

From Energy Security to Strategic Autonomy: Building Resilient Critical Mineral Networks

Dr Parul Bakshi
Fellow – Energy & Climate, ORF ME

Korea-India Strategic Dialogue Symposium
Institute for Future Strategy, Seoul National University
13 November, 2025

Setting the Context

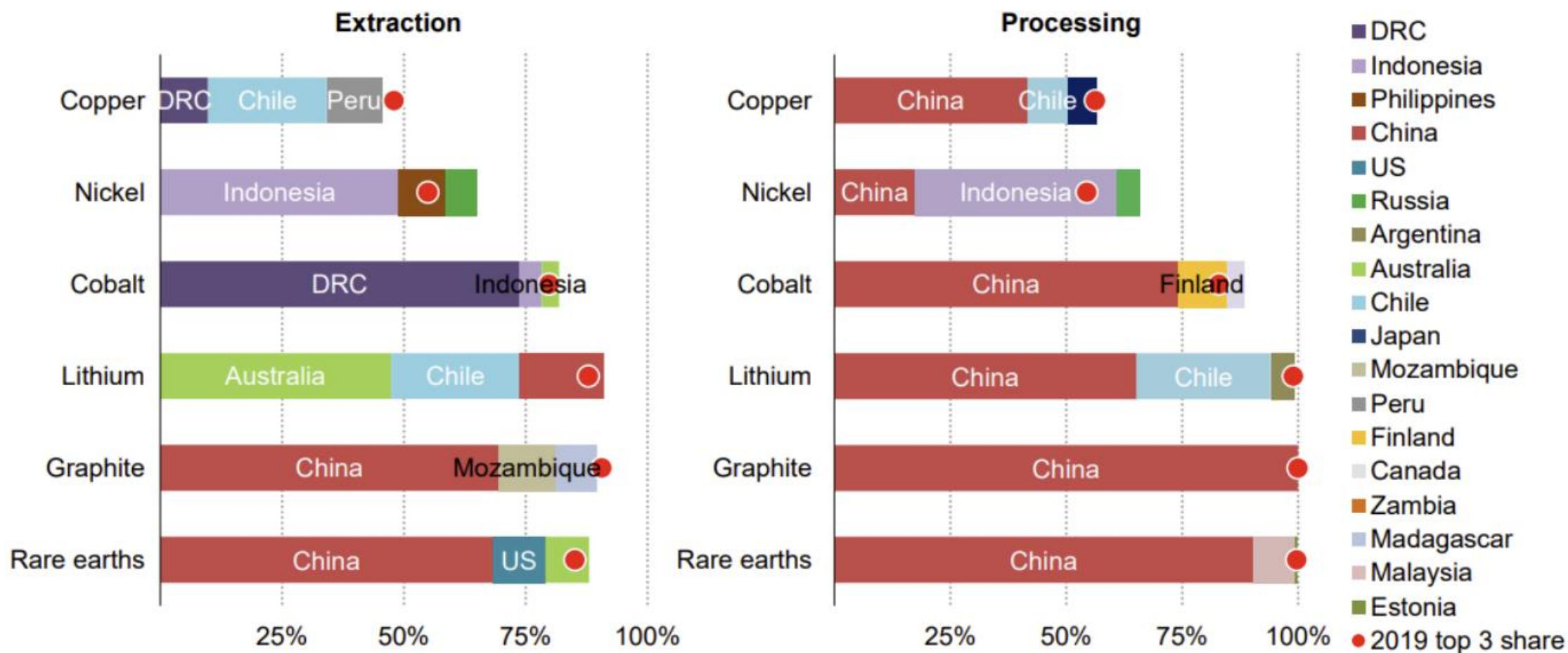
- Global supply chains face overlapping crises: *geopolitical rifts, pandemic, and climate shocks* + System of dynamic multipolarity
- Energy-linked critical minerals (lithium, nickel, cobalt, REEs) now underpin economic and energy security – “**Critical Energy Transition Minerals**”
- Roughly two dozen minerals are essential to clean energy technologies. Equipping the world for net zero by 2050 implies a six-fold increase in production of these minerals from 2022 levels (UNEP, 2024)
- An onshore wind plant needs *nine times* more minerals and metals per unit of energy produced than a gas-fired power plant + An offshore wind plant needs roughly *50 per cent* more minerals and metals than an onshore one (IEA, 2022)
- The central challenge: balancing decarbonization goals with strategic autonomy and resource access

	Wind	Solar PV	CSP	Geother- mal	Hydro	Bioenergy	Hydrogen	Electricity Grids	EVs	Battery Storage
Alumimium	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆
Boron	◆								◆	
Cadmium		◆								◆
Chromium	◆		◆	◆	◆		◆			
Cobalt	◆		◆			◆	◆		◆	◆
Copper	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆
Gallium	◆	◆						◆	◆	
Germanium		◆							◆	
Gold		◆							◆	
Graphite									◆	◆
Indium		◆							◆	◆
Lead		◆			◆	◆			◆	◆
Lithium									◆	◆
Manganese	◆		◆	◆	◆		◆		◆	◆
Molybdenum	◆	◆	◆	◆	◆					◆
Nickel	◆	◆	◆	◆	◆	◆	◆		◆	◆
PGMs							◆			◆
REEs	◆						◆		◆	◆
Silicon		◆							◆	◆
Silver	◆	◆	◆						◆	
Tellurium		◆								
Tin		◆		◆						◆
Titanium				◆		◆				
Vanadium					◆		◆	◆	◆	◆
Zinc	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆
Zirconium							◆			

Critical Energy
Transition Minerals
(UNEP, 2024)

The geoeconomic map
is being redrawn
around these
materials

Supply Risks & Control Points



Consequences of tight, unpredictable supply chains



Volatile prices



Barriers to building new low-carbon energy systems



Growing economic protectionism - **Globally, there are five times more trade restrictions on energy transition minerals exports than there were in 2009**



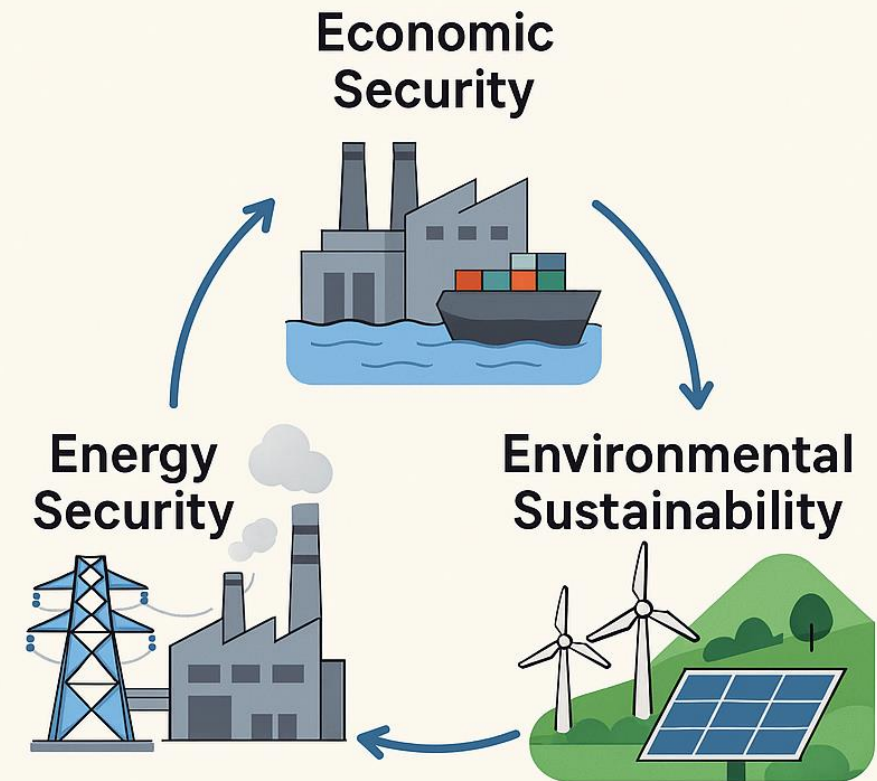
Rising geopolitical tensions

The new resilience paradigm is not just about economic hedging it's about aligning energy security, economic security, and environmental sustainability.

- **Energy Security:** stable access to fuels and technologies.
- **Economic Security:** resilient supply chains and industrial competitiveness.
- **Environmental Sustainability:** emissions reduction and clean tech scaling.

→ The three must now *reinforce* each other not compete.

The Energy–Minerals–Climate Triangle



India-Korea Strategy on Critical Minerals & Clean Energy Supply Chains

India's Approach: Scaling Processing, Manufacturing & Strategic Partnerships

- National Critical Mineral Mission (30) + PLI Scheme
- Global Partnerships: JV exploration & procurement with Australia, Argentina, Africa & Saudi Arabia (e.g., Khanij Bidesh India Ltd – KABIL + IREL)
- India's core strategy is to become a processing & manufacturing hub, converting raw minerals into value-added clean energy components

Korea's Approach: Technology, Downstream Strength & Diversification

- Strategy for Securing Critical Minerals (33) + K-Battery Alliance & K-Semiconductor Strategy + K-RE100
- Korea Mineral Resources Security Act & expanded role of Korea Resources Corporation (KORES) and Korea Development Bank in overseas mineral investment + Supply Chain Stabilization Fund
- Korea's strength is downstream technology and manufacturing precision, but its exposure to upstream minerals drives the need for trusted supply partnerships

Area	What This Means	Potential Collaboration	Strategic Value
Supply & Processing	Secure midstream capacity to reduce exposure to refining dominance.	- Establish joint processing & refining hubs in India for lithium, nickel & cobalt. - Korean & Japanese firms commit off-take agreements to anchor viability. - Co-develop India-based REE magnet value chain (IREL + Korean/Japanese partners).	- Enhances strategic autonomy for both countries. - Creates reliable, diversified mineral supply lines in Indo-Pacific.
Finance & Risk Sharing	De-risk upstream & midstream investment across Africa, Australia, GCC & Latin America.	- Mobilize blended finance. - Create KORES–KABIL Joint Investment Window for overseas mining stakes. - Develop guarantee-backed long-term procurement contracts.	- Lowers investment risk; accelerates project execution. - Avoids “winner-takes-all” scramble dynamics.
Technology & R&D	Build a shared innovation pipeline for mineral efficiency & energy transitions.	Joint R&D centers on recycling & innovation. - Collaborative pilots + workforce - Technology sharing for automated, low-waste processing.	- Moves relationship beyond resource access to industrial upgrading. - Future-proofs both economies in next-gen clean tech.
Standards & Data Transparency	Ensure responsible sourcing + traceable & predictable supply chains.	- Develop shared ESG certification norms for minerals & processing. - Establish shared mineral market early-warning system for supply disruptions.	- Builds trust-based, networked resilience. - Enhances global credibility in sustainable supply chains.

Multilateralism in Motion

We are entering an era of *strategic minerals diplomacy*, where countries must move from bilateral deals to networked resilience through trilateral and multilateral frameworks that integrate *trust, transparency, and technology*

- Interdependence must evolve into **trusted interdependence**
- Most countries are going to try to maximize strategic flexibility within the constraints of their specific circumstances
- **India–Korea–Japan** critical minerals trilateral.
- **Quad+** (critical minerals & clean energy supply chains).
- **IPEF Pillar II** (supply chain resilience).
- **G7 Climate Club** and **G20 Mineral Security Partnerships** - MSP Finance Network

Conclusion: Toward Networked Resilience

- Energy security is the new economic security and critical minerals are its foundation.
- Strategic autonomy today is not self-sufficiency, it is the ability to build trusted interdependencies on our own terms.
- The real shift is from “buyer–supplier” to co-developers of secure mineral ecosystems, where India anchors scale & processing, and Korea anchors technology & industrial upgrading.
- Resilience is no longer a reaction; it’s a design principle.
- Resilience ≠ inefficiency; it’s *strategic flexibility* and *risk visibility*.
- Resilience requires shared transparency frameworks and joint investment models.

Thank you
감사합니다



서울대학교
SEOUL NATIONAL UNIVERSITY

