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Nickel-Powered Sustainability: Revolutionizing the Energy Economy Through Lithium Batteries

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ABSTRACT

Nickel is a chemical element and a transition metal that is commonly used in steel manufacturing. Almost two-thirds of the nickel sold out every year goes into stainless steel. The useage of stainless steel, so the nickel, in the automobile sector is huge. Traditional automobile sector manufacturers require stainless steel metal for their products. Furthermore, the demand for nickel increased with the new electric cars using batteries.

The rising demand for EVs in 2025 is expected to drive a significant increase in nickel prices—potentially up to 1000%—unveiling both economic opportunities and challenges for nickel-producing countries. The complementary relationship between batteries and nickel demand is estimated to increase the contribution to the GDP of nickel supplying countries. However, there is a notable disparity in the economic benefits between nations with large nickel reserves, such as Indonesia and Australia, and EV-manufacturing powerhouses like China. This underscores the urgent need for strategic policy reforms in nickel-supplying countries. This paper analyses the impact of the transition to lithium batteries on fossil energy sources and tries to find an answer to an important question “will the countries with the largest nickel stock become the new energy leaders”.

Keywords: Nickel, Lithium Batteries, Electronic Vehicles

JEL Code: O13, O44, Q42

1. Introduction

The world's energy landscape is rapidly evolving as global temperatures rise and the demand for sustainable energy solutions intensifies. A major player in this transformation is the lithium battery, which has emerged as a crucial technology for storing energy sustainably. This paper examines the vital role that nickel, a key component of lithium batteries, plays in driving both sustainability and economic growth. As societies worldwide transition toward cleaner energy sources, the interplay between lithium batteries and nickel is becoming central to the future of energy.

Lithium batteries, which are essential for electric vehicles (EVs) and renewable energy storage, rely heavily on nickel due to its unique properties that enhance battery efficiency, lifespan, and performance. Nickel's contribution to lithium batteries is not just technical; it's also economic. As the global demand for renewable energy and electric-powered transportation rises, the need for high-performance lithium batteries grows exponentially. This surge in demand is reshaping industries, driving economic growth in nickel-producing countries, and positioning lithium batteries as a cornerstone of the new energy economy.

By 2025, the escalating demand for EVs is expected to drive a significant increase in nickel prices—potentially up to 1000%. Countries rich in nickel resources, such as Indonesia, the Philippines, Russia, Australia, and Canada, are already experiencing substantial economic benefits from this trend. The contributions of nickel to national GDPs are poised to grow as the metal becomes an increasingly valuable asset, comparable to oil in its economic significance. However, this surge also presents challenges, as it raises questions about the responsible sourcing and sustainable use of nickel to ensure minimal environmental impact.

The transition to lithium batteries and the associated demand for nickel is not only an opportunity for economic growth but also a chance to align the global energy economy with sustainability goals. For countries with vast nickel reserves, this shift presents an opportunity to become energy leaders. Yet, there is a notable disparity in the economic benefits between nations that supply nickel, such as Indonesia and Australia, and EV-manufacturing powerhouses like China. This disparity underscores the importance of strategic policy reforms and innovation in mining and production processes to maximize economic benefits while minimizing environmental harm.

This paper explores how the rising demand for lithium batteries is shaping global energy markets, focusing on the impact of nickel as a critical component. It also addresses the broader question: Will countries with the largest nickel reserves become the new energy leaders? By analyzing the economic, environmental, and geopolitical implications of this transition, the study aims to provide insights into how nations can leverage nickel's potential to create a sustainable and thriving energy economy, where economic growth and environmental stewardship go hand in hand.

2. Literature Review

Economic growth is fueled by the utilization of natural resources within a country, with nickel emerging as a prominent mineral resource. Its popularity is attributed to its high corrosion resistance, toughness, strength at varying temperatures, and unique magnetic and electronic properties, crucial for low-carbon technologies like stainless steel pipes for carbon capture, nickel-based superalloys, and batteries for electric vehicles. As nickel's importance in the market grows, trade flows between countries are expanding, particularly between major producers (Canada, Russia, Australia, Indonesia, New Caledonia, etc.) and industrialized nations (Japan, the United States, the Netherlands, China, Germany, etc.). The top 10 trade flows represent 21% of the total nickel trade among 231 countries and regions, while the top 50 flows account for 47% (Nakajima et al., 2017)

In 2023, nickel prices fall by 14% and another 10% in 2024, this is due to a supply surplus by Indonesia and the Philippines, but prices will likely rise again in 2025 due to increasing demand

for electric vehicles as a complementary product to nickel. The GlobalData report citing US Geological Survey data states that the majority of nickel reserves are in Indonesia and Australia, which each contribute 20.6% of the global total. Brazil, Russia and New Caledonia each accounted for 15.7%, and the Philippines and Canada each accounted for 6.9% of the global total. As of right now, Indonesia is the market leader for nickel mining worldwide, and predictions point to this trend continuing in the years to come. Their growth plans are expected to increase production even further, particularly in the nickel smelting industry. The mines of Nickel Asia are fuelling expansion in the Philippines, which follows closely. The nation is trying to shorten waiting times for permits to between six months and a year in order to draw in more investors. (GlobalData Analysis, 2023)

Nickel is a crucial component of many alloys that are pivotal to the development of contemporary technology, including stainless steel. Furthermore, it is a fundamental component in the creation of novel chemical catalysts and rechargeable batteries. The nickel market, despite its pivotal position, is about to undergo a significant shift, with demand expected to peak around the year 2050. By this point, market demand is expected to have surged to the point where nickel extraction would peak. Growth and innovation in the sector have a chance thanks to the increased demand. Additionally, although the quality of nickel has been steadily declining since 1850, the market may be about to undergo resuscitation as a result of the approaching peak in demand. A review of extraction techniques and technical developments is warranted in order to fulfill the growing demand for nickel, which is more evidence of the metal's lasting significance. Nickel's future is brightened by this rising trend in demand, which emphasizes the metal's ongoing importance and potential for steady growth in the market. (Olafsdottir & Sverdrup, 2021)

The environmentally friendly energy transition is driving a significant increase in demand for minerals. From 2017 to 2022, demand from the energy sector is the main factor behind the 40% increase in nickel demand. This is also driven by increasing demand and high prices, therefore the market size of key energy transition minerals has doubled over the last five years. This rapid growth will continue, demand for essential minerals will more than double by 2030. Many mentioned environmentally friendly energy technologies that are experiencing rapid growth, such as electric vehicles, wind turbines and power grids, require essential minerals including lithium, cobalt , nickel, copper, and rare earth elements. As the clean energy transition continues to gain momentum, demand for these minerals is increasing rapidly, the IEA said. (International Energy Agency, 2023)

The dominance of APEC countries in the global nickel landscape underscores their important role in nickel production and use, which has a significant impact on the global economy. APEC members collectively occupy the top spot in nickel mining and first use, with 71% of the world's nickel mined and 69% of primary nickel production coming from them. This large presence is in line with APEC's aggregate share of world nickel reserves and resources, further strengthening their economic impact on the nickel market. In particular, China is emerging as a key player, leading in both primary nickel use and finished nickel production, utilizing a combination of domestic production and imported raw materials. However, this condition also shows the differences between APEC countries, where countries such as the Russian Federation, Canada and Australia utilize their mining strengths to become major exporters of finished nickel. In contrast, countries such as Indonesia and the Philippines, despite having significant nickel mining capabilities, face challenges in downstream development due to limited domestic markets and levels of industrialization. These dynamics underscore the complex interrelationships between mining capabilities, industrial development, and global trade patterns in the APEC region. In addition, the dependence of countries such as the United States on nickel imports shows the interdependence between APEC members and the wider global economy. Because APEC countries control most of the world's nickel resources, their strategic position in the nickel market will continue to shape economic dynamics, trade flows and industrial development on a global scale (APEC report, 2012).

China has become the world leader in adopting new energy vehicles (NEVs) and installing lithium-ion batteries (LIBs). Nonetheless, the widening gap between the demand for and supply of nickel—a key component for LIB production—has become more pronounced, especially with the shift towards nickel-rich, cobalt-free batteries. Projections indicate that China's NEV sales could reach about 3.8 million units by 2030, with around 2.3 million units reaching end-of-life under the higher growth rate (HGR) scenario. If all spent nickel-bearing batteries (NBBs) are recycled, it is expected that 44.5 million tons of nickel could be recovered, accounting for nearly one third of the total nickel demand for manufacturing NBBs. These findings highlight the importance of recycling nickel from spent NBBs to help close the nickel supply loop in China's NEV industry. (Yao et al., 2021)

Nickel has great potential for developing downstream industries such as stainless steel, non-ferrous alloys, and electroplating, which can significantly increase its added value and benefit both the national and regional economies. Enhancing the added value of minerals is crucial for boosting national income and regional development. Added value refers to the techno-economic transformation that increases the economic, practical, and utilitarian value of mineral resources and commodities. This transformation positively impacts the economy, society, and culture on global, regional, national, and local levels.

To increase the added value of nickel, it is essential to develop downstream industries, including stainless steel, non-ferrous alloys, other steel alloys, electroplating, and chemicals. This also enhances regional added value, benefiting local communities near mining sites. Although mining companies have been working on improving nickel's added value, further efforts are needed to expand its role in economic development at national, regional, and local levels. (Soelistijo, 2013)

Being the largest nickel resource globally, Indonesia is prominently positioned in the spotlight. Despite increased demand due to the expanding nickel market, Indonesian exports have not yielded significant profit growth, primarily because the country can only extract the mineral without efficient production. Consequently, the Indonesian Government has implemented an export ban for nickel, aiming to foster industry growth by promoting advanced technology adoption, attracting more investment, increasing value-added production, and generating job opportunities. This move has prompted other nickel-producing nations like the Philippines and New Caledonia to recognize the importance of meeting global Ni demand. Since 2014, when Indonesia initially announced its plan to ban Ni ore exports, the Philippines has boosted its production for China. However, even with ample opportunities for production growth, the Philippines' export still pales in comparison to Indonesia's massive supply to the global market. (Bioantika, 2024)

3. Data Analysis

There has been limited research explicitly stating a correlation between nickel production and rapid economic growth in countries. Nonetheless, one can infer such a relationship by examining various factors influencing economic growth, including resource abundance, demand dynamics, and nickel prices.

Economic growth is a complex interplay of factors, among which a nation's trade dynamics and industrial landscape play pivotal roles. Nickel, emerging as a cornerstone commodity, assumes paramount importance in fostering a sustainable future, notably through its pivotal role in lithium batteries, which underpin the electrification of transportation systems.

Countries with abundant mineral resources have a good opportunity for economic development, as mineral commodities like nickel are in high demand globally. However, it's important to use these resources sustainably and keep up with the latest technologies.

We present information aims to explore the economic progress in countries with significant nickel reserves, such as Indonesia, the Philippines, Russia, Australia, and Canada, as nickel becomes more important in lithium batteries. Additionally, we'll compare nickel and oil prices to

understand trends in these key commodities, especially in the context of advancing nickel-powered sustainability in the energy economy.

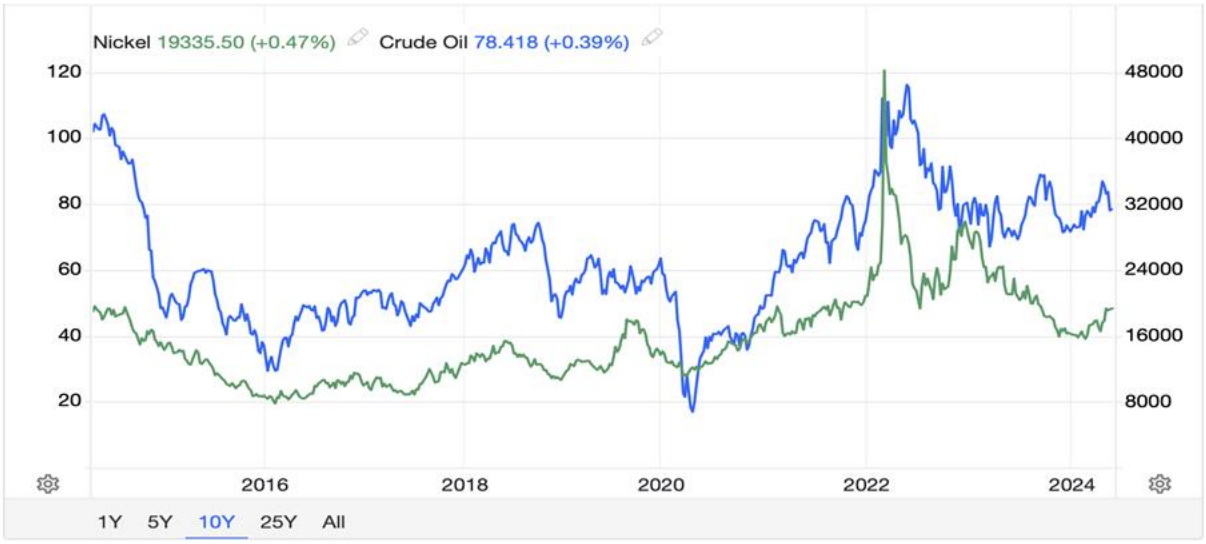
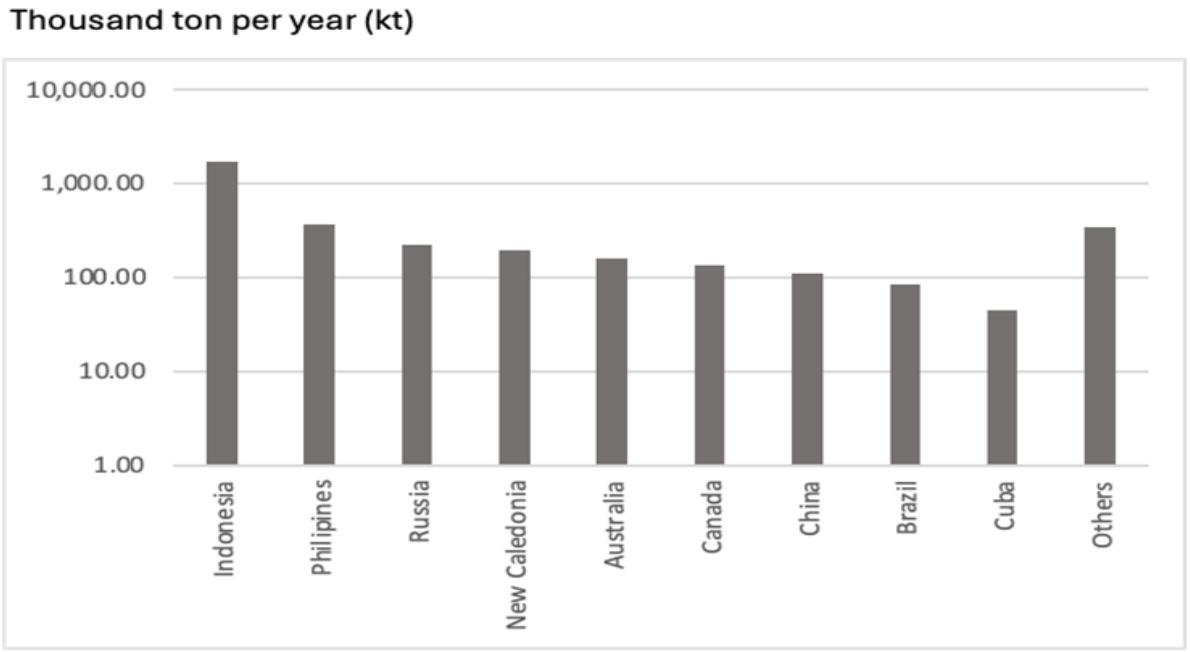


Figure 1. *Nickel Price*

The graph shows the price trends of nickel and crude oil over a certain period, focusing on changes before and after 2020. Before 2020, nickel prices were more stable compared to crude oil prices, which went down more sharply. In 2022, crude oil prices hit their lowest point. After 2020, nickel prices went up significantly. Despite these differences, the price trends of both nickel and crude oil after 2020 look quite similar. This might be due to structural changes in the market. Recently, nickel prices have gone down, likely because of an oversupply from Indonesia and China and political issues in these countries.



Source: *GlobalData, US Geological Survey Data.*

Figure 2. *Largest Nickel Producing Countries in 2023*

The GlobalData report citing US Geological Survey data states that the majority of nickel reserves are in Indonesia and Australia, which each contribute 20.6% of the global total. Brazil, Russia and New Caledonia each accounted for 15.7%, and the Philippines and Canada each accounted for 6.9% of the global total. As of right now, Indonesia is the market leader for nickel

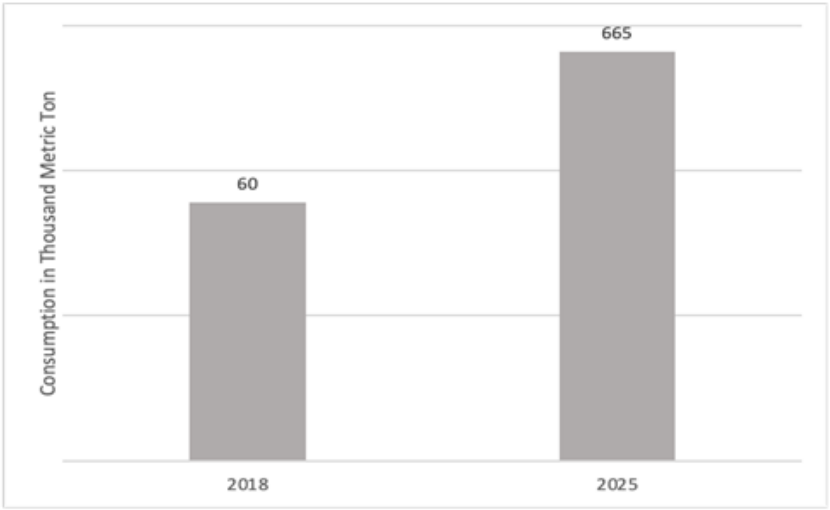
mining worldwide, and predictions point to this trend continuing in the years to come. Their growth plans are expected to increase production even further, particularly in the nickel smelting industry. The mines of Nickel Asia are fuelling expansion in the Philippines, which follows closely.

Economy	2010 shares in global nickel*			Nickel mining, Processing and First use	
	Mine output	Primary production	First use	Share in economy's GDP+	Contribution to GDP (US$ billion)
Australia	11.20%	7.00%	0.20%	0.52%	6.40
Canada	9.30%	7.30%	0.30%	0.27%	4.30
China	5.20%	22.90%	37.60%	0.19%	11.20
Indonesia	17.20%	1.30%	0.03%	0.72%	5.10
Japan		11.50%	11.60%	0.17%	9.30
Korea		1.40%	5.70%	0.20%	2.00
The Philippines	10.60%		0.01%	0.56%	1.10
Russia	17.30%	18.10%	1.60%	0.53%	7.80
Chinise Taipei			4.70%	0.44%	1.90
USA			8.10%	0.02%	2.90
10 target Economies	**70.80%**	**69.40%**	**69.8%#**	**0.16%**	**52.00**

*Source : Metalytics
+Source : Frontier economics's analysis
APEC's Economies

Figure 3. *Primary Nickel's Economic Contributions to the Target Economies*

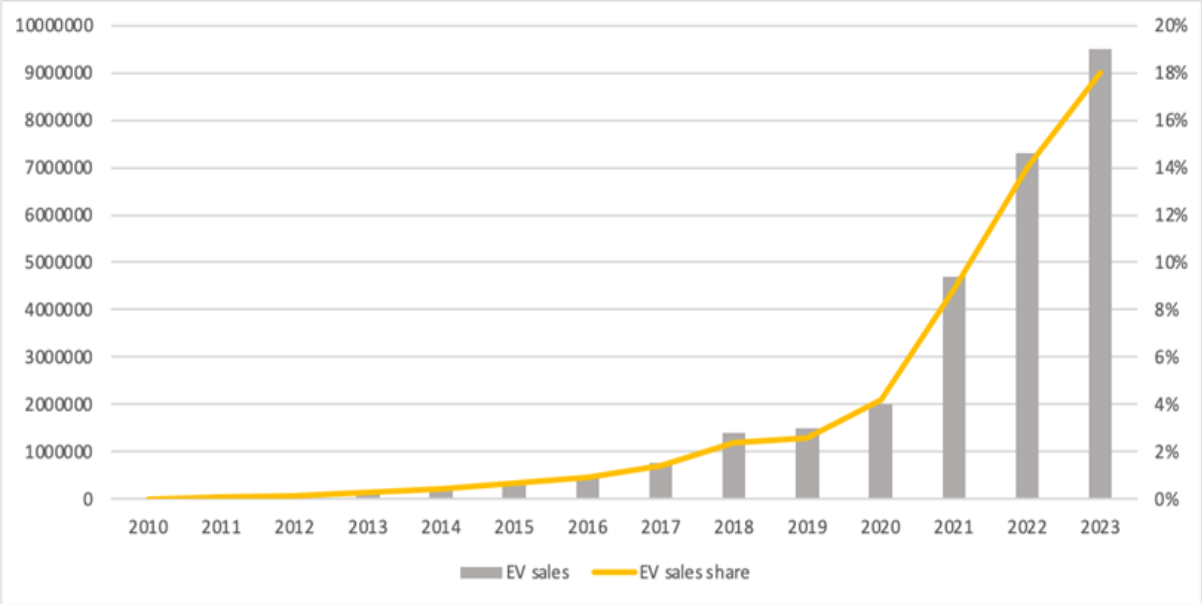
This Figure 3, the largest nickel reserves, Australia, Indonesia, and Russia face significant technological challenges in utilizing nickel as an intermediate good for 'first use' applications. Consequently, their mine outputs stand at 11.20%, 17.20%, and 17.30%, respectively. However, the GDP contributions from these countries remain below 8 billion USD. In contrast, China and Japan, which have lower nickel reserves, achieve higher GDP contributions exceeding 9 billion USD. This discrepancy highlights the critical role of technological capabilities in maximizing the economic benefits from natural resources. China and Japan's advanced technology enables them to process nickel more efficiently for 'first use', resulting in a more significant percentage contribution to their GDP compared to Australia, Indonesia, and Russia.



Source : Statista

Figure 4. *Global Demand for Nickel in Electric Vehicle Batteries from 2018 to 2025*

Figure 4 shows the prediction of global demand for nickel in electric vehicle batteries from 2018 to 2015. The demand is anticipated to experience a significant increase, rising by 1000% over the seven-year period starting from 2018. This dramatic growth reflects the expanding adoption of electric vehicles and the corresponding increase in the need for nickel, a critical component in EV battery production.



Source : International Energy Agency, the Global EV Outlook.

Figure 5. *Electrical Vehicle Sales in the World, 2010-2023*

Figure 5 shows the rapid increase in electric car sales over the past decade. In 2023, sales hit a record high, growing by 35% to nearly 14 million. Since 2010, sales have risen quickly, reaching over 9 million in recent years. This demonstrates the fast-growing popularity of electric cars.

4. Discussion

The research objectives aimed to analyze the relationship between nickel production, economic growth, and sustainable energy transitions. Our results confirm the increasing importance of nickel in global trade, driven by rising demand for EV batteries, and underscore the strategic value of nickel reserves. The price trend analysis also reveals the volatility in nickel prices, influenced by both market dynamics and political factors, particularly oversupply from major producers like Indonesia and China.

Prior studies, such as those by Olafsdottir & Sverdrup (2021), have emphasized the role of nickel in modern technologies, but this research adds depth by analyzing the effects of price fluctuations, global demand, and production capacities in specific countries. Furthermore, it contributes to the discussion on how technological advancements, or the lack thereof, shape the economic outcomes of resource-rich nations. By highlighting the disparities between countries with large reserves but limited technological capabilities (e.g., Indonesia) and those with advanced processing technologies (e.g., China), the study adds nuance to the literature on resource-based economic development. Our results confirm the increasing importance of nickel in global trade, driven by rising demand for EV batteries, and underscore the strategic value of nickel reserves. The price trend analysis also reveals the volatility in nickel prices, influenced by both market dynamics and political factors, particularly oversupply from major producers like Indonesia and China.

Additionally, the study is limited by the availability of data on technological advancements and their impacts on nickel processing efficiency. Future research could focus on comparing the technological progress of nickel processing industries across countries to better understand how

advancements in technology influence economic outcomes. Moreover, exploring the environmental impact of nickel mining and processing, particularly in terms of sustainability and resource management, would be an important area for future investigation as the demand for environmentally friendly practices grows. As global demand for nickel is expected to increase significantly, further research could examine the potential for recycling and reusing nickel, particularly from spent batteries, to meet future demand while reducing environmental impact. This line of research could provide a roadmap for sustainable resource management in the nickel industry.

5. Conclusion

In conclusion, this study identifies nickel as a crucial element in the future clean energy economy, with significant implications for economic growth and environmental sustainability. Our key findings indicate that the increasing demand for lithium batteries, driven by the electric vehicle market, presents substantial economic opportunities for nickel-rich countries. However, the technological gap between these nations and major battery manufacturing hubs poses challenges to fully leveraging their resources.

The significance of this research lies in its contribution to understanding how nickel's role in the energy transition can shape economic dynamics, particularly in resource-rich countries. By highlighting both the opportunities and challenges associated with nickel production, this study provides valuable insights for policymakers, industry stakeholders, and researchers alike.

Ultimately, this research emphasizes the need for strategic investments in technology and sustainable practices to ensure that nickel not only supports economic prosperity but also aligns with broader environmental goals. As the energy landscape continues to evolve, ongoing research will be essential to adapt to changing dynamics and to explore innovative solutions that maximize the potential of nickel in the sustainable energy economy.

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