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Industrial Analysis on Critical Minerals in Indonesia towards the EV and Clean Energy Sector

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Abstract: Indonesia has abundant reserve of critical minerals commodity especially those which required for EV and clean energy development. According to Ministry of Energy and Mineral Resources Decree no. 296.K/MB.01/MEM.B/2023, at least 47 minerals are classified as critical. This regulation defines critical minerals as elements and/or minerals required in enormous quantities for strategic industries. At least 20 commodities listed as a strategicminerals. Four of them will be examined in this academic paper to get a comprehensive perspective regarding its opportunity towards EV and clean energy sector in Indonesia. These are nickel, bauxite, copper, and tin. The method will be utilized are Porter's Five Forces and Market Analysis. These aimed to identify Indonesia's position among the global market and to get detail knowledge regarding each commodity. As the only holding mining company in Indonesia, MIND ID mandated to accelerate the development of critical mineral industry especially commodities required in producing EV and clean energy equipment.

Keywords: Critical Mineral Industry, EV, Clean Energy

INTRODUCTION

In advancing the critical mineral industry in Indonesia, it is essential to ensure that every commodity produced from the land is effectively absorbed by the market for further processing and distribution. Certain commodities, including nickel, bauxite, copper, and tin, currently possess refining facilities in Indonesia. In contrast, it has not yet achieved the necessary scope to manufacture finished products; rather, it produces semi-finished raw materials.

This poses a huge challenge for both the corporation and the government, as both entities attempt to cultivate the downstream industry by ensuring that all phases of the process operate in Indonesia to achieve substantial added value. Despite governmental efforts, the advancement of Indonesia's key mineral industry towards global market leadership is encountering numerous challenges. Price volatility, technological advancement, human resources, energy resources, and inter-institutional coordination are significant constraints in this industry. Moreover, geopolitical concerns related to environmental and national security will consistently remain a primary affliction.

The geopolitical circumstances has become one of the most influential factors in the critical mineral industry. Each nation and alliance is striving to preserve its natural resources and minimize reliance on other countries, especially those holding enormous minerals commodities. Moreover, the political identity of states significantly impacts the global supply chain framework. According to (Kondratiev, 2022), asserts that the worldwide shift towards sustainable development is significantly dependent on the ongoing availability of certain essential minerals. Consequently, it is essential to foster collaboration among various stakeholders in the critical mineral management across the global supply chain. The United States is significantly dependent on the supply of critical minerals to facilitate the production of high-tech products, which substantially influence national security, the shift to renewable energy, and infrastructure development.

However, China, as the market leader in the critical mineral industry for consumer, producer, and even commerce, is currently focusing on developing an assessment process for sustainable critical mineral development, strengthening international collaboration, and promoting governance transformation to strengthen its bargaining power in global oversight of strategic and critical minerals (Wang, 2023).

Nevertheless, Indonesia, as a major nickel producer with significant reserves of other critical minerals, is concentrating on the utilization of electric vehicle batteries to promote sustainable development and technical innovation. This geopolitical rivalry among major countries may be advantageous for Indonesia's position due to the rise in commodity prices. In the meantime, Indonesia is perceived as being pro-China as a result of its sanction of the establishment of a critical mineral refining ecosystem in the country.

Despite that, the Ministry of Energy and Mineral Resources (MoEMR) of Republic of Indonesia is convinced that Indonesia necessitates investment to enhance the downstream industry and remains committed to foreign investment from other nations, as long as it complies to current regulatory frameworks. MoEMR also articulated the need to enhance bilateral collaboration rather than rely on coalitions for communication. This plan will enhance Indonesia's ability to capitalize on the developing the trend and market.

METHOD

This research is using both primary and secondary qualitative data by constructing semi-structured interview to well-experienced interviewees. Interviewees are coming from internal and external of the company including the government institution, SOE, NGO and policy maker. In other side, secondary sources generated from annual report, journal, publication and internal data.

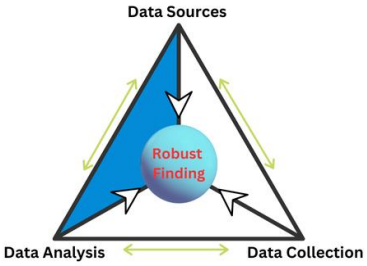

Figure 1. Triangulation Method

Once the data collection generated, the method analysis will be proceed using triangulation method where data from all stakeholders will be compiled to gain findings in critical mineral industry.

RESULTS AND DISCUSSION

Results

1. Porter's Five Forces

The Five Forces framework, developed by Michael E. Porter, analyzes the competitive forces that affect the structure and profitability of an industry. This model is a method for analyzing the competitive landscape of an industry. Substitutes present a possible threat by offering other choices, whereas competitive rivalry reflects the intensity of competition within the industry. Understanding these dynamics allows companies to develop strategies that enhance their competitive positioning (Porter, 2008).

a) **The threat of entry** is affected by barriers including scale and experience, access to supply or distribution channels, anticipated reprisal, legislation or governmental intervention, and product differentiation. These constraints hinder newcomers from competing effectively.
b) **The threat of substitutions** refers to products or services that offer a similar advantage through an alternative method. Substitutes can diminish demand for a particular industry's products and restrict price escalations. When assessing the threat of substitutes, it is essential to analyze the price/performance ratio and inter-industry implications.
c) **The bargaining power of suppliers** is influenced by factors including supplier concentration, elevated switching costs, and competitive threats. High-power suppliers might impose stringent contracts and seize all potential profits from purchasers.
d) **The bargaining power of buyers** is influenced by factors including concentrated buyer groups, low switching costs, the danger of buyer competition, and the disparity between buyers and end customers. Buyers possessing significant bargaining power may exert pressure on suppliers, complicating their ability to achieve profitability.
e) **Competitive rivalry** is affected by the four aforementioned drivers, along with other factors including competitor equilibrium, industry growth rate, substantial fixed costs, significant exit obstacles, and minimal differentiation. Intense competition may arise when companies are approximately equal in size or when industry growth is sluggish. Elevated fixed costs and less differentiation may result in heightened competition.

2. Market Analysis

Market analysis is the methodical gathering, examination, and interpretation of facts related to a market to improve business decision-making. According to marketing91.com (2024), market analysis evaluates the scope and viability of a certain market. It can be employed to analyze the feasibility of new products or services or to assess the potential of success for existing ones.

a) **Market size:** The market size is defined as the aggregate revenue or sales volume of a certain product or service within a specified market. Estimating market size is crucial as it determines the viability of market entry. Market size is often quantified by revenue measures in the literature, which is crucial for assessing potential market share (Kotler et al., 2022).
b) **Market Growth:** Market growth refers to how fast a market expands over time. High-growth markets are generally appealing because they offer prospects for rapid expansion and profitability. Market growth can be quantified by comparing year-over-year revenue gains or by computing the compound annual growth rate (CAGR) (Porter, 2008). Monitoring trends, economic data, and changes in client preferences can provide insight into a market's long-term prospects.
c) **Competition:** The competitive landscape is a thorough examination of established and emerging rivals in a specific industry. This analysis identifies the key rivals, their

market share, price, product offers, and general market strategy. Understanding the competitive landscape provides insight into the intensity of competition, allowing organizations to better grasp the dynamic variables at work in the sector and how these rivals influence customer decisions and market dynamics. Analyzing competitors' strengths, weaknesses, and market positioning can help discover key areas for improvement or distinction.

d) **Profitability:** Profitability is a company's capacity to generate income compared to its revenue, costs, and expenses during a certain time period. It is an important indication of financial health since it represents how efficiently a company uses its resources to generate profit.

e) Profitability is measured by analyzing numerous financial characteristics, including net profit margin, return on assets, and return on equity. In the context of market potential analysis, assessing profitability is critical for determining the financial viability of entering a new market or launching a novel product.

f) **Consumer & Product Type:** Consumer analysis is the practice of defining target groups within a market based on demographic, psychographic, and behavioral factors. Demographics, which include age, income, and education level, are important in the formation of broad consumer groups.

Meanwhile, psychographics enables more detailed understanding of lifestyle, values, and interests, allowing for more complex segmentation. Behavioural analysis, which focuses on product usage and purchasing behaviors, can reveal customer loyalty and preferences for specific product categories, allowing firms to build products or services that appeal to specific consumer groups (Kotler et al., 2022).

Conceptual Frameworks

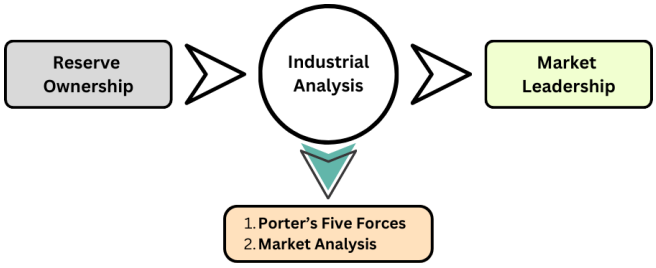

Figure 2. Conceptual Frameworks

The government has established three mandates for MIND ID to accomplish. The initial step is to reserve ownership among multiple companies sharing the same core operation. This phase may also be accomplished by acquiring companies with mining licenses and/or by managing reserves in Indonesia to ensure the future security of critical mineral commodities. Enhancing manufacturing to satisfy global demand can facilitate MIND ID in acquiring reserve ownership.

The objective is to become the global market leader. Being a strategic holding company that is obligated to make profit while fulfilling its purpose to be a worldwide market leader is quite a hard assignment for new corporations. The third objective is to concentrate on the downstream sector of essential mining commodities. This phase necessitated substantial capital expenditure to establish refinery facilities and enhance technological innovation, enabling the corporation to generate a more valuable material utilized in the creation of diverse final products.

To attain the company's objectives, MIND ID must transform its business approach to a blue ocean market. By transitioning from existing conditions to future objectives, MIND ID

could capitalize on opportunities in specific global markets, particularly to meet the increasing demand in the electric vehicle battery sector. The final directive is to infiltrate the downstream sector.

This situation compelled MIND ID to adapt its existing business plan for future success by enhancing commercialization, assuming the role of price setter, forging strategic relationships, and developing downstream businesses. MIND ID necessitated a comprehensive approach to enhance corporate operations and achieve sustained growth in a fluctuating market landscape. Developing a robust strategy enables the company to remain focused on attaining its objectives while managing ongoing operations.

The framework commences with an examination of MIND ID's existing strategy, which emphasizes reserve ownership which required for the production of battery electric vehicles and clean energy equipment. This concern is crucial for guaranteeing the long-term availability of critical minerals, which are the source of renewable energy. MIND ID aims to provide a strong foundation that promotes sustainable development and resource security through the acquisition of reserves. This research will utilize industrial Analysis, which are Porter's Five Forces, and Market Analysis.

Discussion

1. Porter's Five Forces

a) The Threat of Potential New Entrants: Given that MIND ID is a government-appointed holding company overseeing the management and development of the critical mineral industry in Indonesia, the probability of new entrants is deemed exceedingly low. This state-owned enterprise embodies a basic value of dignity, reflecting Indonesia's wealth in mineral resource reserves. Additionally, as a holding company, MIND ID exercises authority over advising and consultation services for its members in accordance with its share ownership. Additionally, substantial capital investment for mineral mining operations, regulatory obstacles, and the establishment of brand loyalty amid established competitors complicate significant difficulties for new entrants. Nevertheless, MIND ID continues to build methods for future scenarios through the following steps: a) Brand and fundamental value Enhancing reputation as a reliable and sustainable provider; b) Technological leadership via the enhancement of patented technologies for economical processing; c) Economies of scale to leverage enormous reserves and operations to sustain low production costs, and d) Customer retention through the establishment of partnerships with long-term contracts. The analysis indicates that the threat of potential entrants is low.

b) The Threat of Product Substitutions: Forecasting product substitution for mineral metal commodities is significantly influenced by market demand trends. MIND ID asserted that future demand will be increasingly sophisticated and necessitate further technology improvement. This circumstance will require each producer to focus on their designated market inside specific categories. Currently, the majority of LFP-based EV batteries utilize paste or liquid lithium. In contrast to the forthcoming five-year technological demand forecast, the trend indicates that electric vehicles will utilize solid-state batteries composed of solid lithium. This technology facilitates the device's connectivity to the IoT, allowing the battery to be both folded and rolled. Another alternative may be the sodium-ion battery; however, its drawback is that it possesses a lesser storage capacity compared to lithium batteries.

Conversely, one of Japan's car brands is concentrating on the development of hydrogen vehicles rather than electric vehicles. However, because hydrogen technology can only produce a constant energy output, it still necessitates the inclusion of an EV battery within the system to stabilize driving speed according to daily needs. Nonetheless, the installed battery capacity

necessitated only one-third of the size compared to a fully electric vehicle. In the long term, nuclear batteries will emerge as a potential substitute product.

The prototype has been converting nickel into the radioactive isotope nickel-62. Upon analysis of the concept, it is evident that technology is rapidly evolving in accordance with the trends of the electric vehicle market; nonetheless, it will not serve as a substitute within each respective category. The company will concentrate on developing their own technological innovations to cater to their specific niche market. Nickel is anticipated to be an essential commodity to facilitate technological advancement, particularly in the electric vehicle battery sector. Consequently, the threat of product substitutions is considered to be moderate-low.

c) The bargaining power of suppliers: Indonesia is the leading nickel producer globally, possessing 52% of the world's reserves, which equates to 72 million tons of nickel. Encouraged by government export prohibition regulations, Indonesia has enhanced its bargaining power as a supplier in the global market. The policy execution draws substantial investment to construct refineries and downstream processing facilities, particularly from China. The prevailing industrial emphasis is on producing mid-products for export, tailored to the specific requirements of manufacturers in their home countries, thus achieving product differentiation. Indonesia ranks sixth in the world for bauxite reserves. And become as the third largest exporter following Guinea and Australia.

In accordance with the nickel commodity, bauxite has been prohibited for export unless it is in the form of alumina and/or aluminium. PT INALUM is concentrating on strengthening the supply chain via business expansion and optimization. PT INALUM anticipates an annual production of 1.5 million tonnes by 2028. The increased production capacity will improve the supplier's bargaining position in aluminium. Nevertheless, PT INALUM deeply regrets the necessity of importing alumina/aluminium from abroad in order to meet the needs of its domestic customers. The supplier's bargaining power is directly weakened by this condition, which also impacts pricing rivalry.

In this context, INDEF advises the government to enforce a policy of restricted imports by raising VAT (Value Added Tax) on products that are domestically manufactured in Indonesia. The implementation of the trade protection law is crucial in preserving the competitiveness of domestic products, particularly in terms of pricing. The Ministry of Energy and Mineral Resources (MoEMR, 2021) indicates that Indonesia's domestic copper processing infrastructure is inadequately developed, notwithstanding the nation's considerable copper resources and mining capabilities.

The (Copper Booklet, 2020) states that there are presently just two functioning copper smelters, which process about 30% of the entire copper concentrate produced domestically, while the remainder is exported. By 2025, it is projected that two more copper smelters will begin operations, raising the total number of copper smelters in Indonesia to four. Due to constrained processing capacity, suppliers have a reduced number of domestic consumers, hence potentially enhancing their bargaining leverage.

The bargaining power of suppliers in Indonesia has decreased due to the diversification efforts of major purchasers such as China. According to (MoEMR, 2023), China is the foremost importer of tin ore and simultaneously the top exporter of PCBs. This demonstrates that China has effectively developed a strong downstream capacity, enabling it to dominate the market for higher value-added products that are nearly 70 times more expensive than the price of tin ore. By enhancing this capacity, China has reduced its reliance on raw materials from Indonesia, thereby undermining the bargaining strength of suppliers.

Fortunately, the Indonesian government has been promoting a downstream plan to enhance the national tin sector. PCBs, PVC, and tin solder are among the high-demand value-added items projected to reach USD 236.5 billion globally by 2040 (Copper Booklet, 2020).

Consequently, the bargaining strength of suppliers in Indonesia's tin sector is currently robust, however it is contingent upon both domestic and global factors. Indonesia has to accelerate the downstream development of the tin sector to reduce its reliance on export markets and enhance value addition to strengthen its position. When they does so, suppliers will enhance their bargaining power in the global market and bolster their resilience to external challenges. The examination of four commodities concludes that the bargaining power of the supplier, specifically Indonesia via MIND ID, is regarded as medium-high.

d) The bargaining power of buyers: akin to that of suppliers, is affected by both global and domestic dynamic forces. Aside from that, each commodity has its own characteristics and causes, which are determined by how well the manufacturing industry in the domestic market is grown. The primary limitation of the critical mineral industry is the country's insufficient processing refinery capacity. Ultimately, limited processing will lead to a saturated market resulting from a lack of product diversification. These symptoms are now affecting some mineral metal commodities, such as copper and tin, and may become severe obstacles to commerce in the future. Although Indonesia is the world's top nickel producer, customers have significant bargaining power because they can influence prices and pressure suppliers to fulfill their expanding demand for raw materials.

This issue results from the market domination of substantial users, such as China, who drives the downstream processes for electric vehicle batteries and the clean energy sector. Consequently, IMEF asserts the necessity of mitigating future risks by creating more appealing business circumstances within the industry, thereby enhancing investment in manufacturing in Indonesia, particularly in the mid-stream and downstream sectors. In conjunction with this policy, both the company and the government may relinquish the bargaining power of purchasers. The bargaining power of buyers in Indonesia's critical mineral industry is categorized as low to moderate.

e) Competitive Rivalry: Analysing competitive competition within Indonesia's essential mining sector necessitates consideration of numerous key factors, including the nickel ore export prohibition regulation. The government advocated this approach to enhance the added value of specific goods. Nevertheless, as INDEF has indicated, it is advisable for the government to evaluate various strategies to mitigate the impact of unabsorbed upstream production in both domestic and export markets.

Fundamentally, this policy provides value-added benefits; however, technically, it may also lead to an oversupply of capacity, which could result in a decrease in commodity prices. The downstream processing of alumina commodities in Indonesia has been gradually advancing. This creates a competitive disparity with nations like China, which has successfully dominated the world market through substantial investment in superior tin processing technology.

The government remains committed to controlling upstream governance and enhancing the downstream business in Indonesia to improve competitiveness. Through the holding company MIND ID, Indonesia has the potential to become more dominant in the global market by enhancing the coordination of various stakeholders, investing in technology, and developing improved policies. Based on the analysis of the five forces, the competitive rivalry within Indonesia's essential mineral industry is determined to be moderate to high. MIND ID, as the sole holding company in mineral mining, in collaboration with the government and other stakeholders, is poised to dominate the global market by accelerating downstream industrialization in Indonesia.

2. Market Analysis

In order to enhance commercialization, a comprehensive market analysis should be undertaken. This sought to compile current information pertaining to the worldwide market. Every commodity possesses distinct background, opportunities, and obstacles to commercialization. To leverage the trend, the following are essential elements of market analysis about several emerging commodities.

a) Market Size: Indonesia holds critical mineral resources of 1.5 billion tons of nickel, 640 million tons of copper, 927 million tons of bauxite, and 1.2 billion tons of tin (trade.gov, 2023). These resources strengthen Indonesia's strategic position in supporting the advancement of the electric vehicle and clean energy sectors globally.

The critical mineral industry has substantially contributed to Indonesia's economic development. The advancement of the essential mineral industry, particularly in the investment and operation of nickel commodities, has a direct effect on gross domestic product. According to MoEMR (2023), the mineral and mining sector contributes considerably to the GDP, accounting for 10.5% of the overall GDP, around IDR 2,198 trillion. According to (Suherman et al., 2021), the electric vehicle battery sector is projected to create around 42,603 employment and increase Indonesia's GDP by $21.434 billion.

According to (Rizal Taufikurahman et al., 2023), foreign direct investment (FDI) in nickel significantly impacts national macroeconomic indicators, as evidenced by export value; specifically, a one percent increase in nickel ore output in North Maluku results in an additional 3.99 percent rise in national export value. Moreover, when assessed regarding the national economy's contribution via Real GDP, each 1 percent rise in nickel ore production in Southeast Sulawesi will produce the most substantial effect of 0.98 percent, succeeded by South Sulawesi at 0.92 percent, North Maluku at 0.72 percent, and Central Sulawesi at 0.66 percent.

MIND ID, the government's holding company in the mining sector, and the related ministry have established numerous regulations and strategic plans to ensure the success of Indonesia's essential mineral industry. The Mining Guide 2023 states that Law number 20, 2020, has limited the export of nickel ore to enhance local value addition.

Simultaneously, the government instituted uniform limitations on bauxite ore in June 2023 and announced impending restrictions on copper ore, which are postponed to commence on December 31, 2024. This plan has facilitated the government in augmenting domestic and foreign investment in 2022 by IDR 8.9 trillion (132%) for metal ore mining and IDR 1.68 trillion (17%) for the base metal industry, relative to 2017. Addressing INDEF, Foreign Direct Investment (FDI) in 2022 rose by USD 1.13 billion (54%), while the Base Metal Industry experienced an increase to USD 8.26 billion (320%) relative to 2017. The substantial increase in investment in the base metal industry indicates that investors are presently attracted to shift towards the downstream industry.

Table 1. Global Market Share in Critical Mineral Industry (various sources)

Commodity	Market Share	Competitors	Global Ranks
Nickel	55 %	Indonesia (55%) Philippines (15 %) Russia (8 %)	1st
Bauxite	5 %	Australia (28 – 30 %) Guinea (25 -28 %) China (16 – 18 %) Indonesia (5 %)	4th
Copper	3-4 %	Chile (27 %) Peru (10 – 12 %) China (8 – 9)	6th
Tin	20 -21 %	China (30 – 32 %)	2nd

	Indonesia (20 – 21 %) Myanmar (12 – 14%)

As per 2023, data from trade.gov shows that the market share among top ten countries in certain commodity is as listed in Table 4.2. The data shown that the market size for critical mineral industry in Indonesia is still promising for further growth.

b) Market Growth:

1) Nickel: Based on MIND ID data, the global nickel demand is not solely driven by battery-based electric vehicles, but also by the expansion of the stainless steel industry. As per wood-mac.com (2024), the stainless steel sector will drive strong nickel demand until 2029, representing over fifty percent of worldwide nickel use.

According to the 2023 LME Nickel Price (USD 16,000/t), more than 60% of nickel producers are incurring losses. Due to this, numerous processed nickel companies have been compelled to decrease their production capacity and potentially terminate certain projects. The entire reduction in nickel output in 2024 is projected to be around 284,000 tons-Ni.

Notwithstanding the anticipated excess, the nickel commodity is projected to exhibit the most substantial increase among other base metals, with an annual growth rate of 7% until 2030. A nickel supply imbalance is anticipated from 2028 onwards due to diminished current production levels and predicted demand for stainless steel and electric vehicles. MIND ID projects that Indonesia's domestic nickel demand for stainless steel would rise by 8.3% year till 2029. This growth excludes nickel demand for fulfilling China's stainless steel needs.

Figure 3 below indicates that nickel production in 2029 is anticipated to be approximately 2.6 million tons of nickel, required up to 250 million wet metric tons of nickel ore. According to MoEMR, the next decade will require 157 domestic nickel smelter and refinery facilities, categorized into two primary processes.

Initially, 147 smelters and refineries employ the pyrometallurgical technology. 177.9 million wmt has been operated, while 115.7 million wmt has been constructed. Secondly, ten smelters and refineries are employing the hydrometallurgy process. 23.6 million wmt has been operated, while 24.6 million wmt is under construction. An additional 176.1 million wmt remains in the planning phase.

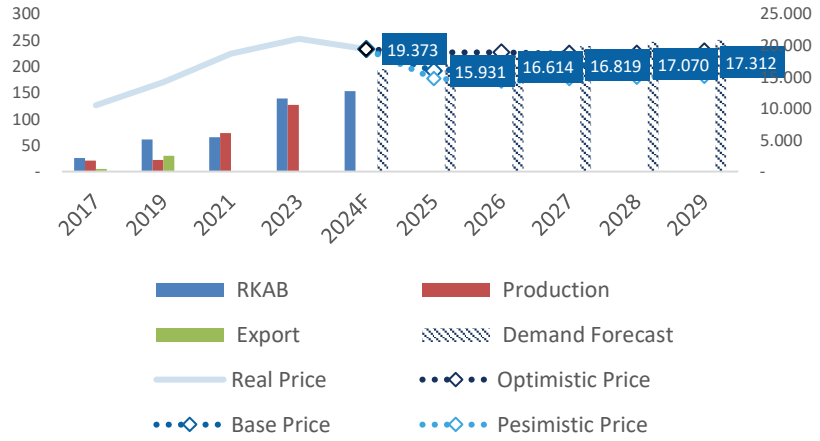

Figure 1. Projection of Nickel Production in Indonesia, Demand & Prices
source: MIND ID, 2024

Given Indonesia's contribution to 75% of world nickel supply by 2029, global nickel prices are likely to be determined by the country's domestic nickel production and consumption balance. Consequently, a prospective deficiency of domestic nickel ore may elevate nickel

prices; yet, several analysts predict a decline in global nickel prices due to excess supply. Notwithstanding this scenario, MIND ID is enthusiastic about expanding manufacturing capacity in both upstream and downstream industries (via strategic alliances), which presents an optimistic outlook for the future market.

2) Bauxite / Alumina / Aluminium: According to MIND ID, there's a potential for aluminium supply to the world market. The global demand for aluminium is roughly equal to its output, as seen in Figure 3 below. Supply deficits are anticipated to begin in 2026 which notably originating from China. Additionally, there is a chance for the development of new aluminium smelting facilities for the global market, especially from China. The demand for aluminium is mostly driven by the transportation sector and long-term clean energy efforts.

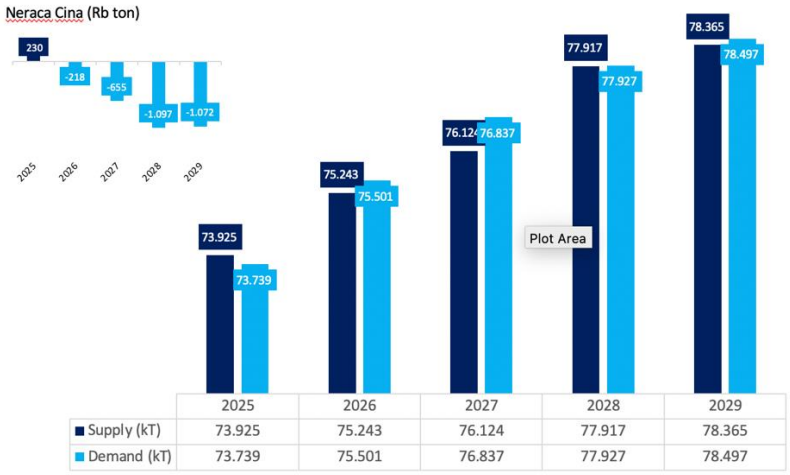

Figure 2. Global Primary Aluminium Supply-Demand (in thousand tons)

PT INALUM stated that the current aluminium production is 600,000 tonnes annually, with an additional 275,000 tonnes per year set to be optimized to 300,000 tonnes per year, resulting in a total capacity of 900,000 tonnes annually. The expansion for an additional smelter currently awaits government and parliamentary approval, with a total production capacity of around 600,000 tons annually. SAGR Line 2 in Mempawah, East Kalimantan, is anticipated to be constructed and operated by 2028. Consequently, aluminium production in 2029 is projected to be approximately 1.5 million tons annually. Nonetheless, the anticipated local demand for bauxite is expected to result in the development of additional alumina refineries with a production capacity of 1 million tonnes per annum by 2029. The domestic alumina market continues to experience a supply deficit of raw bauxite, so enabling MIND ID to seize the opportunity for expediting upstream development or acquisition.

MIND ID projects a significant rise in domestic aluminium supply. This demand will be met by various smelting processing facilities, including Adaro, Nashan, Hua Chin, and Inalum, as illustrated in Figure 4 below. Due to the increasing demand in the domestic market, aluminum might be the first commodity to be prioritized in order to contribute to MIND ID's revenue growth.

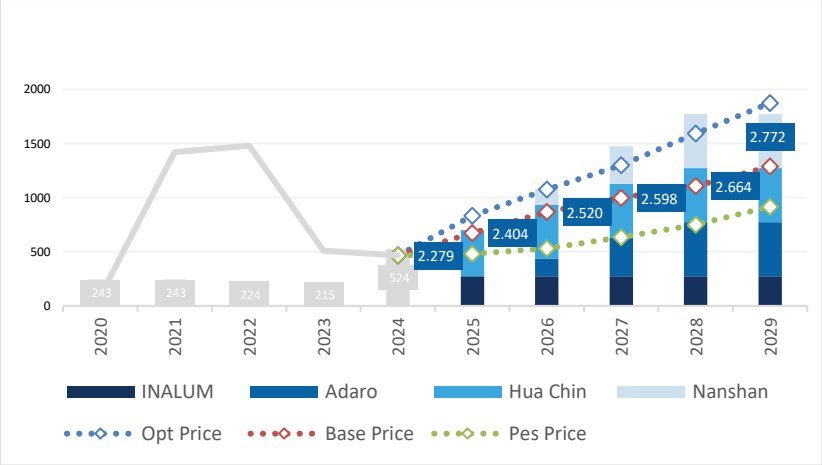

Figure 3. Projection on Aluminium Supply and Commodity Price up to 2029
Source: MIND ID, 2024

3) Copper: Copper production in 2029 is projected to experience a supply deficit in specific regions due to heightened production growth and the expansion of smelting facilities, particularly in China, as seen in Figure 6 below. The increasing demand for copper, an essential mineral mining resource required for the majority of sectors, including transportation (EV), renewable energy (Solar PV, PLTA, AI), and other electrical development, is positively influenced by economic growth. This is due to the favorable combination of properties of copper mineral.

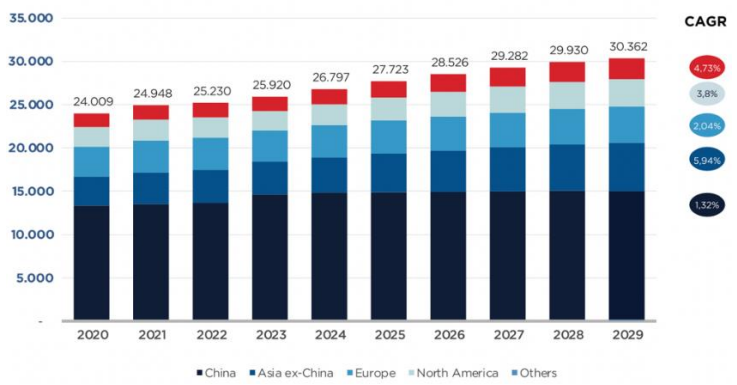

Figure 4. Growing Demand of Copper by Region (in thousands ton-Cu)
Sources: Wood Mackenzie, 2024

Copper production is facing a decline in the upstream sector due to deteriorating ore quality and the inability to finalize several smelter projects. Chile, the leading global copper producer, currently accounts for a quarter of the global supply; nevertheless, its refined copper production is only 8% of the entire output.

Figure 7 indicates that copper ore supply from mines is projected to peak in 2026 which requiring an initial start of new mining projects to meet the rising demand for copper. This scenario motivates MIND ID to maintain and enhance copper production within the 2025-2029 strategic framework, as the demand is on growing and the supply is anticipated to decrease.

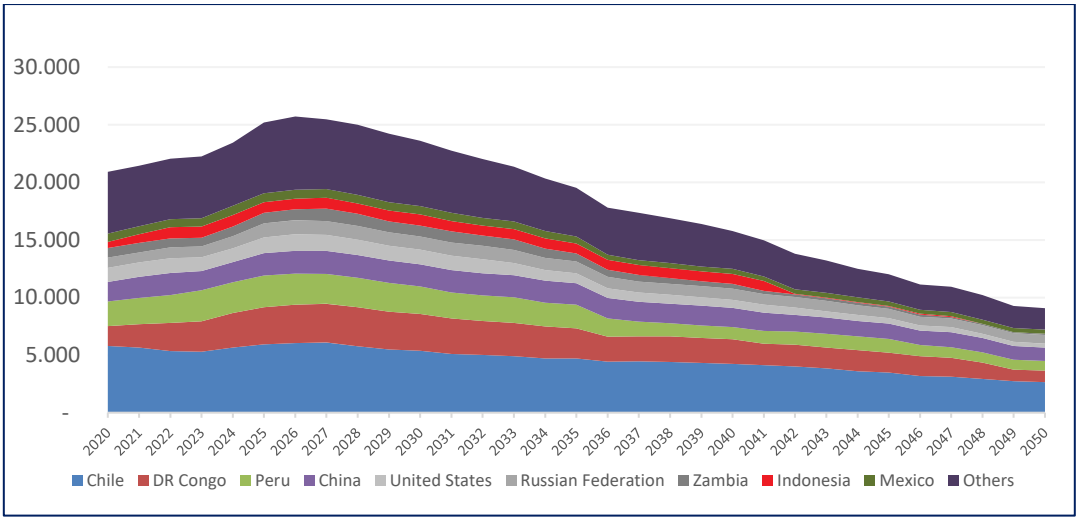

Figure 5. Copper Output Projection by Country (in thousand ton-Cu) (source: IEA, 2024)

4) Tin: Refers to MIND ID; the supply-demand balance of tin commodities will have a deficit due to a surge in demand from the clean energy and electronics sectors. The demand for tin is projected to see a constant growth rate of 1.95% (Wood Mackenzie, 2024).

The International Tin Association indicated that the shortfall will be exacerbated by supply disruptions and increasing consumption from other industries, which will immediately lead to a rise in tin prices. Although China is the largest producer of tin in the world market, with a production capacity of 383,000 tonnes per year in 2023, Indonesia continues to play a crucial role in meeting global tin demand.

MIND ID, listed in 2023, achieved tin production of 14,800 tonnes-Sn annually, representing 20% of the projected domestic tin production. Figure 8 indicates that the worldwide price of tin would increase due to rising demand caused by technological advancements. Moreover, China has limited the use of cadmium metal in the electric vehicle battery industry, with tin emerging as an alternative substitute for this legislation. In 2024, the demand for tin indicates a little decline due to the development of miniaturization in electronic devices. Nonetheless, this trend is decreasing, which will positively influence the increase of tin demand throughout the forthcoming five years. This signifies an opportunity for MIND ID to enhance its benefits by augmenting tin production capability. Furthermore, there is an enormous potential for the acquisition of associated minerals.

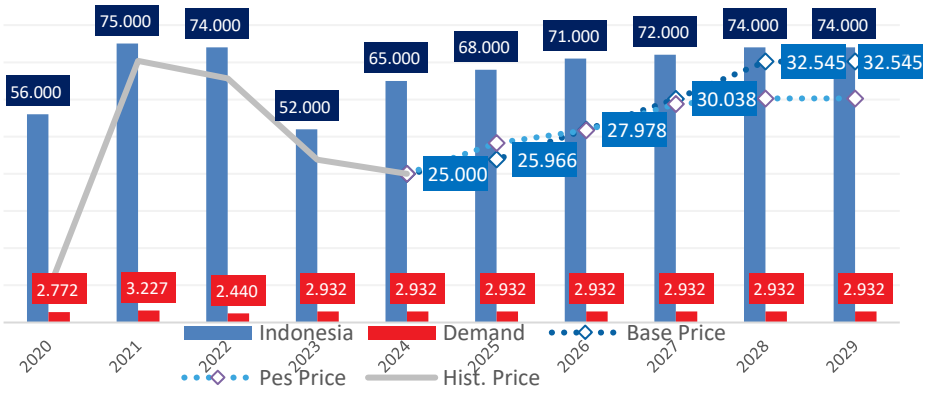

Figure 6. Supply-Demand Projection of Tin in Indonesia (in thousands tonnes)
Sources: IEA, 2024

c) Consumer and Product Category:

1) Nickel: China is the largest consumer of nickel ore, utilizing it as a raw ingredient for the production of electric vehicle batteries and stainless steel. In the immediate run, Ni-Class II will prevail due to the stainless steel industry's greater demand compared to the electric vehicle battery sector (MIND ID, 2024). The growth rate of stainless steel in China is projected to reach 4.87% annually until 2029, boosted by the infrastructure sector. On the other hand, EV batteries, which mostly use LFP, are expected to rise by up to 16,67% every year until 2029 due to the nickel's prior composition in LFP.

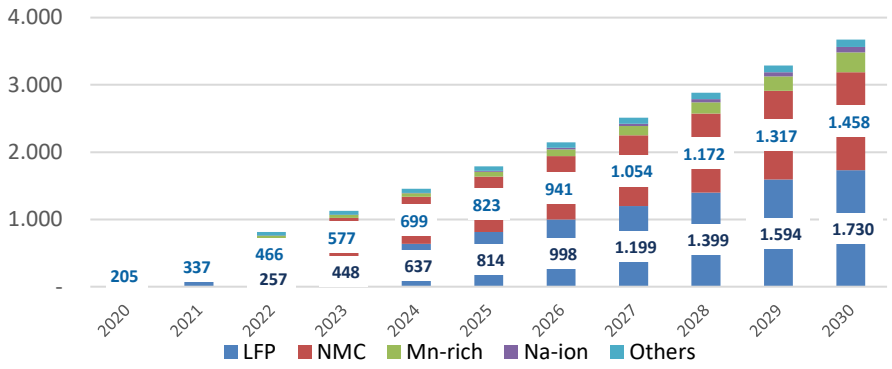

Figure 7. Demand of CAM (Cathode Active Minerals) by Class (in GWh/year)
Source: industry report & BCG Analyst

Figure 9 above demonstrates that nickel-based batteries, specifically lithium nickel manganese cobalt oxide (NMC) and nickel cobalt aluminium oxide (NCA), are projected to be dominant in the electric vehicle market regarding battery technology. The higher energy density of nickel-based batteries is essential for enhancing the range of electric vehicles and optimizing battery efficiency.

According to MIND ID (2024), about 29% of overall aluminium consumption in 2029 will originate from the transportation sector, reaching to 31.9 million tons, with 25% of this consumption anticipated to derive from the electric vehicle sector. Additionally, the demand for aluminium is largely driven by the utilization of EV components in the form of frame, body, and battery parts. This is due to the lightweight and durable nature of aluminium. In the renewable energy sector, aluminium is the most beneficial component, accounting for up to 88% of the total metal used in solar panels, as illustrated in Figure 10.

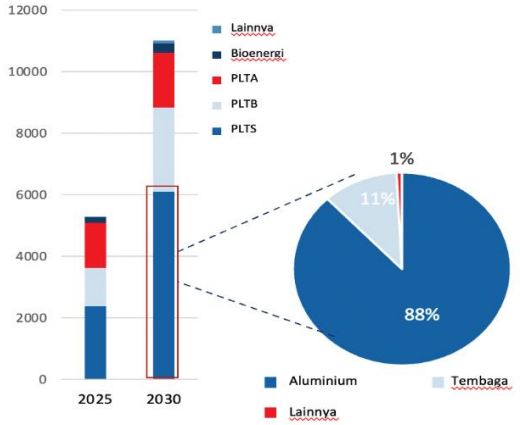

Figure 8. Aluminium Components in Clean Energy Development
Source: IEA, 2024

2) Copper: China's refining and smelting facilities account for up to 45% of worldwide refined copper production. Chile, the foremost global producer of copper, can refine only up to 8%. MIND ID (2024) indicates that the predominant product type of copper is utilized in electric vehicles, solar photovoltaic systems, wind power plants, artificial intelligence, and other developments.

In the domestic market, the demand for tin will be primarily driven by tin chemicals, tin plates, and tin solders. The contribution of tin solder is projected to reach 53% with a growth rate of 2% until 2025, attributed to installations in solar photovoltaic systems. (woodmac.com, 2024) projects a 10.7% annual increase in solar PV installations from 2023 to 2028, totaling 672.6 GW. Global economic growth is anticipated to accelerate, leading to higher demand for electricity, driven by artificial intelligence, and the advancement in construction projects.

3) Profitability: According to MIND ID (2024), the upstream sector of the critical mineral industry, including exploration and ore production, yields the highest margins, ranging from 28% to 55%. However, the margin percentage is decreasing as the value chain increases. Nevertheless, the value added produced by the downstream industry is very substantial; for instance, the processing of grade alumina in smelters is approximately 17 times greater than the value of bauxite. Similarly, when grade alumina undergoes additional processing to create VAP product, the aluminium composition is 33 times more than that of bauxite. Simultaneously, the margin profitability in the midstream sector attained levels between 15% and 31%, while the downstream value chain had the lowest margins, ranging from 6% to 24%.

4) Competition: In the critical mineral industry, the competition is considered to be high due to the presence of numerous large companies that operate across Indonesia and the globe, such as Adaro, BHP, Rio Tinto, Sumitomo Metal Mining, and Glencore. These organizations operate their own specialized business operations, ranging from trading to upstream activities, or perhaps integrating both. These business concepts produce different margin profitability between companies.

CONCLUSION

The economy of Indonesia is significantly influenced by the critical mineral industry, which is particularly strong in nickel, bauxite/aluminium, copper, and tin. The nation has acquired a dominant position in the global market due to its extensive reserves and production capabilities. The objective of the government's resource nationalism policies is to stimulate domestic processing and value-added industries by prohibiting the export of raw minerals such as nickel and bauxite. In addition to fostering competitive dynamics for both domestic and international stakeholders, these policies have significantly enhanced Indonesia's prominence in the supply of critical minerals.

Due to the stringent government regulations and high capital investment requirements, the threat of new entrants in Indonesia's minerals industry is low, as indicated by Porter's Five Forces framework. The industry's dominance by large-scale participants further reduces the potential of new competitors entering the market. Despite the fact that Indonesia's resource abundance restricts the bargaining power of individual suppliers, government policies and concentrated ownership provide larger actors with considerable influence. Additionally, the bargaining power of buyers is influenced by the increasing global demand for nickel in electric vehicle (EV) batteries, despite the limited availability of substitutes, which reduces the buying power.

Technology advancements and market volatility present threats to the demand for base minerals, despite the favorable demand dynamics. Continual research into alternative materials and recycling methods, as well as the development of new mining technologies, has the

potential to disrupt market dynamics and affect mineral prices. In spite of this, the industry's competition for market share remains fierce, as extant players continue to engage in intense competition. The profitability and market positioning of this competition are impacted by the global economic climate, regulatory changes, and altering government policies.

In the global critical mineral market, Indonesia is a significant supplier due to its size and growth. The demand for electric vehicle batteries has resulted in a significant increase in nickel production in recent years, while the bauxite/aluminium sector has benefited from policies that encourage domestic processing. However, copper and tin continue to be substantial contributors to the economy, despite the intense competition they encounter from other global producers like China and Chile. Indonesia's market is expanding driven by the increasing global demand for these minerals, particularly for the application in EV and clean energy sector.

In Indonesia's critical mineral industries, profitability is contingent upon global price fluctuations, competition from international suppliers, and governmental policies. Despite the nickel market's expansion, Indonesia's profitability is threatened by the utilization of advanced technologies by Chinese producers. In the same vein, Indonesia's endeavors to enhance the value of its bauxite exports by requiring domestic processing are not without competition, particularly from major competitors such as Australia. Even though copper and tin are still profitable, their performance is closely correlated with global prices. As market dynamics evolve, it will be essential to maintain a competitive advantage through continuous adaptation and strategic partnerships.

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