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**Journal of Comprehensive Science**

**p-ISSN: 2962-4738 e-ISSN: 2962-4584**

**Vol. 3. No. 11 November 2024**

**Comprehensive Review on the Opportunities and Challenges in the Development of the China’s New Energy Industry in Indonesia**

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**Abstrak**

With the development of sustainable energy industry worldwide, the immense scale of global sustainability challenges requires more than piecemeal solutions from individual country. In general, sustainable development is considered a sign of a country that is moving forward, both in social, economic and political structures. The new energy industry, as the core of global energy development, has become the focus of core business development in the post-epidemic era. Comparing the situation between the government of China and Indonesia, both countries have implemented relevant policies and measures to actively promote the development of new energy industries. Based on the limitations of the current research on the development of the new energy industry in Indonesia and China, this research aims to look at the sustainable development that Indonesia has carried out and also explore in depth the market environment and national conditions of the Indonesian new energy industry, analyze opportunities and risks, and assess the development prospects and challenges of China’s new energy industry in the Indonesian market. This research was prepared using qualitative research methods, namely a data source approach in the form of secondary data from literature and descriptive analysis. Through this method, it is hoped that we can dissect the phenomenon being studied. This qualitative research only describes and explains findings in the field without requiring a hypothesis. This method also raises facts, circumstances, variables and phenomena that occur during research and presents the data as it is. First, Indonesia is a country that has the largest nickel ore reserves in the world. Around 32.7% of global nickel ore reserves are in Indonesia, namely 21 billion tons. Second, nickel is widely used in various industries, including the defense industry. Apart from stainless steel, nickel is also the main ingredient in lithium batteries, which are the main component of electric cars, so it can be said that almost all electronic equipment requires batteries. Thus, the nickel downstream program is an opportunity to transform sustainable national economic development, as well as a ticket for Indonesia to becoming a developed country. This research would bring some reference data analysis and viewpoint support for the development of the China’s new energy industry in Indonesia.

**Keywords**: sustainable development, opportunities, renewable energy industry, china, indonesia

**INTRODUCTION**

Global renewable energy development set another new record in 2021 according to the International Energy Agency (IEA) report (Yana et al., 2022). So far this year, there has been the addition of around 290 gigawatts of renewable energy generation capacity worldwide, mostly in the form of wind turbines and solar panels. This figure beats the previous record which also saw a rapid increase in the addition of installed renewable energy capacity of 260 gigawatts. If this trend continues, electricity generation from renewable energy will beat fossil fuels and nuclear energy combined by 2026 as reported by The Guardian (Midford, 2024). The high growth of renewable energy cannot be separated from the implementation of pro-climate and renewable energy policies in many countries around the world. Following the COP26 climate summit in Glasgow, Scotland, many countries also set more ambitious targets for reducing greenhouse gas emissions. However, the growth of renewable energy is currently considered only half of the target that must be achieved to achieve zero carbon emissions by the middle of this century.

IEA Executive Director Fatih Birol said this year's record growth in renewable energy is another sign that a new global energy economy is emerging. The high commodity and energy prices we are seeing today pose new challenges for the renewable industry. "However, the increase in fossil fuel prices also makes renewable energy more competitive," said Birol. According to IEA projections, renewable energy will account for around 95 percent of the increase in global electricity generation capacity by the end of 2026. Among all countries, China is the country that installed the most renewable energy capacity this year. Now, "Panda Country" is projected to be able to realize 1,200 gigawatts of installed wind and solar energy capacity in 2026, or four years earlier than its target of 2030. So far, China is still the largest carbon emitter in the world. China is targeting peak emissions in 2030, which many analysts say is too late if the world is to limit global temperature rise to no more than 1.5 degrees Celsius. Meanwhile, India, the world's third largest emitter, also experienced rapid growth in renewable energy development last year. However, its target of reaching net zero by 2070 is also considered too weak by many (Prabowo, 2022).

The development of industrialization causes energy demand to increase. This condition then makes energy politics increasingly complex. Especially for newly industrialized countries such as China, which is then rivaling the United States and Europe as the largest energy consumers. Energy access is very important to maintain economic growth in China where industrialization has employed hundreds of millions of people while they are still in poverty and the population continues to grow (Jie et al., 2023). For these countries, their industry must not stop because this will hinder economic growth, causing greater poverty and unemployment. Therefore, the energy supply that supports this industry must always be available and continuously improved. This condition then makes industrial countries compete with each other to find energy sources in new places. As a consequence, the struggle for energy resources will become a fierce battlefield in the 21st century, although on the other hand it will also encourage cooperation (Smith, 2017).

This puts the world's great powers in competition to control the energy reserves in other countries. This competition phenomenon is a reflection of efforts to achieve national interests to gain or increase power. In the future, how big or small a country's power will be will be determined by the amount of energy reserves it has. Without us realizing it, the phenomenon of competition for energy control carried out by developed countries is actually intended to prevent them from using their own energy reserves. Energy sources originating from outside will be used to support industrialization and some will be stored as reserves (Fanchi, 2023). They realized that in the future these reserves would be very valuable and could then be used as a source of power. Therefore, energy sources are also an indicator of a country's capability to carry out war and be able to survive in uncertain conditions (Zakeri et al., 2022). The new energy industry, as the core of global energy development, has become the focus of core business development in the post-epidemic era. Compared with the governments of China and Indonesia, both countries have implemented relevant policies and measures to actively promote the development of new energy industries. In comparison, China carried out technological reforms earlier and was at the forefront of international market development. At the same time, the Chinese government also introduced relevant policies to encourage enterprises to expand global development.

Each country has different challenges and needs in transforming the energy system. The energy transition is not only about changing the utilization and use of fossil fuels to renewable energy, but involves very, very complex aspects from science and technology to socioeconomic and environmental aspects. The energy transition will change many things: changes in jobs, development scenarios, business orientation and others. Therefore, appropriate strategies and mechanisms are needed to identify current and future challenges so that a fair and equitable low-carbon energy transition can be implemented well. There are three big challenges in the energy transition that need the attention of all parties. Firstly, related to access to clean energy, the world is facing the reality that not all world citizens have access to affordable, reliable, sustainable and modern energy. The second challenge, related to funding issues, President Jokowi explained that the transition process requires very large funds. The energy transition requires new projects, which means new investments are also needed. Therefore, it is necessary to explore appropriate financing mechanisms to create economic, competitive prices and not burden the community. The third challenge is research and technology support. In the energy transition, the role of science and technology is needed to produce new technology that is more efficient and more competitive so that it can reduce costs and increase the added value of new renewable energy industrial products (Nugraha et al., 2024). Apart from that, it is necessary to prepare various competencies and expertise from basic to tertiary level so that superior human resources are available to support the energy transition.

The world of the future will experience many changes in energy utilization, one of which is the use of nickel as a vital component of electric vehicle battery energy sources. According to the International Renewable Energy Agency (Irena) scenario, by 2030, electricity generation sources coming from new renewable energy will reach 38 percent (Koutoudjian et al., 2021). The size of this renewable electricity generation source is estimated to increase again in 2050 to 55 percent. This is a very significant jump because in 2019 the number of renewable electricity generators globally was still around 26 percent.

The increase in the number of NRE power plants will be followed by changes in energy source consumption. Energy consumption originating from fossil resources such as oil, gas and coal will decrease (Zou et al., 2016). Meanwhile, final energy consumption in the form of electricity in the world in 2030 is estimated to reach 24 percent, and in 2050 it will increase again to 30 percent (Kober et al., 2020). Until 2019, final energy consumption in the form of electricity was still around 20 percent (Adhiem et al., 2021). One of the reasons for the increase in electricity consumption in the future is a massive shift in technology. One form of this revolution is the use of electric vehicles which are slowly shifting the use of fossil fuel vehicles. It is projected that by 2030 there will be around 269 million electric vehicles worldwide. That number will continue to double in the next decade.

In 2050, it is estimated that the number of electric vehicles will reach more than 600 million vehicles (Muratori et al., 2021). This projection is considered fantastic considering that by 2019 alone it is estimated that the population of electric vehicles will be no more than 8 million units globally. In this context, Indonesia has the opportunity to participate in creating the most important component of electric vehicles, namely batteries as a source of energy storage. The abundance of mineral mining materials in Indonesia causes this country to have a geo-strategic, geo-economic and geopolitical position that has enormous influence in the world. Indonesia has the number one nickel reserves in the world, amounting to approximately 30 percent of world reserves. With this potential, Indonesia has a huge opportunity to become a producer of EV batteries and lithium batteries for electric vehicles. President Joko Widodo visited Chengdu, China at the end of last July. Apart from meeting President Xi Jinping, during his two-day visit, the President also took time to meet with several company leaders in China. The aim, of course, is to discuss investment opportunities in the country. One of the hot topics is electric car investment in Indonesia. To potential investors who are CEOs of Chinese companies, on the second day, President Jokowi said that investment in the electric vehicle ecosystem in Indonesia was the government's priority. The Indonesian government wants to build an electric vehicle ecosystem starting from raw materials, electric vehicle (EV) batteries, to electric vehicles.

Apart from that, nickel management based on environmental social governance also continues to encourage the state to increase state foreign exchange sourced from the mining sector, because through the concept of environmental social governance companies will prioritize green investment which in the end will not only provide profits for the company but the state can also feel the benefits. The aim of implementing this concept is in line with what is outlined in Article 33 Paragraph (3) of the 1945 Constitution that the natural wealth contained in Indonesia should be used for the greatest prosperity of the people. Mineral resources in Indonesia have quite a lot of potential and are almost spread throughout the archipelago. Indonesia is rich in mineral resources so it generates quite a large income for the country through taxes and royalties every year. According to the United States Geological Survey (USGS), Indonesia's nickel reserves are number one in the world. Of the 2.67 million tons of nickel production worldwide, Indonesia has produced 800 thousand tons, far ahead of the Philippines (420 thousand tons of Ni), Russia (270 tons Ni), and New Caledonia (220 thousand tons of Ni) and then also Based on data from the Ministry of Energy and Mineral Resources in 2020, the resilience of nickel reserves in Indonesia reached 2.6 billion tons of reserves with a reserve age of 27 years.



**Figure 1.** Nickel Reserve Resilience

Source: Adapted from Indonesian Directorate General of Mineral and Coal (2022)

Based on mapping by the Geological Agency in July 2020, Indonesia has nickel ore resources of 11,887 million tons (inferred 5,094 million tons, indicated 5,094 million tons, measured 2,626 tons, hypothetical 228 million tons) and ore reserves of 4,346 million tons (proven 3,360 million tons and estimated at 986 million tonnes). Meanwhile, total metal resources reached 174 million tons and 68 million tons of metal reserves. Data shows that nickel natural resources in Indonesia are very supportive of improving the economy, including exports, investment, etc. Investment is one method used to develop the assets owned productively. Investments can be made in the Capital Market in the form of shares which have an important role in economic activities.

# Electric Vehicle Ecosystem in Indonesia

Referring the agreement between countries in the world to achieve net zero emissions (NZE) by 2060 has prompted a number of countries to look for a way out (Lau & Tsai, 2023). One option is to make a transition from using conventional cars to electric cars. This space is used by Indonesia as an opportunity to make a leap to become a developed country and not be trapped in a middle-income country or middle-income trap. In line with this, the Indonesian Government also designed a major strategy. One of them is creating an ecosystem for electric cars and electric vehicle (EV) batteries. This is stated in Presidential Regulation number 55 of 2019 concerning the Acceleration of the Battery Electric Vehicle (BEV) Program for Road Transportation. The big target is to make other countries dependent on Indonesia. The Indonesian government is following in the footsteps of Taiwan and South Korea which have succeeded in making other countries dependent on their products. Taiwan makes chip products and South Korea produces digital components. This desire is not without reason, as stated by President Jokowi, Indonesia has enormous potential to build an electric vehicle ecosystem, especially the production of batteries for electric vehicles. Indonesia has the number one nickel reserves in the world with a stock of around 21 billion tons. This amount is approximately 30 percent of world reserves.

Then Indonesia's tin resources are number two in the world, bauxite number six in the world, and copper number seven in the world. With most of these resources, Indonesia has enormous potential to become a producer of EV batteries and lithium batteries for electric vehicles through a downstream program. Lithium batteries are an important element for electric vehicles, namely 60% of the key electric car components are in the battery. If a large electric vehicle ecosystem is formed, it is believed that developed automotive producing countries will look at Indonesia. A number of electric car manufacturing companies from various countries are said to be interested in investing in Indonesia, which is currently building an EV battery ecosystem. According to the Coordinating Ministry for Maritime Affairs and Investment (Kemenko Marinves), currently there are several international EV manufacturing companies that have shown interest in investing in Indonesia, including BYD Co Ltd., Wuling Motors, Hyundai, NETA Auto, Chery, and Tesla. President Jokowi said that Indonesia is open to this as long as investors collaborate with Indonesian private companies or state-owned enterprises (BUMN). In this way, technology transfer will occur.

Moving on from this reality, this article will highlight Indonesia's current position and what Indonesia must do in the dynamics of energy politics carried out by advanced industrial countries. This discussion is important considering that Indonesia has quite large energy reserves which have the potential to increase Indonesia's bargaining power in global energy politics. The discussion in this article will begin with an overview of the placement of energy issues in the study of energy development in a global scope process. The implication of this condition is Indonesia's position as a country with quite large energy reserves in global energy politics. Finally, this article highlights the existence of Indonesia's energy reserves in the future so that it becomes material for studying the continuity of development and challenges of China's renewable energy development in Indonesia and Indonesia's position in global energy supply.

**Sustainable Development**

Today environmental discourse and nature conservation are important issues in the international world. As part of the international community, Indonesia, which has abundant natural resources, has a moral obligation to manage its natural resources wisely. Apart from that, there is growing awareness among the domestic community that environmental sustainability is a necessity and a necessity of life (Patta Rapanna, 2016). On a country scale, the implementation of obligations and awareness of environmental sustainability is translated into sustainable development policies. Green economy and blue economy policies are one example. Sustainable development is at the heart of achieving a balance between economic sector development, social sector development and environmental protection.

# Definition and Scope of Sustainable Development

The definition of sustainable development since it was introduced by the World Commission on Environment and Development (WCED) as stated in Our Common Future or the Brundtland report, is currently still in the realm of debate among environmental experts (Langhelle, 2017). This gives rise to many interpretations of the definition of sustainable development. The following are some definitions of sustainable development. Ordóñez and Duinker (2010) state that sustainable development is firstly a capacity to maintain ecological, social and economic stability in the transformation of biosphere services to humans, secondly meeting and optimizing the needs of the present and future generations, thirdly the persistence of necessary and desired systems ( socio-political or natural) in unlimited time, fourth integration of ethical, economic, social and environmental aspects in a coherent manner so that generations of humans and other living creatures can live now and in the future without limits, fifth fulfill the needs and aspirations under the factors environmental, social and technological barriers, sixth, living in harmony with nature and others, and seventh, maintaining the quality of the relationship between humans and nature.

The International Union for Conservation of Nature and Natural Resources (IUCN) (1980) in its world conservation strategy defines that to be a sustainable development, the implementation of development must consider environmental, social and economic factors based on living resources and consider long-term and long-term benefits or losses (Tomislav, 2018). short of an alternative course of action. Meanwhile, the Food and Agriculture Organization (1995) through the fisheries commission defines sustainable development, as outlined in the Code of Conduct for Responsible Fisheries, as the preservation and management of natural resources aimed at ensuring the sustainability of the needs of present and future generations.

# Understanding Energy

According to Law of the Republic of Indonesia Number 30 of 2007, energy is the ability to do work which can be in the form of heat, light, mechanics, chemistry and electromagnetics. Energy is one of the basic human needs, one of these energies is petroleum energy, where petroleum energy is the energy most widely used by society, such as the use of fuel oil, daily cooking needs, and others (Walukow, 2024). There are two types of energy, namely energy that will be used up (non- renewable) and energy that will not be used up (renewable). Non-renewable energy is energy that, if used continuously in the long term without being limited, will run out and cannot be renewed. Meanwhile, renewable energy is energy whose use will never run out, which comes from nature and does not cause environmental damage, such as air pollution, the greenhouse effect, etc. If it has been produced as raw material for household needs from renewable energy, it can be in the form of biogas, biofuel and charcoal briquettes.

# Understanding New Renewable Energy

New renewable energy is energy that can be renewed and used again, such as geothermal energy sources, sunlight, wind, water, plants, etc., where the energy sources are renewable, environmentally friendly and do not contribute to climate change and global warming. warming). There are many renewable energy sources in the world, but not all of this renewable energy can be used in remote and rural areas. For example, only solar, wind, water and biomass energy can be used and is most suitable for rural areas, including even remote areas. Other renewable energies such as geothermal energy and sea tides are energy that cannot be used in all places, only certain places can develop this energy (Febriyanita, 2015).

# Nickel Mining

Nickel was first discovered by Crostedt in 1751 (Howard-White, 2024). The earth's core contains approximately 3% nickel while the earth's crust is 0.003%. The term laterite itself is taken from the Latin "later" which means red brick, which was proposed by Buchanan Hamilton (1807). The term "laterite" can be interpreted as a deposit that is rich in iron- oxide, poor in silicate elements and is intensively found in weathered sediments in tropical climates (Cocker, 2014). There are also those who interpret nickel laterite as weathered deposits that contain nickel and can be mined economically (Mudd & Jowitt, 2014). To mine nickel minerals, sufficient knowledge of mineral deposits, mining technology, processing methods and costs required is required.

Feasibility study activities are carried out to prove the prospects before carrying out the planned ore mining. The selling price of mining products is determined by the market price at which bidding occurs. Market price movements reflect supply and demand conditions in the market. These price fluctuations are different from mining costs which are relatively constant or increase due to inflation. The basic costs of mining which consist of the costs of mining itself, processing, transportation and refining will reduce the mining company's income and leave a profit margin. Mining companies must be able to survive conditions of fluctuating selling prices and uncertain margins. The company's strategy in the form of mine planning determines its success. This strategy can take the form of changing the cutting off grade, changing mining methods and/or implementing cheap and efficient technology, so that the mine continues to generate profits (Onifade et al., 2024).

# RESEARCH METHOD

This research aims to gain an in-depth understanding of the opportunities and challenges faced by China's new energy industry in Indonesia through a qualitative approach. This research will use a case study approach to explore an in-depth understanding of the concrete and contextual situation of the development of China's new energy industry in Indonesia. Researchers will be actively involved in activities and environments related to the new energy industry, such as conferences, industry meetings and other related activities to gain first-hand insights. Research subjects will include representatives from various related parties, such as Chinese energy companies operating in Indonesia, government representatives, academics and related local communities. Data collection through in-depth interviews will be conducted with key stakeholders, such as company executives, government officials and community leaders. The interview will focus on their perceptions of the opportunities and challenges they face. Through engaged observation, researchers will observe daily activities related to the new energy industry in the field to understand local dynamics and contexts that may not be revealed through interviews. Document analysis involves a study of literature, industry reports, and relevant government policies. This document will provide further context and understanding of the state of the industry. Qualitative data will be analyzed using a thematic analysis approach. Key themes regarding opportunities and challenges will be identified, and patterns will be explored to gain in-depth understanding. The validity of the data will be strengthened through triangulation of data from various sources, including interviews, observations, and document analysis. Research track records will be tracked to ensure data reliability. Ethics approval will be obtained from participants, and data confidentiality policies will be maintained. This research will ensure that there is no risk to participants and that their contributions are respected. Research results will be presented through a qualitative research report that includes an in-depth narrative of the identified opportunities and challenges. The findings will be linked to the global context and its implications for the development of the new energy industry in Indonesia.

# RESULT AND DISCUSSION

The world's economic and political configuration continues to change. Since the 2000s, the global economic constellation has also changed. It can be seen from several Asian countries that have become important players on the international stage, one of which is China. Luckily, relations between Indonesia and China are relatively good. Now, the relationship between the two is 70 years old and continues to improve over time, especially in economic relations. This continues in the current government period. Since the first term of government, President Joko Widodo (Jokowi) has put forward the World Maritime Axis (PMD) doctrine as the direction of foreign policy and used economic diplomacy to fight for Indonesia's national interests. The PMD doctrine is an effort to link the One Belt One Road (OBOR) initiated by China. The increase in Chinese investment in Indonesia in the last five years cannot be separated from the BRI project. The project focuses on developing connectivity routes, both land and sea via massive infrastructure development in various countries supported by China. The data description above shows how important China is to Indonesia.

Vice versa. Indonesia sees the emergence of opportunities to increase infrastructure development which will cost around IDR 4,796 trillion with the existence of BRI. Indonesia is taking advantage of existing opportunities to build infrastructure in the country, including the construction of sea highways. Apart from increasing infrastructure development initiated by President Jokowi, BRI is also in line with PMD's vision. A number of projects are being carried out, including the construction of Kuala Tanjung Port in North Sumatra and Bitung Port in North Sulawesi. The construction of this port aims to support sea route infrastructure and improve infrastructure and logistics in export and import activities via sea routes. Of course, every collaboration will encounter obstacles and various other challenges. However, overall, this collaboration went well. Value-added investment the basic metals industry is the main focus of China's investment goals in Indonesia, namely 42 percent. The investment portion can be increased, considering the prospects for the development of electric cars and the size of Indonesia's nickel reserves reaching a quarter of world reserves. This could be an opportunity for Indonesia to open up investment in battery processing for the use of electric cars. For example, Contemporary Amperex Technology Co Ltd (CATL) has planned an investment in the development of lithium batteries amounting to US$ 5 billion, among other things, to support the production of electric vehicles in Indonesia. Of course, this opens up new opportunities for other companies, including from China, to develop nickel in Indonesia.

This increasingly strategic role has encouraged BKPM to focus on increasing investment in sectors that provide added value, including export-oriented labor-intensive industries, mining downstream, new and renewable energy and infrastructure. In closing, Indonesia adheres to a free and active foreign policy. Collaboration will be carried out with all countries, including China, by prioritizing equality and mutual benefit. In the future, investment cooperation between Indonesia and China will focus on maximizing the absorption of local workers. Economic interactions with other countries, including in the investment sector, are carried out to support national interests, such as creating jobs, increasing exports, equitable development, increasing community welfare, and others.

# Steps Towards an Energy Transition

The Indonesian government invites countries that are members of the G20 to reach a global agreement by accelerating the energy transition program. Indonesia officially initiated and launched the G20 Energy Transition to bridge and encourage developed countries and developing countries to accelerate the transition from fossil energy to clean energy. This Clean Energy Transition Program is created in a global energy system that is continuously sustainable. The G20 Energy Transition is certainly a leverage to strengthen the sustainable global energy system. There are three things that really support the energy transition, namely access, technology and funding. With these three focuses, it is hoped that the G20 can reach a joint agreement in accelerating the global energy transition, while strengthening a sustainable global energy system. With and without ignoring the values of justice and prosperity. Data shows that G20 member countries contribute at least 75% of global energy demand. Therefore, G20 countries have a big responsibility and must take strategic steps to encourage the use of clean energy.

Energy Transitions Working Group (ETWG) focuses discussions on energy security, access and efficiency, as well as the transition to a low-carbon energy system, including investment and innovation in cleaner and more efficient technologies. This condition requires countries that rely on fossil energy to reformat their national energy consumption. The transition process to lower carbon energy is not an easy challenge. Adapting to the low-carbon era will of course have far- reaching impacts. This adaptation not only concerns investment and capital strategies, but is also closely related to existing culture and habits, in the context of the energy transition. More than 69 countries are expected to massively carry out universal, planned, measurable decarbonization in concrete steps.

# National Energy Transition Steps

First, is through reducing C02 emissions in several very important economic sectors and activities. The two main sectors that are very influential are the energy sector and the forestry/land use sector. Strengthening and controlling policies that support the energy transition, namely:

1. Electricity supply business plan (RUPTL) must always be ensured that it is always on the track. Where in the RUPTL the total EBT generators that will be built in the next 10 years reach 20,923 megawatts (MW). Hydroelectric power plants were the most dominant with 9,272 MW, followed by geothermal power plants (PLTP) with 3,355 MW, and solar power plants with 4,680 MW.
2. The campaign to change culture, perspectives and habits in society continues to be echoed, so that the effects of climate change will affect everyone, although in different portions. With the ease of disseminating information, awareness of the causes of climate change and efforts to avoid or overcome its implications are increasingly accessible to the public. So for many people, the transition to renewable energy is critical to supporting low-carbon growth.
3. It is considered that business actors and business players, industrial players and MSMEs should be encouraged to utilize new, renewable energy, in order to accelerate the growth of the green economy in Indonesia.
4. Regional governments and legislatures (DPRD) have a strong and significant role in taking concrete steps towards policies that support clean energy. The implementation of policy instruments to support accelerated transition in the regions has strong leverage for the application of green energy.
5. Fiscal policy in the form of the Carbon Economic Value (NEK) instrument, for which regulations have been issued, namely Law 7/2021 concerning Harmonization of Tax Regulations - Article 13 Implementation of Carbon Tax, must be strictly enforced. One of the clauses will take effect on April 1 2022, which will be imposed for the first time on entities operating in the field of coal- fired power plants with a cap and tax scheme that is in line with the implementation of the carbon market which has started running in the coal-fired power plant sector.

The steps and strategies above are instruments currently being implemented by the government, within the framework of accelerating the energy transition process. An important point in the energy transition is expanding the use of renewable energy. By continuing to pay attention to energy adequacy to support various community economic activities.

2022 is Indonesia's starting year to accelerate the energy transition, namely a transition from the use of fossil energy to environmentally friendly renewable energy. For example, [the government publishesPresidential Regulation Number 112](https://drive.esdm.go.id/wl/?id=o8WDm5f2AXpP9Awt2y4CFnvB3t2JdOAf) of 2022which is the legal basis for ending the operation of steam power plants (PLTU) in 2050. The government has also set a more ambitious emission reduction target. In the climate commitment document called [Nationally Determined](https://unfccc.int/sites/default/files/NDC/2022-09/23.09.2022_Enhanced%20NDC%20Indonesia.pdf) Contribution (NDC) version 2022,Indonesia increased its emissions reduction target in 2030 to 31.89% with its own efforts, or 43.20% with international support.

Apart from that, as host of the G20 Summit, Indonesia also received funding support for the energy transition through a scheme, [Just Energy Transition](https://bisnis.tempo.co/read/1658787/adb-just-energy-transition-partnership-menjadi-kemenangan-besar-indonesia) Partnership (JETP)from the G7 countries plus Denmark, Norway and Northern Ireland. This group of countries promised financing of up to US$20 billion or around IDR 311 trillion for projects that support reducing emissions in Indonesia. Even so, 2022 also remains [overwhelmed notes](https://theconversation.com/pemulihan-ekonomi-pasca-covid-19-yang-bertumpu-pada-energi-kotor-bisa-timbulkan-masalah-lingkungan-186916) Indonesia has repeatedly managed the fossil energy subsidy budget. The government, in order to maintain people's purchasing power, was forced to increase in 2022 due to a spike in fossil energy prices as a result of Russia's invasion of Ukraine. Entering 2023, Indonesia should focus on more radical energy transition actions. There are at least three aspects that need to be boosted by Indonesia in 2023 so that the climate target of achieving net zero emissions does not slip.

# Increasing clean energy electricity capacity

Growth [Indonesia's renewable energy mix is decreasing](https://iesr.or.id/en/pustaka/indonesia-energy-transition-outlook-ieto-2023) from 11.5% in 2021 to 10.4% in 2022. This decrease was due to [hampered biodiesel program](https://iesr.or.id/en/pustaka/indonesia-energy-transition-outlook-ieto-2023). The increase in renewable energy power generation capacity is also very small in comparison [increasing PLTU capacity](https://www.cnbcindonesia.com/news/20221109142340-4-386396/2-pltu-batu-bara-raksasa-ini-diam-diam-sudah-beroperasi-lho) amounting to 4 gigawatts (GW) on the island of Java during 2022. This is the impact of the post-pandemic economic recovery which still relies on fossil fuels. In order to achieve the 2030 emissions target, the government needs to take several strategic steps to accelerate the addition of renewable energy capacity. First, the government should immediately revise the Electricity Supply Business Plan (RUPTL) so that it is in line with the new commitments stated in the E- NDC document. Second, the development of renewable energy power generation projects must begin in 2023 and continue until 2025 so that they can start operating before 2030. As global support for Indonesia's energy transition efforts increases, 2023 could be a golden year to boost the growth of the renewable energy mix.

[Several clean energy project s](https://iesr.or.id/en/pustaka/indonesia-energy-transition-outlook-ieto-2023)which will start operating in 2023 include the Patuha geothermal power plant in West Java (55 megawatts/MW), the Peusangan hydroelectric power plant in Aceh and Asahan in North Sumatra (45 MW and 174 MW), and the Cirata floating solar power plant in West Java (145 MW). In order to encourage other renewable energy projects, the government needs to provide incentives in the form of tax reductions, as well as clarify and simplify the licensing process for renewable energy investments. In addition, regulations and incentives for the installation of rooftop solar panels in residential and office areas must be improved to stimulate public interest in using clean energy.

# Development of green hydrogen industry

Green hydrogen is a fuel produced from renewable energy. This energy plays an important role in cutting emissions in industrial sectors where it is difficult to electrify their machines. For example, the steel, cement, fertilizer and heavy equipment industries. In Indonesia, the development of the green hydrogen industry is still at a very early stage. In the road map document towards net zero emissions which has not yet been legalized, [the government installed target green hydrogen](https://iea.blob.core.windows.net/assets/8af7e5d0-a594-4bd8-aab7-3f0eec4e878f/ARoadmaptoaNetZeroEnergySectorforIndonesia_ES_Indonesian.pdf) production capacity amounting to 328 MW in 2030 then jumping to 52 GW in 2060. However, the implementation of the green hydrogen development plan is [still constrained](https://penerbit.brin.go.id/press/catalog/view/562/480/11501-1) high production costs and limited supporting infrastructure. Obstacles to the development of green hydrogen in Indonesia must be overcome immediately in 2023 by taking several initial steps.

First, the government needs to prepare a detailed road map for the development of the national green hydrogen industry and supporting policies. This step is important to help achieve competitive production costs and attract investment from within and outside the country.

Second, pilot projects must be realized immediately to demonstrate that the hydrogen industry is economically viable. This year is the starting point with Pertamina's plan to produce green hydrogen on a trial scale with a capacity of 100 kg per day in Indonesia [Ulubelu Geothermal Working Area (WKP), Lampung.](https://www.cnbcindonesia.com/news/20220803172902-4-360878/pertamina-bidik-produksi-hidrogen-100-kg-hari-mulai-2023)

# Downstream the nickel industry into electric car batteries

In the energy transition era, nickel is a vital commodity because it is one of the main raw materials for making electric vehicle batteries. Indonesia is one of the countries with the largest nickel reserves in the wor[ld(21 million tons)](https://www.bkpm.go.id/id/publikasi/detail/berita/nikel-untuk-kesejahteraan-bangsa). Unfortunately, most nickel is still exported in the form of raw materials or ore. In order to increase the value of the nickel commodity, Indonesia has begun to limit nickel ore exports in order to fulfill its ambition to become the "king" of the world's electric vehicle battery producers. However, [this policy stumbled dispute with the](https://www.cnnindonesia.com/ekonomi/20221121200207-85-876711/dalih-wto-kalahkan-ri-di-kisruh-larangan-ekspor-nikel-dengan-uni-eropa) European Union. The government must press forward to achieve this ambition – while resolving the nickel dispute with the European Union.

The reason is that the growing domestic nickel processing industry can stimulate a sustainable economy, as well as support the program to convert motor vehicles into electric vehicles. So far, the government's efforts to process nickel seem half-hearted. Currently, nickel ore is only processed into semi-finished products with little added value. In 2023, the government needs to immediately formulate a targeted nickel processing roadmap that focuses on the final goal, namely electric battery products or electric vehicles. By boosting at least 3 aspects of the energy transition, Indonesia has the opportunity to achieve the net zero emissions target by 2050 in accordance with [Paris Agreement.](https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement) The hope is that national economic growth can also be sustainable.

# Nickel downstream Is a Solution to Encourage Chinese Investment in Indonesia

Downstream mining is part of the industrialization process. Industrialization drives the transformation process from a country with a high level of dependence on its natural resources to become an economically independent country for the prosperity of the people. The success of domestic industrialization cannot occur only by supporting the downstream mining sector, but must also be supported by the development of more downstream industries or domestic manufacturing industries which will produce final products for consumption by the public. The success of downstream mining itself is largely determined by policies and technical regulations in its implementation by considering the provision of raw materials, land, labor, energy, infrastructure, technology, operational and maintenance activities, licensing systems, and investment financing activities.

The mineral downstream policy is one of the fiscal tools to create added value in minerals, increase state revenues, encourage economic growth, create jobs, and bring prosperity to the Indonesian people in a fair and equitable manner. Downstream is often called downstream or value-adding, which means efforts to reduce exports of raw materials and instead encourage domestic industry to use these materials because they increase domestic added value (while creating jobs). If you have to export, then what is exported is finished goods, the results of processing the raw materials. In particular, currently the government has designated Covid-19 as a national disaster through Presidential Decree number 12 of 2020 concerning the Determination of Non-Natural Disasters for the Spread of Corona Virus Diseases 2019 (Covid-19) so that downstream implementation also pays attention to the global situation.

The mineral downstream policy is intended to increase the economic value of goods, but without strengthening the upstream production (supply) base, domestic smelters will have difficulty obtaining raw materials to process into high added value products. The ban on raw mineral exports is not intended to put a brake on the production of ore or raw minerals, but rather to maintain the long-term continuity of raw mineral supplies for the needs of domestic smelters. The positive impact of the added value of nickel downstream is increasing the added value of developing the downstream mineral industry to Gross Domestic Product (GDP). and Gross Regional Domestic Product (GRDP), employment opportunities, increasing technological capabilities and human resources for mineral exports, and growing the national economy.

Investment in the smelter construction project in Indonesia shows the interest of foreign investors, one of whom is Elon Musk, the world electric car icon entrepreneur who has directly expressed his interest openly in nickel products from Indonesia and LG Solution from South Korea which has signed an Investment Agreement (MoU) amounting to US$ 9.8 billion equivalent or Rp. 142 trillion for the development of the integrated nickel industry in Indonesia. China's Chengxin Lithium announced it would take a 65 percent stake in a lithium project worth US$350 million or IDR 5 trillion in Indonesia to build production capacity overseas. factory project that will make lithium chemicals for electric vehicle (EV) batteries and is located in the Indonesia Morowali Industrial Park (IMIP) in Central Sulawesi.

Efforts to increase the added value of minerals, especially nickel, include the construction of smelters. Smelter construction needs to be accompanied by infrastructure development. The government needs to provide support for infrastructure development, especially energy generation, smelter land, import duty and tax incentives for a certain period, as well as legal certainty regarding the mining production period as collateral for smelter raw materials to support industry in realizing downstream towards industrialization. Increasing the Added Value of Coal is the activity of developing and/or utilizing coal to improve the quality of coal with or without changing the physical or chemical properties of the original coal.

Downstream is closely related to the concept of added value and product competitiveness. The further downstream a product is produced from industrial activities, the higher its value or price. In the macroeconomic order, the more downstream a production activity is, the greater the contribution to a country's total gross domestic income. In industrial practice, the concept of added value is the difference or ratio between the sales value of the product produced and all cost components to produce the product in equivalent volume/weight units. The production cost structure per ton of product is an accumulation of raw material prices, wages, management costs, productivity, taxes, depreciation and other costs that are often unexpected. The lower the production cost structure, the higher the competitiveness of the product (or the country). Especially if the quality of the product produced is very good. Minister of Energy and Mineral Resources Regulation No. 11 of 2019 requires every company to be able to process it first to increase local market prices before exporting. One of the obstacles faced regarding nickel processing in Indonesia is the lack of smelters to process nickel. Another obstacle is limited human resources, and many workers in Indonesia do not yet understand how to process nickel. Based on existing regulations, the government is more serious about increasing downstream nickel minerals. The implications of the nickel export ban policy for the Indonesian nation are that the construction of nickel refining facilities is being improved, lithium-ion battery (Li-ion battery) technology is increasingly developing in Indonesia, and increasing the attraction of foreign investment into the country.

The factors that investors take into consideration when investing their capital include: Natural Resource Factors, Human Resources, Political and Economic Stability Factors, Government Policy Factors, and Convenience Factors in Licensing. Realization of investment in the mineral and coal sub-sector itself has only reached US$3.5 billion as of December 10 2021, or 81.3 percent of the target of US$4.3 billion. In supporting the development of an integrated nickel industry, the Government will increase domestic nickel downstream, one of which is by increasing the number of smelters. The government is targeting the construction of

53 smelters by 2024, where in 2021 there will be 19 smelters established with an additional 4 smelters targeted for completion by the end of the year. The four smelters belong to PT Aneka Tambang Tbk. with progress of 97.7 percent, PT Smelter Nickel Indonesia (100 percent), PT Cahaya Modern Metal Industri (100 percent), and PT Kapuas Prima Citra with work progress reaching 99.87 percent in Minister of Energy and Mineral Resources Regulation Number 11 of 2019 concerning the Second Amendment Based on Minister of Energy and Mineral Resources Regulation Number

25 of 2018 concerning Mineral and Coal Mining Business, namely that as of January 2020, nickel ore with a grade below 1.7 percent cannot be sent/exported raw abroad. This decision was made in an effort to maintain nickel reserves by considering sustainable supply of raw materials from existing smelters.

One of the reasons the government imposed a ban on exports of nickel ore is that nickel can be used as a raw material for electric car components. The aim of accelerating the export ban is to support the government's program to accelerate the electric car program. The electric car industry is very dependent on nickel as a raw material for making electric car batteries. The program is contained in Presidential Regulation no. 55 of 2019 concerning Acceleration of the Battery-based Electric Motor Vehicle Program for Road Transportation. Indonesia also has the technology to process low grade nickel which can be converted into cobalt and lithium as raw materials for making batteries for electric vehicles, which is the program for making electric vehicles. Nickel is the most profitable commodity because it is the main material for making lithium batteries, especially considering the production demand for electric vehicles which have been increasing in popularity recently. Currently there are several types of nickel processed products in Indonesia, namely nickel pig iron (NPI), ferronickel (FeNi), Ni-matte, mixed hydroxide precipitate (MHP), mixed sulphide precipitate (MSP), and stainless steel.

**Figure 2.** Resilience of Nickel Reserves Based on Refining Technology

Source: Adapted from Indonesian Directorate General of Mineral and Coal (2022)

PIN 2022 and 2023, Indonesia will enter the era of downstream natural resources. Talking about mineral downstream, it is worth knowing first what the main activities are in the mineral and coal (mineral) business. First, mining activities, then smelting, and finally refining. Of the three main activities, those in the upstream sector in the coal mineral business are mining activities, while the other two (smelting and refining) are downstream activities. Thus, downstream is interpreted as all processes of smelting and refining mining products. This was marked by the cessation of nickel exports abroad as a raw material. On the other hand, nickel will be processed first in Indonesia before the results will be exported. Current downstream challenges include the fact that almost all nickel processing products in Indonesia are exported abroad as vital and strategic industrial raw materials with high economic value and processing and refining technology is still in use. controlled by foreigners, especially China, Japan, etc. Apart from that, there are several obstacles in developing downstream smelters in Indonesia, including limited mineral reserves and the distribution of mineral reserves so that there is no guarantee of raw material supply; limited land area in Mining Business Permits (IUP) which are issued simultaneously, several IUPs must be combined to provide sufficient raw materials to build one smelter unit.

There is no adequate and economical energy supply available on site or accessible at the mine site; and synergy between industries has not yet been developed; lack of infrastructure for transporting raw materials and factory production; and the absorption capacity of products by the domestic downstream industry is still small, even though the export market is quite saturated. Minister of Energy and Mineral Resources Regulation 11/2020 concerning the Third Amendment to the Regulation of the Minister of Energy and Mineral Resources Number 07 of 2017 concerning Procedures for Determining Benchmark Prices for the Sale of Metallic Minerals and Coal states that Smelters are Mandatory Buy Nickel Ore According to the Mineral Benchmark Price. The increase in nickel royalties will also encourage increased added value of nickel through downstream activities. This is because the nickel royalty value has indeed increased to 10%. However, the royalty conditions for nickel that has been processed into ferronickel have actually decreased from 4% to 2%. In its development for the energy and mineral natural resources sector, the government has issued Minister of Energy and Mineral Resources Regulation (Permen ESDM) Number 11 of 2019 which requires companies to establish smelters (refining), this of course can make nickel ore processing valuable. better sales but also have cost constraints in the construction and industrial development of the smelter.

# Electric Cars and the Future of the Indonesian Nickel Industry

The momentum for the development of electric cars that continues to strengthen has the potential to have a positive impact on the nickel industry in Indonesia. This is related to the use of nickel as a component of electric car batteries. It is believed that the use of nickel as a battery component can encourage the production costs of electric cars to be competitive with cars that use fuel. Currently, the portion of battery costs is reported to be around 40% of the total production costs of electric cars. Therefore, reducing battery production costs will reduce the overall production costs of electric cars. Currently there are three types of batteries used for electric vehicles, namely Nickel Cobalt Aluminum (NCA), Nickel Manganese Cobalt (NMC), and Lithium Iron Phosphate (LFP). For heat resistance, NCA type batteries have a heat resistance of around 150°C, NMC type batteries around 210°C, and LPF type batteries around 270°C. In terms of costs, production of NCA type batteries is around US$ 350 per kWh, NMC type is around US$ 420, and LPF type is around US$ 580.

Indonesian Nickel Industry Of the three types of electric car batteries, the production costs of batteries that use nickel components, namely NCA and NMC, are recorded to be cheaper than those that do not use nickel components (LPF). Based on this information, the difference in production costs between batteries that use nickel and those that do not is US$ 70 – 230 for each kWh. It can be said that the use of nickel is an important part of reducing the overall production costs of batteries and electric cars. Therefore, countries that have nickel reserves, especially Indonesia, will play an important role in the supply chain for the battery and electric car industry as a whole. Indonesia, which has nickel reserves of around 52% of the world's reserves, will determine whether the electric car industry is competitive or not compared to oil- fueled cars. With this portion of reserves, Indonesia's nickel production is reported to be around 800 thousand tons or around 30% of total world nickel production.

**Figure 3.** Electric Vehicle Industry Supply Chain

Source: Adapted from MIND ID 2020.

Currently, domestic nickel demand is around 30 thousand tons per year. So far, around 770 thousand tons or 96% of Indonesia's total nickel production is destined for the export market. Apart from Indonesia, the world's main nickel producers are the Philippines and Russia. The Philippines' nickel production is around 420 thousand tons, while Russia's is around 270 thousand tons. Advertisement By controlling 52% of world reserves, it is almost certain that Indonesia will play an important role in the global nickel industry, including in this case the nickel industry for electric car batteries. The European Union's objection regarding Indonesia's decision to implement a moratorium on nickel exports further emphasizes that Indonesia plays an important role. For the domestic context, the nickel industry also plays an important role in the Indonesian mineral industry as a whole. The relatively large investment portion of the nickel processing or refining industry confirms that the nickel industry is an important one. By 2024, Indonesia targets to complete 53 smelter construction projects, of which 30 smelters or 57% will be for nickel refining. The investment value of the 53 smelters is around US$ 21.59 billion, and US$ 8 billion is allocated to build a nickel smelter. Even though overall it is positive, I think there are still several things that need to be paid attention to by the government and the business world regarding the development of the nickel industry which is used for electric car batteries. From a technical aspect, nickel used for electric car batteries requires a smelter using the high-pressure acid leaching (HPAL) method.

Therefore, it would be logical if by the end of 2020 four nickel cobalt smelters using the HPAL method were being built in Indonesia, specifically in the Indonesia Morowali Industrial Park (IMIP). To build a battery factory, in general you will need a supply of raw materials, namely mix hydroxide precipitate (MHP) and mix sulphide precipitate (MSP). This product is the raw material for nickel sulphate or cobalt sulphate which will be the raw material for battery components. Currently, in the world there are several smelters that use the HPAL method to process low grade nickel ore. A number of information states that processing nickel ore using the HPAL method has several obstacles, including relatively higher costs compared to processing Nickel Pig Iron (NPI). Therefore, regarding techno- economics, there is a problem that processed nickel ore must have a silicate (Si) content below 10% so that it becomes uneconomical if it continues to be produced.

One of the techno-economic obstacles to nickel production operations for electric car batteries is reflected in the closure of a number of nickel smelters that use the HPAL method. The HPAL method smelters that have stopped operating include the Bulong smelter owned by Resources company in Australia with a production capacity of 7,000 tons of Ni/year and the Cawse smelter owned by Centaur company in Australia with a production capacity of 9,000 tons Ni/year. Apart from techno-economic issues, the availability of regulations as a legal umbrella for production operations needs to be a concern for the government. Regarding price regulation policies, the government is quite progressive. One of them is reflected in the formation of the Work Team for Monitoring the Implementation of the Nickel Mineral Benchmark Price which has carried out its main duties and tasks well. The formation of the Working Team is an implementation of Minister of Energy and Mineral Resources Regulation No. 11/2020 concerning the Third Amendment to Minister of Energy and Mineral Resources Regulation No.7/2017 concerning Procedures for Determining Benchmark Prices for the Sale of Metallic Minerals and Coal.

Although in general nickel production activities can refer to Minerba Law no. 3/2020, Minister of Energy and Mineral Resources Regulation No. 25/2018 in conjunction with Minister of Energy and Mineral Resources Regulation No. 11/2019, and Minister of Energy and Mineral Resources Regulation No. 25/2018 jo. ESDM Ministerial Regulation No. 11/2019, I think the government needs to issue regulations that specifically regulate the use of nickel for the battery industry. Moreover, the regulation of the electric vehicle battery industry through Presidential Decree no. 55/2019 concerning the Acceleration of the Battery Electric Vehicle (Battery Electric Vehicle) Program for Road Transportation is still observed to be quite macro in nature.

Based on the analysis and discussion above, cooperation between Indonesia and China is very well established, and bilateral relations between Indonesia and China have entered the age of 70 years and continue to experience improvement, especially in economic relations. The Jokowi government adheres to the Global Maritime Axis (PMD) doctrine and uses economic diplomacy to fight for Indonesia's national interests. China plays an important role in investing in Indonesia through the One Belt, One Road (OBOR) and One Belt, One Road Initiative (BRI) projects. Chinese investment in Indonesia increase over the last five years cannot be separated from the Belt and Road project. The Belt and Road project focuses on developing connectivity routes both land and sea through large-scale infrastructure development in various countries supported by China.

Next is the prospect of China's base metal and electric vehicle industry in Indonesia, especially the base metal industry which is attracting attention with an investment share of 42 percent. The development of electric vehicles creates opportunities for Indonesia to invest in battery processing to offset Indonesia's huge nickel reserves. This strengthens the strategic role of Indonesia and China, thereby encouraging the Investment Coordinating Board (BKPM) to focus on value-added sectors such as labor-intensive industry, downstream mining, new and renewable energy, and infrastructure. The Indonesian government launched the G20 Energy Transition to accelerate the transition from fossil energy to environmentally friendly energy. Three energy transition priorities: access, technology and financing, with the aim of global agreement within the G20. The Indonesian government is taking strategic steps to achieve the energy transition, including increasing environmentally friendly energy generation capacity and developing an environmentally friendly hydrogen industry. In the context of the downstream nickel industry, the Indonesian nickel industry plays an important role in the supply chain for the electric vehicle battery industry. Limiting nickel ore exports and developing the downstream electric vehicle battery industry to increase added value and support the net zero emissions target.

However, there are various obstacles and limitations in the development of the nickel industry, especially regarding nickel processing technology for electric vehicle batteries which requires smelting using high pressure acid leaching (HPAL). Obstacles include high production costs compared to other processes such as nickel pig iron (NPI) and the need for special regulations on the use of nickel in the battery industry. Challenges and steps forward include increasing green energy power capacity, developing a green hydrogen industry, and decoupling the nickel industry into electric vehicle batteries, which is an important step towards the energy transition. Renewable energy projects and downstream industries must be supported, including tax and licensing incentives.

The momentum in developing electric vehicles has had a positive impact on the Indonesian nickel industry. The development of the nickel and electric vehicle battery industry is aimed at supporting sustainable national economic growth and achieving the goal of net zero emissions. The analysis covers the challenges of bilateral cooperation, investment, energy transition, and downstream industrial development. Strategic steps and a focus on clean energy and sustainable industry are important points in considering the future of economic cooperation between Indonesia and China.

# CONCLUSION

Based on the results and discussions, it can be concluded that the nickel downstream program in Indonesia has great potential to encourage national economic transformation and accelerate Indonesia's journey to developed country status. With significant nickel ore reserves, Indonesia is in a strategic position to develop a high-value processing industry, especially in the context of increasing global demand for electric vehicle batteries. Strong bilateral relations between Indonesia and China, especially through the Belt and Road Initiative (BRI), are a key factor in strengthening the investment and infrastructure development needed to support the energy transition.

To make optimal use of nickel resources, the Indonesian government is advised to implement policies that support sustainable investment and innovation, as well as increase clean energy capacity and develop a green hydrogen industry. On the other hand, Chinese companies need to focus on integration in the global production network to improve their competitiveness and profitability in the Indonesian market. Overall, strategic cooperation in the nickel and new energy sectors will not only strengthen Indonesia's position on the global economic map, but also contribute to sustainable development and the achievement of net-zero emission targets.

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