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Conference Paper

POWERING INDONESIA'S GREEN REVOLUTION: LEADING THE CHARGE IN SUSTAINABLE ENERGY SOLUTIONS

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Abstract.

Nickel is a key raw material for both the stainless-steel industry and the fast-growing electric-vehicle (EV) battery sector. As the world's largest nickel producer, Indonesia is crucial in ensuring supply security and has the potential in promote the nation's downstream industrialization. This paper uses PT Vale Indonesia as a case study to discuss how competitiveness and sustainability can be embedded into nickel production. Drawing on qualitative content analysis of corporate reports, government papers, institutional reports, and academic scholarship, the study investigates operations strategy, ESG performance metrics, and technological developments in downstream processing. Results shows PT Vale Indonesia is able to be cost efficient as well as to perform well in ESG by adopting the hydropower integration, huge land reclamation and by responsibly managing the concession areas. The company's strategic partnership with its global partners has further provided the scalability for it to increase its capacity in accordance with the national down streaming policy of Indonesia. In the end, the study finds that competitive and sustainable ambitions are compatible, placing Indonesia as a major supplier of responsibly sourced nickel to the world energy transition.

Keywords: electric vehicles; ESG; hydropower; nickel industry; resource-based industrialization

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Introduction

Nickel is an essential ingredient for the production of stainless steel and the burgeoning electric vehicle (EV) battery sector (1–3). Indonesia plays a pivotal role in supplying this essential metal, capitalizing on its position as the world's foremost nickel producer. PT Vale Indonesia, operating in the country for nearly sixty years, is acknowledged for its pioneering efforts in nickel down streaming by converting ore into nickel matte (4,5). The company's operations in Sorowako, Sulawesi, amalgamate mining with the utilization of renewable energy, specifically hydropower, thereby facilitating low-carbon nickel production. This pioneering strategy has positioned PT Vale Indonesia as a competitive entity in sustainable nickel production, establishing a standard for environmental, social, and governance (ESG) principles.

Literature Review

Theoretical Studies

Resource-based industrialization emphasizes the need of enhancing the value of natural resources through downstream processing (4–7). In the nickel sector, downstream processing converts raw ore into intermediate or finished products, thereby improving industrial competitiveness and reducing reliance on raw material exports. Economic theories of competitiveness highlight the need of cost efficiency, particularly in volatile commodities markets. Operating within the lowest-cost segment of the global cost curve is crucial for maintaining resilience.

The theory of sustainability emphasizes the balance of resource extraction, environmental stewardship, and community development (8,9). ESG principles offer mining companies a framework to meet global standards and sustain long-term competitiveness. Integrating renewable energy into extractive industries promotes progress towards low-carbon transitions and international climate objectives (4,5).

Empirical Studies

PT Vale Indonesia manages an industrial area of 118,000 hectares, which 80% of the area located in the forest, therefore, the requirement is strictly following the reclamation and post mining rehabilitation program and 70% of the mined-out area have been revegetated. The company also operates three hydropower plants in Sorowako, with a total capacity of 360 MW, which making the company's nickel smelting operation as one of the lowest carbon-emitting nickel producers in Indonesia (4,5).

Organizationally, PT Vale Indonesia holds a strong ownership structure with Mine ID, a state-owned mining enterprise, and Vale Canada as major shareholders. The company provide employment for around 3,000 people, most of whom are local residents, to support regional development. In Pomala, Bahodopi, and Malili the company's plans for increase in production power from 70 thousand tons to 450 thousand tons of nickel annually to be reached in upcoming years (4,5).

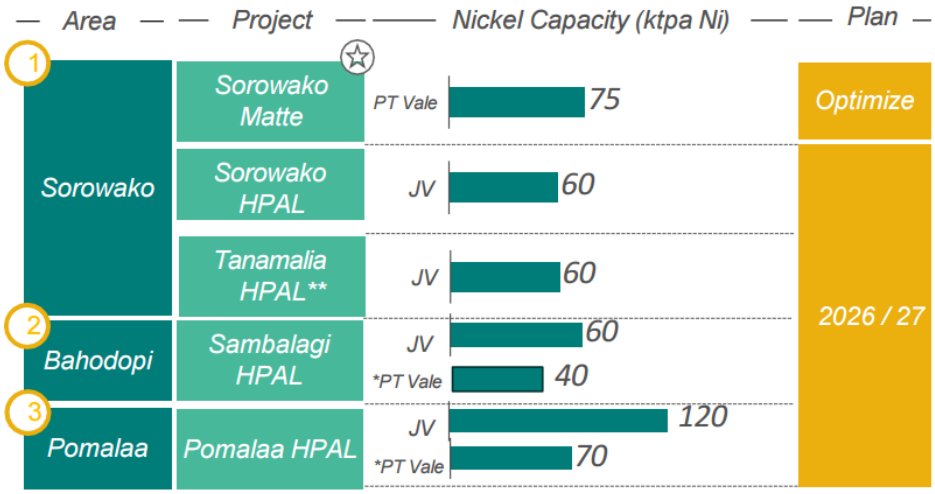

Figure 1. Growth Project of Nickel Down streaming in Indonesia
Source: Mendes (2025)

One of the key for technological shift involves processing both high-grade saprolite ore for stainless steel and low-grade ore through high-pressure acid leach (HPAL) technology to produce mixed hydroxide precipitate (MHP), a vital precursor for EV batteries (3,10,11). This dual processing strategy maximizes resource utilization while supporting Indonesia's downstream policy.

Methods

This study apply qualitative content analysis approach for generating valid interpretations from textual and documentary data (12,13). The focus analysis is on corporate sustainability practices, industrial competitiveness, and strategic partnerships within Indonesia's nickel sector. The primary data of this study are PT Vale Indonesia's corporate disclosures, shareholder reports, government publications, and international institutional assessments on mining and ESG compliance. Secondary data include peer-reviewed studies, industry analyses, and expert commentary on resource-based industrialization, downstream policy, and sustainable mining practices. Selection criteria are focused on the relevance to nickel down streaming, renewable energy integration, environmental governance, and global supply chain positioning. The unit analysis is PT Vale Indonesia's

operational strategies, project expansion plans, and ESG benchmarks as a representative case study within Indonesia's nickel industry. The credibility of the data is ensured by combining official company documents, government assessments (the PROPER Award, for example), international ESG rating assessments, as well as academic articles and industry reports.

Results and Discussion

PT Vale Indonesia demonstrates that complying to ESG standards not necessarily have to run counter to competitiveness. The company demonstrates that sustainability does not necessarily reduce efficiency. Upholding responsible practices contributes to global competitiveness by gaining reputable technologies partners from abroad, such as Ford and Chinese technology companies (4,5).

Strategic partnerships represent a model for downstream projects, combining technological expertise, offtake agreements, and ESG commitments (8,9,14). One of the examples could be seen in the Pomala Project, which integrates Chinese HPAL technology with Ford's offtake agreement, creating a balance between East and West stakeholders. This collaboration also involves Indonesian universities, ensuring knowledge transfer, research and development, and local talent development.

PT Vale Indonesia has made substantial advances in the ESG area. The continued safety of water quality around Sorowako after six decades of the company's operation is an evidence of good environmental management. This is the first time since it was introduced that a nickel producer has received the Gold PROPER Award from the Ministry of Environment and Forestry indicating performance beyond regulatory requirements. Global ESG risk ratings place PT Vale Indonesia on par with industry leaders like BHP, Rio Tinto, and Eramet, reinforcing Indonesia's position as a hub for responsible nickel supply (4,5).

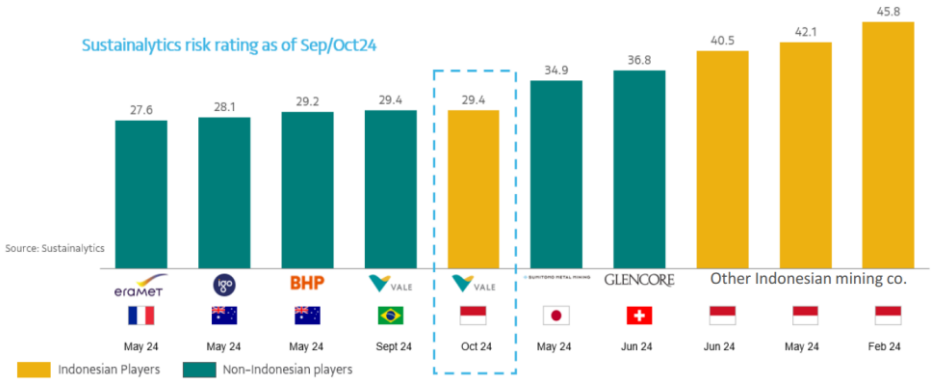

Figure 2. ESG Risk Rating Nickel Mining Industry Players
Source: Mendes (2025)

Conclusion

Indonesia's status as a global nickel centre hinges really on downstreaming policies that combine competitiveness and sustainability. PT Vale Indonesia epitomizes this balancing act by combining low-cost operations, portion of renewable energy, good reclamation activities and strong collaboration with global partners as well. The technological shift will accommodate both high- and low-grade ores which is resource efficient and synergises with the EV Industry. The company's history demonstrates that ESG compliance and competitiveness are not in conflict but complementary. As the Company follows global ESG standards and remains cost leader, PT Vale Indonesia strengthens Indonesia's strategic position in world nickel market. They are not just ways to increase industrial capacity, however they also build a legacy that benefits communities, the environment and the wider economy.

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