United Nations Trade and Development (UNCTAD)

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## Minerals and the Circular Economy

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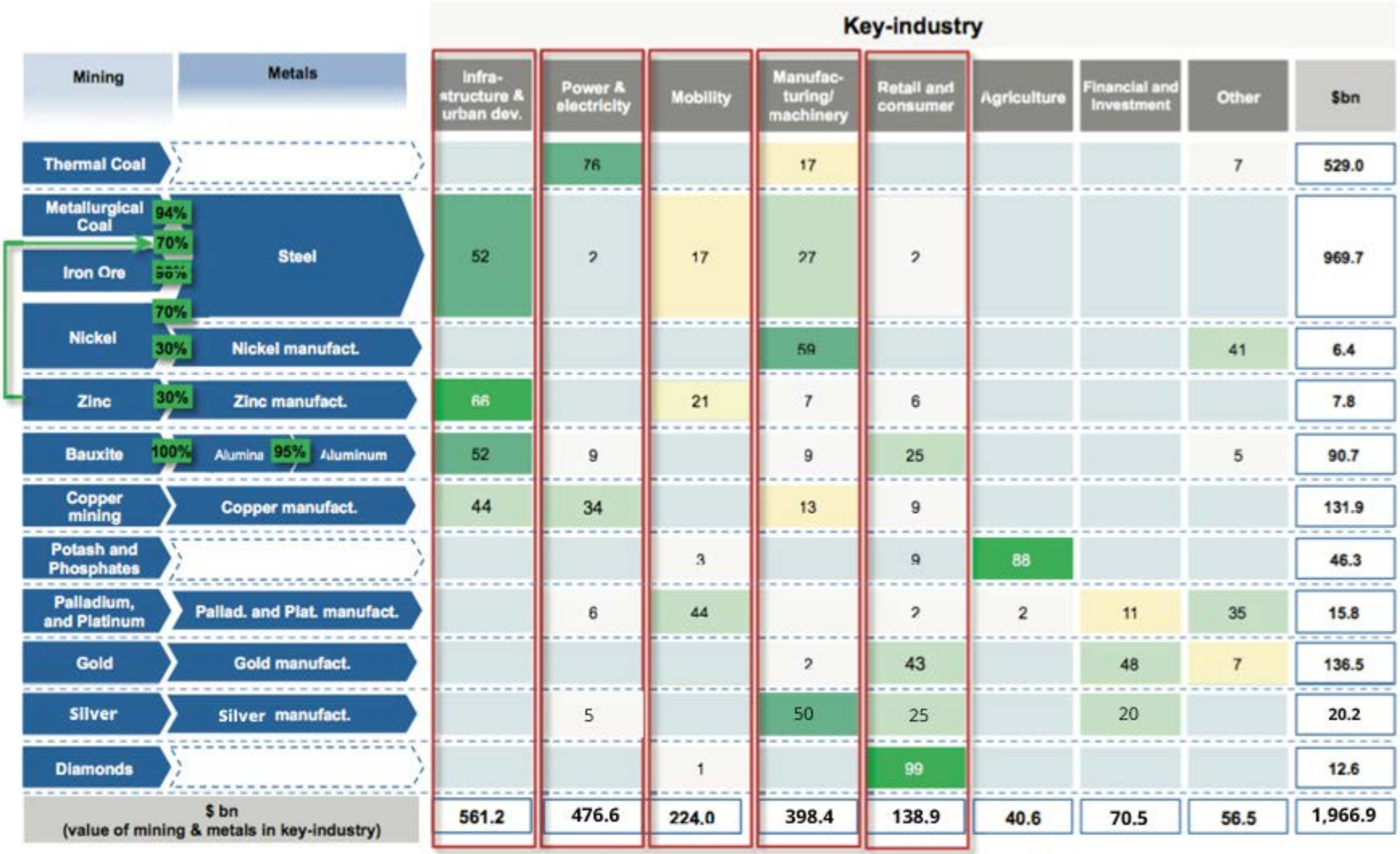
# THE $2 TRILLION MINING VALUE CHAIN




Source: BCG, WEF, MINING.com

# WASTE ANALYSIS DIAGRAM

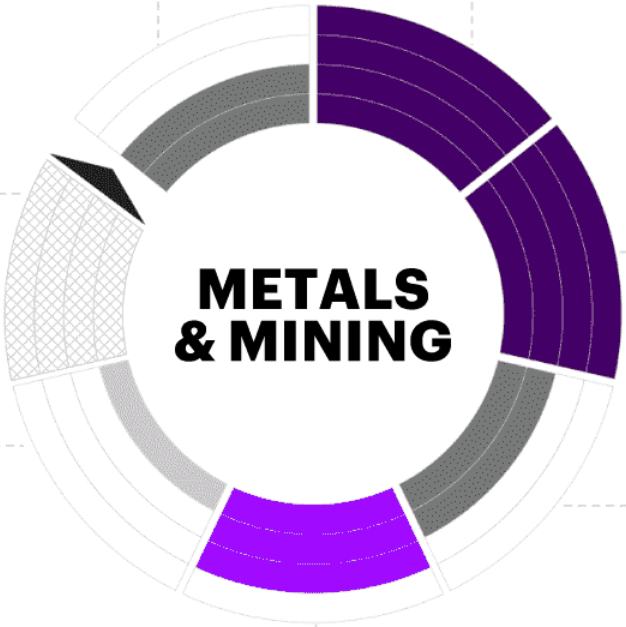
**Waste Volume:** Very high · High · Medium · Low · Not Applicable

**Engineering & Design**
Design choices for upgradeability, repair and second life options

**Reverse Logistics***

**Consumer Use**
High volumes of waste from disposal of consumer products

**Manufacturing**
Energy intensive processes, manufacturing waste



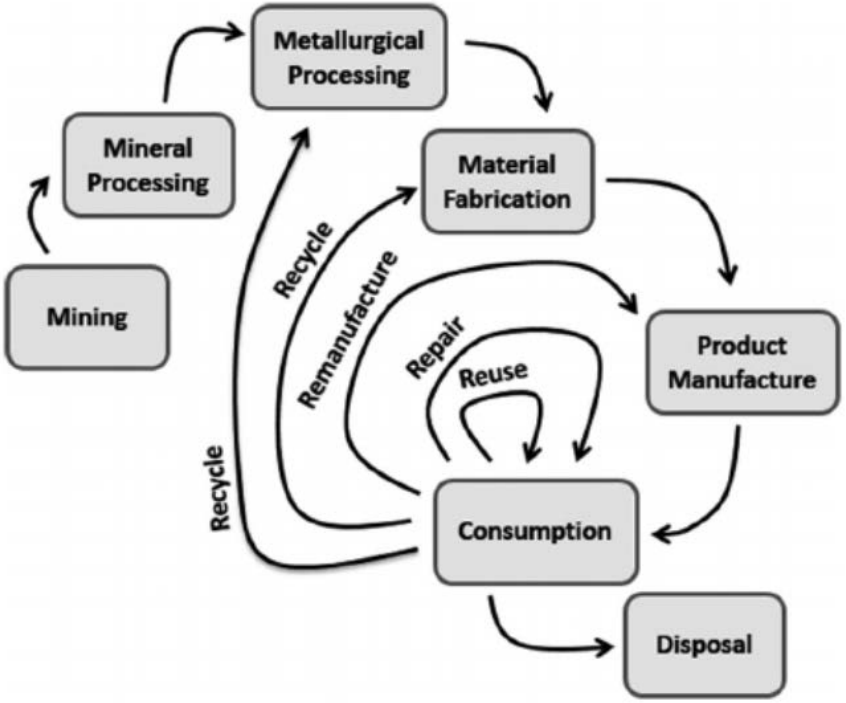

**Extension & Extraction**
Asset inefficiencies, energy and resource intensive extraction (and resulting waste)

**Processing**
Hazardous waste from operations, barren land after mining (known as mine-spoil)

**Logistics**
Energy usage and transport

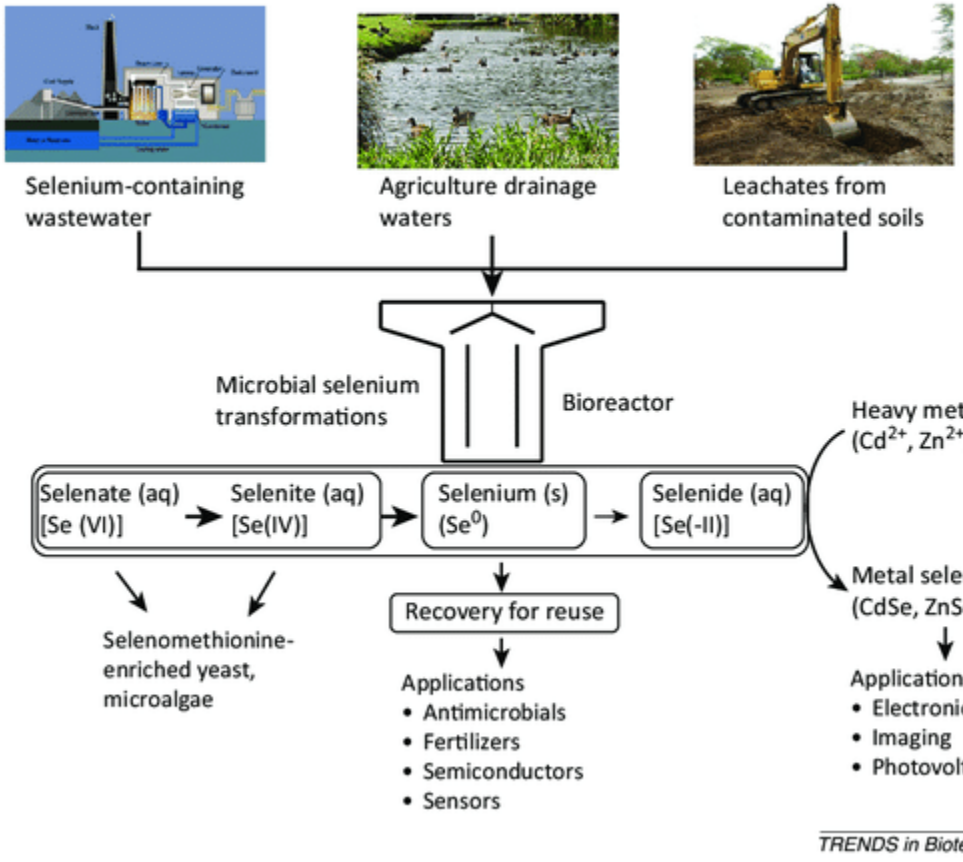
*Source: Accenture Strategy*

**Note: While the "Reverse Logistics" stage does not produce unique waste streams per se, it is included in the diagram as it is a key part of a circular value chain.*

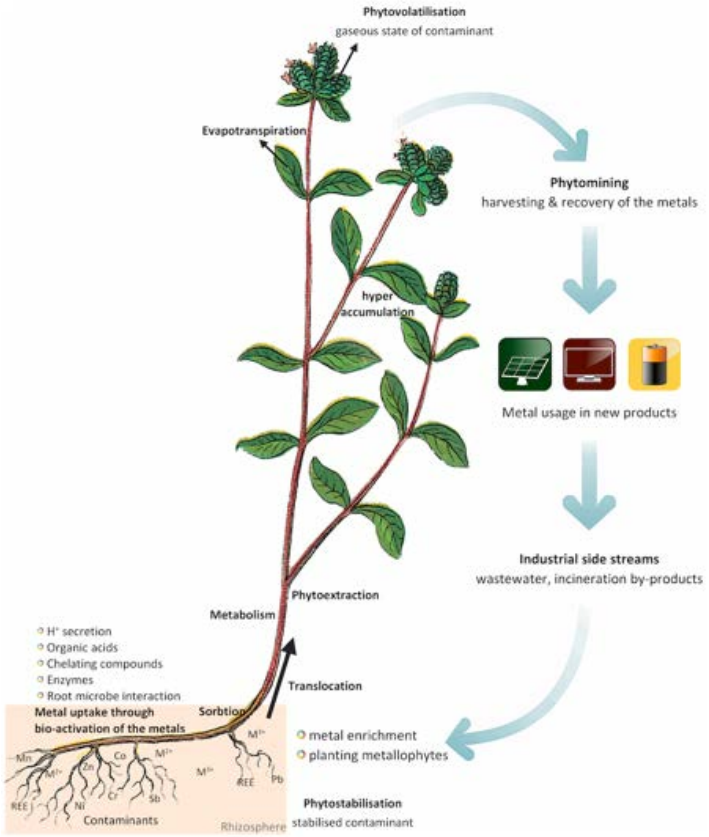



Lèbre, É., Corder, G., & Golev, A. (2017). The Role of the Mining Industry in a Circular Economy: A Framework for Resource Management at the Mine Site Level. *Journal of Industrial Ecology*, *21*(3), 662–672. https://doi.org/10.1111/jiec.12596

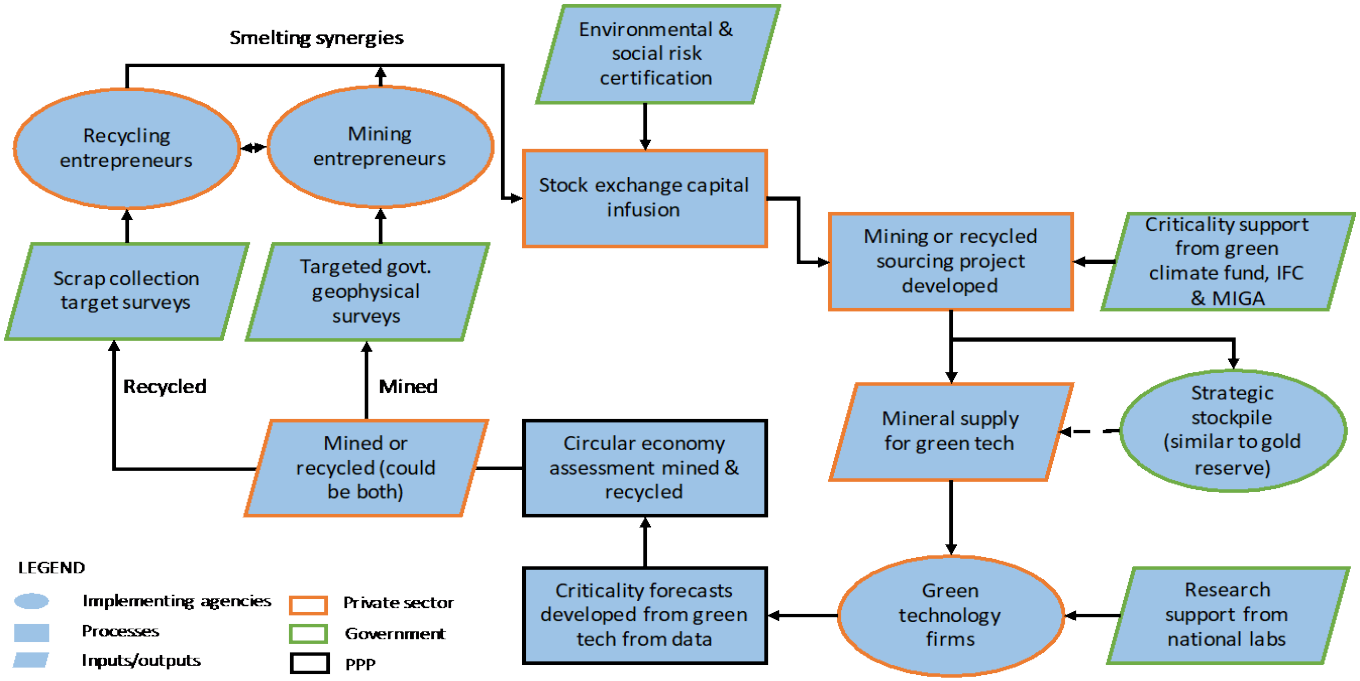
# Biomining


Selenium-containing wastewater
Agriculture drainage waters
Leachates from contaminated soils
Microbial selenium transformations
Bioreactor
Selenate (aq) [Se (VI)]
Selenite (aq) [Se(IV)]
Selenium (s) ($Se^0$)
Selenide (aq) [Se(-II)]
Heavy metals ($Cd^{2+}$, $Zn^{2+}$, $Pb^{2+}$)
Metal selenides (CdSe, ZnSe, PbSe)
Selenomethionine-enriched yeast, microalgae
Recovery for reuse
Applications
• Antimicrobials
• Fertilizers
• Semiconductors
• Sensors
Applications
• Electronics
• Imaging
• Photovoltaics
TRENDS in Biotechnology

# Phytomining




# SMED Model




Ali, Saleem H., Robert K. Perrons, Perrine Toledano, and Nicolas Maennling. 2019. “A Model for ‘smart’ Mineral Enterprise Development for Spurring Investment in Climate Change Mitigation Technology.” *Energy Research & Social Science* 58 (December): 101282. https://doi.org/10.1016/j.erss.2019.101282.

# Systems alternatives

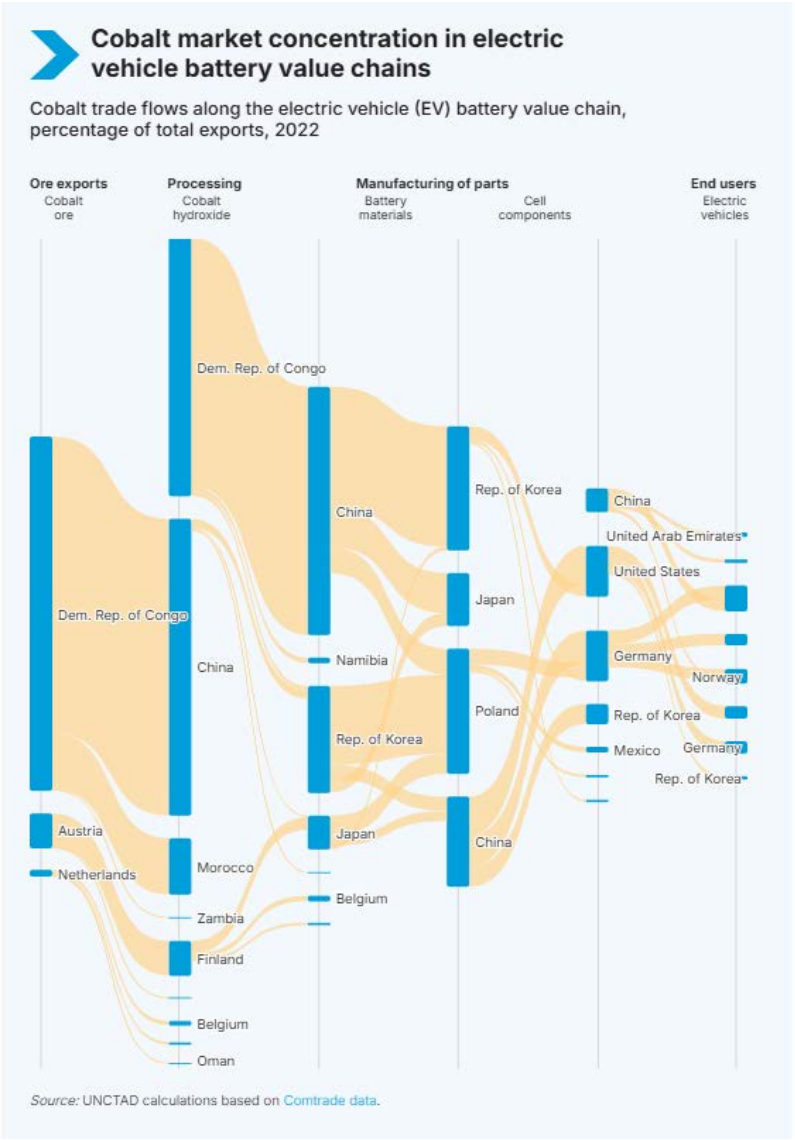
- Reducing metal demand for green technology products
- Switching to products which have more circular metallic flows possible with existing stocks – only ones with enough stocks for no mining required are thorium or gold
  - Building stocks requires a tradeoff with durability of product and energy required for recycling
- Switching to products with organic inputs that can be cultivated
  - Biofuels
  - Organic Radical Batteries – polymers, quinones but metal catalysts still often needed
  - However, carbon balance of fuels needs to be evaluated

# Role of UNCTAD

- Revisiting the lessons from your work on tin from the 1970s – lessons learned from that experience
- Providing a clean circular economy incentive mechanism in developing countries
- Extending your work on plastics to metals supply chains that might challenger findings of your earlier report on new mine forecasts – specially for copper

# Revisiting the UNCTAD Sankey Diagram on Cobalt

- Considering scenarios for where the end use of each product can be brought forth in the circular economy
- Adding a layer of ecological efficiency to such analysis to consider if localized value addition would be appropriate or economic other diversification is in order
- Lessons from recent visit to Indonesia in this context with their mineral regulation reforms and the absence of mining in their circular economy program



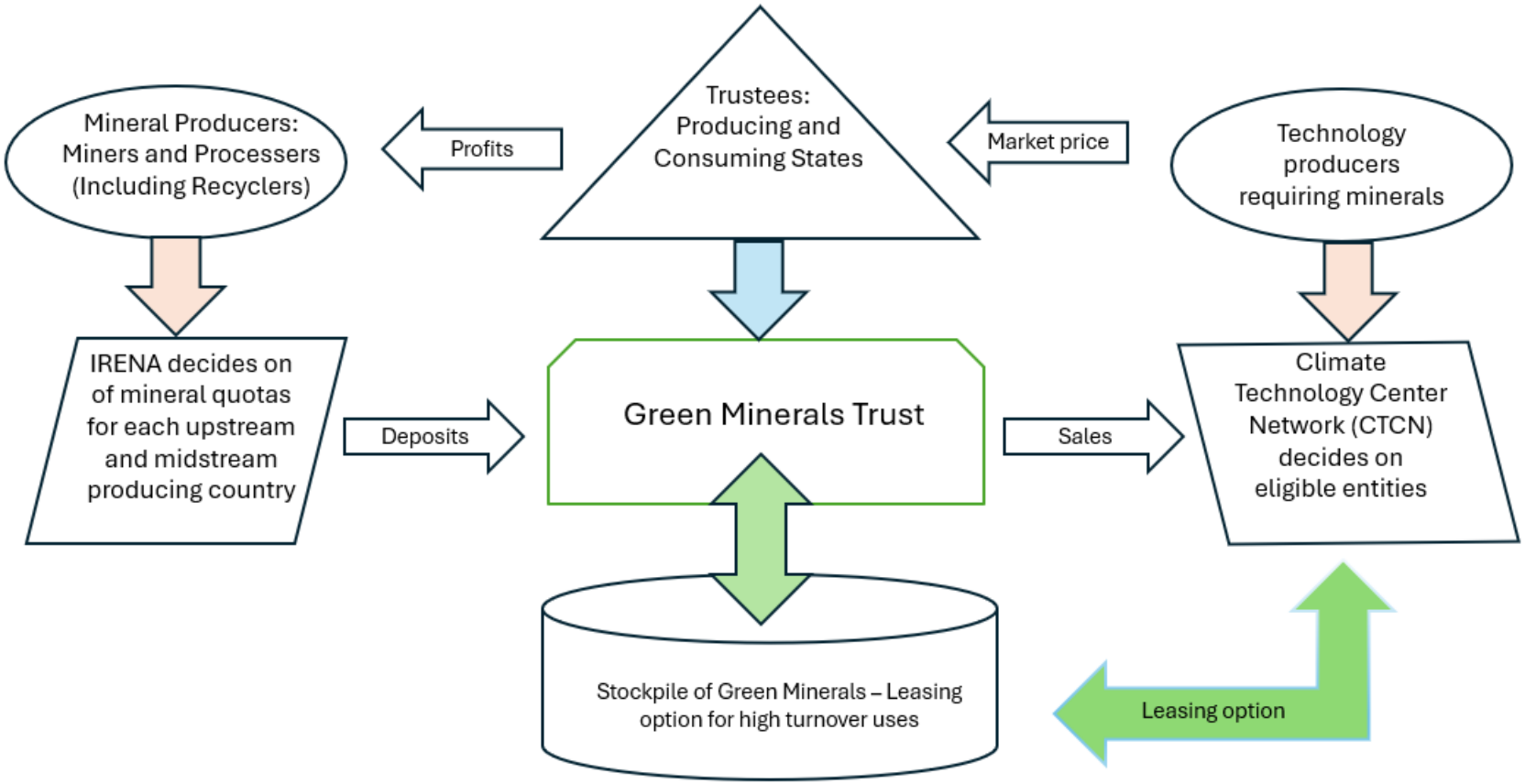



Diagram by Saleem H. Ali – further details TED Talk