ACTA LAW JOURNAL
Magister Kenotariatan Fakultas Hukum Universitas Sumatera Utara
Jl. Sivitas Akademika No.9, Padang Bulan, Kec. Medan Baru
Kota Medan, Sumatera Utara 20155
Email: acta@usu.ac.id Telepon: +62 61 8200738
Website: https://talenta.usu.ac.id/ALJ

Mission-Oriented Policy for a Greener Nickel Industry in Indonesia: Challenges and Pathways

Ari Wijayanto[1], Annisa Hafizhah[2*], Muhammad Rudy Aqbar[3]
[1,3] Fakultas Hukum, Universitas Gadjah Mada, Yogyakarta
[2] Fakultas Hukum, Universitas Sumatera Utara, Medan
Email : [1]ariwijayanto1997@mail.ugm.ac.id, [2*]annisahafizhah@usu.ac.id, [3]muhammadrudyaqbar@mail.ugm.ac.id

Abstract

This article explores policy strategies necessary to promote a sustainable and eco-friendly nickel mining industry in Indonesia, especially as it relates to the electric vehicle (EV) sector. With Indonesia's substantial nickel reserves, demand is expected to rise sharply, driven by the global shift to EVs. However, nickel production is a significant contributor to greenhouse gas emissions, with one kilogram of nickel generating approximately 13 kilograms of CO_2. By 2035, Indonesia's demand for nickel for EV batteries alone could lead to 773 thousand tons of CO_2 emissions. This paper aims to assess green-oriented policies that could mitigate these impacts, drawing on Mariana Mazzucato's Mission-Oriented Policies as a strategic framework. The methodology used includes literature review and case study analysis of successful policies in other countries, such as renewable energy integration in mining and efficient recycling methods. Three primary strategies are examined: improving energy efficiency, incorporating renewable energy, and sustainable recycling. Findings indicate that these policies could foster sustainable growth, reduce emissions, and align with Indonesia's green economy goals. This paper concludes that implementing a mission-oriented, environmentally sustainable approach could pave the way for a greener, more resilient nickel industry.
Keywords: Green Economy; Mission Oriented; Nickle; Sustainable.

Introduction

Amid global discussions on climate change and the expansion of the Electric Vehicle (EV) industry,[1] Indonesia stands out as one of the world's largest holders of nickel reserves. Nickel is a crucial commodity for the EV sector, serving as a primary material for the production of EV batteries. Indonesia has responded to this industrial shift by enacting the Minister of Energy and Mineral Resources Regulation No. 11 of 2019.[2] This policy aims to halt nickel ore exports and drive value-added processes within Indonesia's nickel mining sector, integrating the country more deeply into the global supply chain. Since Indonesia imposed the export ban in 2020,[3] President Joko "Jokowi" Widodo's nickel downstream program has garnered recognition for its success. Indonesia's

[1] CNN Indonesia, "RI Jadi Produsen Nikel Terbesar, Negara Mana Saja Pesaingnya?," 2023, https://www.cnnindonesia.com/ekonomi/20230704134901-85-969308/ri-jadi-produsen-nikel-terbesar-negara-mana-saja-pesaingnya.

[2] Kementerian Energi dan Sumber Daya Mineral (ESDM), "Bijih Nikel Tidak Boleh Diekspor Lagi per Januari 2020," ESDM.go.id, https://www.esdm.go.id/id/media-center/arsip-berita/bijih-nikel-tidak-boleh-diekspor-lagi-per-januari-2020.

[3] Lowy Institute, "Indonesia's Uncertain Climb Up the Nickel Value Chain," 2023, https://www.lowyinstitute.org/the-interpreter/indonesia-s-uncertain-climb-nickel-value-chain.

prominence in the global market has surged, with a 41% increase in production during the first seven months of 2022, which boosted the country's share to 47% of the world's total nickel production.[4]

However, with these achievements come notable areas for improvement, particularly in fostering environmentally responsible industrial practices. Environmental concerns can significantly impact investment and market access in regions emphasizing environmental, social, and governance (ESG) standards. Even before addressing specific technical options for mining management, the nickel downstream program in Indonesia faces several ESG-related challenges. These challenges present additional hurdles for Indonesia in accessing global markets, particularly in the United States and the European Union, where ESG considerations are prioritized by consumers and investors alike. Entering these markets, however, is far from simple.

This paper concludes with several strategic recommendations, adopting a mission-oriented policy approach inspired by Mariana Mazzucato. These strategies include preliminary policy recommendations on recycling, green hydrogen utilization, and the repurposing of used batteries to mitigate potential environmental impacts stemming from future nickel utilization.

Formulation of the Problem

This paper aims to discuss what challenges and policy strategies are required for Indonesia to enhance value-added processes within the supply chain, especially amid global climate change concerns.

Research methods

This research employs a normative juridical method, relying on secondary data sources. Through an analysis of laws, regulations, and relevant literature, the study explores the intersection of environmental and economic policy considerations in the nickel industry. This method enables a thorough examination of existing legal frameworks and their implications for sustainable development within the sector.

Discussion

1. Environmental Sustainability Challenges in the Global Market

To date, nickel-derived products in Indonesia remain largely dominated by stainless steel due to the country’s class 2 nickel reserves, found primarily in laterite deposits, which are rich in iron oxide. This type of nickel is more suited for conversion into stainless steel through pyrometallurgy, a high-temperature process that separates metals from ore. Given this focus, investment in stainless steel production is considered excessive, and there is a recognized need for the government to shift investment focus toward the battery cell sector.[5]

Fortunately, class 2 nickel can still be processed into battery cells through hydrometallurgy, a solution-based extraction process.[6] The government is

[4] Reuters, “Indonesia’s Nickel Surge Is Bad News for Prices,” 2022, https://www.reuters.com/markets/commodities/indonesias-nickel-surge-bad-news-price-pricing-2022-09-29/.

[5] The Conversation, “Isu Lingkungan dan Perkembangan Teknologi Ancam Ambisi Kendaraan Listrik Berbasis Nikel Indonesia, Apa yang Harus Dilakukan Pemerintah?,” 2023, https://theconversation.com/isu-lingkungan-dan-perkembangan-teknologi-ancam-ambisi-kendaraan-listrik-berbasis-nikel-indonesia-apa-yang-harus-dilakukan-pemerintah-201186.

[6] Brookings Institution, “Indonesia’s Electric Vehicle Batteries Dream Has a Dirty Nickel

currently crafting policies to encourage the construction of hydrometallurgical plants. However, this process is highly capital-intensive and has lower predictability. Additionally, it demands higher energy and generates more complex waste than processes using class 1 nickel, which is predominantly mined in countries like Russia, Canada, and Australia.[7] For Indonesia, which has set a target for carbon neutrality by 2060, environmental and energy challenges are crucial.

Further, environmental concerns have led to setbacks, as evidenced by Elon Musk's withdrawal from investment in Indonesia due to the country's reliance on coal in its upstream industries.[8] Operating a single nickel smelter requires an annual power supply of 4.8 gigawatts, mostly sourced from coal,[9] which contradicts the Indonesian government's environmental goals.[10] In another context, the United States recently passed the Inflation Reduction Act, aiming to curb inflation.[11] This act includes tax incentives for EV buyers, stipulating that vehicles must use components sourced from countries with trade agreements with the U.S. and be assembled in North America. Indonesian-made EVs may face challenges meeting these criteria, which could undermine their competitiveness in the U.S. market.

Trade relations between Indonesia and the European Union are similarly fraught, especially regarding natural resources. The EU has reacted strongly to Indonesia's nickel export ban by taking the issue to the World Trade Organization (WTO) and imposing anti-dumping and anti-subsidy tariffs on Indonesia's stainless steel exports.[12] Coupled with ongoing ESG-related issues surrounding the Indonesian palm oil industry,[13] it is unsurprising that the EU may consider similar actions against EV exports from Indonesia. Additionally, the EU plans to introduce EV subsidies akin to those in the U.S., potentially posing discriminatory challenges for Indonesian EVs in the European market.

Problem," 2023, https://www.brookings.edu/articles/indonesias-electric-vehicle-batteries-dream-has-a-dirty-nickel-problem/.

[7] The Assay, "The Great Laterite Challenge: Why Scaling Class 1 Nickel Production Won't Be Easy, Cheap, or Environmentally Friendly," 2023, https://www.theassay.com/articles/investor-insight/the-great-laterite-challenge-why-scaling-class-1-nickel-production-wont-be-easy-cheap-or-environmentally-friendly/.

[8] Prambors FM, "Elon Musk Akui Enggan Bangun Pabrik di Indonesia, Ternyata Ini Alasannya," 2023, https://www.pramborsfm.com/news/elon-musk-akui-enggan-bangun-pabrik-di-indonesia-ternyata-ini-alasannya.

[9] Media Indonesia, "Kebutuhan Listrik Smelter Capai 4798 MW," 2023, https://mediaindonesia.com/ekonomi/286392/kebutuhan-listrik-smelter-capai-4798-mw.

[10] Kementerian Keuangan RI, "Indonesia Committed to Achieving Target," 2023, https://www.kemenkeu.go.id/informasi-publik/publikasi/berita-utama/Indonesia-Committed-Achieving-Target.

[11] Bisnis Indonesia, "Apa Itu Inflation Reduction Act (IRA) AS? Begini Penjelasannya," 2023, https://ekonomi.bisnis.com/read/20230516/620/1656429/apa-itu-inflation-reduction-act-ira-as-begini-penjelasannya.

[12] Reuters, "EU's Tariffs on Indonesian Stainless Steel Curtailed Exports, Jakarta Says," 2023, https://www.reuters.com/markets/commodities/eus-tariffs-indonesian-stainless-steel-curtailed-exports-jakarta-says-2023-01-31/.

[13] CNBC Indonesia, "Bukan Cuma Nikel, Ini Penyebab Uni Eropa Jengkel dengan RI," 2023, https://www.cnbcindonesia.com/news/20230222113701-4-415959/bukan-cuma-nikel-ini-penyebab-uni-eropa-jengkel-dengan-ri.

a. Re-evaluating Value-Added Gains from the Export Ban

While downstream nickel exports have exceeded raw nickel ore exports, which are now banned, measuring domestic value-added benefits solely by the value of processed nickel exports may not fully capture the objective.[14] Evaluating value transfer requires a more nuanced approach, particularly when interventionist policies, such as an export ban, are in place. One primary issue is potential tax revenue loss. With the nickel export ban, the state forfeits income from corporate taxes on mining companies and export duties on nickel. Thus, income from the upstream nickel sector must compensate for these losses.

However, attracting investors to build nickel smelters requires not only an export ban but also tax incentives.[15] Nickel smelters may receive tax reductions or even full income tax exemptions, along with lower export duties on their products. A second issue is the value transfer from mining to smelting companies.[16] The export ban forces mining companies to sell nickel ore domestically at prices below global market rates, especially given today's high nickel prices. [17] Consequently, the mining sector loses value from the export restriction. Determining the domestic purchase price and nickel content adds further complexity to this situation.

The third issue is employment impact.[18] While the government argues that higher value-added processes will boost domestic employment, it must also consider potential job losses in the mining sector due to the export restrictions. Unfortunately, employment data for the mining sector remains scarce, and no significant increase in basic metal industry jobs has been observed thus far. These three issues underscore the challenges in accurately assessing value-added gains from the export ban and tax incentives. The government should also assess the extent to which the export ban policy aligns with beneficiaries of the value transfer. For instance, some foreign companies, particularly from China, may invest in Indonesia to benefit from favorable tax treatment and cheaper nickel, exporting their products back to their home country.

b. Dynamics of EV Battery Technology

China, projected to remain the largest EV market through 2030, presents a promising opportunity for Indonesian EV producers. Currently, China is Indonesia's top destination for nickel-derived exports and the primary source of funding for integrated nickel processing facilities. With the Regional Comprehensive Economic Partnership (RCEP) trade agreement involving both

[14] The Conversation, "Klaim Sukses Hilirisasi Nikel Berbasis Larangan Ekspor Masih Memiliki Segudang Masalah," 2023, https://theconversation.com/klaim-sukses-hilirisasi-nikel-berbasis-larangan-ekspor-masih-memiliki-segudang-masalah-177735.

[15] Kontan, "Pengumuman Insentif Tax Holiday Bagi Smelter NPI dan Feronikel Dihapus," 2023, https://industri.kontan.co.id/news/pengumuman-insentif-tax-holiday-bagi-smelter-npi-dan-feronikel-dihapus.

[16] Universitas Gadjah Mada (UGM), "Industri Nikel Indonesia Pasca Sengketa Perdagangan dengan Uni Eropa," 2022, https://cwts.ugm.ac.id/2022/11/03/industri-nikel-indonesia-pasca-sengketa-perdagangan-dengan-uni-eropa/.

[17] S&P Global Market Intelligence, "COVID-19 Turns Indonesian Ore Export Ban into Curse for Nickel Market," 2023, https://www.spglobal.com/marketintelligence/en/news-insights/research/covid19-turns-indonesian-ore-export-ban-into-curse-for-nickel-market.

[18] Kumparan Bisnis, "Menguak Jumlah Tenaga Kerja Asing di Industri Mineral dan Batu Bara," 2023, https://kumparan.com/kumparanbisnis/menguak-jumlah-tenaga-kerja-asing-di-industri-mineral-dan-batu-bara-1wsuFNFPGp8.

Indonesia and China, exploring the Chinese market seems prudent.[19] However, as in Indonesia, China's market is dominated by light-duty vehicles, which increasingly utilize lithium iron phosphate (LFP) batteries. Although LFP batteries have a lower capacity than nickel-based alternatives, they are more economical to produce as they do not require nickel or cobalt. Therefore, Indonesia's nickel advantage diminishes in the context of LFP battery technology.[20]

LFP batteries are well-suited for smaller, energy-efficient vehicles with short travel ranges, particularly in urban environments—a significant market in China, India, and Indonesia.[21] For example, the affordable Wuling Air EV, available in Indonesia, uses LFP batteries.[22] Moreover, companies like Tesla and Volkswagen[23] have shown interest in LFP batteries for their affordable models.[24] The rise in nickel prices due to the Russia-Ukraine conflict, coupled with reduced subsidies for nickel-based batteries, has bolstered LFP battery adoption. With limited class 1 nickel supply and sustainability challenges with class 2 nickel, LFP batteries are predicted by the International Energy Agency (IEA) to dominate the battery market by 2030.[25] Nickel scarcity has driven increased research into alternatives such as LFP.

c. Leveraging Trade Agreements

The Indonesian government must comprehensively consider target markets for battery cells. In the lower-end EV market, non-nickel EVs are gaining ground, while accessing the high-end market in Europe and North America remains challenging. Indonesia recently announced incentives for over 200,000 EVs, aiming to strengthen the domestic market.[26] However, this figure pales compared to nearly 8 million EVs in the global market. Relying solely on the domestic market may limit Indonesia's potential value-added gains from exports. Hence, the global market remains essential and will increasingly play a vital role. The government's nickel sector management efforts must continue, with trade agreements also being key to enhancing Indonesia's global advantage. With many international companies seeking alternatives to China, trade agreements could provide Indonesia with an edge. Indonesia's nickel wealth is a valuable asset in such negotiations. Currently, Indonesia is negotiating a trade agreement with the

[19] Kementerian Perdagangan RI, "Regional Comprehensive Economic Partnership (RCEP)," FTACenter.kemendag.go.id, https://ftacenter.kemendag.go.id/regional-comprehensive-economic-partnership-rcep.

[20] The Conversation, "Isu Lingkungan …," *Op.Cit.*

[21] EETimes, "Lithium Batteries for EVs: Go NMC or LFP?," https://www.eetimes.com/lithium-batteries-for-evs-go-nmc-or-lfp/.

[22] Astra Credit Companies, "Pakai Jenis LFP? Ini Dia Baterai Mobil Listrik Wuling," 2023, https://www.acc.co.id/accone/InfoTerkini_Detail?Id=6302&title=Pakai-Jenis-LFP-Ini-Dia-Baterai-Mobil-Listrik-Wuling.

[23] S&P Global, "Volkswagen's Plan on LFP Use Shifts Hydroxide Dominance Narrative in EV Sector," 2021, https://www.spglobal.com/commodityinsights/en/market-insights/latest-news/metals/031721-volkswagens-plan-on-lfp-use-shifts-hydroxide-dominance-narrative-in-ev-sector.

[24] EE Power, "Tesla Kicks Off Future of LFP Batteries in EVs," https://eepower.com/market-insights/tesla-kicks-off-future-of-lfp-batteries-in-evs/.

[25] International Energy Agency (IEA), "Global Supply Chains of EV Batteries," 2023, https://www.iea.org/reports/global-supply-chains-of-ev-batteries.

[26] Kompas, "Insentif Kendaraan Listrik Mulai 20 Maret 2023: Simak Skema Penerima dan Ketentuannya," 2023, https://money.kompas.com/read/2023/03/07/083400626/insentif-kendaraan-listrik-mulai-20-maret-2023-simak-skema-penerima-dan?page=all.

European Union (IEU CEPA).[27] Despite ongoing trade disputes, it is crucial to expedite the finalization of this agreement and ensure EU market access remains a priority in negotiations.

The same applies to the U.S. In addition to fostering relationships with investors like Tesla, Indonesia should strive to benefit from incentives in the U.S. Inflation Reduction Act.[28] A trade agreement with Australia could also enhance Indonesia's market access while securing lithium supplies essential for battery components. With numerous battery cell investment commitments in Indonesia, the country must ensure market access remains open to achieve economies of scale and prevent domestic oversupply. Additionally, the government should carefully evaluate the impact of its interventions. Using export value as a metric may be problematic given the substantial fiscal incentives for investors and consumer subsidies.[29] Monitoring the dominance of certain investors in the nickel value chain is also essential. Although Indonesia has successfully managed its nickel sector, future challenges remain. The government's current actions will have a lasting impact on the future of Indonesia's nickel downstream industry.

2. Environmental Policy for a Nickel-Friendly Industry

Producing just one kilogram of nickel can release around 13 kilograms of CO2 greenhouse gasses.[30] With an estimated need for 59.5 thousand tons of nickel for electric vehicle (EV) batteries in Indonesia by 2035, CO2 emissions from nickel alone could reach approximately 773 thousand tons.[31] Given the environmental crisis, there is a critical need for economic policies geared toward a greener, simultaneous growth model. Mariana Mazzucato's Mission-Oriented Policies advocate for a green-oriented economic policy that necessitates active cooperation between governments and transnational organizations. This policy framework can support Indonesia's mission to achieve sustainable and environmentally friendly nickel mining practices.[32]

a. Enhancing Energy Efficiency

Energy efficiency improvements across all stages of mining and mineral processing can significantly reduce greenhouse gas emissions.[33] Grinding ore is particularly energy-intensive, consuming up to 40% of the total energy in the

[27] DPR RI, "Masuki Tahapan Negosiasi ke-16, BKSAP-Parlemen Eropa Percepat Penyelesaian IEU-CEPA," 2023, https://www.dpr.go.id/berita/detail/id/47915/t/Masuki+Tahapan+Negosiasi+ke-16%2C+BKSAP-Parlemen+Eropa+Percepat+Penyelesaian+IEU-CEPA+.

[28] CNBC Indonesia, "AS Rilis Kebijakan Industri Hijau, Apa Dampaknya ke RI?," 2023, https://www.cnbcindonesia.com/news/20230907163934-4-470458/as-rilis-kebijakan-industri-hijau-apa-dampaknya-ke-ri.

[29] Kementerian Keuangan RI, "Anggaran dan Kebijakan untuk Industri Hijau," 2023, https://anggaran.kemenkeu.go.id/api/Medias/eeeee47a-5bda-4447-bddb-951fba7150f2.

[30] Nickel Institute, "LCA Nickel Metal Final Report," https://nickelinstitute.org/media/4809/lca-nickel-metal-final.pdf.

[31] Kontan, "Kebutuhan Nikel untuk Baterai Kendaraan Listrik Capai 59.000 Ton," https://industri.kontan.co.id/news/kebutuhan-nikel-untuk-baterai-kendaraan-listrik-capai-59000-ton#google_vignette.

[32] Mazzucato, Mariana. "Mission-Oriented Innovation Policies: Challenges and Opportunities." Industrial and Corporate Change 27, no. 5 (2018): 803–815. https://doi.org/10.1093/icc/dty034.

[33] Worrell, Ernst, Lynn Price, and Nathan Martin. "Industrial Energy Efficiency and Climate Change Mitigation." Energy Efficiency 2, no. 2 (2009): 109–123. https://doi.org/10.1007/s12053-008-9032-8.

production cycle of essential minerals. Optimizing this process using high-efficiency equipment like high-pressure grinding rolls (HPGR) could boost energy efficiency by 80% compared to the widely-used semi-autogenous grinding (SAG) mills. Furthermore, the electrification of heavy mining equipment can be an effective energy-saving strategy.[34] For instance, the electrified mining equipment produced by Caterpillar is used by Rio Tinto in Australia, reaching energy efficiencies of up to 95% compared to diesel-based equipment.[35] The Indonesian mining sector should consider allocating resources toward the electrification of mining machinery to leverage such advancements in energy efficiency.

b. Incorporating Renewable Energy

Direct integration of renewable energy into mining and mineral processing operations is essential. According to McKinsey, using renewable sources instead of coal in mining could cut greenhouse gas emissions by 80%.[36] Solar microgrid systems in mining regions offer a feasible solution, especially with falling solar panel costs and Indonesia's high solar energy potential. For example, Nickel Industries Ltd has committed to building a solar power plant within PT Indonesia Morowali Industrial Park.[37] Another promising alternative is green hydrogen, produced through electrolysis powered by renewables, to fuel mining machinery and mineral processing where electrification isn't feasible.[38] Companies like Anglo American in the UK are already using green hydrogen for mining vehicles, reducing CO2 emissions significantly compared to conventional processes.[39]

c. Efficient and Sustainable Recycling

Recycling nickel from electronic waste (e-waste) can help reduce dependency on mining. Indonesia, producing approximately 2 million tons of e-waste in 2021, is a significant source of reusable metals such as nickel.[40] This approach is economically beneficial and environmentally safer than traditional mining, though complex due to hazardous materials like heavy metals, PVC, and PCBs.[41] By establishing partnerships with experienced recycling firms, the Indonesian government can leverage e-waste as a sustainable metal source,

[34] Caterpillar, "Caterpillar Successfully Demonstrates First Battery Electric Large Mining Truck," 2023, https://www.caterpillar.com/en/news/corporate-press-releases/h/caterpillar-succesfully-demonstrates-first-battery-electric-large-mining-truck.html.

[35] Australian Government, "Mining Sector Guide," Energy.gov.au, https://www.energy.gov.au/business/sector-guides/mining.

[36] McKinsey & Company, "Capturing the Green Premium: Value from Sustainable Materials," 2023, https://www.mckinsey.com/industries/metals-and-mining/our-insights/capturing-the-green-premium-value-from-sustainable-materials.

[37] Tambang.co.id, "Gandeng Sesna Nickel Industries, Bangun PLTS Berkapasitas 200 MWp di IMIP," 2023, https://www.tambang.co.id/gandeng-sesna-nickel-industries-bangun-plts-berkapasitas-200-mwp-di-imip.

[38] WRI India, "Green Hydrogen through Electrolysis: Fuelling the Future," 2023, https://wri-india.org/blog/green-hydrogen-through-electrolysis-fuelling-future.

[39] H2 Green Steel, "Green Hydrogen Enables the Decarbonization of Steel Production," 2023, https://www.h2greensteel.com/articles/green-hydrogen-enables-the-decarbonization-of-steel-production.

[40] Tempo, "Meredam Emisi Karbon Penambangan Nikel," 2023, https://koran.tempo.co/read/lingkungan/482993/meredam-emisi-karbon-penambangan-nikel.

[41] Alabi, O. A., Adeoluwa Y. M., Huo, X., Xu, X., and Bakare, A. A. "Environmental Contamination and Public Health Effects of Electronic Waste: An Overview." Environmental Health Science & Engineering 19, no. 1 (2021): 1211. https://doi.org/10.1007/s40201-021-00673-3.

minimizing environmental impacts.

3. Additional Strategies for Nickel-Based Products

a. Avoiding Landfill Disposal

Lithium-ion batteries, commonly used in EVs, contain harmful metals like cobalt, copper, and lead. Improper disposal poses environmental risks, including fire hazards at landfills.[42] Switzerland's example of recycling 68% of lithium batteries purchased annually offers valuable lessons. Battery sellers are required to accept used batteries from consumers, with funds raised from a levy on battery purchases supporting recycling logistics. Indonesia could adopt similar regulations to encourage proper battery disposal and recycling.[43]

b. Regulations on Repurposing Used EV Batteries

Used EV batteries have potential for stationary applications, such as supporting solar power plants.[44] Research from MIT has demonstrated the effectiveness of repurposing batteries for solar power storage.[45] Indonesia can promote battery recycling by mandating specifications for lithium-ion batteries that allow reuse or easier recycling, similar to regulations in place for plastic packaging reduction.

Conclusion

This article discusses Indonesia's need for environmental and policy strategies for managing nickel reserves, especially for the EV industry, aligning with Environmental, Social, and Governance (ESG) principles. Despite the success in nickel downstreaming programs, challenges remain, particularly concerning environmental impacts and ESG issues. Indonesia must prioritize sustainable mining practices by incorporating renewable energy and efficient technologies. Implementing Mariana Mazzucato's Mission-Oriented Policies can guide the government in achieving a green economy and sustainable mineral mining.

Reference

Alabi, O. A., Adeoluwa Y. M., Huo, X., Xu, X., and Bakare, A. A. "Environmental Contamination and Public Health Effects of Electronic Waste: An Overview." Environmental Health Science & Engineering 19, no. 1 (2021): 1211. https://doi.org/10.1007/s40201-021-00673-3.

Astra Credit Companies, "Pakai Jenis LFP? Ini Dia Baterai Mobil Listrik Wuling," 2023, https://www.acc.co.id/accone/InfoTerkini_Detail?Id=6302&title=Pakai-Jenis-LFP-Ini-Dia-Baterai-Mobil-Listrik-Wuling.

[42] The Conversation, "Dua Cara Pemerintah Bisa Kelola Limbah Baterai Kendaraan Listrik," 2023, https://theconversation.com/dua-cara-pemerintah-bisa-kelola-limbah-baterai-kendaraan-listrik-155715.

[43] Swiss Federal Office for the Environment, "Guide to Waste: Batteries," 2023, https://www.bafu.admin.ch/bafu/en/home/topics/waste/guide-to-waste-a-z/batteries.html.

[44] Canals Casals, Lluc, B. Amante García, and Camille Canal. "Second Life Batteries Lifespan: Rest of Useful Life and Environmental Analysis." Journal of Environmental Management 232 (2019): 354–363. https://doi.org/10.1016/j.jenvman.2018.11.046.

[45] MIT News, "Solar Energy Farms Give New Life to Electric Vehicle Batteries," 2020, https://news.mit.edu/2020/solar-energy-farms-electric-vehicle-batteries-life-0522.

Australian Government, "Mining Sector Guide," Energy.gov.au, https://www.energy.gov.au/business/sector-guides/mining.

Bisnis Indonesia, "Apa Itu Inflation Reduction Act (IRA) AS? Begini Penjelasannya," 2023, https://ekonomi.bisnis.com/read/20230516/620/1656429/apa-itu-inflation-reduction-act-ira-as-begini-penjelasannya.

Brookings Institution, "Indonesia's Electric Vehicle Batteries Dream Has a Dirty Nickel Problem," 2023, https://www.brookings.edu/articles/indonesias-electric-vehicle-batteries-dream-has-a-dirty-nickel-problem/.

Canals Casals, Lluc, B. Amante García, and Camille Canal. "Second Life Batteries Lifespan: Rest of Useful Life and Environmental Analysis." Journal of Environmental Management 232 (2019): 354–363. https://doi.org/10.1016/j.jenvman.2018.11.046.

Caterpillar, "Caterpillar Successfully Demonstrates First Battery Electric Large Mining Truck," 2023, https://www.caterpillar.com/en/news/corporate-press-releases/h/caterpillar-succesfully-demonstrates-first-battery-electric-large-mining-truck.html.

CNBC Indonesia, "Bukan Cuma Nikel, Ini Penyebab Uni Eropa Jengkel dengan RI," 2023, https://www.cnbcindonesia.com/news/20230222113701-4-415959/bukan-cuma-nikel-ini-penyebab-uni-eropa-jengkel-dengan-ri.

CNBC Indonesia, "AS Rilis Kebijakan Industri Hijau, Apa Dampaknya ke RI?," 2023, https://www.cnbcindonesia.com/news/20230907163934-4-470458/as-rilis-kebijakan-industri-hijau-apa-dampaknya-ke-ri.

CNN Indonesia, "RI Jadi Produsen Nikel Terbesar, Negara Mana Saja Pesaingnya?," 2023, https://www.cnnindonesia.com/ekonomi/20230704134901-85-969308/ri-jadi-produsen-nikel-terbesar-negara-mana-saja-pesaingnya.

DPR RI, "Masuki Tahapan Negosiasi ke-16, BKSAP-Parlemen Eropa Percepat Penyelesaian IEU-CEPA," 2023, https://www.dpr.go.id/berita/detail/id/47915/t/Masuki+Tahapan+Negosiasi+ke-16%2C+BKSAP-Parlemen+Eropa+Percepat+Penyelesaian+IEU-CEPA+.

EE Power, "Tesla Kicks Off Future of LFP Batteries in EVs," https://eepower.com/market-insights/tesla-kicks-off-future-of-lfp-batteries-in-evs/.

EETimes, "Lithium Batteries for EVs: Go NMC or LFP?," https://www.eetimes.com/lithium-batteries-for-evs-go-nmc-or-lfp/.

H2 Green Steel, "Green Hydrogen Enables the Decarbonization of Steel Production," 2023, https://www.h2greensteel.com/articles/green-hydrogen-enables-the-decarbonization-of-steel-production.

International Energy Agency (IEA), "Global Supply Chains of EV Batteries," 2023, https://www.iea.org/reports/global-supply-chains-of-ev-batteries.

Kompas, "Insentif Kendaraan Listrik Mulai 20 Maret 2023: Simak Skema Penerima dan Ketentuannya," 2023, https://money.kompas.com/read/2023/03/07/083400626/insentif-kendaraan-listrik-mulai-20-maret-2023-simak-skema-penerima-dan?page=all.

Kontan, "Kebutuhan Nikel untuk Baterai Kendaraan Listrik Capai 59.000 Ton," https://industri.kontan.co.id/news/kebutuhan-nikel-untuk-baterai-kendaraan-listrik-capai-59000-ton#google_vignette.

Kontan, "Pengumuman Insentif Tax Holiday Bagi Smelter NPI dan Feronikel

Dihapus," 2023, https://industri.kontan.co.id/news/pengumuman-insentif-tax-holiday-bagi-smelter-npi-dan-feronikel-dihapus.

Kementerian Energi dan Sumber Daya Mineral (ESDM), "Bijih Nikel Tidak Boleh Diekspor Lagi per Januari 2020," ESDM.go.id, https://www.esdm.go.id/id/media-center/arsip-berita/bijih-nikel-tidak-boleh-diekspor-lagi-per-januari-2020.

Kementerian Keuangan RI, "Anggaran dan Kebijakan untuk Industri Hijau," 2023, https://anggaran.kemenkeu.go.id/api/Medias/eeeee47a-5bda-4447-bddb-951fba7150f2.

Kementerian Keuangan RI, "Indonesia Committed to Achieving Target," 2023, https://www.kemenkeu.go.id/informasi-publik/publikasi/berita-utama/Indonesia-Committed-Achieving-Target.

Kementerian Perdagangan RI, "Regional Comprehensive Economic Partnership (RCEP)," FTACenter.kemendag.go.id, https://ftacenter.kemendag.go.id/regional-comprehensive-economic-partnership-rcep.

Kumparan Bisnis, "Menguak Jumlah Tenaga Kerja Asing di Industri Mineral dan Batu Bara," 2023, https://kumparan.com/kumparanbisnis/menguak-jumlah-tenaga-kerja-asing-di-industri-mineral-dan-batu-bara-1wsuFNFPGp8.

Lowy Institute, "Indonesia's Uncertain Climb Up the Nickel Value Chain," 2023, https://www.lowyinstitute.org/the-interpreter/indonesia-s-uncertain-climb-nickel-value-chain.

Mazzucato, Mariana. "Mission-Oriented Innovation Policies: Challenges and Opportunities." Industrial and Corporate Change 27, no. 5 (2018): 803–815. https://doi.org/10.1093/icc/dty034.

McKinsey & Company, "Capturing the Green Premium: Value from Sustainable Materials," 2023, https://www.mckinsey.com/industries/metals-and-mining/our-insights/capturing-the-green-premium-value-from-sustainable-materials.

Media Indonesia, "Kebutuhan Listrik Smelter Capai 4798 MW," 2023, https://mediaindonesia.com/ekonomi/286392/kebutuhan-listrik-smelter-capai-4798-mw.

MIT News, "Solar Energy Farms Give New Life to Electric Vehicle Batteries," 2020, https://news.mit.edu/2020/solar-energy-farms-electric-vehicle-batteries-life-0522.

Nickel Institute, "LCA Nickel Metal Final Report," https://nickelinstitute.org/media/4809/lca-nickel-metal-final.pdf.

Prambors FM, "Elon Musk Akui Enggan Bangun Pabrik di Indonesia, Ternyata Ini Alasannya," 2023, https://www.pramborsfm.com/news/elon-musk-akui-enggan-bangun-pabrik-di-indonesia-ternyata-ini-alasannya.

Reuters, "EU's Tariffs on Indonesian Stainless Steel Curtailed Exports, Jakarta Says," 2023, https://www.reuters.com/markets/commodities/eus-tariffs-indonesian-stainless-steel-curtailed-exports-jakarta-says-2023-01-31/.

Reuters, "Indonesia's Nickel Surge Is Bad News for Prices," 2022, https://www.reuters.com/markets/commodities/indonesias-nickel-surge-bad-news-price-pricing-2022-09-29/.

S&P Global, "Volkswagen's Plan on LFP Use Shifts Hydroxide Dominance Narrative in EV Sector," 2021, https://www.spglobal.com/commodityinsights/en/market-insights/latest-news/metals/031721-volkswagens-plan-on-lfp-use-shifts-hydroxide-

dominance-narrative-in-ev-sector.

S&P Global Market Intelligence, "COVID-19 Turns Indonesian Ore Export Ban into Curse for Nickel Market," 2023, https://www.spglobal.com/marketintelligence/en/news-insights/research/covid19-turns-indonesian-ore-export-ban-into-curse-for-nickel-market.

Swiss Federal Office for the Environment, "Guide to Waste: Batteries," 2023, https://www.bafu.admin.ch/bafu/en/home/topics/waste/guide-to-waste-a-z/batteries.html.

Tambang.co.id, "Gandeng Sesna Nickel Industries, Bangun PLTS Berkapasitas 200 MWp di IMIP," 2023, https://www.tambang.co.id/gandeng-sesna-nickel-industries-bangun-plts-berkapasitas-200-mwp-di-imip.

Tempo, "Meredam Emisi Karbon Penambangan Nikel," 2023, https://koran.tempo.co/read/lingkungan/482993/meredam-emisi-karbon-penambangan-nikel.

The Assay, "The Great Laterite Challenge: Why Scaling Class 1 Nickel Production Won't Be Easy, Cheap, or Environmentally Friendly," 2023, https://www.theassay.com/articles/investor-insight/the-great-laterite-challenge-why-scaling-class-1-nickel-production-wont-be-easy-cheap-or-environmentally-friendly/.

The Conversation, "Dua Cara Pemerintah Bisa Kelola Limbah Baterai Kendaraan Listrik," 2023, https://theconversation.com/dua-cara-pemerintah-bisa-kelola-limbah-baterai-kendaraan-listrik-155715.

The Conversation, "Isu Lingkungan dan Perkembangan Teknologi Ancam Ambisi Kendaraan Listrik Berbasis Nikel Indonesia, Apa yang Harus Dilakukan Pemerintah?," 2023, https://theconversation.com/isu-lingkungan-dan-perkembangan-teknologi-ancam-ambisi-kendaraan-listrik-berbasis-nikel-indonesia-apa-yang-harus-dilakukan-pemerintah-201186.

The Conversation, "Klaim Sukses Hilirisasi Nikel Berbasis Larangan Ekspor Masih Memiliki Segudang Masalah," 2023, https://theconversation.com/klaim-sukses-hilirisasi-nikel-berbasis-larangan-ekspor-masih-memiliki-segudang-masalah-177735.

Universitas Gadjah Mada (UGM), "Industri Nikel Indonesia Pasca Sengketa Perdagangan dengan Uni Eropa," 2022, https://cwts.ugm.ac.id/2022/11/03/industri-nikel-indonesia-pasca-sengketa-perdagangan-dengan-uni-eropa/.

Worrell, Ernst, Lynn Price, and Nathan Martin. "Industrial Energy Efficiency and Climate Change Mitigation." Energy Efficiency 2, no. 2 (2009): 109–123. https://doi.org/10.1007/s12053-008-9032-8.

WRI India, "Green Hydrogen through Electrolysis: Fuelling the Future," 2023, https://wri-india.org/blog/green-hydrogen-through-electrolysis-fuelling-future.