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## CRITICAL MINERALS INDUSTRY:

# SUSTAINABILITY TRANSITIONS IN THE PHILIPPINES

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# CRITICAL MINERALS INDUSTRY: SUSTAINABILITY TRANSITIONS IN THE PHILIPPINES

The Philippines is at a critical crossroads in its economic and sustainable development trajectory, with ambitious goals detailed in the Philippine Development Plan (PDP) 2023-2028 and the Philippine Energy Plan (NEDA 2023). While the country possesses substantial mineral reserves that are essential for infrastructure growth and the clean energy transition, significant challenges hinder the effective and sustainable utilization of these resources. There are 5 major concerns, including the following: (1) regulatory efficiencies, (2) underutilization of mineral resources; (3) sustainability issues; (4) lack of strategic industry alignment; and (5) high costs and risks.

Regulatory inefficiencies refer to the lengthy and fragmented permitting processes, requiring multiple steps and signatures across various agencies, which delay mining activities and deter investment. The underutilization of mineral resources is characterized by low levels of mineral value addition, reliance on raw material exports, and inactive mining claims held by licensees that contribute to underperformance in the mining sector. Sustainability concerns involve balancing mineral extraction with environmental protection, community development, and adherence to international sustainability standards, which remain challenging.

The lack of strategic industry alignment can be seen in the absence of comprehensive industry roadmaps and limited downstream processing capabilities, which hinder the country's integration into global value chains for critical minerals and renewable energy technologies. On the other hand, the high costs and risks are reflected in mining operations in unexplored areas, which involve significant financial and operational risks, further compounded by inadequate geo-mapping and unclear investment incentives.

The research problem, therefore, focuses on how the Philippines can establish a robust, transparent, and sustainable critical minerals industry that aligns with its economic transformation goals, renewable energy aspirations, and global competitiveness, while addressing regulatory, environmental, and investment challenges.

The Philippines has long been recognized for its mineral wealth, with substantial reserves of nickel, copper, gold, and other strategic minerals crucial for industrial development and renewable energy technologies. The Philippine Statistics Authority's 2022 Annual Report on Mining and Quarrying provides a comprehensive overview of the sector's performance, highlighting its contributions to the national economy. The report indicates that the mining and quarrying sector has experienced fluctuations in output and employment, influenced by factors such as global commodity prices, regulatory changes, and environmental considerations.

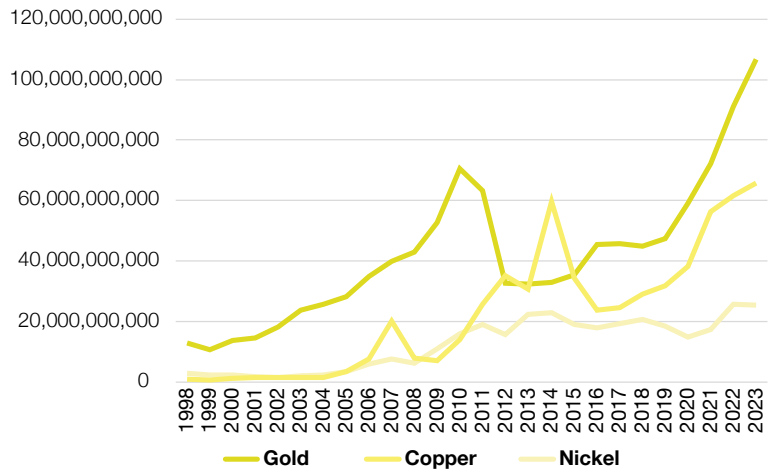
The Asian Development Bank (ADB) has highlighted the significant role of mineral development in the economic outlook of Southeast Asian countries, including the Philippines. In its report, ADB notes that rising commodity prices have bolstered exports of minerals such as copper from the Philippines, thereby contributing to economic growth in the region (ADB 2022).

The World Bank's 2021 report, "Critical Minerals for a Sustainable Future," underscores the essential role of minerals like nickel, cobalt, and lithium in advancing clean energy technologies. While the report does not provide country-specific analyses, its insights are particularly relevant to the Philippines, a nation rich in mineral resources. The report highlights that the global shift towards renewable energy is expected to significantly increase demand for these critical minerals, presenting substantial economic opportunities for mineral-rich countries.

For the Philippines, this surge in demand could catalyze economic growth through the development of its mining sector.

## Philippine Gold, Copper, and Nickel Production Value
(PHP Billions)

Figure 1




Source: Mines and Geosciences Bureau (MGB) (n.d.)

## Production Volume
(Metric Tons)

Table 1

| | Gold ** | Copper ^ | Nickel ^ |
|---|---|---|---|
| 1998 | 34 | 177,868 | 959,949 |
| 1999 | 31 | 151,219 | 625,286 |
| 2000 | 37 | 129,768 | 1,023,382 |
| 2001 | 34 | 95,983 | 1,282,710 |
| 2002 | 36 | 79,213 | 1,200,204 |
| 2003 | 38 | 80,917 | 962,485 |
| 2004 | 35 | 70,578 | 874,193 |
| 2005 | 37 | 75,283 | 1,106,903 |
| 2006 | 36 | 71,842 | 3,912,396 |
| 2007 | 39 | 88,096 | 6,751,099 |
| 2008 | 36 | 92,809 | 5,459,128 |
| 2009 | 37 | 203,414 | 8,283,110 |
| 2010 | 41 | 236,814 | 13,763,734 |
| 2011 | 31 | 253,975 | 20,683,132 |
| 2012 | 15 | 268,046 | 25,270,822 |
| 2013 | 17 | 376,106 | 29,085,191 |
| 2014 | 18 | 349,269 | 34,334,892 |
| 2015 | 21 | 337,185 | 33,448,138 |
| 2016 | 23 | 335,665 | 29,279,106 |
| 2017 | 23 | 280,394 | 27,085,778 |
| 2018 | 21 | 282,391 | 25,923,000 |
| 2019 | 21 | 296,997 | 26,212,124 |
| 2020 | 21 | 242,075 | 26,781,654 |
| 2021 | 25 | 214,684 | 32,933,346 |
| 2022 | 29 | 258,729 | 29,423,836 |
| 2023 | 31 | 266,532 | 35,144,306 |

***Production volumes of gold was converted to metric tons from kilograms for comparison purposes.*
*^^Production volumes of copper and nickel are in dry metric tons.*

Source: Mines and Geosciences Bureau (MGB) (n.d.)

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# sustainable systems

However, the report also emphasizes the need to sustainable and responsible mining practices to mitigate environmental and social impacts. This aligns with the Philippines' need to balance economic development with environmental stewardship and social responsibility. By implementing climate-smart mining practices, the Philippines can position itself as a key supplier in the global renewable energy supply chain, thereby contributing to both national economic objectives and global sustainability goals.

The United Nations Framework Classification for Resources (UNFC) provides comprehensive guidelines for the sustainable development of mineral resources, emphasizing a holistic approach that integrates environmental, social, and economic considerations throughout the entire resource lifecycle. By incorporating these dimensions, the UNFC aligns resource management practices with the United Nations Sustainable Development Goals (SDGs), promoting responsible extraction and utilization of minerals. The framework facilitates transparent and consistent classification of mineral projects, aiding stakeholders in making informed decisions that balance economic benefits with environmental stewardship and social responsibility. UNFC's adaptability to various resource types and its emphasis on sustainability make it a vital tool for countries aiming to manage their mineral resources effectively while adhering to global sustainability standards (UNFC 2023).

The Sustainability Transitions Framework guides this study to provide an analytical lens for understanding how the Philippines can optimize its mineral resource potential while aligning with global sustainability goals and economic transformation. Wieczorek (2018) examines sustainability transitions in developing countries, highlighting their unique characteristics, such as weaker institutional frameworks, resource constraints, and socio-economic inequalities. The study emphasizes the importance of considering local contexts, addressing systemic barriers, and leveraging niche innovations that are culturally and institutionally appropriate. It advocates for inclusive and participatory approaches to sustainability transitions, acknowledging the role of diverse actors and power dynamics. Applied to mineral policy reform, this theory suggests analyzing the sector's challenges—such as regulatory gaps, environmental degradation, and social inequities—through a systems perspective. It highlights opportunities for reform by promoting community-driven innovations, strengthening institutional capacity, and fostering multi-stakeholder collaboration to achieve sustainable and equitable governance of mineral resources.

This framework explores the socio-technical and policy shifts required to transition toward sustainable systems. In the Philippine mining sector, it emphasizes balancing economic development with environmental and social responsibilities. It provides a lens to evaluate the alignment of mining policies with the UN SDGs, ensuring that mineral extraction supports broader societal goals, such as poverty alleviation, education, and climate action. This paper seeks to propose a strategic roadmap for mineral resource development that not only addresses immediate economic goals but also ensures long-term sustainability and resilience.

This study adopts a multidisciplinary methodology, incorporating document analysis and case study evaluation to achieve a comprehensive understanding. Data collection was conducted by sourcing information on mineral reserves, production levels, and market trends from government reports, industry publications, and international databases. This included key data points such as mineral prices, resource estimates, and sector performance metrics.

As the country embarks on ambitious infrastructure programs and transitions towards a sustainable energy future, its ability to harness these resources effectively will play a pivotal role in achieving its economic, social, and environmental objectives. This paper explores the policy measures required to establish a transparent, sustainable, and responsible critical minerals industry, ensuring the alignment of mineral resource development with national growth priorities and global sustainability commitments.

## Strategic Context and Current Landscape

The "Build Better More" (BBM) program and NEDA's infrastructure flagship projects aim to enhance connectivity, industrial capacity, and economic resilience. The Luzon Economic Corridor, a cornerstone of this strategy, envisions a robust infrastructure network facilitating industrial growth and regional integration. Minerals are critical to these efforts, providing raw materials for construction, electronics, and transportation systems. The untapped potential of the Philippines' mineral resources, if harnessed responsibly, can fuel the nation's infrastructure aspirations and drive industrial diversification.

### Renewable Energy Transition and Strategic Minerals

The Philippine Energy Plan's renewable energy (RE) targets—35% by 2030, 50% by 2040, and beyond 50% by 2050—underscore the increasing demand for critical minerals, including lithium, cobalt, and rare earth elements (DOE 2023). These materials are essential for manufacturing batteries, wind turbines, and solar panels. Developing a robust critical minerals industry is vital for achieving energy security, reducing dependence on imports, and supporting the global shift towards carbon neutrality (IEA 2022).

### Challenges in Mineral Resource Development

Despite its mineral potential, the Philippines faces significant challenges, including regulatory inefficiencies, environmental concerns, social opposition, and inadequate investment in downstream industries. These hurdles must be addressed through a coherent policy framework that balances economic, social, and environmental priorities.

### Defining Critical Minerals

Presently, there is no universally agreed global definition of critical and strategic minerals. The definition is context and country-specific, reflecting technical, economic, and geopolitical perspectives. For the Philippines, adopting a formal definition of "critical minerals" aligned with its unique development priorities is essential. Broadening the definition to include both metallic and non-metallic resources will align with the nation's goals for infrastructure and industrial growth.

Critical minerals are vital metallic and non-metallic resources crucial for the Philippines' development and clean energy transition. These are intended to support key growth sectors like renewable energy, manufacturing, and infrastructure, while positioning the country for a competitive role in the global supply chain and leadership in the production of technologies essential for the clean energy shift.

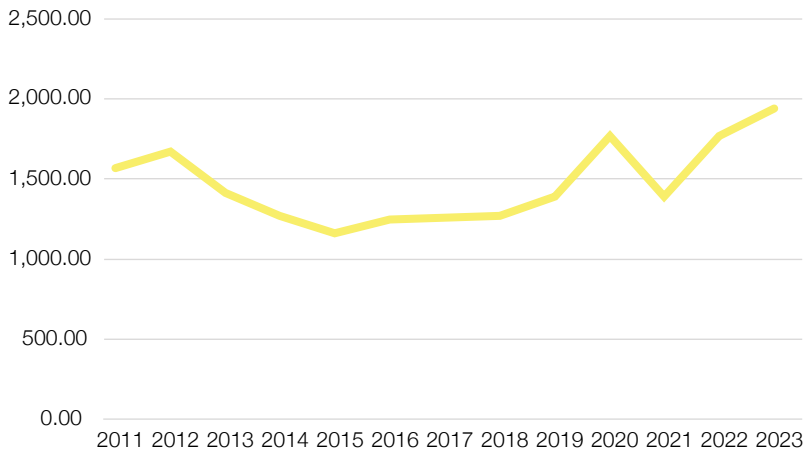
By clearly defining which minerals are deemed critical, the Philippines can strategically direct policies and investments to enhance local value addition, decrease dependence on imports, and build capacity for domestic processing and manufacturing. This approach will enable the Philippines to not only fulfill domestic development targets but also carve out a significant role in the global supply chain of green technology industries.

### Unlocking the Potential of the Gold Industry

To fully leverage critical minerals, the Philippine government has initiated policies aimed at unlocking the mining industry's potential and capturing economic opportunities typically lost by exporting raw materials. Recognizing that each mineral presents unique economic and strategic advantages, there is a need to adopt a mineral-specific approach, with tailored strategies to maximize the value of each resource.

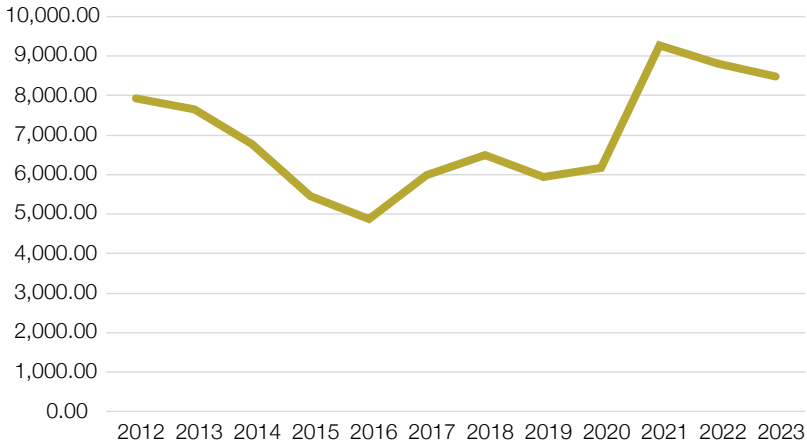
The current Philippine gold resource estimate is 153 million ounces (oz). Gold prices have risen from USD1,700/oz in 2022 to today's USD2,746/oz, amounting to a total resource value of USD420 billion. Despite this, gold production from registered companies was only worth USD259 million in 2022, while small-scale gold mining and illegal trading may be worth more than USD500 million annually.

Historical Average Price of Gold
(USD Thousands per Ounce)
Figure 2




Source: Bangko Sentral ng Pilipinas (BSP) (2011-2023) as cited in Mines and Geosciences Bureau (MGB) (n.d.)

Historical Average Metal Prices: Copper
(USD Thousands per Metric Ton)
Figure 3




***Historical average prices of Copper was converted to USD per metric ton from USD per pound for comparison purposes*

Source: London Metal Exchange (LME) (2012-2023) as cited in Mines and Geosciences Bureau (MGB) (n.d.)

According to the 2024 Gold Jewelry Business Report, "The global market for Gold Jewelry was estimated at USD206.6 billion in 2023 and is projected to reach USD304.2 billion by 2030, growing at a Compound Annual Growth Rate (CAGR) of 5.7% from 2023 to 2030."

The proposed strategies for the gold sector include: (1) Registering all small-scale miners and establishing an incentivized and convenient system for selling gold to the Bangko Sentral ng Pilipinas (BSP); and (2) Developing local gold jewelry-making industries, particularly in gold-rich areas. Given the creative talent in the Philippines, this can be a potential new industry that taps into a global market valued at USD206.6 billion in 2023.

## Copper Industry Development

Similar to gold, copper prices have risen steadily in the last five years to a current price of USD9,490/metric ton (MT). With 44 million MT of known reserves, this amounts to USD418 billion. Copper is a vital component in renewable energy technologies. Currently, the Philippines exports copper concentrates while the Philippine Associated Smelting and Refining Corporation (PASAR) processes some concentrates into copper anodes and cathodes.

The proposed strategies for the copper sector include the following: (1) Increase copper production and aim to be among the top three producers in the region by opening new mines; and (2) Increase PASAR's copper cathode production and utilize local copper concentrates more effectively.

## Maximizing Nickel Laterites

The country's vast nickel laterite deposits

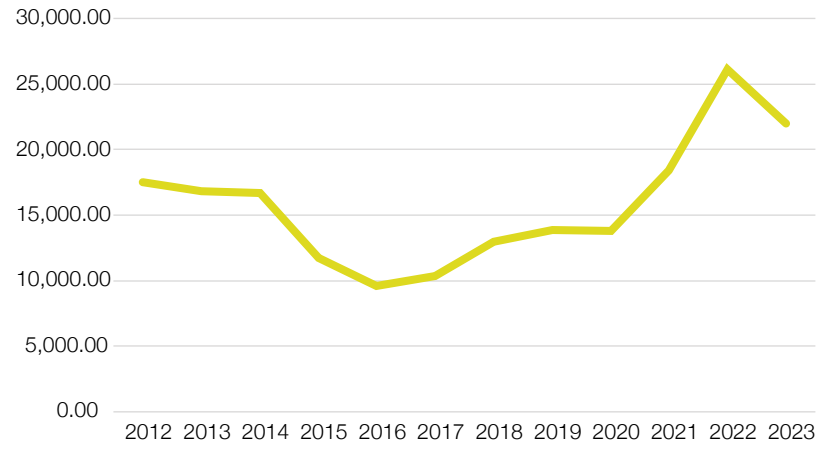



Figure 4

***Historical average prices of NIckel was converted to USD per metric ton from USD per pound for comparison purposes*

Source: London Metal Exchange (LME) (2012-2023) as cited in Mines and Geosciences Bureau (MGB) (n.d.)

are, in most cases, considered low-grade nickel ore (0.8–1.3% Ni). These deposits also contain allied minerals such as iron, chromite, cobalt, and rare earth elements (REEs), which are often not separated or valued when raw nickel ore is exported.

The proposed strategies for the nickel sector consist of the following: (1) Increasing exploration and development of new nickel deposits; (2) Investing in research and development (R&D) to enable 0.6–0.8% nickel laterite deposits to be "high-graded" and exported, potentially doubling the country's nickel reserves; (3) Establishing shared service facilities (SSFs) in Zambales and Surigao for processing laterites into mixed sulfides; and (4) Launching pilot projects to extract REEs from laterite deposits.

## Development of Non-Metallic Minerals

Non-metallic mineral resources, such as limestone, sand, and gravel, constitute an even larger resource value (USD5.9 trillion) than metallic mineral resources combined. These are critical to the Philippines' ambitious infrastructure drive.

The proposed strategies for non-metallic resources includ: (1) Developing new sources of non-metallic resources in strategic regions where national infrastructure projects are planned; (2) Mapping limestone reserves to identify proximity to development sites, ensuring lower transportation costs and higher efficiency; and (3) Identifying rivers suitable for aggregate sourcing and auctioning non-metallic mining contracts through government bidding processes.

## Addressing Costs, Risks, and Inactive Mining Claims

Addressing the costs, risks, and inefficiencies in the mining sector is essential to unlock its full potential. The high costs and operational risks associated with exploring undeveloped areas pose significant challenges to growth, while inactive mining claims held by licensees lead to a low percentage of operational mines, hampering the sector's overall productivity.

To tackle these issues, the Department of Environment and Natural Resources (DENR) must expand its geo-mapping activities to identify new extraction sites and designate mineral reservation areas, providing clearer opportunities for development. Government-owned and controlled corporations (GOCCs) such as the Philippine Mining Development Corporation (PMDC), Philippine National Oil Company (PNOC), and Maharlika Investment Corporation should be empowered to invest in and explore mineral resources. These entities can also engage in joint ventures or mining contracts to accelerate project implementation.

Additionally, the DENR should review and revise the Department Administrative Order (DAO) 2021-12 guidelines governing the automatic renewal of exploration periods, introducing stricter criteria for extensions to ensure timely progress. A thorough audit of inactive Mineral Production Sharing Agreements (MPSAs) must also be conducted within six months, revoking licenses that have remained dormant. These measures will help mitigate risks, optimize resource utilization, and encourage more dynamic and sustainable mining activities.

## Streamlining Permitting Processes

The permitting process for mining activities in the Philippines has long been criticized for its complexity and inefficiency, requiring sequential

approval from various agencies, over 150 procedural steps, and more than 1,000 signatures. This cumbersome process discourages investment and delays project implementation, underscoring the urgent need for reform.

To streamline these procedures, simultaneous permit processing should replace the current sequential system, significantly reducing time and administrative hurdles. Additionally, the DENR, the Department of the Interior and Local Government (DILG), and the National Commission on Indigenous Peoples (NCIP) should collaborate with the Anti-Red Tape Authority (ARTA) to minimize the number of required signatures, restricting them to officers directly supervising the responsible offices or departments.

Consolidating tree-cutting permits with other mining permits is another essential step to eliminate redundancy and simplify the application process. These reforms will create a more efficient permitting system, fostering a conducive environment for investment while maintaining rigorous environmental and regulatory standards.

## Guiding Principles of the National Policy Framework for Mineral Resource Development

The Philippines' mining sector is at a pivotal moment in its development, presenting a unique opportunity to align economic growth with social equity, environmental protection, and sustainable practices. Key policy frameworks are being proposed to transform the industry into a driver of inclusive development while addressing critical challenges. At the heart of these reforms is the Social Development and Management Program (SDMP), which aims to integrate community needs with the UN SDGs. By prioritizing education, healthcare, livelihoods, and infrastructure investments, and mandating stakeholder engagement, the SDMP seeks to empower local communities and ensure tangible benefits from mining activities.

Complementing these social initiatives, the framework emphasizes robust state ownership and regulation to ensure fair economic value from the country's mineral wealth. Transparent revenue-sharing mechanisms and stringent regulatory oversight will prevent illegal mining while safeguarding environmental and worker safety standards. Economic development strategies focus on incentivizing value-added processing, fostering downstream industries, and encouraging private sector participation, all of which are critical to enhancing global competitiveness.

Equally important are measures to protect indigenous rights, promote environmental restoration, and establish comprehensive industry roadmaps to guide sustainable resource management. By integrating these elements, the proposed policies aim to create a resilient and equitable mining sector that not only contributes to the nation's economic goals but also aligns with global sustainability standards.

### Social Development and Management Program

The SDMP is poised for a transformative overhaul to better serve the developmental needs of host communities while aligning with the UN SDGs. Central to this reform is the revision of the DENR's guidelines. These updates will ensure that SDMP initiatives focus on critical community activities, including education, healthcare, livelihoods, and infrastructure development. Additionally, measurable indicators will be introduced to evaluate the program's effectiveness in achieving key SDG objectives, such as poverty reduction, gender equality, quality education, and environmental sustainability.

To further embed sustainability into the mining sector, mining operators will be required to integrate SDG-specific objectives into their SDMPs. This alignment will promote inclusive growth and ensure that mining activities contribute to broader developmental goals. Active engagement with local stakeholders will also be mandated, enabling communities to participate in the planning, implementation, and evaluation of SDMP projects. This collaborative approach ensures that programs are responsive to community priorities and deliver tangible benefits, fostering a more equitable and sustainable framework for mining operations.

### State Ownership and Regulation

The principle of state ownership and regulation underscores the critical need to manage the Philippines' mineral wealth responsibly and equitably. Recognizing minerals as state-owned assets is fundamental to ensuring that their extraction and utilization yield fair economic benefits for the nation. To achieve this, transparent revenue-sharing mechanisms must be established, coupled with clear benchmarks for

royalties and taxes. These measures will ensure that the economic gains from mining activities are distributed equitably, benefiting both the government and local communities.

Simultaneously, strengthening regulatory frameworks is essential to uphold the integrity of the mining sector. Robust measures must be implemented to prevent illegal mining activities, which undermine the country's resources and economic stability. Additionally, strict enforcement of environmental and safety standards will ensure that mining operations are conducted responsibly, safeguarding natural ecosystems and the well-being of workers and host communities. Together, these strategies will build a foundation for sustainable and accountable mineral resource management.

## Economic Development

Economic development in the mining sector hinges on maximizing the value derived from the country's rich mineral resources. A key strategy is to incentivize investments in mineral processing and value-added industries. By shifting away from reliance on raw material exports, this approach not only enhances the Philippines' global competitiveness but also bolsters the domestic economy through industrial diversification.

Downstream integration is another vital component, aimed at fostering collaborations with both domestic and international stakeholders. These partnerships will facilitate the transfer of advanced technologies and create meaningful employment opportunities, aligning with the goals of the PDP 2023-2028. To complement these efforts, the government must actively engage the private sector by creating favorable business conditions. Highlighting growth opportunities and offering a stable

investment environment will attract the private sector's resources and expertise, driving innovation and ensuring sustainable growth in the mining industry.

### Social and Cultural Development

Social and cultural development in the mining sector must prioritize the empowerment and inclusion of host communities and Indigenous peoples. To achieve this, benefit-sharing agreements should be mandated, ensuring that mining operations directly contribute to community well-being. These agreements must focus on critical areas such as education, healthcare, and infrastructure investments, providing tangible improvements to the quality of life for those most affected by mining activities.

Equally important is the protection of Indigenous rights. The enforcement of free, prior, and informed consent (FPIC) from Indigenous Cultural Communities (ICCs) and Indigenous Peoples (IPs) is essential. This ensures their equitable participation in decisions related to mining projects while safeguarding their cultural heritage and ancestral lands. Together, these measures foster a more inclusive and respectful approach to resource development, balancing economic goals with the rights and aspirations of local communities.

### Environmental Protection

Environmental protection is a cornerstone of sustainable mining practices, requiring a proactive approach to safeguard natural ecosystems. Strict environmental regulations must be enforced, mandating that mining operations incorporate reclamation, reforestation, and ecosystem restoration as integral components of their activities. These measures ensure that the environmental footprint of mining is minimized and that degraded areas are restored to support biodiversity and community resilience.

Also critical is the need for robust accountability and monitoring systems. Strengthened mechanisms will ensure compliance with sustainability standards and hold mining operators accountable for their environmental impacts. By combining rigorous regulations with transparent oversight, these measures promote responsible resource development while protecting the Philippines' rich natural heritage for future generations.

### Role of the Private Sector

The private sector plays a pivotal role in driving the growth and sustainability of the mining industry. To attract robust private sector involvement, policies must be designed to actively promote investment in exploration, extraction, and mineral processing industries. By offering targeted incentives and highlighting the potential for growth, these policies can position the Philippines as an attractive destination for responsible and innovative mining ventures.

Equally important is creating an environment that fosters ease of doing business. Enhancing the predictability and stability of national and local policies will provide the private sector with the confidence needed to make long-term investments. Clear, consistent, and transparent regulatory frameworks will not only reduce uncertainties but also pave the way for partnerships that contribute to the sustainable development of the mining sector and the broader economy.

### Industry Roadmaps

There is a need to formulate and implement comprehensive industry roadmaps that focus on increasing value-added mineral processing and developing downstream industries. These roadmaps should clearly outline the specific goods, strategies, and timelines required to harness the potential of critical minerals effectively. By providing a structured approach to sector development, these roadmaps will serve as actionable guides for stakeholders, ensuring alignment with national economic objectives and global sustainability goals. It is important to prioritize the timely updating and publication of these roadmaps to reflect advancements in technology, market demands, and policy shifts, positioning the Philippines as a competitive player in the global mineral value chain.

## Policy Recommendations

The Philippine mining sector is poised to play a transformative role in the country's economic development, sustainability goals, and global competitiveness. A comprehensive set of policy recommendations has been proposed to address critical challenges and unlock the full potential of the industry. Central to these recommendations are strategies to streamline regulatory processes, ensuring that mining permits are processed efficiently without compromising environmental and social safeguards. Enhanced regulatory oversight through independent authorities will promote transparency, accountability, and adherence to sustainability standards. Fiscal incentives, such as tax breaks

and equitable revenue-sharing models, will stimulate investment and ensure that benefits are shared equitably with communities.

Further, the recommendations emphasize the need for investments in R&D and capacity building to adopt cutting-edge technologies and develop a skilled workforce. Strengthening infrastructure and logistics, including the development of export hubs and integration with national infrastructure initiatives, will optimize connectivity and enhance the country's global value chain participation. Environmental and social safeguards will ensure responsible mining practices, while international cooperation and partnerships will bring in expertise, technology transfer, and access to global markets.

Additionally, boosting mineral production, advancing value-added processing, and fostering downstream industries will enhance the Philippines' economic impact and position the country as a leader in sustainable mining and mineral resource management. Together, these policies provide a strategic roadmap for transforming the mining sector into a cornerstone of inclusive, sustainable, and globally competitive development.

## Streamline Regulatory Processes

There is a need to simplify and modernize mining permitting procedures to attract investment while ensuring adherence to stringent environmental and social safeguards. A single-window mechanism for processing mining permits to reduce bureaucratic delays and enhance efficiency can be implemented. This model, successfully employed in Chile, demonstrates how streamlined processes can promote investments without compromising on sustainability or regulatory rigor.

## Strengthen Regulatory Oversight

An independent regulatory authority should be established to monitor compliance, oversee revenue generation, and address disputes in the mining sector. Drawing from Australia's example, such institutions should focus on promoting transparency and accountability by leveraging environmental, social, and governance (ESG) frameworks. These frameworks, like the Minerals Council of Australia's initiatives, provide practical tools and indicators to assess sustainability practices and encourage continuous improvement in areas such as community engagement, environmental stewardship, and safety (MCA 2023). By integrating these reforms, the Philippines can attract responsible investments, enhance governance, and align its mining sector with global best practices for sustainable development.

## Introduce Tax Incentives

There is a need to implement tax breaks and other fiscal incentives for companies investing in value addition and downstream processing industries. These incentives, modeled on Zambia's approach, could include reduced corporate tax rates and exemptions from value-added tax (VAT) for investments in processing facilities such as smelters and refineries. This policy aims to stimulate local industry growth, enhance resource utilization, and increase the domestic economic impact of mining activities.

## Adopt Equitable Revenue-Sharing Models

It is important to establish a royalty system that ensures fair sharing of mining revenues between the government, investors, and local communities. Following Ghana's example, allocate a portion of these revenues to community development funds, such as a Mineral Development Fund, to directly support social and economic projects in resource-rich regions. This approach will enhance community benefits from resource extraction while promoting equitable and inclusive development. By implementing these fiscal and economic incentives, the Philippines can attract responsible investments, boost local industrial capacity, and ensure that mineral wealth contributes to both national and community-level development goals.

## Invest in Technology Development

Research and Development (R&D) programs focused on advancing sustainable mining techniques, enhancing the efficiency of mineral processing technologies, and promoting the recycling of strategic minerals should be created. Drawing inspiration from South Africa's example, partnerships with research institutions like Mintek can position the Philippines as a leader in mining innovation, driving environmentally responsible practices and technological advancements.

## Enhance Capacity Building

It will be productive if academic institutions and industry stakeholders can collaborate to develop training programs and certifications tailored to the mining and renewable energy sectors. By following Canada's model, initiatives led by organizations such as the Mining Industry Human Resources Council (MiHR) can ensure a steady pipeline of skilled labor, fostering a highly capable workforce that meets industry demands.

These R&D and capacity-building initiatives will enable the Philippines to adopt cutting-edge technologies, improve resource efficiency, and strengthen its human capital, ensuring the mining sector's sustainability and competitiveness in the global market.

## Strengthening Infrastructure and Logistics for Mining Development

It is important to align mining projects with national infrastructure initiatives, such as the "Build Better More" (BBM) program, which aim to optimize logistics, connectivity, and resource allocation. This integrated development approach, modeled on Brazil's Carajás mining complex, leverages dedicated transport systems like railways and ports to improve the efficiency of mineral extraction and distribution. Additionally, strategic export hubs for processed minerals, inspired by Indonesia's example, should be set up to enhance the Philippines' role in global value chains. By promoting local processing and restricting the export of raw materials, these hubs can maximize value addition and economic benefits from mineral resources while boosting the country's competitiveness in international markets.

## Strengthening Environmental and Social Safeguards

Mining operators should be mandated to allocate a portion of their revenues to community development programs, ensuring that resource extraction directly benefits local populations through investments in education, healthcare, infrastructure, and livelihoods. Inspired by Norway's model of community development funds, this approach fosters equitable growth in mining-affected areas.

Additionally, mining companies should be required to provide environmental bonds as financial guarantees for site restoration and rehabilitation. Drawing from Finland's example, these bonds enhance accountability and ensure that companies fulfill their environmental responsibilities, setting a standard for sustainable and responsible mining practices. Together, these measures promote environmental stewardship and social inclusion, aligning the mining sector with broader sustainability goals.

## International Cooperation

There is a need to foster strategic partnerships with countries and organizations at the forefront of sustainable mining and renewable energy technologies. These alliances, modeled on Germany's approach, should prioritize joint ventures, technology transfer, and mutual capacity-building to secure sustainable supplies of critical minerals. Additionally, trade agreements should be conducted to ensure access to international markets for processed minerals and renewable energy components.

Following the European Union's example, it is useful to incorporate sustainability criteria into these agreements to align with global environmental standards and support the transition to a green economy. By leveraging international cooperation, the Philippines can strengthen its position in global supply chains while advancing domestic sustainability and technological innovation.

## Boosting Mineral Production for Global Competitiveness

It is necessary to position the Philippines as a significant player in the global value chain, implement strategies to increase mineral production through targeted initiatives. Introduce exploration incentives, such as tax holidays and investment subsidies, to encourage the discovery of new mineral reserves, following Mongolia's success in identifying significant deposits like the Oyu Tolgoi copper-gold site.

Mining practices should be modernized by investing in advanced technologies, including automation and AI, to enhance operational efficiency and minimize environmental impact, modeled after China's approach to sustainable mining innovation. Additionally, it is important to foster public-private partnerships (PPPs) to attract private investments and expand production capabilities, leveraging shared resources and expertise. These measures will enhance the Philippines' mineral output while ensuring sustainability and global competitiveness.

## Advancing Value-Added Mineral Processing for Economic Growth

There is a need to promote the development of local processing facilities for critical minerals such as nickel and copper to reduce dependence on raw material exports and enhance domestic value addition. Drawing from Indonesia's model, the establishment of processing plants, including smelters, should be required to stimulate growth in value-added industries. It is important to foster technology partnerships with global leaders in mineral processing, emulating Japan's approach of leveraging international

collaboration to adopt best practices and maintain competitiveness in advanced sectors like battery manufacturing and electronics. These initiatives will position the Philippines as a key player in the global supply chain, while maximizing the economic and technological benefits of its mineral resources.

### Developing Downstream Industries to Maximize Economic Value

It is necessary to encourage the growth of downstream industries to enhance value addition and diversify the Philippine economy. The establishment of lithium-ion battery manufacturing facilities should be supported to meet the rising demand for electric vehicles and renewable energy storage, following South Korea's successful model of fostering innovation hubs and R&D incentives. There is a need to expand the production of components for electronics and renewable energy technologies, such as solar panels and wind turbines, leveraging Malaysia's approach of attracting foreign direct investment (FDI) to strengthen its electronics industry. It is imperative to promote local gold jewelry production to capitalize on global demand, drawing inspiration from Switzerland's high-quality craftsmanship and export-driven strategies.

There is a need to increase copper refinement by boosting PASAR's capacity and aligning domestic copper production for maximum value addition, as seen in Australia's integrated mining and refining practices. Shared service facilities for nickel laterite processing and pilot rare earth element (REE) extraction projects are required to enhance critical mineral utilization. There is a need to optimize non-metallic mining, such as limestone and aggregates, by aligning with national infrastructure projects to ensure cost efficiency and strategic resource allocation. Finally, there should be incentives for exporters of value-added products to improve competitiveness in global markets. These measures will position the Philippines as a leader in downstream industries, driving sustainable economic growth and global market integration.

## Conclusion

The Philippines, rich in critical mineral resources like nickel, copper, and gold, is at a pivotal moment in leveraging its mining industry for economic growth, infrastructure development, and the transition to renewable energy. Despite this potential, challenges such as regulatory inefficiencies, underutilization of resources, environmental concerns, and the lack of strategic alignment hinder the sector's growth. This paper uses sustainability transition frameworks, such as those by Wieczorek (2018) and Kern et al. (2019), to propose a comprehensive roadmap for reforming the Philippine mining sector.

The study highlights the importance of adaptive policy mixes, stakeholder collaboration, and industry-specific strategies to address systemic barriers and promote sustainable development. Recommendations include streamlining permitting processes, fostering downstream processing and value addition, investing in technology and innovation, and ensuring alignment with the UN SDGs. A strategic focus on non-metallic and metallic resources, enhanced by public-private partnerships and international cooperation, aims to position the Philippines as a key player in the global supply chain for green technologies.

The Philippine mining sector holds immense potential to drive the nation's economic transformation and renewable energy ambitions. Achieving this requires a shift toward sustainable and responsible practices, supported by coherent policies and strategic investments. By addressing regulatory inefficiencies, enhancing value addition, and fostering innovation, the sector can overcome existing challenges and unlock new opportunities. Integrating environmental and social safeguards, promoting community development, and leveraging global best practices are essential to ensuring long-term resilience and sustainability. With the proposed framework and reforms, the Philippines can establish a robust critical minerals industry that aligns with national development goals and global sustainability commitments, securing its role in the transition to a greener and more inclusive economy.

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