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Conference Paper

ADVANCING INDONESIA'S ROLE IN THE GLOBAL COPPER SUPPLY CHAIN: DOWNSTREAM INTEGRATION, PRODUCTION CAPACITY EXPANSION, AND ENERGY TRANSITION IMPLICATIONS

Jenpino Ngabdi
PT Freeport Indonesia, Jakarta, Indonesia

Abstract.

Copper remains to be the critical subject in the global economy, underpinning renewable energy technologies, electric vehicles, and broader carbon reduction strategies. Urbanisation, technological advances, and a transition towards lower carbon energy systems are the primary sources of the ongoing rise in demand for copper. By undertaking a qualitative content analysis of policy documents, capacity expansion plans and production data, this paper seeks to explore the role of Indonesia in the global copper market. Indonesia possesses substantial copper reserves and has advanced down streaming policy through the construction of the world's largest single-line copper smelter in Gresik, East Java. Teaming up with the existing PT Smelting plant, the new facility includes mining and smelting operations and is responsible for around 800,000 tonnes of copper cathodes annually, capable of supporting the production of electric vehicles and renewable energy sources worldwide. When it comes to full production at the end of 2025, Indonesia will become one of the top five producers in the world with an annual production of 1.1 million tonnes. These developments are contributing to Indonesia's status as an important player in the international energy transition and are also expanding the country's engineering capacity.

Keywords: copper industry; downstream policy; electric vehicles; mineral supply chain; renewable energy

Corresponding Author:
Jenpino Ngabdi
Email: jenpino.n@gmail.com

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Introduction

Copper is very important to the world economy and is a key part of the shift to clean energy, electric cars, and other projects that cut down on carbon emissions. As more people move to cities in emerging countries and the world becomes more connected, the demand for copper will rise even more (1). Copper has been an important part of human civilisation for hundreds of years. It is still important for modern technology and is sometimes called the "metal of the future" (2,3).

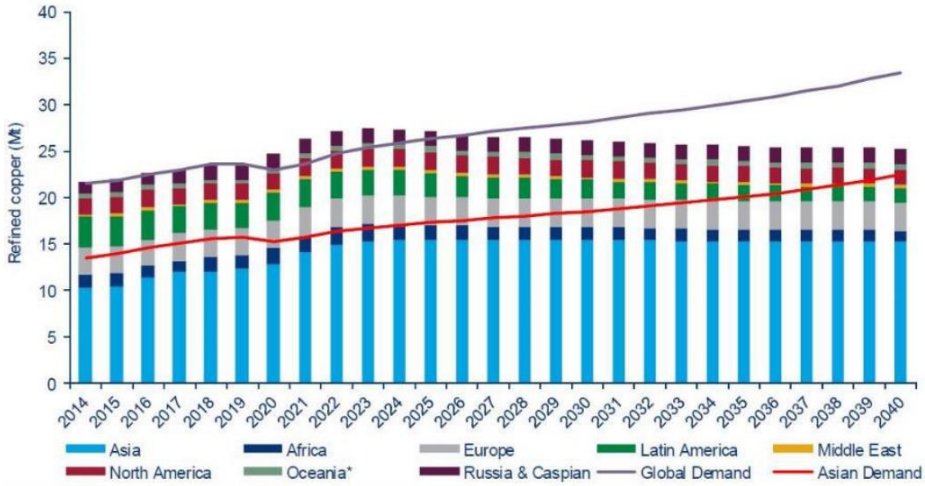

Figure 1. Global Copper Supply and Demand
Source: Ngabdi (2025)

More than 65% of the world's copper is used in applications that deliver electricity (4,5). Renewable energy technologies require four to five times more copper than fossil fuel-based power generation, while electric vehicles consume up to four to five times more copper than internal combustion engine vehicles.

Literature Review

Theoretical Studies

Electric vehicle batteries require various critical minerals, that are graphite, aluminium, nickel, copper, and cobalt (2,3,6). Copper content in electric vehicle batteries accounts for approximately 11% of their total material composition. Indonesia possesses abundant reserves of critical minerals, ranking first in global nickel reserves, sixth in bauxite reserves, and tenth in copper reserves (2,3).

Table 1. Indonesia Minerals and Coal Reserves
Source: Ngabdi (2025)

No	Metal	Total Reserves (Ton)		World Ranks
		Ore	Metal	
1	Gold	3,477,235,625	3,418	6
2	Silver	3,231,362,489	42,657	-
3	Copper	2,845,468,894	21,410,613	10
4	Nickel	5,325,790,841	56,117,187	1
5	Bauxite	2,777,981,035	531,423,887	6
6	Tin	6,361,967,124	1,367,502	2
7	Coal	31,713,550,000		7

The long-term outlook for copper is still good because its significance in the global economy is expanding and supply growth is constrained (7). Global refined copper could be expected to expand by 2.9% in 2025, but supply growth will only be 1.2%. The market is predicted to have a slight deficit in 2025, reach balance in 2026, and then have a structural shortfall of about 6.2 million tonnes by 2035, which will require large-scale mining growth.

Empirical Studies

Few large-scale copper mines have been developed. In Indonesia, annual refined copper consumption is between 300,000 and 400,000 tons, with domestic demand expected to grow. Growth drivers comprise of expansion of PLN's transmission network and the development of the domestic electric vehicle ecosystem (2,3).

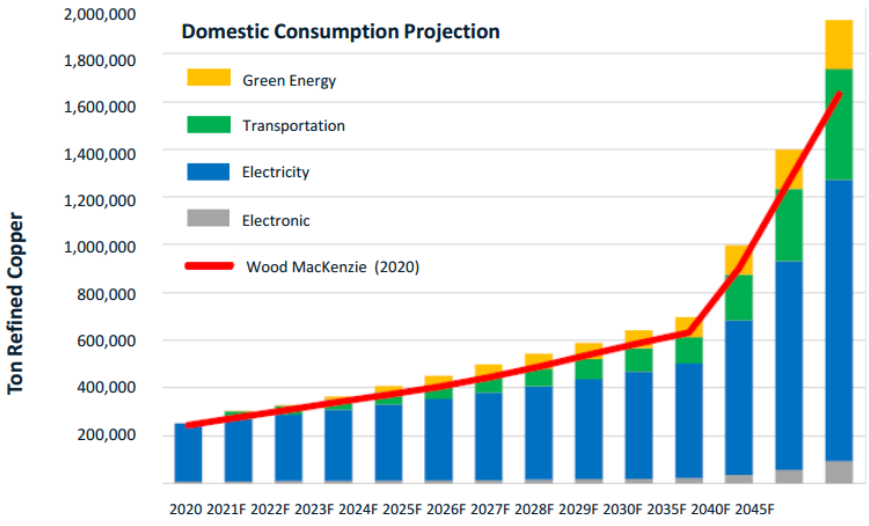

Figure 2. Indonesian Domestik Refined Copper Demand
Source: Ngabdi (2025)

In keeping with Indonesia's downstream mining policy, the world's largest single-line copper smelter was built in Gresik, East Java. It works with the PT Smelting facility that is already there. The new smelter can process 1.7 million tonnes of concentrate each year, which is enough to make about 450,000 tonnes of copper cathodes. They also built a precious metals refinery that can process 6,000 tonnes of metals a year and make 50 to 60 tonnes of fine gold. Construction was done in June 2024, and then there were two further phases, that are pre-commissioning and commissioning (2,3).

Methods

The research uses a qualitative content analysis method, described as a research method of making replicable and valid inferences from texts (8,9). The review focuses on industrial capacity expansion, policy implementation, and market prospects for Indonesia's copper industry. Primary sources include government regulations, company filings, industry sponsored reports/consulting studies, and academic articles written over the last two decades. The indicators selected by their relevance to mineral down streaming policy, global copper demand forecasts, renewable energy deployment and bring electric car supply chains, especially that relevance to Indonesia's place in global copper production. The unit of analysis centres on large-scale infrastructure development, integration of mining and smelting operations, and projected production outcomes. The validity of the data is assured through triangulation of official government declarations, independent market research, and cross referencing with peer-reviewed studies.

Results and Discussion

In 2024, a fire in part of the sulphuric acid plant caused operations to be put on hold for six months so that repairs and restoration could be made. Operations were able to start up again, which allowed for the combining of mining and smelting processes in line with Indonesia's downstream policy (2,3).

The new smelter and PT Smelting facilities in Gresik can process about 800,000 tonnes of copper cathodes per year (2,3). This much is enough to make 8 million electric cars, 160 GW of solar power, or 480 GW of wind power every year. Indonesia's copper cathode output is expected to reach 1.1 million tonnes per year by the end of 2025, when the country is fully operational. This would make it one of the top five producers in the world, along with China, Chile, the Democratic Republic of Congo, and Japan (2,3,10).

Conclusion

Copper is important for renewable energy and electric cars, as well as for making the world more electrified. This means that demand is likely to keep growing. Indonesia is known for possessing some of the greatest copper reserves in the world, and Gresik is now boosting its smelting capacity. Indonesia will become one of the world's top manufacturers of copper cathodes and a significant player in the shift to a low-carbon world when mining and smelting operate together.

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