borates.

End-of-life recycling input rates (EOL-RIR) in the EU[1]

Source: 3rd RM Scoreboard, Commission Europeenne, Mai 2021

EXAMPLE OF ELEMENTS IN SMARTPHONE



https://www.compoundchem.com/2015/09/15/recycling-phone-elements/

THE WAY TO DECREASE DEPENDENCY: CIRCULAR ECONOMY

1. **Extend life cycle**
2. **Repair**
3. **Better design for circularity**
4. Better use of materials
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SUBSTITUTION

- Element by another element:
  - Very long process
  - Very often unsuccessful
  -
- Element by another material
  - Metals by composite (mostly in Automotive industry)
- Blocking points
  - Price
  - Characteristics not meet

BETTER USE OF MATERIALS

- New technology allows reduction of amount of **materials: Additive Manufacturing**
  - AM strongly enters market
  - Lighter parts
  - Less material needed, less losses
  - Parts with challenging shapes
  - Association of elements impossible with other traditional way

VALORISING WASTE

- At each step of the process:
  - Mining (tailing)
  - Hydrometallurgy
  - Pyrometallurgy: dust, slag, sludge, ashes…
  - End user processes: ships, rejects, defects…
- Advantages
  - New significant sources of raw materials
- Blocking points
  - Price volatility
  - No Process or process not efficient (yield)

RECYCLING EOL

End of Life products:

- E-waste, Automotive, Appliance, Buildings…

Blocking points:

- Not available immediately (fuel cells electrical battery…)
- Collect channel not so well-developed
- Flux leaving Europe
- Design to be improved for dismantling and recycling
- No process available
- Small amounts to recover
- Cost of the different steps → no competitive price vs 1ary resource

INDUSTRIAL SYMBIOSIS

The Waste of a company becomes a Raw Material at another one

- Benefits
  - Valorisation of waste and cost savings in landfilling or waste disposal (solid waste, heat, enrgy…)
- Blocking points
  - Waste shipment very regulated
  - Limited knowledge on the subject
  - Limited knowledge on what is available and where

- Project Circlean: aims at developing a platform where industrial can add their waste with some characteristics, and look for waste they could use. https://circlean-symbiosis.eu

CONCLUSION

European companies engaged in Circular Economy:

- decrease of natural resources
- stricter and more severe environmental regulations (disposal, air…)
- supply risk
- customers

Remains limited due to

- economical aspects
- limited connection between manufacturers and recyclers (design)
- lack or collection channel
- processes to be further developed

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