

The Analysis of Carbon Credit Monetization in the Mining & Energy Company

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Abstract

This study examines the recently launched Indonesian carbon market, IDX Carbon, with a focus on its applicability to publicly listed mining and energy companies. The research compares IDX Carbon with established carbon trading systems in the European Union and China to assess structural differences and pricing mechanisms. Using emissions data from 2020 to 2023, the study calculates annual emission surpluses and deficits based on Phase 1 carbon accounting. Findings reveal that most Indonesian companies are in a carbon credit deficit, resulting in added operational costs. Although the potential for monetizing carbon credits exists, particularly for companies with emission surpluses, the overall financial benefit remains limited under current market conditions. Notably, the price per ton of CO₂e in Indonesia is significantly lower than in the EU and China, indicating that the Indonesian carbon market is still undervalued and lacks liquidity. These conditions may discourage active participation and weaken the market's role in driving corporate decarbonization. This research contributes to the understanding of early-stage carbon market implementation in developing economies and highlights areas for improvement in regulatory design, carbon pricing, and reporting transparency. It also provides a basis for future studies on sustainable finance and carbon policy reform in Indonesia, especially in high-emission sectors like mining and energy.

Keywords: Carbon Market, Carbon Accounting, Emissions Trading System (ETS), Green Finance, Mining and Energy

A. INTRODUCTION

Indonesia's mining and energy sector remains a critical pillar of national economic development, contributing over IDR 300 trillion to state revenues in 2023, comprising IDR 117 trillion from oil and gas, and IDR 173 trillion from mineral extraction activities (Ministry of Energy and Mineral Resources, 2024). Despite its economic significance, the sector is a major emitter of greenhouse gases (GHGs), thereby intensifying environmental concerns amid the escalating global climate crisis. As part of its international commitments, Indonesia has ratified the Paris Agreement and pledged to align with the United Nations' Net Zero 2050 agenda, targeting a 50% reduction in national emissions by 2030.

Market-based mechanisms, particularly emissions trading schemes (ETS), have emerged globally as pragmatic tools to incentivize carbon abatement while preserving economic efficiency. In this context, the Government of Indonesia launched IDX Carbon in 2023—a regulated carbon exchange hosted by the Indonesia Stock Exchange—intended to operationalize domestic carbon trading and attract investment in decarbonization. While inspired by more mature models such as the European Union Emissions Trading System (EU ETS) and China's National ETS, IDX Carbon remains in a nascent phase, raising critical questions about its structural effectiveness, market valuation, and economic impact on carbon-intensive industries.

The mining and energy industries, as dominant GHG contributors, represent a focal point for understanding the efficacy and monetization potential of carbon trading. Yet, prior to market engagement, firms must undertake rigorous carbon accounting to identify their baseline emissions, evaluate offset opportunities, and manage surplus or deficit positions. Although the mining value chain—encompassing extraction, processing, transportation, and waste handling—is recognized as a high-emission domain (National Research Council, 2002), the sector's readiness to engage in structured carbon markets remains empirically underexplored.

This study aims to fill this critical gap by addressing two primary research questions:

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1. How does the institutional and regulatory architecture of the Indonesian carbon market compare with mature carbon trading systems such as those in the EU and China?
2. To what extent is carbon trading economically viable for publicly listed mining and energy companies in Indonesia?

To answer these questions, this research analyzes Scope 1 emissions data and sustainability reports of selected companies from 2020 to 2023. A monetization framework is constructed to quantify the financial implications of carbon surplus or deficit positions under the current market price regime. The Rich Picture presented in Figure 1 provides a systems-level overview of the relationships among market infrastructure, corporate emissions behavior, carbon credit components, and cost-benefit outcomes..

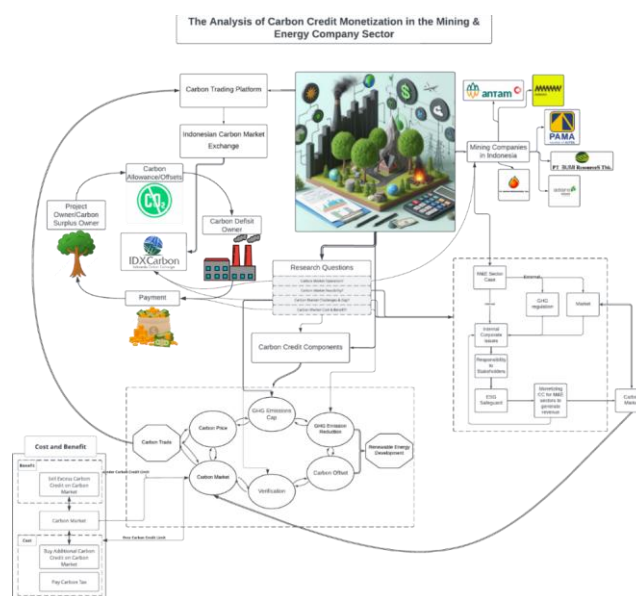


Figure 1. Rich Picture of The Analysis of Carbon Credit Monetization in The Mining & Energy Sectors
 Source: Research data, 2025

As depicted, the framework integrates key operational elements: the carbon trading platform (IDX Carbon), carbon accounting mechanisms, surplus-deficit dynamics, and financial implications through offset and pricing systems. Companies with emission deficits are obligated to procure additional credits, while surplus holders may monetize excess through sales or project-based offsetting. These interactions are further influenced by regulatory enforcement, market liquidity, and verification standards. By combining visual systems mapping with empirical analysis, this research sets the foundation for evaluating Indonesia's early-stage carbon market performance. It contributes to the discourse on sustainable industrial transition in emerging economies and provides evidence-based recommendations for strengthening regulatory architecture, pricing accuracy, and institutional credibility within the domestic carbon ecosystem.

B. METHODS

This study adopts a qualitative case study approach to investigate carbon credit monetization in Indonesia's mining and energy sector. The research is structured across five interconnected stages, beginning with defining the research scope and problem identification, followed by a literature review, data collection, data synthesis, and concluding with analysis and policy recommendations. These stages are illustrated in the research design below, which serves as the structural backbone of the study.

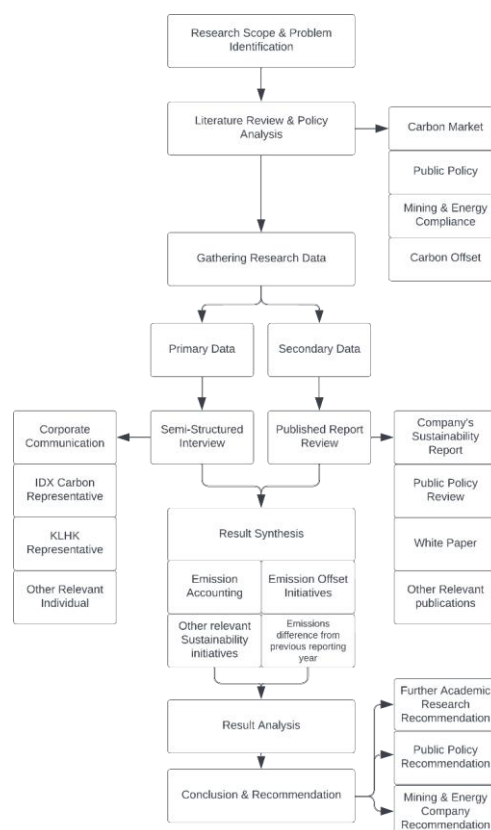


Figure 2: Research Design

Source: Research data, 2025

The primary data were drawn from two sources: semi-structured interviews with sustainability and environmental managers at selected mining and energy companies, and published corporate sustainability and annual reports covering the period from 2020 to 2023. The sample includes five publicly listed Indonesian companies that 1) are not subsidiaries of multinational corporations, 2) are registered on the Indonesia Stock Exchange (IDX), and 3) actively participate in the IDX Carbon market. The interviews were conducted to capture firsthand insights regarding carbon credit readiness, accounting practices, and internal monetization strategies. Simultaneously, document analysis was employed to assess disclosed emissions data, offset project participation, and reported carbon performance trends over the observed years. This study employs a combination of thematic and content analysis to analyze the data. Thematic analysis was applied to the interview transcripts, enabling the identification of recurring patterns and themes relevant to institutional behavior in relation to carbon trading.

Meanwhile, content analysis was conducted on corporate reports to extract quantitative and qualitative indicators related to carbon accounting and emissions management. Both datasets were manually transcribed and coded using inductive reasoning. The full analytical workflow is represented in the figure below.

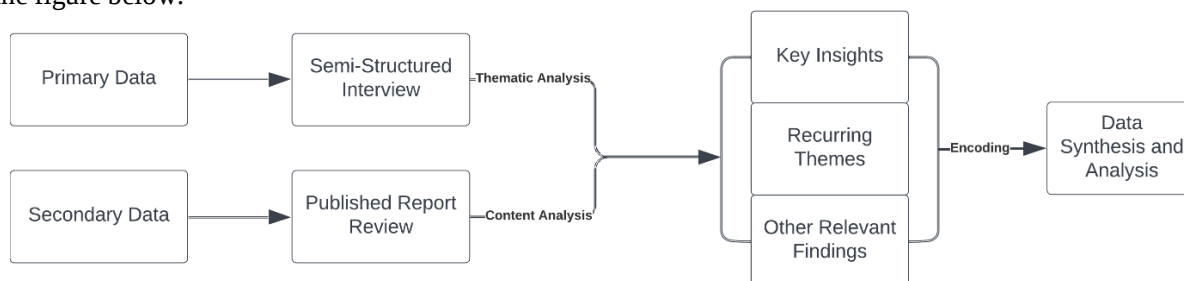


Figure 3. Data Analysis Process

Source: Research data, 2025

After coding, the data were synthesized by cross-referencing themes emerging from interviews and corporate disclosures. This triangulation process enabled a comprehensive understanding of how firms navigate the complexities of emissions reporting, engage with offset mechanisms, and respond to financial incentives embedded in the emerging carbon market framework. Special attention was paid to the calculation of carbon deficits and surpluses, their potential monetization through IDX Carbon, and the extent to which such mechanisms are viable in Indonesia's regulatory and economic context. Through this method, the study provides robust empirical insights into the operationalization of carbon credit systems within developing economies and the strategic behavior of emission-intensive industries during the early stages of market implementation.

C. RESULTS AND DISCUSSION

This research regarding the Analysis of Carbon Credit Monetization in the Mining and energy Company Sector is in its infancy, albeit with limited practical application in the world, let alone in Indonesia. However, the potential of the carbon credit and carbon market initiative has endless implications on sustainable finance, reducing emissions, and corporate sustainability goals. The following chapter will explore what this research has found regarding the carbon market initiative in Indonesia.

Market Benchmark Between the Developed Nation Carbon Market and the Indonesian Carbon Market

As of Q1 2025, the Carbon Market initiative is relatively new as a concept, but fairly new in its global application. Therefore, only a handful of carbon market initiatives are being implemented, let alone carbon markets that are currently operational. However, a few key players, such as China and the European Union, have implemented a solid carbon market framework in their respective regions.

Chinese Carbon Market Framework

To start with, the Chinese Carbon Market was established in 2021 and has developed and refined their Emission Trading System (ETS) Framework. The Chinese Carbon Market uses a Cap-and-Trade Framework where the regulatory authorities set an emission cap, allowing emission-emitting entities to trade their carbon credit. The detailed Framework of China's ETS is illustrated below.

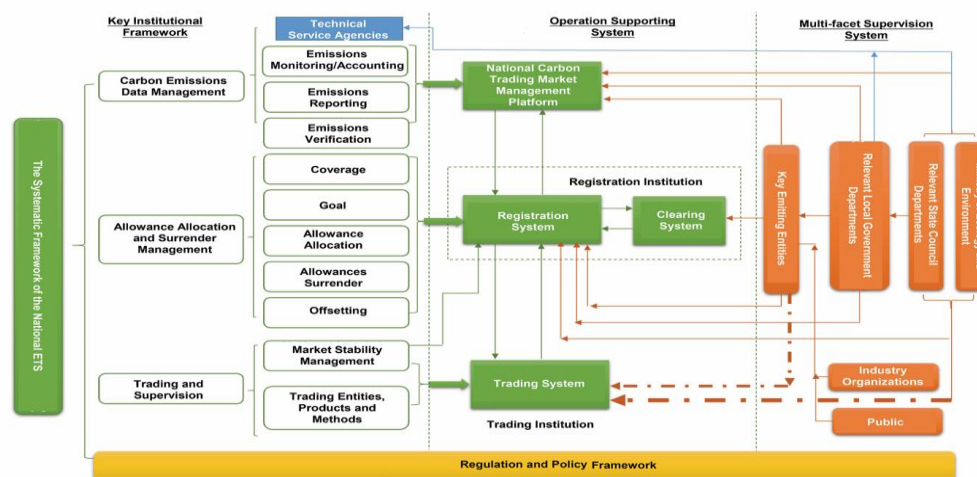


Figure 4. China's National Emission Trading System Framework

Source: Ministry of Ecology and Environment of China (2024)

The framework could be categorized into three parts: Regulatory Authority (Supervision System), Market Participants, Support Mechanism, and the technical services themselves.

The European Union Carbon Market Framework

Moving on to the EU Carbon Market, which was established in 2005 and is the pioneer of carbon market initiatives to combat excess GHG emissions. However, the EU's carbon market framework is not very different from the Chinese carbon market framework in terms of the carbon market framework since

both the Chinese and EU carbon markets use cap-and-trade mechanisms. Other similarities also include their carbon market framework's monitoring, reporting, and verification systems. A detailed, simplified flowchart below illustrates the EU's ETS.

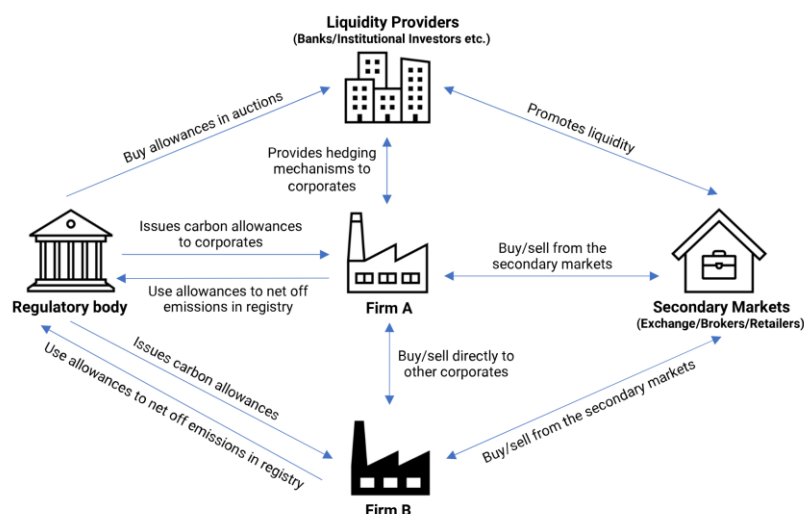


Figure 5: European Union Emission Trading System Framework

Source: MSCI (2025)

The Indonesian Carbon Market Framework

This brings this research to the Indonesian Carbon Market. The carbon market in Indonesia is in its pilot stage. After all, Indonesia's Carbon Trading Market, launched under the Indonesian Stock Exchange (IDX), was just launched in late 2023, and in January 2025, IDX launched its International Carbon Market. The Indonesian carbon market is very similar to China's and the EU carbon markets. However, just like China's carbon market, the Indonesian carbon market only accounts for CO₂ emissions rather than other global warming potential (GWP) emissions. The flowchart below will illustrate the flow of the carbon market trading mechanism in the Indonesian carbon market.

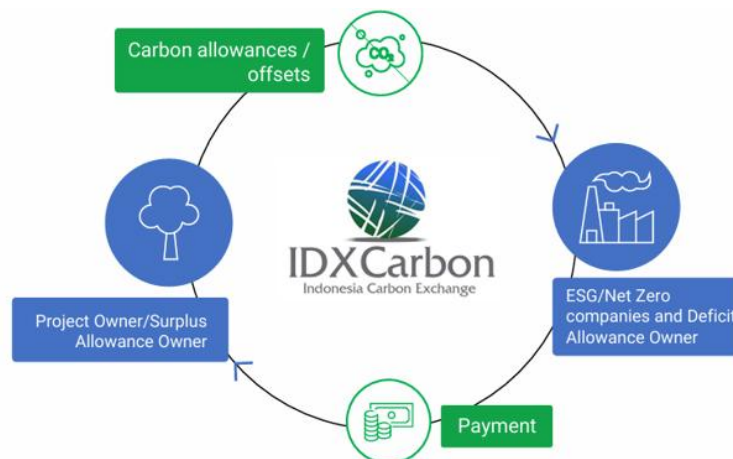


Figure 6: Indonesian Carbon Market Framework

Source: IDX (2025)

To understand further the differences between these carbon markets, we need to compare them with one another, starting with market maturity, emission scope, liquidity, and offset mechanism. To start with, the market maturity, the EU carbon markets lead in market maturity and institutional robustness, followed by the Chinese carbon markets, which show impressive scaling and progression but need to

improve their regulatory foundations. At the same time, the Indonesian carbon market is in its infancy, needing improvements on credibility, investor confidence, and regulatory enforcement structures. Moving on to emission coverage scope, only the EU covers emissions broadly, including CO₂, N₂O, HFCs, PFCs, and SF₆, with extensive industrial sectors. However, both Chinese and Indonesian carbon markets only cover CO₂ emissions for the energy sectors. Moving on to carbon market liquidity, the EU is highly liquid with EUR 38,8 billion (\$42 billion) traded, followed by the Chinese carbon market with \$2,3 billion, and finally, the Indonesian carbon market revenue with only \$4 million. Another aspect to consider is the offset mechanism. While the Chinese and Indonesian offset mechanisms rely more on offsets of green projects, the EU offset mechanism prefers stricter emission cuts over flexibility in offset mechanisms.

The Indonesian Carbon Monetization Flow

To start with, the Carbon Credit Monetization initiative. This research has identified the flow of carbon monetization in the Mining & Energy Company Sector. The diagram below outlines the 5 phases of the carbon monetization flow.

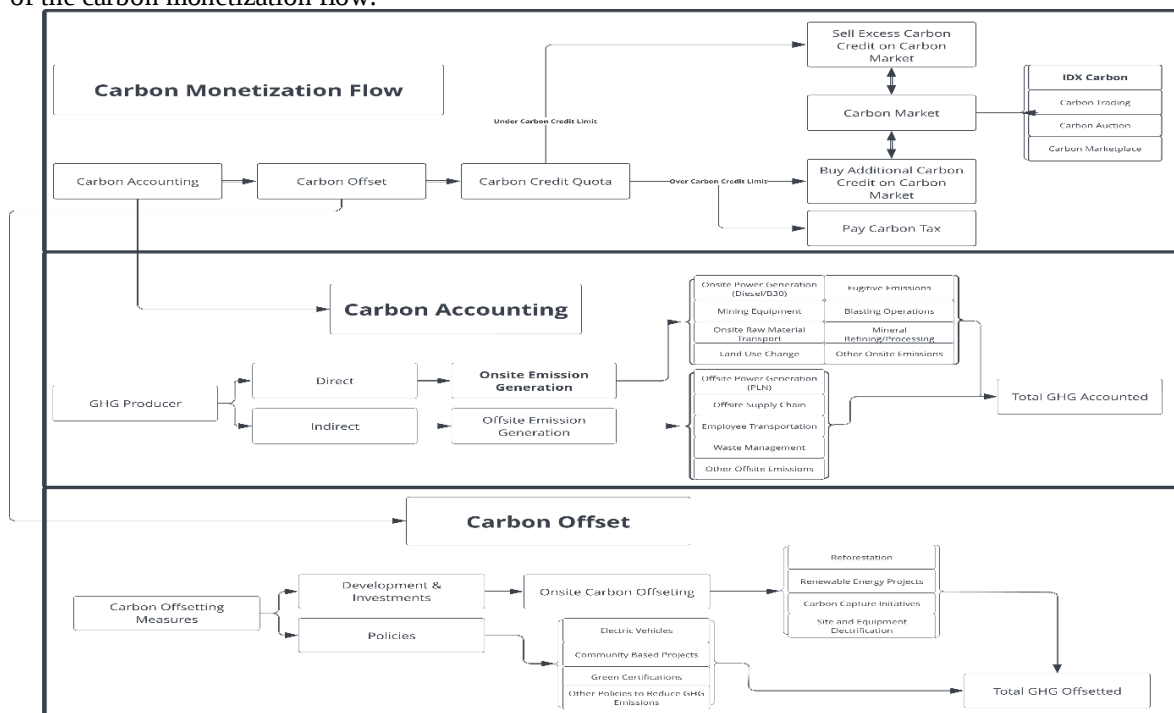


Figure 7. Indonesian Carbon Monetization Flow

Source: Adapted from (IDX, 2025; Wardhana, 2025)

Once the carbon accounting and the carbon offset phase of each company are complete, it can move on to the monetization aspect of the Indonesian carbon market. The table below shows the results of the carbon accounting and offset phases.

Table 1. Total Emissions of Each Mining and Energy Company Per Year In TCO2e

Entity	2020	2021	2022	2023
AMMN	1,875.314	1,608.848	1,755.213	1,743.694
ADMR			11.091	11.425
BUMI	2,161.256	2,680.572	3,013.366	3,833.360
ADRO			1,063.328	1,153.876
BYAN	51.291	55.593	59.683	139.473

Source: Research data, 2025

Some mining companies, such as Adaro Minerals and Alamtri Resources, started their emissions accounting in 2021, so the scope 1 emissions data for these companies in 2020 and 2021 is unavailable. Once the carbon accounting and offset process has been tabulated and completed, this research can move on to the next phase of the carbon market framework which is identifying if the total emission is above or below the carbon credit limit, the term can be simplified as carbon credit deficit or surplus by

identifying the difference between current reporting year with the last reporting year. The table below presents how the carbon credit deficit or surplus is identified.

Table 2. Total Emissions Difference of Each Mining And Energy Company Per Year In tCO₂e

Name of Entity	2020	2021	2022	2023
AMMN		-266.466	146.338	-11.562
ADMR				334
BUMI		267.316	126.433	569.382
ADRO				90.547
BYAN		4.302	4.090	79.790

Source: Research data, 2025

Once the difference in total emissions has been identified, this research can move forward to the final phase of the carbon market frameworks, which is the monetization aspect of the carbon market initiatives. The table below will illustrate mining and energy companies' projected earnings and expenses.

Table 9: Total Projected Earnings Or Expense Of Mining And Energy Companies From Their Carbon Credit Surplus or Deficit

Name of Entity	Total Emission Surplus (-Deficit) per tCO ₂ e (2020-2023)	Current Indonesian Carbon Market Price per tCO ₂ e	Total Earnings (-Expense) from Carbon Trading
AMMN	-131.690	Rp77.000,00	Rp10.140.118.296,00
ADMR	334	Rp77.000,00	-Rp25.700.290,00
BUMI	963.131	Rp77.000,00	-Rp74.161.087.000,00
ADRO	90.547	Rp77.000,00	-Rp6.972.131.320,00
BYAN	88.182	Rp77.000,00	-Rp6.790.014.000,00

Source: Research data, 2025

The table above illustrates the list of companies participating in the carbon market, along with their total scope 1 emission surplus or deficit, the current carbon price per tCO₂e of the Indonesian market, and the potential projected earnings or expenses from participating in the carbon market. The total earnings or expenses are calculated by multiplying the value of the total emission difference by the current carbon market price per tCO₂e. At the time of writing, the carbon credit market price is at Rp77,000 per tCO₂e. Here are the total earnings: Amman Minerals earned Rp10.140.118.296, Adaro Minerals carbon trading expense is Rp25.700.290, BUMI Resources carbon trading expense is Rp74.161.087.000, Adaro Energy (Alamtri Resources) carbon trading expense is Rp6.972.131.320, and finally, Bayan Resources carbon trading expense is Rp6.790.014.000. Only Amman Minerals, among the companies listed here, has a carbon credit surplus and the potential to sell its excess carbon credits to the carbon market on the carbon trading platform. The rest of the companies must purchase or trade additional carbon credits to balance their emissions.

Theoretical, Practical, and Policy Implications

To start with the thematic implications, this research has found that all carbon market frameworks mentioned share similar frameworks, including the regulatory group, the participants, and the carbon market itself. After all, these frameworks are based on the Paris Agreement of 2015 with a shared goal of reducing emissions and a new revenue stream. The practical implications however, there is a chance where emissions reporting could be ineffective due to different emissions accounting methodologies, there is also a possibility emission reporting manipulation of their carbon credit either to inflate the carbon credit surplus to generate revenue and restrict the excess and emissions deficit to avoid paying the carbon tax and purchasing additional carbon credits. Finally, regarding the policy implications, the regulatory organizations responsible for this carbon market framework have the possibility of being stringent or lax in emissions and carbon market platform regulations. Since the carbon market initiative is in its infancy, there are bound to be regulatory lapses and loopholes that the participants of the carbon market platform could exploit to their benefit.

D. CONCLUSIONS

To conclude this research, this research is encompassing the carbon market initiative, comparing the frameworks of EU and Chinese Carbon Markets as a developed carbon market benchmark with Indonesian Carbon Market. is that the landscape of Indonesian carbon market operates similarly compared

to more developed carbon market such as EU's and the Chinese carbon markets. This research also discussed the profitability of the Indonesian carbon market for mining and energy companies. The research methodology starts by gathering emissions data from each company's sustainability and annual reports from 2020 to 2023, as well as carbon offset initiatives that the respective companies participated in. This research has found that most companies still operate in a carbon credit deficit. If Indonesia's carbon market platform is operational and the carbon tax is implemented, these companies' revenue might be negatively impacted due to their emission deficit. However, since the Indonesian carbon market platform is in its infancy and the carbon tax implementation is postponed indefinitely, at the current time, the scope of this research does not include companies that are not affected financially by the carbon market or carbon tax.

Moving on to the recommendation of this research and future research regarding Indonesian Carbon Markets. This research paves the way for future studies on carbon accounting methodologies, viability of carbon offset projects, enhancing the carbon market and sustainable economics, and emission reduction frameworks, especially in mining and energy companies in Indonesia. Future research about this topic can start from the carbon market platform in Indonesia, especially in its monetization aspect. Three main aspects must be revamped to improve the Indonesian carbon market further. Firstly, A more standardized, transparent, and robust regulatory supervision system surrounds emission accounting methodologies to minimize emissions inaccuracies among the company's emission reporting. The second aspect is the carbon credit price in Indonesia. Given that the carbon price in Indonesia is way undervalued compared to the EU and Chinese carbon markets, companies may trivialize the carbon market initiatives along with the emission reduction goals. Finally, once the core and extended carbon monetization framework of the Indonesian carbon market has been fully developed, the carbon credit can expand by also taking into account other emissions other than CO₂, such as Nitrous Oxide (N₂O), Methane (CH₄), or other high global warming potential gases. The Indonesian carbon market is expected to operate ideally per the Paris Agreement and the UN Sustainable Development Goals (SDGs). Future research can revolve towards better carbon accounting methodologies and offset opportunities, as well as, but not limited to, researching a better carbon market framework.

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