

Unveiling the Future: The Rise of Nickel Mining in Indonesia

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I. Introduction

Nickel mining in Indonesia has experienced substantial growth, making the country the largest producer of nickel globally. In 2023, Indonesia's nickel production reached approximately 1.2 million metric tons, which accounted for about 30% of the world's total production [1]. The primary regions for nickel mining in Indonesia are Sulawesi, Halmahera, and Maluku, with several large-scale operations led by companies such as PT Vale Indonesia and PT Aneka Tambang (Antam). These regions have benefited from significant investments in mining infrastructure, enhancing the country's capacity to extract and process nickel ore efficiently.

Nickel is a critical component in the production of stainless steel and electric vehicle (EV) batteries, driving its global demand. The global nickel market was valued at USD 20 billion in 2022 and is projected to reach USD 40 billion by 2027, with a compound annual growth rate (CAGR) of 14.7% [2]. Indonesia plays a pivotal role in this market, not only as a major supplier of raw nickel but also as a key player in the nickel refining sector. The country's nickel exports were valued at USD 10 billion in 2023, a significant increase from USD 5 billion in 2019 [3]. This growth is driven by increasing demand from the EV industry, which relies on nickel for high-capacity batteries.

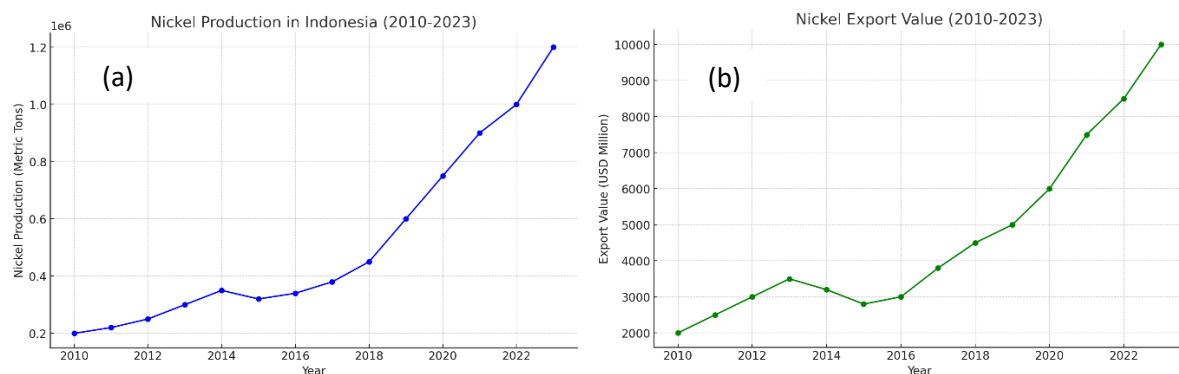
Indonesia has seen several key milestones in its nickel mining industry. One notable development was the implementation of the raw nickel ore export ban in 2014, which aimed to boost domestic processing and value addition. This policy led to a surge in investment in smelting and refining facilities, with over USD 5 billion invested between 2014 and 2020 [4]. Another significant milestone was the establishment of the Indonesia Battery Corporation (IBC) in 2021, a state-owned enterprise focused on developing an integrated EV battery supply chain [5]. These initiatives have positioned Indonesia as a critical hub for nickel processing and battery production, aligning with global trends towards sustainable energy solutions.

The future outlook for nickel mining in Indonesia appears promising, driven by ongoing investments and strategic initiatives aimed at enhancing value chain integration. Moving forward, Indonesia aims to further capitalize on its abundant nickel resources by expanding refining capacities and fostering technological advancements in battery materials. For instance, the development of high-capacity nickel-cobalt-manganese (NCM) and nickel-cobalt-aluminum (NCA) batteries holds promise for supporting the growing EV market, which is projected to exceed 50 million units by 2025 globally. Moreover, Indonesia's strategic collaborations with international partners in battery manufacturing and technology

transfer are poised to strengthen its position as a global leader in sustainable nickel production and battery innovation.

II. Economic Impact of Nickel Mining

The nickel mining is a significant contributor to Indonesia's GDP and export earnings. In 2023, the nickel industry generated approximately USD 10 billion in export revenue, marking a substantial increase from USD 5 billion in 2019 [3]. This surge reflects the growing global demand for nickel, particularly from the stainless steel and EV industries. Nickel mining and processing have become key drivers of economic growth, with the industry contributing around 1.5% to Indonesia's GDP. The country's focus on developing downstream processing facilities has further enhanced the value addition of its nickel exports, positioning Indonesia as a crucial player in the global nickel market.



Source: Indonesian Investment Coordinating Board (BKPM) (2023).

Figure 1. (a) Nickel production and (b) nickel export value in Indonesia from 2010 to 2023.

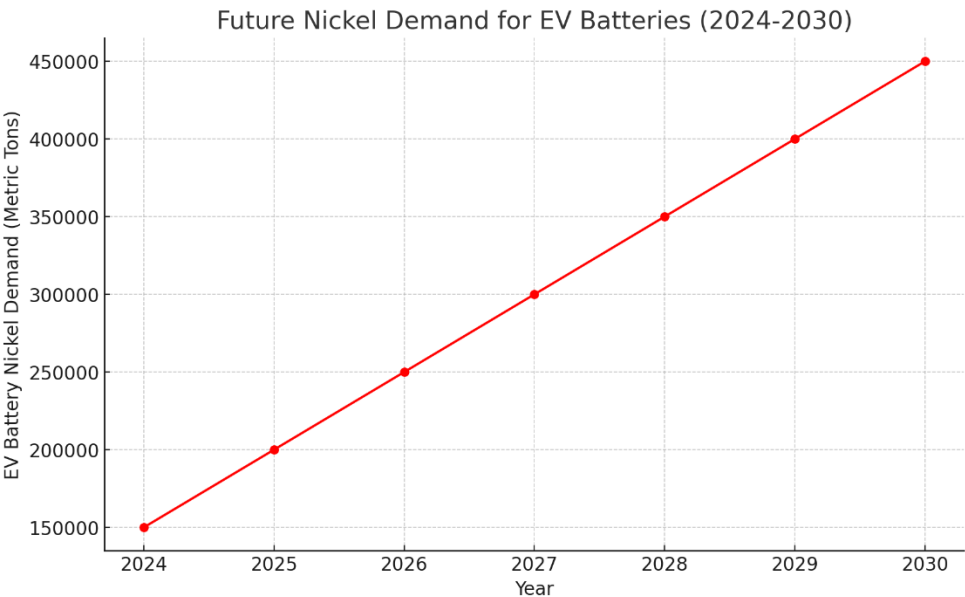
The graphs depicting nickel production and export value in Indonesia from 2010 to 2023 show a parallel upward trend (**Figure 1**), reflecting the country's growing dominance in the global nickel market [3]. In **Fig. 1(a)**, nickel production started at 200,000 metric tons in 2010 and increased steadily, reaching 300,000 metric tons in 2013 and 450,000 metric tons in 2018, with a sharp rise from 2018 onwards, peaking at 1.2 million metric tons by 2023. Correspondingly, in **Fig. 1(b)** the export value of nickel rose from USD 2 billion in 2010 to USD 3.5 billion in 2013, despite a dip to USD 2.8 billion in 2015, and then surged from 2018, reaching USD 10 billion in 2023. This growth in both production and export value highlights Indonesia's enhanced capacity and investment in nickel extraction and processing, driven by the global demand from the stainless steel and EV industries.

The nickel mining industry in Indonesia also plays a vital role in job creation and social development. As of 2023, the sector employed approximately 100,000 workers directly, with an additional 300,000 jobs supported indirectly through related industries and services [6]. These employment opportunities have significantly improved the livelihoods of local communities in major mining regions such as Sulawesi, Halmahera, and Maluku. Beyond job creation, the industry has contributed to social and economic benefits, including improved infrastructure, education, and healthcare services in mining areas. Investments in community

development programs by major mining companies have further enhanced the quality of life for residents, fostering sustainable growth and development.

III. Investment Analysis

The global demand for nickel is expected to rise significantly, driven primarily by the EV industry [5]. **Figure 2** shows a graph forecasting future nickel demand for EV batteries from 2024 to 2030, indicating a significant upward trajectory. Starting at 150,000 metric tons in 2024, the demand is projected to grow rapidly, reaching 250,000 metric tons by 2026 and 450,000 metric tons by 2030. This projection underscores the critical role nickel plays in the EV industry, with demand driven by the global shift towards electric mobility and the need for high-capacity batteries. The anticipated increase in demand highlights the importance of sustainable and efficient nickel mining practices to meet future requirements.



Source: Indonesia Battery Corporation (IBC)

Figure 2. Future nickel demand for EV batteries from 2024 to 2030.

The potential for foreign and domestic investments in Indonesia's nickel mining sector remains robust. With the increasing global demand, Indonesia is poised to attract significant investments in both mining and downstream processing. According to the Indonesian Investment Coordinating Board (BKPM), the sector received over USD 5 billion in foreign direct investment (FDI) between 2018 and 2023, with projections indicating continued growth [7]. The Indonesian government is also providing various incentives, such as tax holidays, reduced import duties, and streamlined licensing processes, to encourage investments in nickel smelting and battery manufacturing facilities. These measures aim to enhance Indonesia's value chain and solidify its position in the global market.

Technological innovations and infrastructural developments are critical to sustaining the growth of Indonesia's nickel industry. Future technological advancements, such as the

adoption of high-pressure acid leach (HPAL) technology, are expected to improve the efficiency and environmental sustainability of nickel extraction. Additionally, significant infrastructure projects are underway, including the development of industrial parks and dedicated processing zones. For example, the Morowali Industrial Park in Sulawesi has attracted over USD 10 billion in investments and is projected to further expand to support integrated nickel processing and battery production [8]. These developments are essential for meeting the increasing global demand and maintaining competitive production costs.

In remote mining areas, infrastructure challenges often hinder operational efficiency and safety. According to a report by the International Council on Mining and Metals (ICMM) (2023), over 60% of mining operations face difficulties related to inadequate infrastructure, including road access and power supply. These deficiencies not only impede the timely transport of equipment and personnel but also escalate operational costs significantly. For instance, the lack of reliable roads increases transportation times, leading to delays in ore extraction and shipment, which can impact revenue streams and overall project timelines [9].

In addition to infrastructure, compliance with international standards poses another critical challenge in the mining industry. The World Bank (2022) highlights that adherence to stringent environmental and safety regulations is crucial for sustainable mining practices. Non-compliance can result in substantial fines and operational suspensions, affecting profitability and reputation. For example, achieving compliance with regulations such as ISO 14001 for environmental management and ISO 45001 for occupational health and safety requires substantial investment in training and technology, adding to operational costs and complexity [10]. These challenges underscore the importance of strategic planning and regulatory foresight in navigating the complexities of the global mining sector.

IV. Case Studies and Success Stories

One notable example of a successful nickel mining project in Indonesia is the PT Vale Indonesia Tbk operation in Sorowako, South Sulawesi. As of 2023, PT Vale's nickel production reached approximately 77,000 metric tons annually, contributing significantly to the national output [11]. Another success story is the Morowali Industrial Park in Central Sulawesi, developed by a consortium led by PT Indonesia Morowali Industrial Park (IMIP). The park, which hosts several nickel smelting and processing plants, has attracted over USD 10 billion in investments and supports the production of 1 million metric tons of nickel pig iron per year [8]. Key factors contributing to the success of these projects include substantial foreign direct investment, government incentives, and advanced technological adoption, which have collectively enhanced production efficiency and output quality.

From these successful projects, several insights and lessons have been gleaned that are valuable for future nickel mining endeavors in Indonesia. One critical lesson is the importance of robust infrastructure development. For instance, the Morowali Industrial Park's integrated infrastructure, including roads, ports, and power plants, has been pivotal in supporting large-scale nickel production and processing activities [8]. Additionally, fostering strong partnerships with international investors and technology providers has proven essential

in enhancing operational efficiencies and ensuring compliance with global environmental and safety standards. Finally, community engagement and sustainable development practices, as demonstrated by PT Vale Indonesia's community development programs, have been key to securing social license to operate and fostering long-term project sustainability.

V. Conclusion

The prospects for nickel mining in Indonesia are promising, driven by rising global demand for stainless steel and electric vehicle (EV) batteries. This demand is fueled by the global shift towards sustainable energy solutions, which rely heavily on high-capacity nickel-based batteries. Additionally, Indonesia's strategic policies, such as the raw nickel ore export ban, have played a crucial role in promoting domestic processing and value addition, positioning the country as a key player in the global nickel market. The projected growth in the electric vehicle market, which is expected to exceed 50 million units by 2025 globally, further underscores the critical role of nickel in this industry. This anticipated demand highlights the importance of sustainable and efficient nickel mining practices to meet future requirements. As Indonesia continues to attract significant investments in both mining and downstream processing, the country's nickel industry is poised to support the global transition to clean energy and drive sustainable economic growth.

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