

Global Sourcing of Minerals for the Battery Revolution

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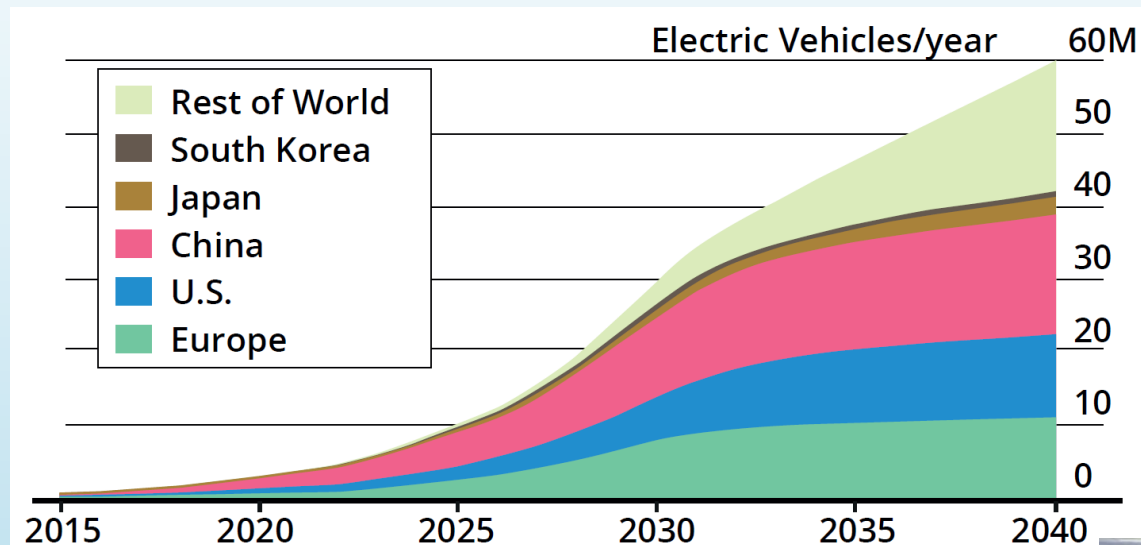


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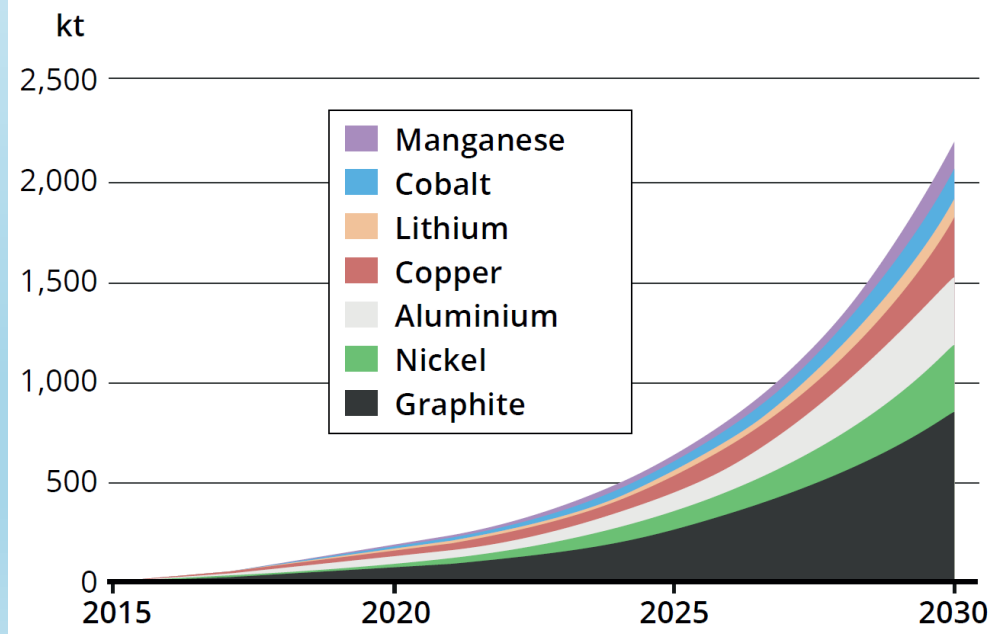


Forecast for Future Development

EV manufacturing



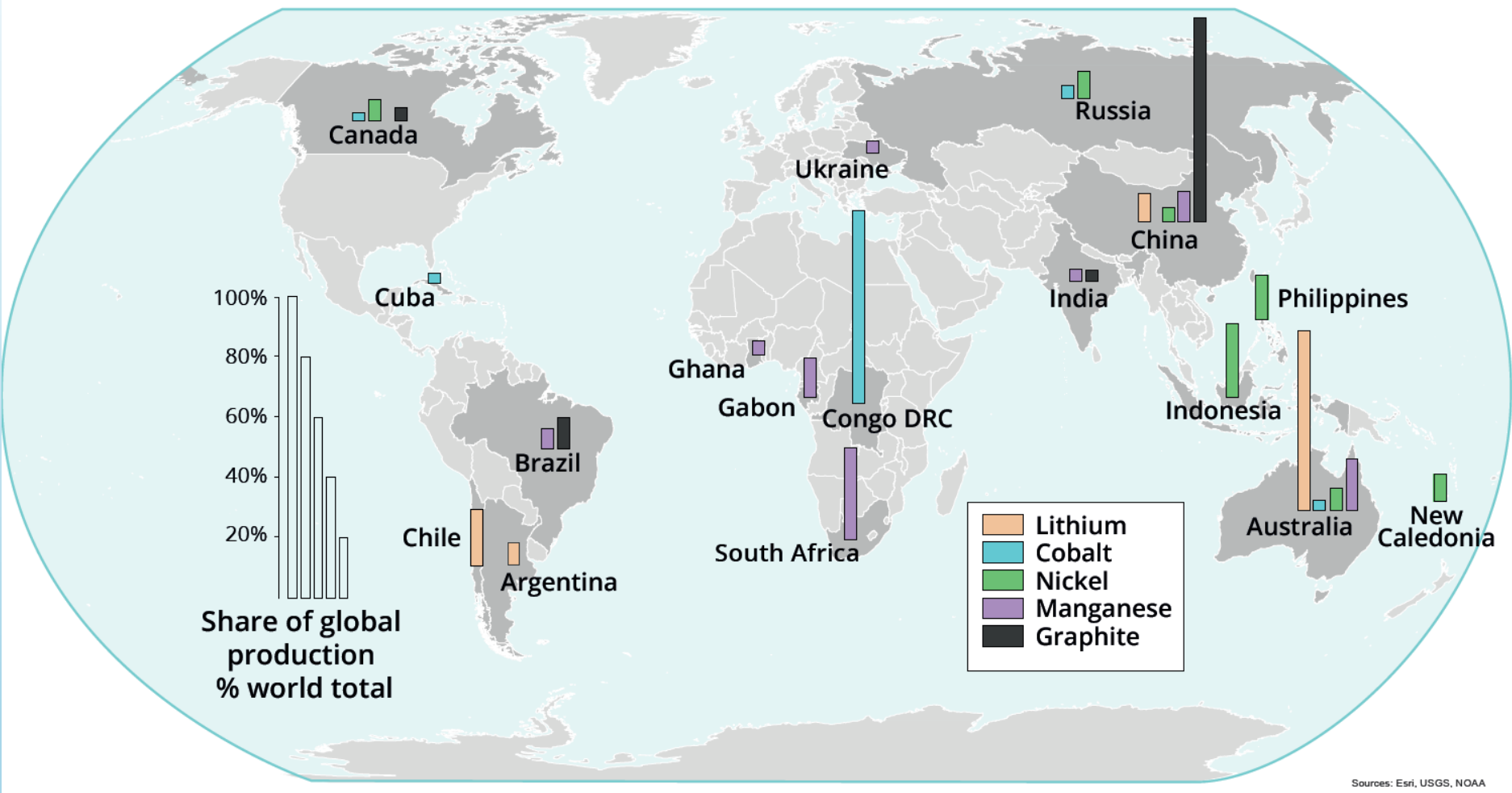
Raw materials need



Source: Bloomberg

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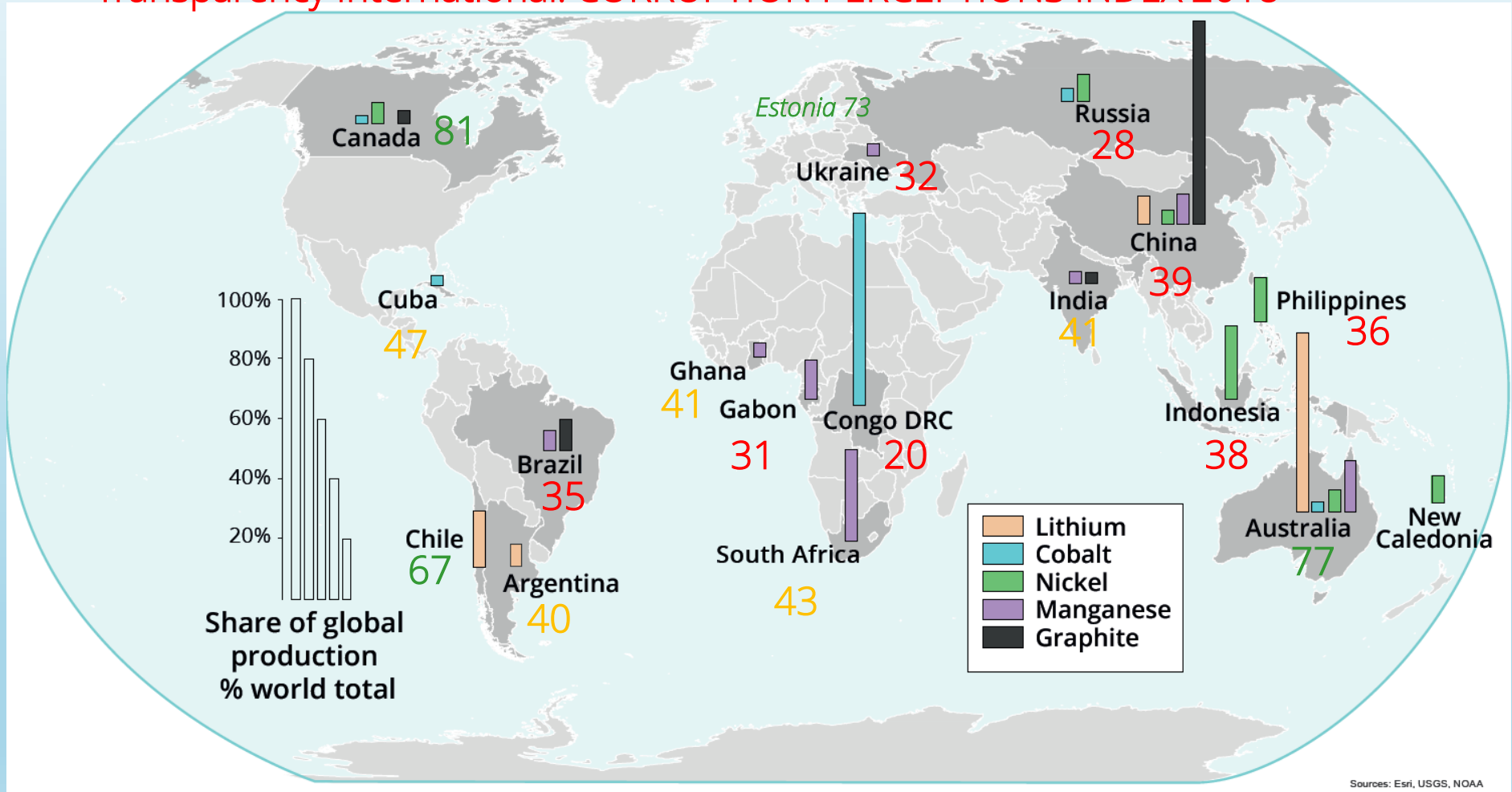
A Global View of Battery Minerals Production



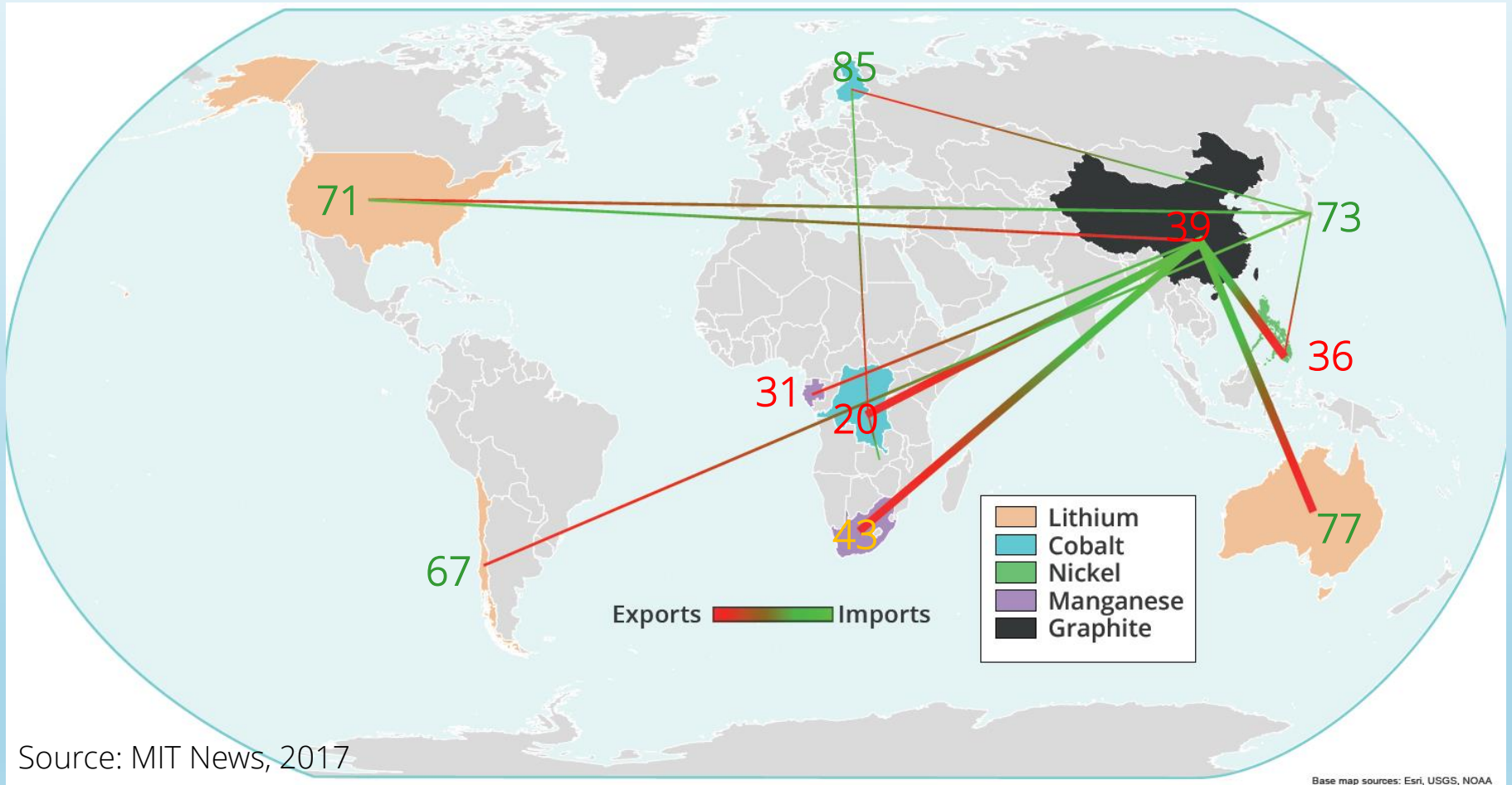
Sources: Esri, USGS, NOAA

A Global View of Battery Minerals Sourcing

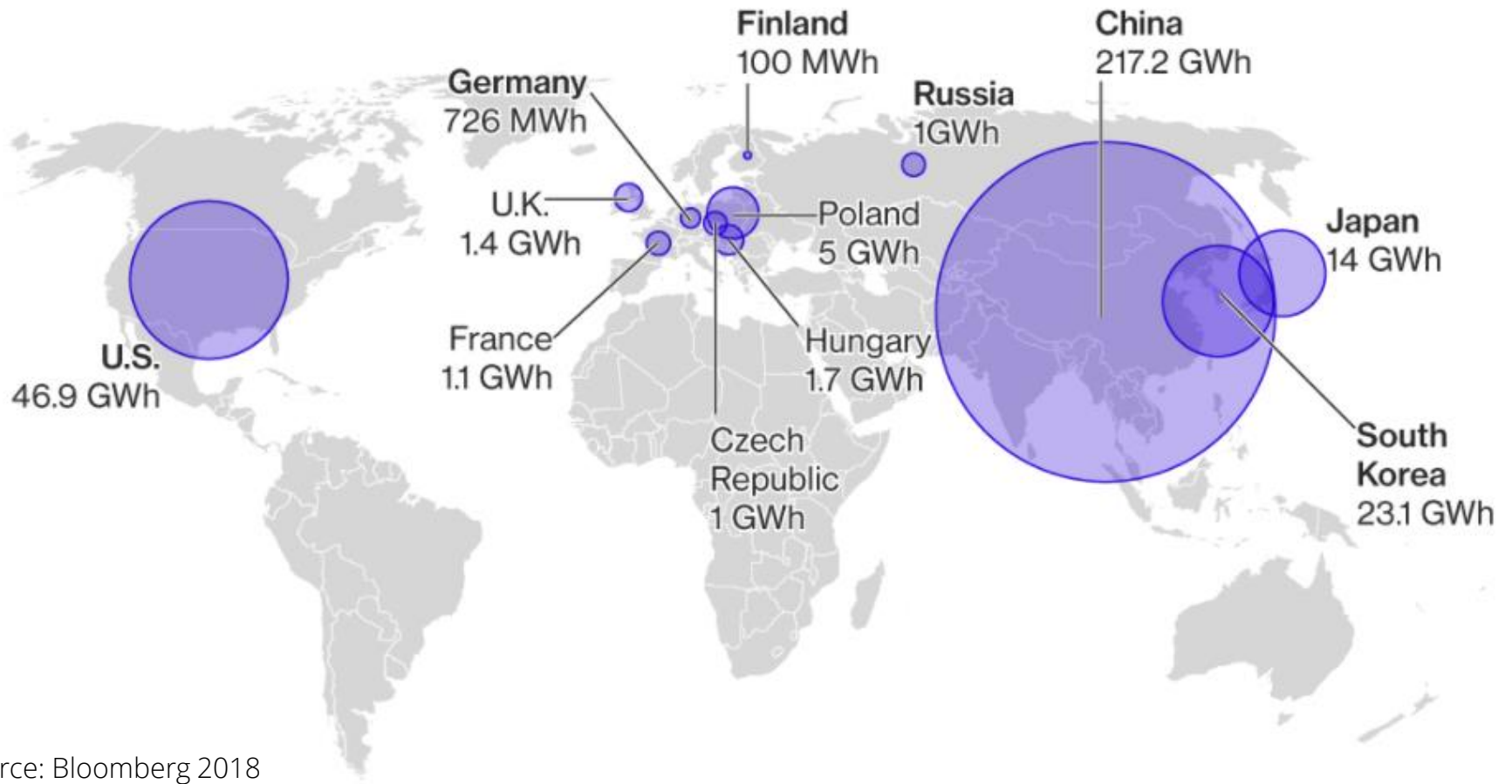
Transparency International: CORRUPTION PERCEPTIONS INDEX 2018



China Controls the Trade Flows Battery Materials



Where the LIBs are Made?



Source: Bloomberg 2018

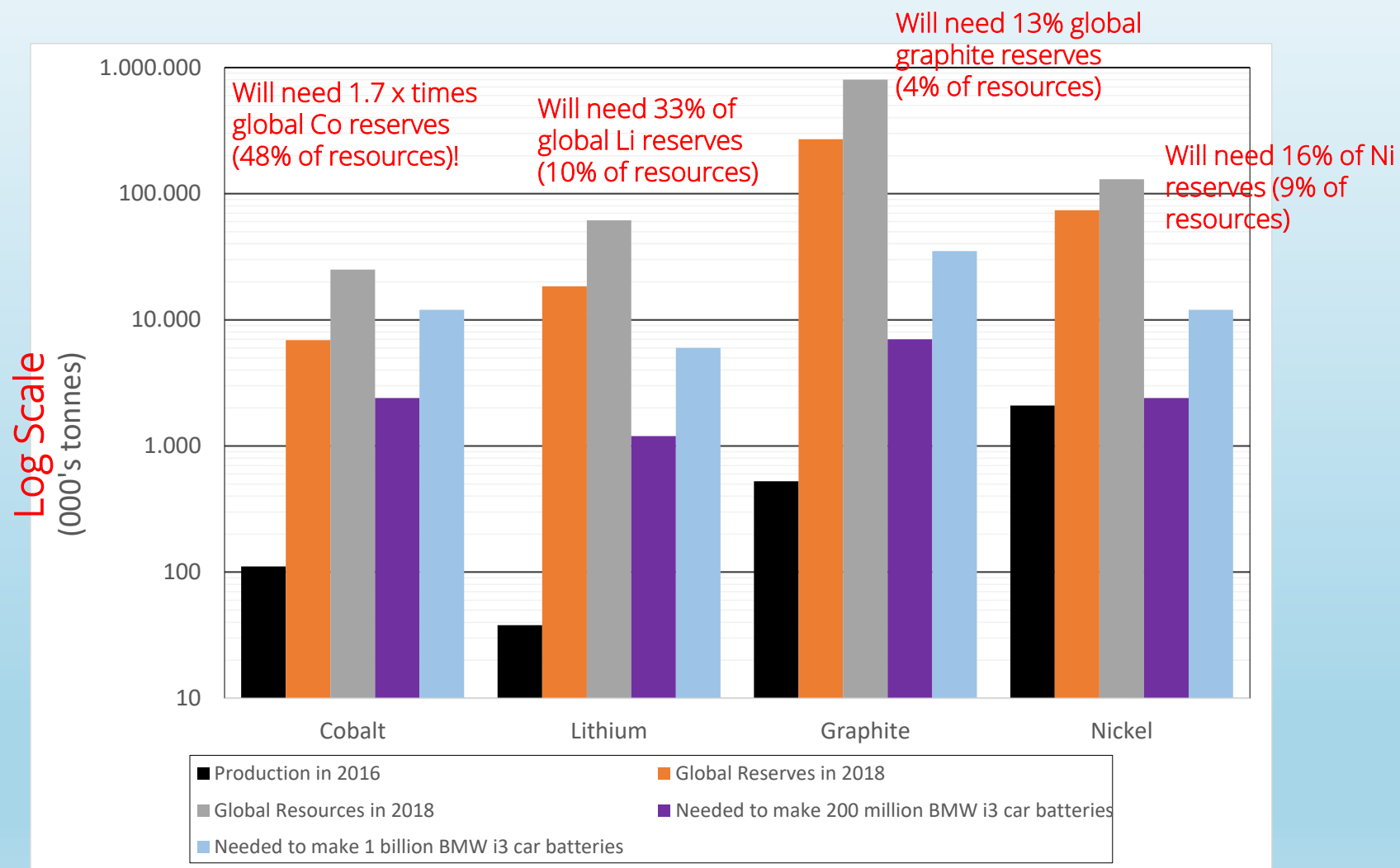
Global Reserves, Production and Average Price

Mineral	Global reserves 2018 (kt)	Production 2018 (kt)	Average price (\$/t)
Cobalt	6 900	140	33 000
Lithium	4 000	85	*14 000
Nickel	189 000	2 300	13 000
Graphite	300 000	930	**900
Manganese	760 000	18 000	1 800

* battery-grade lithium carbonate

** battery-grade flake graphite

Will Current Global Resources be Enough to Replace Existing Passenger Car Fleet with mid-size EV's?

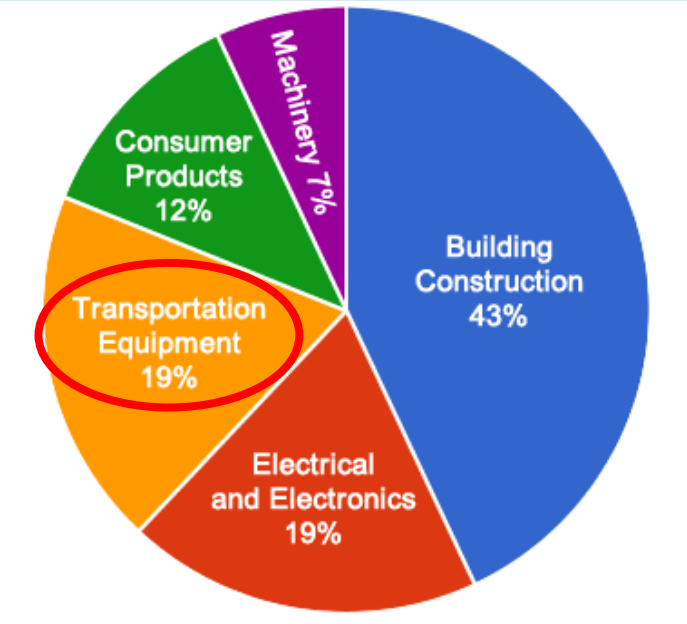


Source: USGS, Global EV Outlook 2018

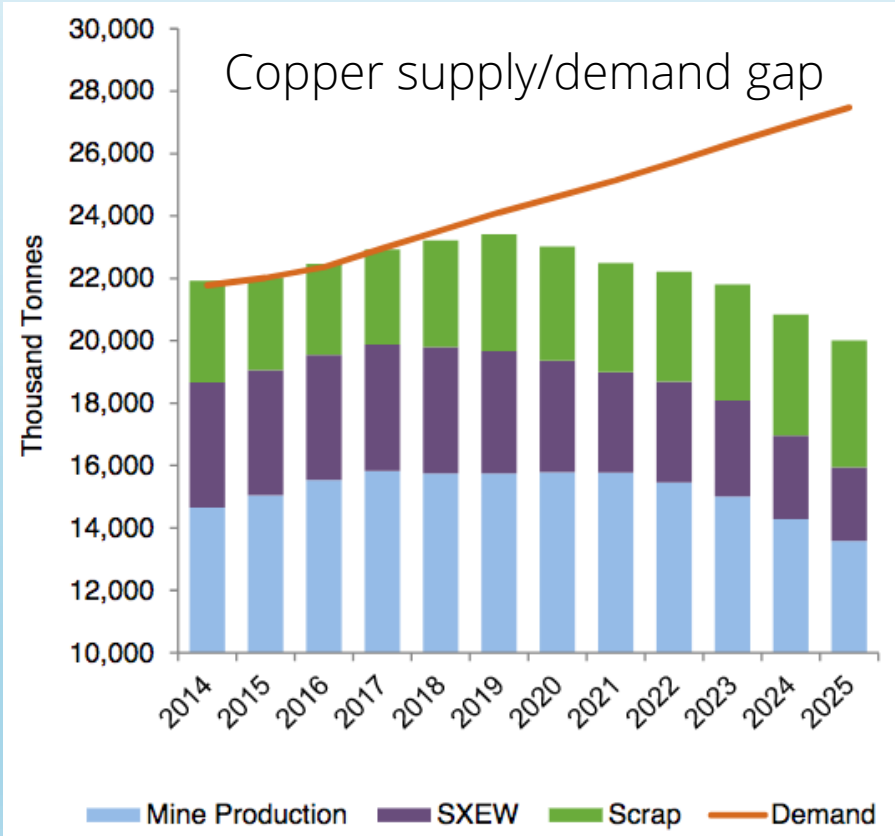
Will Copper actually be the Most Critical Mineral for Electric Mobility?

- Global Cu production is 23 Mt
- Each EV will need 80 kg and a bus 350 kg of Cu
- 1 bill. passinger EV's would need 4 times annual Cu production
- Plus buses, other applications and the global charging network

Global Copper Use in 2017



Source: International Wrought Copper Council

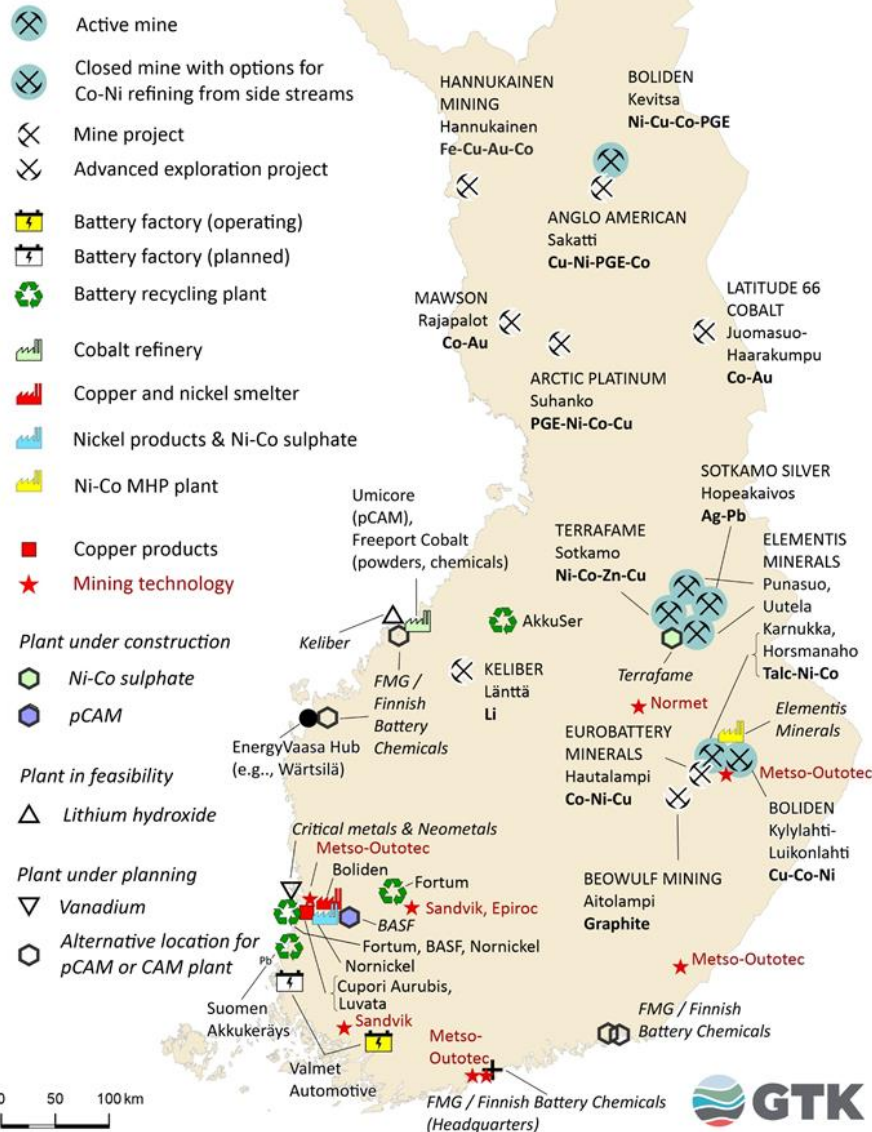


Source: Wood Mackenzie, CRU, ICSG, Teck

Finland's Strategic Roadmap



BATTERY MINERAL MINES AND PROCESSING PLANTS



- Finland's battery cluster include dozens of companies through the value chain from exploration/mining, processing, chemicals, precursors, battery manufacturing to recycling.
- National goal is to develop multi billion scale business.
- Finnish primary nickel production could reach 50,000...60,000 tpa in 2030s (currently ca. 40,000 tpa). Respectively cobalt production could be 2,500... 3,000 tpa (ca. 2,200 tpa currently)
- This enables also increase of domestic raw material refining in the ecosystem and hence promotion of sustainable Finnish Battery Cluster

Source: GTK 2021

Summary

- Raw materials reserves, production and refining capacity are getting scarce to supply the needs.
- Particularly, Co, Cu and possibly Ni are in supply shortage risk.
- Global race for raw materials, processing capacity and battery manufacturing ongoing.
- Several politically unstable countries are the main players.
- Strategic ownership, controls of raw materials trade and manufacturing are becoming critical.
- China has made strategic acquisitions and investments and is the dominant player through the value chain.
- EC has a strategic action plan for batteries, emphasizing availability of raw materials from EU sources, and EU processing and manufacturing capacity, but are we acting fast enough?
- Traceability would increase the competitiveness of sustainable countries.
- NE Europe has great opportunities to contribute the battery ecosystem in Europe.

