

Strategic Minerals for the Energy Transition: Indonesian Resources and Korea's Stake in Supply Chain Resilience

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Introduction

The global energy landscape is undergoing a profound transformation, marked by a shift towards cleaner and more sustainable sources of energy. This transition is driven by the imperative to mitigate climate change, reduce greenhouse gas emissions, and ensure long-term energy security.¹ Governments, industries, and societies worldwide are increasingly recognizing the need to move away from fossil fuels and embrace renewable and low-carbon alternatives. As nations commit to ambitious climate targets and the adoption of cleaner technologies, the global energy transition represents a pivotal moment in reshaping how we generate, distribute, and consume energy.²

Strategic minerals play a pivotal role in powering the clean energy revolution.^{3,4} These minerals, including rare earth elements, lithium, cobalt, and others, are essential components in the manufacturing of renewable energy technologies such as solar panels, wind turbines, and electric vehicle batteries. They are the building blocks of innovations that enable the transition to a low-carbon and sustainable energy ecosystem. As the demand for clean energy technologies continues to rise, strategic minerals become increasingly critical, positioning them at the forefront of global efforts to reduce reliance on fossil fuels and combat climate change.

Importance of Strategic Minerals' Supply Chain Resilience



Figure 1. Indonesia mining map.⁵

Indonesia stands as a key player in the global supply chain of strategic minerals, boasting abundant reserves of critical elements essential for clean energy technologies.^{6,7} The archipelagic nation is rich in rare earth elements, nickel, tin, and other minerals vital for the production of batteries, wind turbines, and various electronic components. Indonesia's strategic mineral wealth positions the country as a significant contributor to meeting the growing global demand for clean energy technologies, providing a valuable resource pool for both domestic consumption and international export. Figure 1 illustrates Indonesia mining map. More specific, Indonesia boasts a formidable mineral potential that positions it prominently on the global stage (Table 1). With its metal reserves reaching staggering figures, the archipelagic nation emerges as a key player in the mining industry. Additionally, Indonesia's strategic geographical location enhances its role as a key supplier to various regions, facilitating the transportation of raw materials to manufacturing hubs. The commitment to sustainable extraction practices further solidifies Indonesia's influence, as evidenced by initiatives promoting responsible mining and environmental conservation. As Indonesia continues to play a central role in global supply chains, its actions reverberate across industries, influencing the trajectory of the international clean energy transition.

Table 1. Indonesia's significant metal reserves and global rankings.⁸

Metal	Mining Reserve (million ton)	World Rank
Nickel	21	1 st
Copper	51	5 th
Aluminum	1200	6 th
Manganese	43	6 th

The importance of supply chain resilience in the context of strategic minerals cannot be overstated. Very recently, in a special address to the annual meeting of the World Economic Forum in Davos, President Yoon Suk Yeol emphasized the critical importance of strengthening supply chain resilience, characterizing it as the most urgent task facing the world.^{9,10} He highlighted South Korea's readiness to be a key partner in this effort, leveraging its world-leading production technologies and manufacturing capabilities in key sectors such as

semiconductors, rechargeable batteries, steelmaking, and biotechnology. This proactive stance not only emphasizes the significance of resilient supply chains but also positions South Korea as a pivotal player in fostering global cooperation and stability in the face of multifaceted challenges.

Collaboration between Indonesia and Korea

South Korea, home to several major companies at the forefront of diverse industries, plays a pivotal role in global technological and industrial landscapes. Notably, these companies, such as POSCO in steel production, LG Chem in chemicals and batteries, and Samsung Electronics in consumer electronics, rely on a myriad of mineral resources for their manufacturing processes.¹¹ Indonesia, with its abundant mineral wealth, emerges as a strategic partner in meeting the mineral needs of these Korean giants. Table 2 provides a comprehensive overview, detailing the business activities of these companies and the critical minerals crucial for their production lines. From iron ore and nickel for steel production to lithium and cobalt for battery technologies, Indonesia's mineral potential aligns seamlessly with the requirements of these Korean industry leaders. Moreover, Indonesia holds significant potential in rare earth mineral mining, boasting vast reserves of these critical resources crucial for various technological applications.^{12,13} However, the nation faces challenges in harnessing this potential due to a lack of advanced processing technologies. In this context, Korea's technological prowess becomes a crucial catalyst for unlocking Indonesia's untapped rare earth wealth.

Table 2. Overview of potential Korean companies, their business activities, and associated critical minerals.

Company Name	Business Activities	Critical Mineral Needed
POSCO	Steel production and trading	Iron ore, nickel, chromium
LG Chem	Chemicals, batteries, and energy storage	Lithium, nickel, cobalt
SK Hynix	Semiconductor manufacturing	Rare earth elements,

		gallium
Samsung Electronics	Consumer electronics, semiconductor manufacturing	Rare earth elements, gallium, tantalum
Hyundai Mobis	Automotive parts manufacturing	Rare earth elements, cobalt
Daewoo Shipbuilding & Marine Engineering	Shipbuilding and offshore projects	Iron ore, nickel, aluminum
Lotte Chemical	Petrochemicals and chemicals manufacturing	Rare earth elements, phosphorus, titanium
Kia Corporation	Automotive manufacturing	Rare earth elements, cobalt
Korea Electric Power Corporation (KEPCO)	Power generation and distribution	Rare earth elements, uranium
POSCO Chemtech	Specialty chemicals and materials manufacturing	Rare earth elements, lithium, nickel
Kolon Industries	Textiles, chemicals, and materials	Rare earth elements, titanium, lithium
SK Innovation	Energy, chemicals, and batteries	Lithium, nickel, cobalt
Hanwha Q Cells	Solar cell manufacturing	Silicon, tellurium, silver
LG Display	Display technology manufacturing	Rare earth elements, indium
Doosan Infracore	Heavy machinery manufacturing for construction	Iron ore, aluminum
OCI Company Ltd.	Chemicals, solar materials, and green energy solutions	Silicon, phosphorus, rare earth elements
Hanwha Solutions	Chemicals, solar, and energy storage	Silicon, rare earth elements, lithium, nickel

It also worth noting that South Korea's strategic move to acquire a 20% stake in an

Indonesian nickel mine marks a significant step in addressing the nation's dependence on critical minerals.¹⁴ Given that nickel is a crucial raw material for cathode materials in electric vehicle batteries, the acquisition by STX Corp., a key player in South Korea's industrial landscape, aligns perfectly with South Korea's aspirations to fortify its standing in the secondary battery material industry. By securing a stake in the Indonesian nickel mine, South Korea aims to mitigate potential vulnerabilities in its supply chain, ensuring a stable and consistent flow of strategic minerals essential for the production of advanced technologies.

Call to Action for Furthering Sustainable and Resilient Supply Chains in the Energy Transition

The Indonesian government, through the Ministry of Energy and Mineral Resources (ESDM), has recently designated 47 mining commodity minerals as critical minerals. This is outlined in Ministerial Decree Number 296.K/MB.01/MEM.B/2023 regarding the Classification of Critical Minerals. It is important to note that the management of these critical minerals requires collaboration schemes with countries possessing advanced technological capabilities, such as South Korea. Therefore, imperative for sustainable and resilient supply chains in the energy transition demands a unified call to action. As nations worldwide commit to ambitious clean energy goals, the critical need for stable access to strategic minerals and resources becomes increasingly apparent. This call to action resonates across governments, industries, and stakeholders to prioritize collaborative efforts that ensure the ethical extraction, responsible management, and sustainable utilization of essential resources.

Governments play a pivotal role in shaping the trajectory of sustainable supply chains. Policymakers are urged to enact regulations that incentivize responsible mining practices, transparent resource management, and environmentally conscious approaches. By fostering an environment conducive to ethical resource extraction, governments can set the foundation for a sustainable and resilient supply chain that aligns with global energy transition goals. Industries, particularly those heavily reliant on strategic minerals, are implored to embrace collaborative initiatives. Joint ventures, technology sharing, and knowledge transfer among companies can fortify supply chains against disruptions and contribute to the establishment of ethical and sustainable practices throughout the value chain. Industries should actively seek partnerships with resource-rich nations, fostering mutually beneficial collaborations that

prioritize responsible resource management and environmental stewardship. On the other hand, stakeholders, including investors, environmental advocates, and communities impacted by resource extraction, are encouraged to actively engage in the call for sustainability. Environmental advocates play a crucial role in holding industries accountable and advocating for the adoption of sustainable technologies. Local communities, often at the forefront of resource extraction, should be included in decision-making processes to ensure that their interests are considered and that the benefits of resource extraction are equitably distributed.

Concluding Remarks

Indonesia holds a key position in meeting the escalating global demand for strategic minerals, this prominence comes with both challenges and opportunities. Challenges arise in the form of environmental concerns associated with mining activities, the need for sustainable extraction practices, and potential geopolitical tensions that may impact supply chains. However, within these challenges lie opportunities. Indonesia has the chance to pioneer environmentally responsible mining practices, setting a global standard for sustainable resource extraction. The nation can leverage its resource wealth to attract foreign investments, fostering partnerships that prioritize technological advancements, especially with South Korea, responsible mining, and community development. By addressing these challenges head-on, Indonesia can not only meet global demand for strategic minerals but also establish itself as a model for sustainable and ethical resource management. The country stands at a crossroads, with the potential to play a transformative role in the global clean energy transition while navigating the intricate landscape of challenges and opportunities inherent in meeting the world's increasing appetite for strategic minerals. South Korea's active involvement in securing these resources and highlights the opportunities for collaborative endeavors between Indonesia and South Korea to bolster the resilience of the supply chain, ensuring a sustainable and efficient energy transition.

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