

Critical materials for the energy transition

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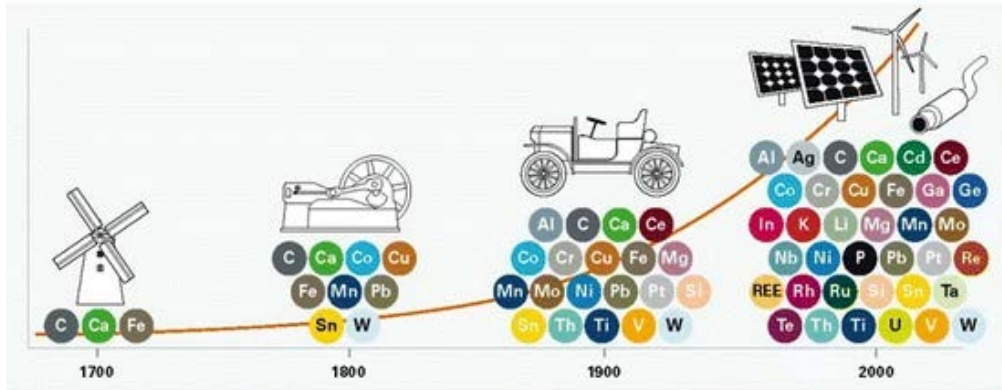
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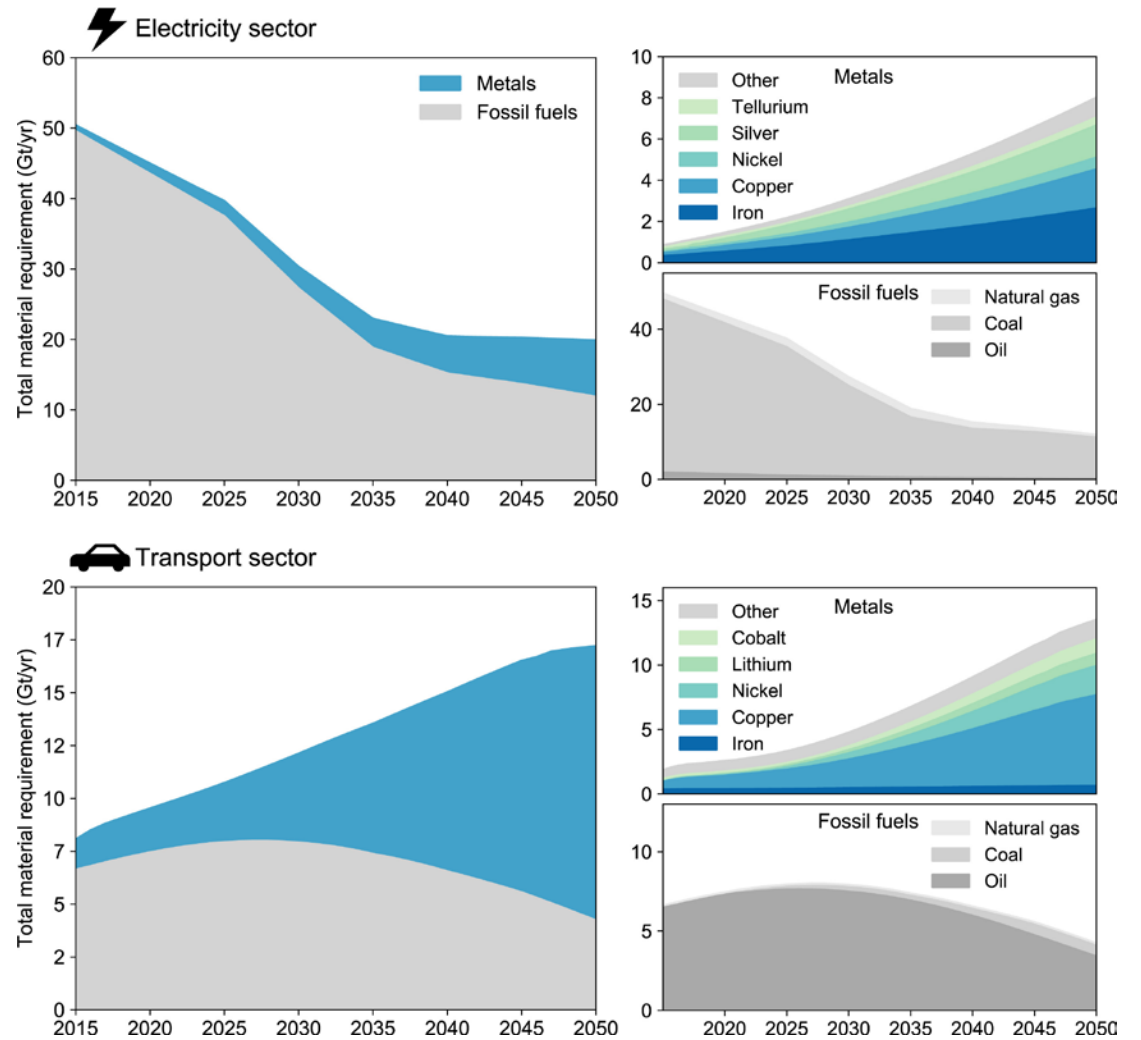


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MATERIALITY OF THE ENERGY TRANSITION



Elements widely used in energy pathways.
Source: Zepf et al, 2015.

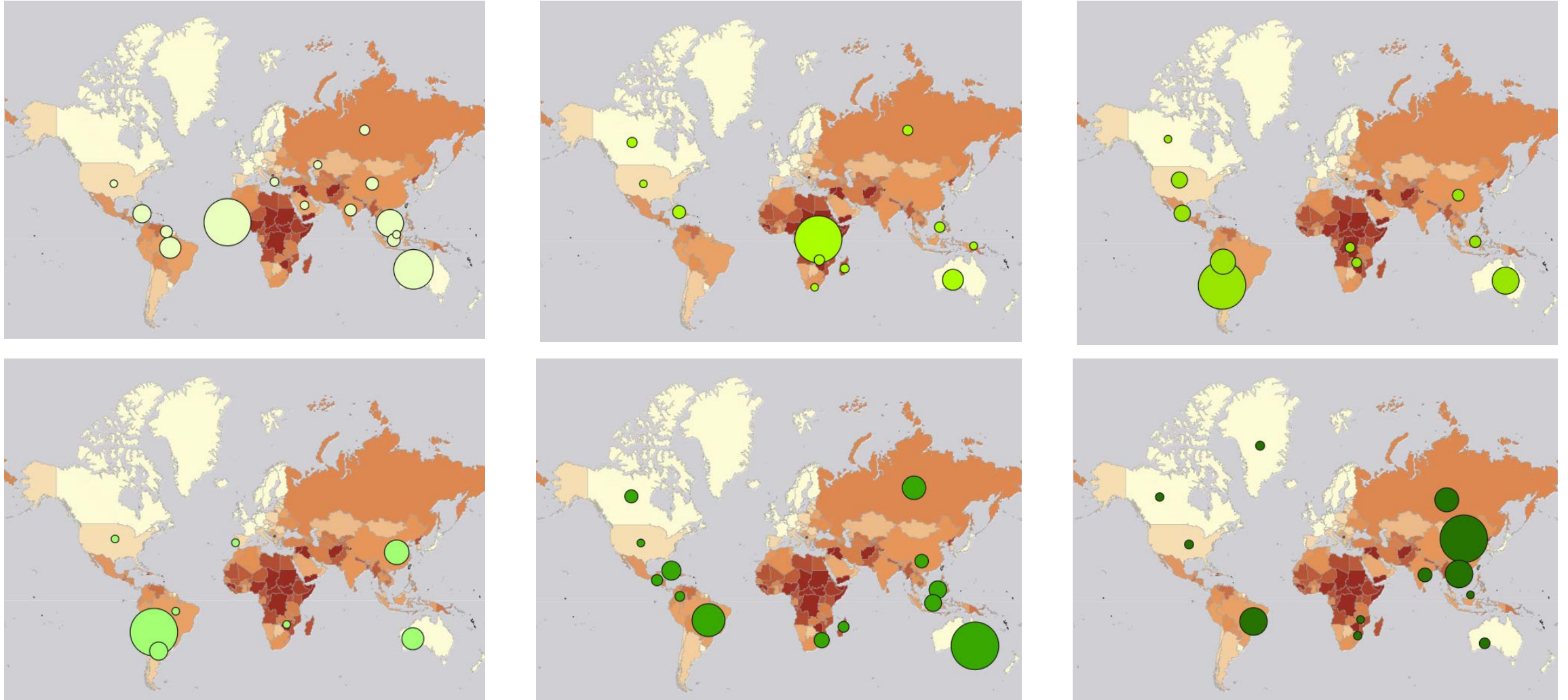


Total quantity of materials required for the global energy system in the IEA scenario limiting global warming to 2°C. Source: Watari et al, 2021.

MINERAL PRODUCTION & RESERVES

Mineral/Metal	Global Mine Production (P) 2022 (t)	Largest supplier		Global Reserves (R)			R/P (Years)
		Country	Share of total (%)	Total (kt)	Largest	Share of total (%)	
Aluminum	69 000 000	China	58%	-	-	-	-
Bauxite	380 000 000	Australia	26%	31 000 000	Guinea	24%	82
Cobalt	190 000	Congo (Kinshasa)	68%	8 300	Congo (Kinshasa)	48%	44
Copper	22 000 000	Chile	24%	890 000	Chile	21%	40
Gallium	870	United States	86%	-	-	-	-
Hafnium	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Lithium	130 000	Australia	47%	26 000	Chile	36%	200
Magnesium	1 000 000	China	90%	N/A	N/A	N/A	N/A
Manganese	20 000 000	South Africa	36%	1 700 000	South Africa	38%	85
Nickel	3 300 000	Indonesia	48%	>100 000	Australia, Indonesia	21%	>30
PGMs	-	-	-	70	South Africa	-	-
Palladium	210	Russia	42%				
Platinum	190	South Africa	74%				
Rare Earths	300 000	China	70%	130 000	China	34%	433
Strontium	340 000	Spain	38%	N/A	N/A	N/A	N/A
Tantalum	2000	Congo (Kinshasa)	43%	N/A	N/A	N/A	N/A
Titanium	9 500 000	China	36%	700 000	China	27%	74
Vanadium	100 000	China	70%	26 000	China	37%	260

NEW OPPORTUNITIES FOR PRODUCERS OR OBSTACLES TO A FAIR TRANSITION?



NEW GEOPOLITICAL CHALLENGES ARE EMERGING

New strategies

- **Producers:** capturing more added value
 - Ex: Indonesia & nickel ban
- **Consumers:** securing supply
 - Ex: EU & Critical Raw Materials Act
 - Ex: China & Belt and Road Initiative

New alliances

- **Producers:** Towards an OPEC for critical minerals ?
 - Ex: Indonesia & battery metals cartel
- **Consumers:** Friend-shoring, consumers club
 - Ex: Mineral Security Partnership
 - Ex: BRICS+6 as an emerging rival trade block (Vivoda et al, 2024)

Need for **international cooperation** → creation of an international organization for metal governance?