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# Causality of Bank Financial Performance, Green Bond, CSR, Green Financing Portofolio and CO2 Emissions in Transportation: Evidence from Indonesia

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**Abstract**

This study aims to identify the causality between bank financial performance measured by Return on Assets (ROA), Return on Equity (ROE), Net Interest Margin (NIM), and Operating Expenses to Operating Income (BOPO) with Green Financing Portfolio and CO2 emissions in the transportation sector. This study uses descriptive quantitative research methods and content analysis of the Sustainability Report of Bank Mandiri, Indonesia for the period 2016 to 2022. In this study, we collected data from Bank Mandiri's financial statements which included information on ROA, ROE, NIM, and BOPO. In addition, we also collected CO2 emission data available from 2016 to 2022. The research sample is Bank Mandiri as one of the state-owned banks in Indonesia. We used purposive sampling technique to select samples that meet the inclusion criteria. The collected data was then analyzed using statistical methods to test the relationship between the variables involved, namely the bank's financial performance (ROA, ROE, NIM, and BOPO), Green Financing Portfolio, and CO2 emissions in the transportation sector. We use content analysis to illustrate the results of Bank Mandiri's financial statements in graphical form. The results of the analysis show that the increase in Green Bond that started in 2016 has a significant impact on the increase in fund allocation for Green Financing Portfolio. This indicates a positive causality between Green Bond and Green Financing Portfolio. In this context, the causality between Green Financing Portfolio and CO2 emissions can be explained through the influence of investment in green technology and sustainable practices. With significant funds allocated through the Green Financing Portfolio, companies and institutions can implement projects that aim to reduce CO2 emissions in the transportation sector. This means that the use of Green Bond as a sustainable funding source has the potential to reduce the negative impact of transportation on the environment.

**Keywords:** Green Bond, Green Financing Portofolio, Financial Performance, CO2 Emision In Transportation.

## I. INTRODUCTION

In an increasingly environmentally conscious era, green finance has emerged as a financial initiative that focuses on sustainable and environmentally friendly investments. The green finance narrative illustrates how the financial sector can be a positive force in promoting sustainable economic

growth and protecting the environment (Wang et al., 2023). Green finance encompasses a wide range of financial instruments designed to support environmentally friendly projects, such as renewable energy, energy efficiency, good water management, forest protection, and sustainable transportation (Falcone, 2020). In this study, we can see how green finance provides solutions to today's environmental challenges, while creating profitable business opportunities. Green finance plays a key role in driving a paradigm shift in how we view investment and economic growth (Ainou et al., 2023). With increasing awareness of the negative impact of human activity on the environment, financial market participants are increasingly recognizing the importance of considering environmental, social, and governance (ESG) factors in their investment decisions (Serrano-García et al., 2023). The green finance narrative also highlights the importance of collaboration between governments, financial institutions, companies, and communities to create an ecosystem that supports sustainable investments. Initiatives such as the issuance of green bonds, whose proceeds will be used for environmental projects, as well as the establishment of financial institutions that specialize in funding sustainable projects, are examples of successful collaboration in advancing green finance (Asiri et al., 2020).

*Phenomena dan Research Gap*

In particular, the Government of Indonesia encourages the development of ESG through relevant policies and regulations. For example, the Indonesian government launched the Green Finance Initiative and created the Sustainable Financial Reporting Guidelines. This aims to provide guidance and a framework for companies to report on their performance in terms of environmental, social, and corporate governance (Liebman et al., 2019). In addition, there is also the development of institutions and initiatives that support ESG development in Indonesia. For example, the establishment of the Indonesian Sustainable Finance Initiative (ISFI) which is a consortium of banks and financial institutions to promote sustainable finance practices in Indonesia (Setyowati, 2023); (Volz, 2018). ISFI works with various parties, including the government, companies, and civil society, to increase understanding and awareness of ESG. The Indonesian government has also encouraged more transparent and comprehensive ESG reporting. In 2020, the Indonesia Stock Exchange (IDX) introduced mandatory guidelines for listed companies to report ESG information periodically. The move aims to provide stakeholders with a clearer picture of companies' ESG performance and encourage companies to improve their business practices. However, of the 10 state-owned banks in Indonesia, only 3 banks have implemented ESG reporting, namely Bank BNI, Bank BRI, and Bank Mandiri until 2023. So it can be assumed that in the midst of the world program on ESG to support sustainability, Indonesia until 2023 is still in the stage of development and improvement (OJK, 2021).

There are various key issues that need to be addressed in the development of green finance in Indonesia, for example, first, many market participants do not fully understand the concepts and benefits of green finance (Katadata Center Insight, 2022), so there needs to be wider education to encourage the adoption and implementation of sustainable practices (Ņikitina et al., 2022). Second, inconsistent ESG performance measurement and reporting standards are still a challenge in Indonesia (Prihandono & Yuniarti, 2023); (Kamil et al., 2021). Third, there is a lack of availability of sustainable financial instruments, such as sustainable loans and sustainable mutual funds, that can support the financing of green projects (Guild, 2020). Fourth, Indonesia has a great need for sustainable infrastructure development, such as renewable energy, environmentally friendly transportation, and waste management which is certainly not cheap (Ronaldo & Suryanto, 2022). Fifth, greater awareness and incentives are needed for companies to integrate ESG factors in their decision-making and daily operations (Maniora, 2017). Therefore, to address these challenges, cooperation between the government, financial institutions, companies, and civil society is needed. Measures that can be taken include the provision of greater fiscal incentives for sustainable projects, increased awareness and

education on green finance, the development of clear standards and frameworks, and increased collaboration and partnerships between different stakeholders (Hafner et al., 2020); (Clark et al., 2018).

This study aims to identify the relationship between bank financial performance as measured by Return on Assets (ROA), Return on Equity (ROE), Net Interest Margin (NIM), and Operating Expenses to Operating Income (BOPO) with Green Financing Portfolio and CO2 emissions in the transportation sector. This research has significant relevance given the challenges faced by the financial and transportation sectors in achieving sustainable development goals (Schroeder et al., 2019); (Zhan & Santos-Paulino, 2021); (Litvinenko et al., 2022). There are several research gaps that need to be filled in this context. First, the relationship between bank financial performance and sustainable funding portfolios is still not fully understood (Badía et al., 2019); (Iazzolino et al., 2023); (Atz et al., 2023); (Mirza et al., 2023). While several studies have investigated the impact of financial performance on sustainable funding decisions, there is still a lack of understanding on how ROA, ROE, NIM, and BOPO specifically relate to sustainable funding portfolios.

Second, the effect of financial performance on CO2 emissions in the transportation sector has not been widely studied (Abid et al., 2022). While banks and financial institutions are increasingly interested in minimizing the environmental impact of their funding portfolios, the relationship between financial performance and CO2 emissions in the transportation sector remains unclear. This study will investigate whether banks' financial performance has an impact on investment decisions in environmentally friendly transportation and to what extent it can reduce CO2 emissions. In addition, this study will also examine the role of financial intermediation in promoting sustainable financing and CO2 emission reduction in the transportation sector. This relates to the influence of NIM and BOPO on sustainable funding portfolios as well as CO2 emissions (Nugrahaeni & Muharam, 2023). Through this analysis, this research will contribute a new understanding of how banks' financial performance can impact responsible and sustainable financial practices, as well as their impact on the environment.

The research methodology will involve the analysis of secondary data from banks' financial statements as well as transportation sector data related to CO2 emissions. The use of statistical regression will enable the identification of causal relationships between ROA, ROE, NIM, BOPO, and sustainable funding portfolio and CO2 emissions. The research may also include a case study of bank Mandiri as an Indonesian state-owned bank that has implemented a sustainable funding strategy and reduced CO2 emissions in the transportation sector. By filling this research gap, it is hoped that this research can provide important insights for the financial and transportation sectors in driving the transition to a low-carbon and sustainable economy. The results of this study can serve as a basis for banks and financial institutions to develop more effective policies and strategies in integrating environmental aspects in their funding decisions.

In addition, the findings of this study may also benefit regulators and governments in developing policies that encourage the adoption of sustainable finance and the reduction of CO2 emissions in the transportation sector. With a better understanding of the relationship between financial performance and environmental impact, more effective policy measures can be taken to encourage positive changes in the financial and transportation sectors. The research can also identify potential obstacles or barriers that may be faced in implementing sustainable finance and reducing CO2 emissions in the transportation sector. In this regard, the research can provide recommendations and solutions to address these challenges, such as the development of financial instruments that support sustainable investment, the engagement of key actors in the industry, and government policies that encourage the transition to greener transportation. Overall, this research will fill an important knowledge gap in relation to the linkages between bank financial performance (ROA, ROE, NIM, BOPO), sustainable financing portfolio, and CO2 emissions in the transportation sector. Through this research, a more

comprehensive understanding of the role of the financial sector in promoting sustainable development and reducing greenhouse gas emissions in the transportation sector is expected.

*State of the art and Novelty*

In our research, we sought to analyze the relationship between financial performance and green bonds, as well as green financing portfolios. However, we realized that there was limited relevant data and information that we could find in the available literature and sources. While there have been studies addressing financial performance and sustainable financial instruments such as green bonds, we conclude that ours is the first study that attempts to comprehensively examine this aspect by involving the comparison of banking performance ratios through Sustainability reports to the effect of carbon emission reduction on the transportation sector nationwide in Indonesia. We did not find enough relevant fundamentals that address the specific relationship between financial performance and green bonds in the context we studied. The unavailability of specific data and information in the literature suggests that this topic is still relatively new or has not been extensively researched. Therefore, our study makes an important contribution to further understanding and thinking in the relationship between financial performance and green bonds. Our study provides a strong foundation for future research in this domain. We hope that our findings and research methods will inspire other researchers to further explore the relationship between financial performance and sustainable financial instruments such as green bonds, as well as its practical implications in the context of sustainable investment. Although we did not find many studies related to this topic, it is important to continue to explore knowledge and expand understanding of the relationship between financial performance and green bonds. As such, it can inform more sustainable and responsible investment decision-making in the future.

## II. LITERATURE REVIEW

The relationship between financial performance metrics and sustainable financing practices has gained significant attention in recent years. This literature review aims to explore the existing body of research on the association between Return on Assets (ROA), Green Financing Portfolio, and CO2 emissions in the transportation sector. Understanding this relationship is crucial for promoting sustainable financial decision-making and reducing environmental impacts.

### *2.1. Return on Assets (ROA)*

Return on Assets (ROA) is a fundamental financial metric that provides insights into a company's ability to generate profits in relation to its total assets (Malikah, 2021); (Tangngisalu, 2022); (Allo et al., 2021). It is widely used by investors, analysts, and financial institutions to evaluate a firm's efficiency and effectiveness in utilizing its available resources (Olarewaju & Msomi, 2021). In recent years, the concept of sustainable finance has gained traction, emphasizing the integration of environmental, social, and governance (ESG) factors into financial decision-making (Huang, 2021); (Clementino & Perkins, 2021). Several research studies have explored the relationship between ROA and sustainable finance, with a specific focus on green lending and investment practices (Xu et al., 2020); (Banker et al., 2014). These studies have revealed a positive association between a bank's ROA and its engagement in green financing activities (Xu et al., 2020); (Banker et al., 2014). Banks with higher ROA tend to demonstrate a greater propensity to allocate funds toward sustainable initiatives, including green projects, renewable energy ventures, energy-efficient technologies, and environmentally responsible businesses (Bohora, 2018); (Hodge, 2002). The findings of these studies underscore the significance of financial performance in shaping a bank's commitment to sustainable

portfolio allocation. Higher profitability, as indicated by a strong ROA, provides financial institutions with the capacity to expand their green financing activities (Hodge, 2002). This positive association between ROA and green financing highlights the potential for financial institutions to align their profitability goals with sustainability objectives (Hodge, 2002).

The positive correlation between ROA and green financing can be attributed to various factors. Firstly, banks with higher profitability have greater financial resources at their disposal, enabling them to invest in sustainable projects and initiatives (Sahoo & Nayak, 2007). Moreover, engaging in green financing can enhance a bank's reputation, attract socially conscious investors, and foster long-term relationships with environmentally responsible clients (Zhang et al., 2022). These factors contribute to increased profitability and a positive feedback loop, wherein higher ROA enables further expansion of green financing activities. Furthermore, the integration of sustainability into financial decision-making processes aligns with the growing regulatory frameworks and global initiatives aimed at addressing climate change and promoting sustainable development (Clark et al., 2018). Banks that prioritize sustainable finance not only contribute to a greener economy but also mitigate risks associated with climate change and environmental degradation (Blazquez et al., 2021). Consequently, the positive association between ROA and green financing supports the notion that financial performance and sustainable practices are not mutually exclusive but rather mutually reinforcing. In conclusion, the existing literature highlights the positive relationship between ROA and sustainable finance, particularly in the context of green lending and investment. Financial institutions with higher ROA demonstrate a greater propensity to allocate funds toward sustainable projects, thereby fostering environmental sustainability (Fatica & Panzica, 2021); (Guo et al., 2022). This connection emphasizes the potential for financial institutions to integrate profitability goals with sustainable portfolio allocation.

### 2.2. *Green Financing Portfolio*

Green financing plays a pivotal role in promoting environmentally friendly projects and initiatives by providing financial support through specialized products and services (Chen et al., 2022). It encompasses various forms of investments, including but not limited to renewable energy, energy efficiency, sustainable infrastructure, and other sectors that prioritize environmental responsibility (Tang et al., 2021). Research studies have consistently highlighted the positive impact of green financing on mitigating climate change and fostering sustainable development. The company that actively engage in green financing and have a larger portfolio dedicated to environmentally friendly projects contribute significantly to reducing carbon emissions and promoting a low-carbon economy (Tian et al., 2022). By directing their financial resources towards green initiatives, these banks facilitate the transition to renewable energy sources, encourage energy efficiency practices, and support sustainable infrastructure development. One significant advantage of expanding green financing portfolios is the enhancement of a bank's reputation and credibility (Akomea-Frimpong et al., 2022); (Bal et al., 2013). By actively supporting environmentally responsible projects, financial institutions signal their commitment to sustainability and position themselves as key players in the transition to a greener future. This fosters trust among stakeholders, including customers, investors, and regulatory bodies, and may result in increased business opportunities and market share (Fieseler, 2011).

In addition to reputational benefits, green financing aligns with evolving regulatory requirements and policy frameworks. Governments and regulatory bodies worldwide have recognized the urgent need to address climate change and have implemented measures to incentivize and regulate sustainable finance practices (Falcone, 2020). Banks with a larger green financing portfolio are better positioned to meet these regulatory obligations, thereby reducing compliance risks, and ensuring long-term sustainability in their operations (Dikau & Volz, 2021). Moreover, the expansion of green financing portfolios attracts environmentally conscious investors. In recent years, there has been a

growing trend of investors seeking financial opportunities that align with their sustainability values (Azman & Ali, 2019). By offering green financial products and services, banks can tap into this investor demand, expanding their customer base and potentially accessing additional sources of capital for future investments (Clark et al., 2018). This not only strengthens the financial position of the bank but also provides a platform for fostering sustainable economic growth.

In conclusion, green financing is a crucial component of sustainable finance, supporting environmentally friendly projects and initiatives. Banks with a larger green financing portfolio actively contribute to reducing carbon emissions, promoting sustainable development, and aligning with regulatory requirements. The benefits extend beyond environmental impact, encompassing reputational advantages, investor appeal, and regulatory compliance. As the importance of sustainability grows, expanding green financing portfolios becomes a strategic imperative for financial institutions seeking to align profitability with environmental responsibility.

### 2.3. *CO2 Emission in Transportation*

The transportation sector stands as a major contributor to global carbon dioxide (CO2) emissions, largely attributed to its heavy reliance on fossil fuels and inefficient transport systems. Recognizing the urgent need to address climate change, several studies have explored the role of financial institutions in reducing CO2 emissions within the transportation sector (Ballot & Fontane, 2010); (Timilsina & Shrestha, 2009). Several of prior Research has indicated a positive association between financial institutions with a strong focus on sustainable financing and their support for low-carbon transportation projects (Kong, 2022). Banks that prioritize sustainable finance are more inclined to allocate funds towards initiatives that promote environmentally friendly transportation alternatives. This includes investments in electric vehicles, public transportation systems, and the development of sustainable mobility infrastructure. One area where financial institutions play a crucial role is in supporting the adoption of electric vehicles (EVs) (Tabelin et al., 2021). By providing financing options and incentives for the purchase and use of EVs, banks contribute to the reduction of CO2 emissions from traditional gasoline-powered vehicles. This support helps accelerate the transition to cleaner transportation and encourages individuals and businesses to choose more sustainable alternatives.

Furthermore, financial institutions can play a vital role in supporting the development and improvement of public transportation systems. Investments in efficient, affordable, and sustainable public transportation infrastructure can significantly reduce the number of private vehicles on the road, leading to lower overall emissions (Patil, 2021); (Shah et al., 2021). By providing financial backing for such projects, banks can contribute to the expansion and improvement of public transportation networks, making them more accessible and appealing to commuters. Sustainable mobility infrastructure is another area where financial institutions can make a difference. Investments in infrastructure projects that facilitate walking, cycling, and other forms of sustainable transportation help reduce the reliance on carbon-intensive modes of transportation (Mittal & Woodside, 2022). By allocating funds towards the development of bike lanes, pedestrian-friendly walkways, and integrated transportation systems, financial institutions contribute to creating more sustainable and environmentally friendly urban environments (Mittal & Woodside, 2022).. The allocation of funds towards these sustainable transportation initiatives by financial institutions can result in a significant reduction in CO2 emissions within the transportation sector. By supporting the shift towards low-carbon alternatives and promoting the adoption of sustainable transportation practices, banks actively contribute to mitigating climate change and fostering a greener future.

In conclusion, financial institutions have a vital role to play in reducing CO2 emissions in the transportation sector. By prioritizing sustainable financing and allocating funds towards low-carbon transportation projects, such as electric vehicles, public transportation systems, and sustainable mobility infrastructure, banks can help drive the transition to cleaner and more environmentally

friendly transportation options (Rodríguez-García et al., 2022). Through their support, financial institutions actively contribute to the global efforts to combat climate change and create a more sustainable future.

### *2.4. Existing Research*

Several studies have explored the connection between ROA, green financing portfolios, and CO2 emissions in the transportation sector. For example, research has shown that banks with higher ROA are more inclined to allocate funds to sustainable transportation projects, resulting in reduced CO2 emissions. These findings suggest that financial performance and sustainable finance are interconnected, with positive financial outcomes supporting green portfolio expansion and carbon reduction efforts. Furthermore, studies have identified various factors influencing the association between ROA, green financing portfolios, and CO2 emissions in transportation. These factors include regulatory frameworks, government policies, stakeholder pressures, and institutional factors. Understanding these factors can help policymakers and financial institutions develop strategies to encourage sustainable financing and mitigate CO2 emissions in the transportation sector.

## III. RESEARCH METHOD

This study aims to analyze the effect of the Green Financing Portfolio on Return on Assets (ROA), Return on Equity (ROE), Net Interest Margin (NIM), and Operating Costs to Operating Income (BOPO), and examine the level of CO2 emissions in the transportation sector. This research uses descriptive quantitative research methods. The data used will be analyzed statistically to test the relationship between the variables involved. The sample in this study is a company that implements a sustainable funding portfolio (Green Financing Portfolio) in this case is PT Bank Mandiri as one of the state-owned banks in Indonesia. The research sample will be selected using purposive sampling technique, with the inclusion criteria of transportation companies that actively use sustainable funding and have complete financial data. The data used in this study will be sourced from the financial statements of transportation companies and CO2 emissions data available from 2016 to 2022. Financial statement data includes information on ROA, ROE, NIM, and BOPO, while CO2 emissions data is obtained from reliable sources such as official reports or related research. The collected data will be analyzed using content analysis in the form of the results of Bank Mandiri's financial statements from 2016 to 2022 which are then illustrated in the form of graphs.

## IV. RESULT AND DISCUSSION

### *4.1. Data Description*

In our research, we sought to analyze the relationship between financial performance and green bonds, as well as green financing portfolios. However, we faced challenges in finding relevant references related to the use of regression analysis that is commonly used in quantitative research in finance.

When we searched for literature that could be used as a reference to apply regression analysis to the relationship between financial performance and green bonds, we did not find many sources that were relevant and appropriate to our research context. This may be since research on the relationship is still in its infancy and specialized research using regression analysis approaches may not have been conducted. However, we remain committed to presenting our data objectively and explaining the relationship between the variables we examined. To overcome these limitations, we decided to present our data in the form of content analysis and causality graphs. Through content

analysis, we drew in-depth information from relevant sources and identified important patterns or findings that could illustrate the relationship between financial performance and green bonds.

In addition, we use graphs and data visualizations to present our results more clearly and facilitate understanding. Causality graphs help illustrate the relationships between the variables we examine, although they do not use a direct regression analysis approach. This allows readers and stakeholders to visually understand those relationships and identify possible patterns or trends. While the use of regression analysis is not directly applicable in our study, we still try to present our results in a valid and informative way. In Table 1 we illustrate the financial statement data related to the financial performance of Bank Mandiri, Indonesia from 2016 - 2022.

**Table 1. Financial Performance Ratios of Bank Mandiri, Indonesia**

| Year | ROA | ROE | NIM | BOPO |
|---|---|---|---|---|
| 2016 | 1,95 | 11,12 | 6,29 | 80,94 |
| 2017 | 2,72 | 14,53 | 5,63 | 71,78 |
| 2018 | 3,17 | 16,23 | 5,52 | 66,48 |
| 2019 | 3,03 | 15,08 | 5,46 | 67,44 |
| 2020 | 1,64 | 9,36 | 4,48 | 80,03 |
| 2021 | 2,53 | 16,24 | 4,73 | 67,26 |
| 2022 | 3,30 | 22,62 | 5,16 | 57,35 |

In general, the data in Table 1 provides an overview of the financial performance of Bank Mandiri, Indonesia from the perspectives of ROA, ROE, NIM, and BOPO over the time presented. The data can be interpreted that:

1. ROA (Return on Assets): Shows the efficiency with which the company's assets are used to generate profits. The higher the ROA number, the more efficient the company is in utilizing its assets. In the table, ROA increased from 2016 to 2018, peaked in 2018, and then fluctuated in the following years.
2. ROE (Return on Equity): Measures the rate of return on the company owner's equity. A high ROE indicates that the company is successfully generating good returns for its owners. In the table, ROE also increases over time, with annual fluctuations.
3. NIM (Net Interest Margin): This is the difference between the interest income received by the company and the interest paid on loans and funds received from customers. A high NIM indicates that the company is able to maximize interest income. In the table, NIM shows a downward trend from 2016 to 2022.
4. BOPO (Operating Expenses to Operating Income): Shows the extent to which operating expenses affect the company's operating income. A low BOPO indicates efficiency in managing operating costs. In the table, BOPO shows a downward trend over time.

Furthermore, Table 2 presents data in the form of Green Bond Bank Mandiri, Indonesia and CSR allocation of Bank Mandiri, Indonesia since the period 2016-2022.

**Table 2. Green Bond and CSR Allocation Report of Bank Mandiri, Indonesia (In Billion Rupiah)**

| Year | Green Bond | CSR |
|---|---|---|
| 2016 | 131,9 | 63,43 |
| 2017 | 141 | 118,88 |
| 2018 | 182,3 | 114,52 |
| 2019 | 208,9 | 150,17 |
| 2020 | 204 | 133,90 |
| 2021 | 224,6 | 132,37 |

| | | |
|---|---|---|
| 2022 | 250,2 | 137,60 |

Green Bond in table 2 shows a number that reflects the amount of funds obtained from the issuance of Green Bond by companies in certain years. This number reflects the level of investor interest in supporting environmentally friendly projects through Green Bond. The data in the table shows a significant increase from 2016 to 2022, with the amount of funds obtained increasing from 131.9 to 250.2 (in billion rupiah). Meanwhile, CSR (Corporate Social Responsibility) shows numbers that reflect the implementation of CSR by companies in certain years. While it is not explained in detail what this figure represents, a possible assumption is that it reflects the amount invested or allocated by companies for various CSR initiatives. The data in the table shows annual fluctuations, but with a general trend of increase from 2016 to 2022.

During the period of 2016 to 2022, Bank Mandiri Indonesia has allocated funds in Corporate Social Responsibility (CSR) programs for various areas that have a positive impact on society and the environment. Significant CSR allocations have been made in various important sectors, reflecting Bank Mandiri's commitment to contributing to sustainable development and community welfare.

One of the areas that receives special attention in Bank Mandiri's CSR allocation is the Environment/Nature Preservation Sector. To preserve nature, Bank Mandiri has supported projects that focus on reforestation, environmental conservation, carbon emission reduction, and natural resource protection. Through the allocation of CSR funds, Bank Mandiri plays an active role in maintaining biodiversity, reducing negative impacts on the environment, and encouraging awareness about the importance of nature conservation. Health is also an important focus in Bank Mandiri's CSR allocation. Bank Mandiri recognizes that health is a fundamental right of every individual, and through its CSR programs, it supports public health initiatives that include improving access to health services, education on health, development of health infrastructure, and support on disease prevention and treatment efforts. In addition, Bank Mandiri also pays attention to Public Facilities and Worship. To improve the quality of life of the community, Bank Mandiri has contributed to the development of public infrastructure such as the construction of sports facilities, educational facilities, and the improvement of places of worship. Through this, the Bank supports equitable access and quality improvement of public facilities and facilitates religious activities that are important to the community. In situations of natural disasters, Bank Mandiri also pays serious attention through CSR allocations in the Natural Disaster Sector. Bank Mandiri has been involved in disaster management and post-disaster recovery efforts by aiding with disaster victims, supporting infrastructure reconstruction, and developing effective disaster response programs.

Poverty alleviation and social community development are the focus of Bank Mandiri's Social Community Development Program. Through its CSR programs, Bank Mandiri has supported initiatives aimed at reducing poverty levels, improving community welfare, and strengthening the competitiveness of local economies. This includes community economic empowerment through skills training, provision of business capital to vulnerable groups, and support to poverty alleviation programs that include the provision of social assistance, scholarships, and assistance in developing micro and small businesses.

Lastly, the education sector is also a major concern for Bank Mandiri in its CSR allocation. Bank Mandiri recognizes the importance of education in advancing society and creating equal opportunities. Through its CSR programs, Bank Mandiri has committed to support inclusive and quality education. This includes the construction of educational facilities, increasing educational accessibility for children from underprivileged families, developing innovative curricula, and providing scholarships to outstanding but financially underprivileged students. Furthermore, Table 3 presents the report data on Bank Mandiri's Green Financing allocation portfolio from 2016 to 2022.

**Table 3. Green Financing Portfolio of Bank Mandiri, Indonesia (In Billion Rupiah)**

| Year | Renewable energy | Pollution Prevention & Control | Environmentally sustainable management of living natural resources and land use | Clean transportation | Sustainable water & wastewater management | Eco-efficient/circular economy adapted products, production technologies & processes | Green Buildings | Total Green Financing Portofolio |
|---|---|---|---|---|---|---|---|---|
| 2016 | 2.487 | 0 | 3.186 | 5.622 | 0 | 0 | 0 | 11,295 |
| 2017 | 3.068 | 0 | 3.186 | 6.522 | 0 | 0 | 0 | 12,776 |
| 2018 | 4.372 | 0 | 0 | 6.491 | 0 | 0 | 0 | 10,863 |
| 2019 | 1.350 | 136 | 57.539 | 0 | 245 | 0 | 0 | 59,27 |
| 2020 | 2.540 | 21 | 74.948 | 1.408 | 1.200 | 0 | 307 | 80,424 |
| 2021 | 4.281 | 0 | 88.537 | 2.028 | 1.214 | 0 | 205 | 96,265 |
| 2022 | 6.149 | 92,956 | 3.107 | 867 | 3.307 | 0 | 16 | 13,539 |

Table 3 displays data on the allocation of funds in the Green Financing Portfolio in various sectors that contribute to environmental sustainability. Each column shows the amount of funds allocated in specific years to each sector related to environmental conservation efforts. Below is the interpretation of each column in the table:

1. Renewable energy: This data shows the amount of funding allocated to renewable energy projects. This includes investments in environmentally friendly energy sources such as solar energy, wind energy, biomass energy, and hydroelectric energy. The data in the table shows an increase in funding allocations from 2016 to 2022, indicating a greater commitment to developing the renewable energy sector.
2. Pollution Prevention & Control: This data shows the amount of funding allocated for pollution prevention and control. This can include investments in technologies and systems to reduce pollutant emissions, manage waste, and mitigate negative impacts on the environment. In the table, the data shows the allocation of funds that vary from year to year.
3. Environmentally sustainable management of living natural resources and land use: This column shows the amount of funds allocated for environmentally sustainable management of living natural resources and land use. This includes efforts to conserve biodiversity, sustainable forest management, control deforestation, and environmentally friendly agricultural practices. The data in the table shows fluctuations in the allocation of funds from year to year.
4. Clean transportation: This data shows the amount of funds allocated to clean transportation. This includes investments in sustainable transportation such as electric vehicles, environmentally friendly recharging infrastructure, and the development of more efficient and low-emission transportation systems. The data in the table shows the increase in funding allocation from 2016 to 2022.
5. Sustainable water & wastewater management: This data shows the amount of funding allocated for sustainable water management and wastewater treatment. This includes investments in water management infrastructure, water conservation, waste treatment, and

efforts to protect aquatic ecosystems. The data in the table shows an increase in funding allocation from year to year.

6. Eco-efficient/circular economy adapted products, production technologies & processes: This data shows the amount of funds allocated to environmentally friendly and sustainable products, production technologies, and processes. This includes investments in the development of more ecologically efficient products, production technologies that reduce environmental impact, and the application of circular economy principles. The data in the table shows fluctuations in the allocation of funds from year to year.
7. Green Buildings: This data shows the amount of funds allocated for the construction of green buildings. This includes investments in environmentally friendly building design and construction, energy efficiency, use of renewable materials, and reduction of construction waste. The data in the table shows fluctuations in the allocation of funds from year to year.
8. Total Green Financing Portfolio: This data shows the grand total of allocated funds in the green financing portfolio. It covers all the sectors listed above and provides an overall picture of investments in projects that contribute to environmental sustainability. The data in the table shows the fluctuation of total fund allocation from 2016 to 2022.

In interpreting table 3, it can be observed that most sectors saw an increase in funding allocations year-on-year, indicating a greater commitment to environmental sustainability. Some sectors, such as renewable energy and water management, showed significant increases in funding allocations, reflecting a focus on environmentally friendly solutions.

### *4.2. Causality Between BOPO, NIM, ROE, ROA, and CSR*

Although the quantitative research literature that directly analyzes the causality between BOPO, NIM, ROE, ROA, and CSR is limited, there are still ways to illustrate these interrelationships by analyzing the content of financial statements and presenting them in graphical form. This approach can provide insight into how the variables are interrelated and how changes in one variable can affect the others. In financial statement content analysis, we can see trends and patterns emerging from the data recorded in a company's financial statements from year to year. For example, we can see how BOPO, NIM, ROE, ROA, and CSR evolve over time and whether there is a link between changes in these values.

In Figure 1, BOPO, NIM, ROE, ROA, and CSR can be represented as a timeline showing the change in values from year to year. Using this graph, we can compare the changes in these variables and see if there is a discernible pattern. The graph can provide a clearer visual picture of the interrelationship between BOPO, NIM, ROE, ROA, and CSR and how changes in one variable can affect the other. While it cannot provide direct causal inferences, analyzing financial statement content in graphical form can help identify trends and patterns and gain initial insights into the relationships between these variables.

Theory states that the higher the BOPO, the less efficient the company is in managing its operating costs. This can have a negative impact on the company's profitability, such as ROE and ROA. However, there is no direct causal relationship between BOPO and CSR. Furthermore, theoretically the higher the NIM, the higher the profitability of the company. The increase in profitability can have a positive impact on ROE and ROA, but there is no direct causal relationship between NIM and CSR. In theory, however, good financial performance reflected in ROE may provide companies with greater resources to allocate funds for CSR. However, ROE can also be influenced by other factors beyond CSR. In theory, if ROA increases, companies have the potential to allocate more resources to CSR. However, like ROE, ROA is also affected by other factors that are not directly related to CSR.

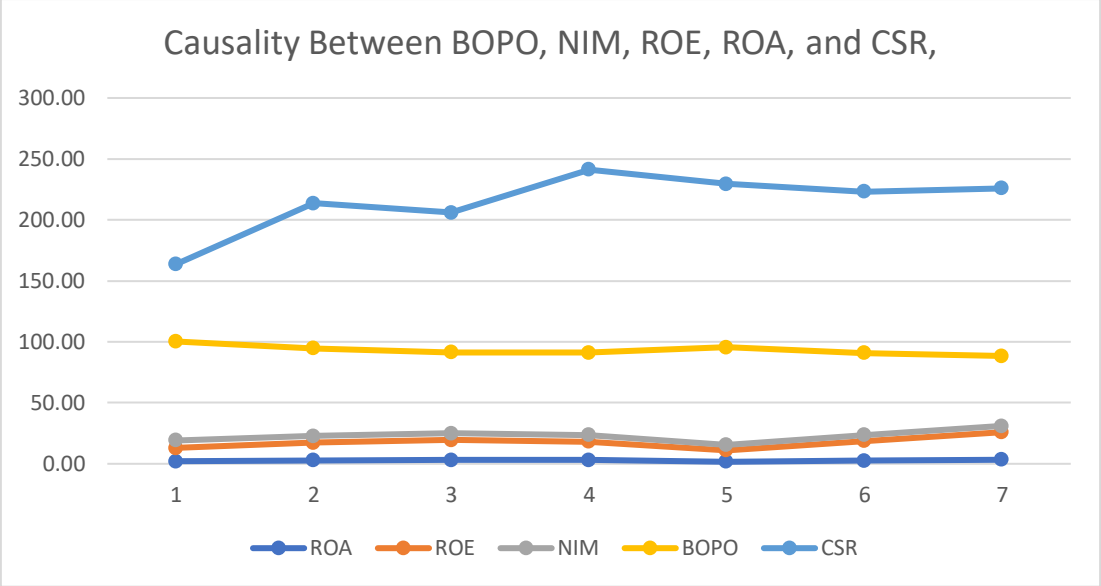


**Figure 1. Causality Between BOPO, NIM, ROE, ROA, and CSR**

In the context of the relationship between ROA, ROE, NIM, BOPO, and CSR, it is important to remember that the causality and relationship between these variables can be very complex and influenced by various external and internal factors. There is no definitive conclusion on the direct relationship between these variables as it can vary between different companies and industry sectors. However, in general, it is argued that good financial performance, such as high ROA and ROE, can provide companies with greater resources to allocate funds for CSR. If companies can generate high profits and are efficient in the use of their assets, they have a greater financial ability to set aside funds for CSR initiatives. However, based on the illustrated explanation, it can be assumed that companies that perform well financially may gain a better reputation in the eyes of stakeholders and society. In this case, companies may feel the need to participate in CSR activities as an effort to maintain a good image and gain support from society.

### *4.3. Causality Between Green Bond, Green Financing Portofolio and CO2 Emmision in Transportation*

Figure 2 illustrates the causality between Green Bond, Green Financing Portfolio of Bank Mandiri from 2016 to 2022 and compares the progress of CO2 Emissions in transportation nationally in the same period. The graph aims to see the extent to which ESG effects have an impact on reducing carbon emissions in the transportation sector in Indonesia.

Figure 2 shows the development of Green Bond and Green Financing Portfolio issued by Bank Mandiri from 2016 to 2022. The Green Bond and Green Financing Portfolio reflects Bank Mandiri's commitment in supporting sustainable and environmentally friendly projects, including projects in the transportation sector that contribute to the reduction of CO2 emissions. In addition, the graph also shows the development of CO2 emissions in the transportation sector in Indonesia during the same period. This data reflects the amount of CO2 emissions generated by the transportation sector nationwide. By looking at Figure 2, it can be observed whether there is a relationship between the increase in Green Bond, Green Financing Portfolio, and changes in CO2 emissions in the transportation sector. If there is a significant relationship between the increase in Green Bond and Green Financing Portfolio and the decrease in CO2 emissions in the transportation sector, this will show that the efforts of banks in supporting sustainable projects have had a positive impact in reducing carbon emissions.

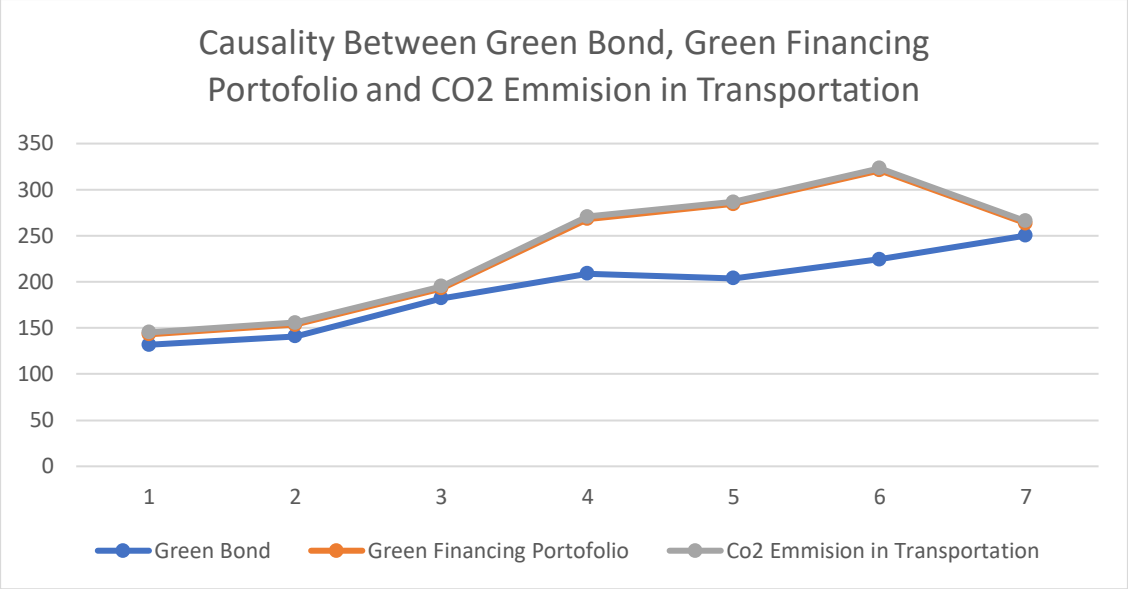


**Figure 2. Causality Between Green Bond, Green Financing Portofolio and CO2 Emmision in Transportation**

From the data generated in Figure 2, there is a significant relationship between the increase in Green Bond and the increase in allocation of Green Financing Portfolio by Bank Mandiri, Indonesia. The graph shows that as the number of Green Bonds issued since 2016 increased, there was also a significant increase in the allocation of funds for Green Financing Portfolio by Bank Mandiri. This shows the strong awareness and commitment of Bank Mandiri in supporting sustainable and environmentally friendly projects through Green Bond issuance. Green Bond provides the necessary funding source to support projects that contribute to the reduction of CO2 emissions and environmental protection. In addition, the data on the graph also shows that the increase in Green Financing Portfolio follows the same trend as the resulting Green Financing effect. That is, the more Green-Bond issued by Bank Mandiri, the greater the allocation of funds allocated to the Green Financing Portfolio. This indicates that an increase in Green Bond directly impacts the increase in funds available to finance sustainable projects in the transportation sector and other sectors. In this context, an increase in the Green Financing Portfolio also means an increase in investment in projects aimed at reducing CO2 emissions in the transportation sector. This reflects Bank Mandiri's significant role in supporting carbon emission reduction efforts and driving the shift towards greener transportation in Indonesia.

In conclusion, the data in Figure 2 shows a close relationship between the increase in Green Bond, Green Financing Portfolio allocation, and CO2 emission reduction efforts in the transportation sector. Bank Mandiri as a financial institution has played an important role in supporting sustainable projects through the issuance of Green Bond and allocation of funds for Green Financing Portfolio. By doing so, they contribute significantly to reducing carbon emissions and driving positive change in the transportation sector towards a cleaner and more sustainable environment.

### *4.4. Discussion*

Green Bonds are financial instruments issued to finance sustainable and environmentally friendly projects. The Green Financing Portfolio reflects the allocation of funds allocated to these projects. The causality between Green Bond and Green Financing Portfolio can be seen from the cause-and-effect relationship formed between the two. The issuance of Green Bonds by financial institutions, such as Bank Mandiri in Indonesia, provides the necessary resources to support sustainable projects in the

transportation sector. Green Bond attracts investors who are concerned about environmental issues to invest in projects that contribute to the reduction of CO2 emissions, such as the development of electric vehicles or environmentally friendly recharging infrastructure. In this sense, the Green Bond serves as a catalyst in increasing the allocation of funds to sustainable projects in the Green Financing Portfolio.

In the context of Bank Mandiri, the results of the data demonstration show that the increase in Green Bond, which began in 2016, has a significant impact on increasing the allocation of funds for the Green Financing Portfolio. In other words, the more Green-Bond issued, the greater the allocation of funds allocated for sustainable projects to reduce CO2 Emission in the transportation sector. This shows that Green Bond has a positive causality on Green Financing Portfolio. In this case, the causality between Green Financing Portfolio and CO2 Emission can be explained through the influence of investment in green technology and sustainable practices. With significant funds allocated through the Green Financing Portfolio, companies and institutions can implement projects that aim to reduce CO2 emissions in the transportation sector. For example, investments in the development of electric vehicles, environmentally friendly recharging infrastructure, or the use of cleaner alternative fuels. Through these projects, a significant reduction in CO2 emissions in the transportation sector is expected.

What Bank Mandiri is doing as one of the three state-owned banks in Indonesia that is currently a pioneer in terms of ESG provides an indication that the increase in Green Financing Portfolio goes hand in hand with the downward trend in CO2 emissions in transportation. From 2016 to 2022, along with the increased allocation of funds for sustainable projects, there has been progress in reducing CO2 emissions in the transportation sector in Indonesia. This suggests a positive causality between the Green Financing Portfolio and the reduction of CO2 emissions in transportation. In this context, the Green Financing Portfolio acts as a key driver in allocating funds to sustainable projects that contribute to the reduction of CO2 emissions. Investments made through the Green Financing Portfolio encourage the adoption of green technologies, sustainable innovations, and greener practices in the transportation sector. Thus, there is a positive causality between the Green Financing Portfolio and CO2 emission reduction.

Managerial Implications: The causality established between Green Bond, Green Financing Portfolio, and CO2 Emissions in transportation has significant implications for environmental sustainability. First, through Green Bond issuance, financial institutions such as Bank Mandiri can mobilize the necessary resources to support sustainable projects in the transportation sector. This strengthens the commitment to accelerate the shift to greener transportation. Second, the increased allocation of funds through the Green Financing Portfolio provides opportunities for companies and institutions to implement sustainable projects. Investments in green technologies and sustainable practices in the transportation sector have the potential to significantly reduce CO2 emissions. In addition, it can also encourage innovation and development of more efficient and environmentally friendly transportation solutions. Third, the positive causality between the Green Financing Portfolio and CO2 emission reductions suggests that efforts to reduce the environmental impact of the transportation sector can be successful through proper allocation of funds. By increasing investment in sustainable projects, such as green infrastructure development or the use of renewable energy in transportation, significant reductions in CO2 emissions can be achieved.

In the context of Green Bond, there is a positive causality between the issuance of Green Bond by Bank Mandiri and the increased allocation of funds for sustainable projects in the Green Financing Portfolio. This suggests that the Green Bond serves as a catalyst in increasing investment in sustainable projects in the transportation sector. In addition, the adoption of Green Bond and Green Financing Portfolio also has a broader positive impact. Investment in sustainable projects in the transportation sector can drive sustainable economic growth, create new jobs, and increase innovation in the

transportation industry. This is in line with the concept of sustainable development that integrates environmental, social, and economic aspects.

## V. Conclusion

In the Indonesian context, Bank Mandiri's adoption of the Green Bond and Green Financing Portfolio is a positive step in supporting environmental sustainability in the transportation sector. However, to achieve greater change, more involvement of other financial institutions and the private sector is required. The causality between Green Bond, Green Financing Portfolio, and CO2 Emissions in transportation provides a strong foundation in supporting environmental sustainability in the transportation sector. Through Green Bond issuance and increased allocation of funds in the Green Financing Portfolio, investments in sustainable projects can reduce CO2 emissions, advance green technologies, and drive innovation in transportation. However, to ensure the sustainability and effectiveness of efforts in reducing CO2 emissions in transportation, further steps are needed. First, it is important to continue to increase the number of Green Bonds issued and the allocation of funds in the Green Financing Portfolio. This can be done through collaboration between financial institutions, government, and the private sector to mobilize investment in sustainable projects in the transportation sector. Furthermore, there needs to be transparent monitoring and reporting regarding the use of funds in the Green Financing Portfolio. Financial reports and information related to projects funded by Green Bonds should be easily accessible and verifiable. This will provide confidence to investors and the public about the effectiveness of the use of funds in reducing CO2 emissions in transportation.

In addition, it is important to continue innovating green technologies and sustainable solutions in the transportation sector. The development of more efficient electric vehicles, wider recharging infrastructure, and the implementation of policies that support the use of environmentally friendly public transportation can make a significant contribution to reducing CO2 emissions. Furthermore, there is a need for cross-sector and cross-country cooperation in promoting and encouraging the adoption of Green Bonds and Green Financing Portfolios. Experience exchange, technology transfer, and training on best practices in supporting sustainable projects in the transportation sector can accelerate the shift towards greener transportation at the global level. In addition, public education and awareness also play an important role in creating environmental sustainability in the transportation sector. Easy-to-understand information about the benefits of using sustainable transportation and individual contributions to reducing CO2 emissions can motivate people to adopt greener travel habits. Finally, it is important to continue to evaluate and research the impact of Green Bond and Green Financing Portfolios on reducing CO2 emissions in transportation. In-depth quantitative and qualitative studies can provide better insights into the effectiveness of policies and measures that have been implemented, as well as assist in better decision-making for the future.

## VI. Limitations and Future Research Agenda

While our study has provided an initial understanding of the causality between Green Bond, CSR, Financial Performance, Green Financing Portfolio, and their effects on CO2 Emissions in Transportation nationwide, we realize that there are several shortcomings in this study that limit the interpretations and conclusions that can be drawn. First, this study relies on data interpretation based on visual graphs of financial statements and sustainability reports. While this provides a rough idea of the relationship between the observed variables, a more comprehensive study still has enormous opportunities to be implemented. Secondly, in the context of sustainability reporting, there are challenges in terms of consistency and assessment standards. In our study, we relied on a limited

number of sustainability reports available from companies. In addition, there are no consistent standards in sustainability reporting in Indonesia, which limits uniformity and comparability between companies. For future research, it is important to consider using more consistent frameworks and standards to facilitate cross-company analysis. Third, this study is also limited to one banking subject in Indonesia. Although Bank Mandiri is one of the largest banks in Indonesia and has a commitment to sustainability, it cannot be considered representative of the entire banking sector and its influence on reducing CO2 emissions in the transportation sector nationwide. Research involving more companies in different sectors is needed to gain a more comprehensive understanding of the impact of ESG and sustainable fund allocation on CO2 emission reduction in transportation.

In the face of these limitations, our study proposes several recommendations for future research. First, the use of more advanced quantitative analysis methods, such as panel regression or path analysis, can help measure the causal impact between the variables studied more accurately. Second, it is important to expand the scope of companies involved in the study to obtain more representative data and represent various industry sectors. Third, standardization and harmonization efforts in sustainability reporting should be encouraged, allowing for easier benchmarking and cross-company analysis.

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# 2. Bukti konfirmasi review dan hasil review pertama (18 November 2023)

# Causality of Bank Financial Performance, Green Bond, CSR, Green Financing Portfolio and CO2 Emissions in Transportation: Evidence from Indonesia

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**Abstract**

This study aims to identify the causality between bank financial performance measured by Return on Assets (ROA), Return on Equity (ROE), Net Interest Margin (NIM), and Operating Expenses to Operating Income (BOPO) with Green Financing Portfolio and CO2 emissions in the transportation sector. This study uses descriptive quantitative research methods and content analysis of the Sustainability Report of Bank Mandiri, Indonesia for the period 2016 to 2022. In this study, we collected data from Bank Mandiri's financial statements which included information on ROA, ROE, NIM, and BOPO. In addition, we also collected CO2 emission data available from 2016 to 2022. The research sample is Bank Mandiri as one of the state-owned banks in Indonesia. We used purposive sampling technique to select samples that meet the inclusion criteria. The collected data was then analyzed using statistical methods to test the relationship between the variables involved, namely the bank's financial performance (ROA, ROE, NIM, and BOPO), Green Financing Portfolio, and CO2 emissions in the transportation sector. We use content analysis to illustrate the results of Bank Mandiri's financial statements in graphical form. The results of the analysis show that the increase in Green Bond that started in 2016 has a significant impact on the increase in fund allocation for Green Financing Portfolio. This indicates a positive causality between Green Bond and Green Financing Portfolio. In this context, the causality between Green Financing Portfolio and CO2 emissions can be explained through the influence of investment in green technology and sustainable practices. With significant funds allocated through the Green Financing Portfolio, companies and institutions can implement projects that aim to reduce CO2 emissions in the transportation sector. This means that the use of Green Bond as a sustainable funding source has the potential to reduce the negative impact of transportation on the environment.

**Keywords:** Green Bond, Green Financing Portofolio, Financial Performance, CO2 Emision in Transportation.

**JEL Classifications: Q56, G21, G32, M14**

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## I. INTRODUCTION

In an increasingly environmentally conscious era, green finance has emerged as a financial initiative that focuses on sustainable and environmentally friendly investments. The green finance narrative illustrates how the financial sector can be a positive force in promoting sustainable economic growth and protecting the environment (Wang et al., 2023). Green finance encompasses a wide range of financial instruments designed to support environmentally friendly projects, such as renewable energy, energy efficiency, good water management, forest protection, and sustainable transportation (Falcone, 2020). In this study, we can see how green finance provides solutions to today's environmental challenges, while creating profitable business opportunities. Green finance plays a key role in driving a paradigm shift in how we view investment and economic growth (Ainou et al., 2023). With increasing awareness of the negative impact of human activity on the environment, financial market participants are increasingly recognizing the importance of considering environmental, social, and governance (ESG) factors in their investment decisions (Serrano-García et al., 2023). The green finance narrative also highlights the importance of collaboration between governments, financial institutions, companies, and communities to create an ecosystem that supports sustainable investments. Initiatives such as the issuance of green bonds, whose proceeds will be used for environmental projects, as well as the establishment of financial institutions that specialize in funding sustainable projects, are examples of successful collaboration in advancing green finance (Asiri et al., 2020).

In particular, the Government of Indonesia encourages the development of ESG through relevant policies and regulations. For example, the Indonesian government launched the Green Finance Initiative and created the Sustainable Financial Reporting Guidelines. This aims to provide guidance and a framework for companies to report on their performance in terms of environmental, social, and corporate governance (Liebman et al., 2019). In addition, there is also the development of institutions and initiatives that support ESG development in Indonesia. For example, the establishment of the Indonesian Sustainable Finance Initiative (ISFI) which is a consortium of banks and financial institutions to promote sustainable finance practices in Indonesia (Setyowati, 2023); (Volz, 2018). ISFI works with various parties, including the government, companies, and civil society, to increase understanding and awareness of ESG. The Indonesian government has also encouraged more transparent and comprehensive ESG reporting. In 2020, the Indonesia Stock Exchange (IDX) introduced mandatory guidelines for listed companies to report ESG information periodically. The move aims to provide stakeholders with a clearer picture of companies' ESG performance and encourage companies to improve their business practices. However, of the 10 state-owned banks in Indonesia, only 3 banks have implemented ESG reporting, namely Bank BNI, Bank BRI, and Bank Mandiri until 2023. So it can be assumed that in the midst of the world program on ESG to support sustainability, Indonesia until 2023 is still in the stage of development and improvement (OJK, 2021).

There are various key issues that need to be addressed in the development of green finance in Indonesia, for example, first, many market participants do not fully understand the concepts and benefits of green finance (Katadata Center Insight, 2022), so there needs to be wider education to encourage the adoption and implementation of sustainable practices (Ņikitina et al., 2022). Second, inconsistent ESG performance measurement and reporting standards are still a challenge in Indonesia (Prihandono & Yuniarti, 2023); (Kamil et al., 2021). Third, there is a lack of availability of sustainable financial instruments, such as sustainable loans and sustainable mutual funds, that can support the financing of green projects (Guild, 2020). Fourth, Indonesia has a great need for sustainable infrastructure development, such as renewable energy, environmentally friendly transportation, and waste management which is certainly not cheap (Ronaldo & Suryanto, 2022). Fifth, greater awareness and incentives are needed for companies to integrate ESG factors in their decision-making and daily

operations (Maniora, 2017). Therefore, to address these challenges, cooperation between the government, financial institutions, companies, and civil society is needed. Measures that can be taken include the provision of greater fiscal incentives for sustainable projects, increased awareness and education on green finance, the development of clear standards and frameworks, and increased collaboration and partnerships between different stakeholders (Hafner et al., 2020); (Clark et al., 2018).

This study aims to identify the relationship between bank financial performance as measured by Return on Assets (ROA), Return on Equity (ROE), Net Interest Margin (NIM), and Operating Expenses to Operating Income (BOPO) with Green Financing Portfolio and CO2 emissions in the transportation sector. This research has significant relevance given the challenges faced by the financial and transportation sectors in achieving sustainable development goals (Schroeder et al., 2019); (Zhan & Santos-Paulino, 2021); (Litvinenko et al., 2022). There are several research gaps that need to be filled in this context. First, the relationship between bank financial performance and sustainable funding portfolios is still not fully understood (Badía et al., 2019); (Iazzolino et al., 2023); (Atz et al., 2023); (Mirza et al., 2023). While several studies have investigated the impact of financial performance on sustainable funding decisions, there is still a lack of understanding on how ROA, ROE, NIM, and BOPO specifically relate to sustainable funding portfolios.

Second, the effect of financial performance on CO2 emissions in the transportation sector has not been widely studied (Abid et al., 2022). While banks and financial institutions are increasingly interested in minimizing the environmental impact of their funding portfolios, the relationship between financial performance and CO2 emissions in the transportation sector remains unclear. This study will investigate whether banks' financial performance has an impact on investment decisions in environmentally friendly transportation and to what extent it can reduce CO2 emissions. In addition, this study will also examine the role of financial intermediation in promoting sustainable financing and CO2 emission reduction in the transportation sector. This relates to the influence of NIM and BOPO on sustainable funding portfolios as well as CO2 emissions (Nugrahaeni & Muharam, 2023). Through this analysis, this research will contribute a new understanding of how banks' financial performance can impact responsible and sustainable financial practices, as well as their impact on the environment.

The research methodology will involve the analysis of secondary data from banks' financial statements as well as transportation sector data related to CO2 emissions. The use of statistical regression will enable the identification of causal relationships between ROA, ROE, NIM, BOPO, and sustainable funding portfolio and CO2 emissions. The research may also include a case study of bank Mandiri as an Indonesian state-owned bank that has implemented a sustainable funding strategy and reduced CO2 emissions in the transportation sector. By filling this research gap, it is hoped that this research can provide important insights for the financial and transportation sectors in driving the transition to a low-carbon and sustainable economy. The results of this study can serve as a basis for banks and financial institutions to develop more effective policies and strategies in integrating environmental aspects in their funding decisions.

In addition, the findings of this study may also benefit regulators and governments in developing policies that encourage the adoption of sustainable finance and the reduction of CO2 emissions in the transportation sector. With a better understanding of the relationship between financial performance and environmental impact, more effective policy measures can be taken to encourage positive changes in the financial and transportation sectors. The research can also identify potential obstacles or barriers that may be faced in implementing sustainable finance and reducing CO2 emissions in the transportation sector. In this regard, the research can provide recommendations and solutions to address these challenges, such as the development of financial instruments that support sustainable investment, the engagement of key actors in the industry, and government policies that encourage

the transition to greener transportation. Overall, this research will fill an important knowledge gap in relation to the linkages between bank financial performance (ROA, ROE, NIM, BOPO), sustainable financing portfolio, and CO2 emissions in the transportation sector. Through this research, a more comprehensive understanding of the role of the financial sector in promoting sustainable development and reducing greenhouse gas emissions in the transportation sector is expected.

In our research, we sought to analyze the relationship between financial performance and green bonds, as well as green financing portfolios. However, we realized that there was limited relevant data and information that we could find in the available literature and sources. While there have been studies addressing financial performance and sustainable financial instruments such as green bonds, we conclude that ours is the first study that attempts to comprehensively examine this aspect by involving the comparison of banking performance ratios through Sustainability reports to the effect of carbon emission reduction on the transportation sector nationwide in Indonesia. We did not find enough relevant fundamentals that address the specific relationship between financial performance and green bonds in the context we studied. The unavailability of specific data and information in the literature suggests that this topic is still relatively new or has not been extensively researched. Therefore, our study makes an important contribution to further understanding and thinking in the relationship between financial performance and green bonds. Our study provides a strong foundation for future research in this domain. We hope that our findings and research methods will inspire other researchers to further explore the relationship between financial performance and sustainable financial instruments such as green bonds, as well as its practical implications in the context of sustainable investment. Although we did not find many studies related to this topic, it is important to continue to explore knowledge and expand understanding of the relationship between financial performance and green bonds. As such, it can inform more sustainable and responsible investment decision-making in the future.

## II. LITERATURE REVIEW

The relationship between financial performance metrics and sustainable financing practices has gained significant attention in recent years. This literature review aims to explore the existing body of research on the association between Return on Assets (ROA), Green Financing Portfolio, and CO2 emissions in the transportation sector. Understanding this relationship is crucial for promoting sustainable financial decision-making and reducing environmental impacts.

### *2.1. Return on Assets (ROA)*

Return on Assets (ROA) is a fundamental financial metric that provides insights into a company's ability to generate profits in relation to its total assets (Malikah, 2021); (Tangngisalu, 2022); (Allo et al., 2021). It is widely used by investors, analysts, and financial institutions to evaluate a firm's efficiency and effectiveness in utilizing its available resources (Olarewaju & Msomi, 2021). In recent years, the concept of sustainable finance has gained traction, emphasizing the integration of environmental, social, and governance (ESG) factors into financial decision-making (Huang, 2021); (Clementino & Perkins, 2021). Several research studies have explored the relationship between ROA and sustainable finance, with a specific focus on green lending and investment practices (Xu et al., 2020); (Banker et al., 2014). These studies have revealed a positive association between a bank's ROA and its engagement in green financing activities (Xu et al., 2020); (Banker et al., 2014). Banks with higher ROA tend to demonstrate a greater propensity to allocate funds toward sustainable initiatives, including green projects, renewable energy ventures, energy-efficient technologies, and environmentally responsible businesses (Bohora, 2018); (Hodge, 2002). The findings of these studies

underscore the significance of financial performance in shaping a bank's commitment to sustainable portfolio allocation. Higher profitability, as indicated by a strong ROA, provides financial institutions with the capacity to expand their green financing activities (Hodge, 2002). This positive association between ROA and green financing highlights the potential for financial institutions to align their profitability goals with sustainability objectives (Hodge, 2002).

The positive correlation between ROA and green financing can be attributed to various factors. Firstly, banks with higher profitability have greater financial resources at their disposal, enabling them to invest in sustainable projects and initiatives (Sahoo & Nayak, 2007). Moreover, engaging in green financing can enhance a bank's reputation, attract socially conscious investors, and foster long-term relationships with environmentally responsible clients (Zhang et al., 2022). These factors contribute to increased profitability and a positive feedback loop, wherein higher ROA enables further expansion of green financing activities. Furthermore, the integration of sustainability into financial decision-making processes aligns with the growing regulatory frameworks and global initiatives aimed at addressing climate change and promoting sustainable development (Clark et al., 2018). Banks that prioritize sustainable finance not only contribute to a greener economy but also mitigate risks associated with climate change and environmental degradation (Blazquez et al., 2021). Consequently, the positive association between ROA and green financing supports the notion that financial performance and sustainable practices are not mutually exclusive but rather mutually reinforcing. In conclusion, the existing literature highlights the positive relationship between ROA and sustainable finance, particularly in the context of green lending and investment. Financial institutions with higher ROA demonstrate a greater propensity to allocate funds toward sustainable projects, thereby fostering environmental sustainability (Fatica & Panzica, 2021); (Guo et al., 2022). This connection emphasizes the potential for financial institutions to integrate profitability goals with sustainable portfolio allocation.

### 2.2. *Green Financing Portfolio*

Green financing plays a pivotal role in promoting environmentally friendly projects and initiatives by providing financial support through specialized products and services (Chen et al., 2022). It encompasses various forms of investments, including but not limited to renewable energy, energy efficiency, sustainable infrastructure, and other sectors that prioritize environmental responsibility (Tang et al., 2021). Research studies have consistently highlighted the positive impact of green financing on mitigating climate change and fostering sustainable development. The company that actively engage in green financing and have a larger portfolio dedicated to environmentally friendly projects contribute significantly to reducing carbon emissions and promoting a low-carbon economy (Tian et al., 2022). By directing their financial resources towards green initiatives, these banks facilitate the transition to renewable energy sources, encourage energy efficiency practices, and support sustainable infrastructure development. One significant advantage of expanding green financing portfolios is the enhancement of a bank's reputation and credibility (Akomea-Frimpong et al., 2022); (Bal et al., 2013). By actively supporting environmentally responsible projects, financial institutions signal their commitment to sustainability and position themselves as key players in the transition to a greener future. This fosters trust among stakeholders, including customers, investors, and regulatory bodies, and may result in increased business opportunities and market share (Fieseler, 2011).

In addition to reputational benefits, green financing aligns with evolving regulatory requirements and policy frameworks. Governments and regulatory bodies worldwide have recognized the urgent need to address climate change and have implemented measures to incentivize and regulate sustainable finance practices (Falcone, 2020). Banks with a larger green financing portfolio are better positioned to meet these regulatory obligations, thereby reducing compliance risks, and ensuring long-term sustainability in their operations (Dikau & Volz, 2021). Moreover, the expansion of green

financing portfolios attracts environmentally conscious investors. In recent years, there has been a growing trend of investors seeking financial opportunities that align with their sustainability values (Azman & Ali, 2019). By offering green financial products and services, banks can tap into this investor demand, expanding their customer base and potentially accessing additional sources of capital for future investments (Clark et al., 2018). This not only strengthens the financial position of the bank but also provides a platform for fostering sustainable economic growth.

In conclusion, green financing is a crucial component of sustainable finance, supporting environmentally friendly projects and initiatives. Banks with a larger green financing portfolio actively contribute to reducing carbon emissions, promoting sustainable development, and aligning with regulatory requirements. The benefits extend beyond environmental impact, encompassing reputational advantages, investor appeal, and regulatory compliance. As the importance of sustainability grows, expanding green financing portfolios becomes a strategic imperative for financial institutions seeking to align profitability with environmental responsibility.

### 2.3. *CO2 Emission in Transportation*

The transportation sector stands as a major contributor to global carbon dioxide (CO2) emissions, largely attributed to its heavy reliance on fossil fuels and inefficient transport systems. Recognizing the urgent need to address climate change, several studies have explored the role of financial institutions in reducing CO2 emissions within the transportation sector (Ballot & Fontane, 2010); (Timilsina & Shrestha, 2009). Several of prior Research has indicated a positive association between financial institutions with a strong focus on sustainable financing and their support for low-carbon transportation projects (Kong, 2022). Banks that prioritize sustainable finance are more inclined to allocate funds towards initiatives that promote environmentally friendly transportation alternatives. This includes investments in electric vehicles, public transportation systems, and the development of sustainable mobility infrastructure. One area where financial institutions play a crucial role is in supporting the adoption of electric vehicles (EVs) (Tabelin et al., 2021). By providing financing options and incentives for the purchase and use of EVs, banks contribute to the reduction of CO2 emissions from traditional gasoline-powered vehicles. This support helps accelerate the transition to cleaner transportation and encourages individuals and businesses to choose more sustainable alternatives.

Furthermore, financial institutions can play a vital role in supporting the development and improvement of public transportation systems. Investments in efficient, affordable, and sustainable public transportation infrastructure can significantly reduce the number of private vehicles on the road, leading to lower overall emissions (Patil, 2021); (Shah et al., 2021). By providing financial backing for such projects, banks can contribute to the expansion and improvement of public transportation networks, making them more accessible and appealing to commuters. Sustainable mobility infrastructure is another area where financial institutions can make a difference. Investments in infrastructure projects that facilitate walking, cycling, and other forms of sustainable transportation help reduce the reliance on carbon-intensive modes of transportation (Mittal & Woodside, 2022). By allocating funds towards the development of bike lanes, pedestrian-friendly walkways, and integrated transportation systems, financial institutions contribute to creating more sustainable and environmentally friendly urban environments (Mittal & Woodside, 2022).. The allocation of funds towards these sustainable transportation initiatives by financial institutions can result in a significant reduction in CO2 emissions within the transportation sector. By supporting the shift towards low-carbon alternatives and promoting the adoption of sustainable transportation practices, banks actively contribute to mitigating climate change and fostering a greener future.

In conclusion, financial institutions have a vital role to play in reducing CO2 emissions in the transportation sector. By prioritizing sustainable financing and allocating funds towards low-carbon transportation projects, such as electric vehicles, public transportation systems, and sustainable

mobility infrastructure, banks can help drive the transition to cleaner and more environmentally friendly transportation options (Rodríguez-García et al., 2022). Through their support, financial institutions actively contribute to the global efforts to combat climate change and create a more sustainable future.

### *2.4. Existing Research*

Several studies have explored the connection between ROA, green financing portfolios, and CO2 emissions in the transportation sector. For example, research has shown that banks with higher ROA are more inclined to allocate funds to sustainable transportation projects, resulting in reduced CO2 emissions. These findings suggest that financial performance and sustainable finance are interconnected, with positive financial outcomes supporting green portfolio expansion and carbon reduction efforts. Furthermore, studies have identified various factors influencing the association between ROA, green financing portfolios, and CO2 emissions in transportation. These factors include regulatory frameworks, government policies, stakeholder pressures, and institutional factors. Understanding these factors can help policymakers and financial institutions develop strategies to encourage sustainable financing and mitigate CO2 emissions in the transportation sector.

## III. RESEARCH METHOD AND DATA

This study aims to analyze the effect of the Green Financing Portfolio on Return on Assets (ROA), Return on Equity (ROE), Net Interest Margin (NIM), and Operating Costs to Operating Income (BOPO), and examine the level of CO2 emissions in the transportation sector. This research uses descriptive quantitative research methods. The data used will be analyzed statistically to test the relationship between the variables involved. The sample in this study is a company that implements a sustainable funding portfolio (Green Financing Portfolio) in this case is PT Bank Mandiri as one of the state-owned banks in Indonesia. The research sample will be selected using purposive sampling technique, with the inclusion criteria of transportation companies that actively use sustainable funding and have complete financial data.

The data used in this study will be sourced from the financial statements of transportation companies and CO2 emissions data available from 2016 to 2022. Financial statement data includes information on ROA, ROE, NIM, and BOPO, while CO2 emissions data is obtained from reliable sources such as official reports or related research. The collected data will be analyzed using content analysis in the form of the results of Bank Mandiri's financial statements from 2016 to 2022 which are then illustrated in the form of graphs.

## IV. RESULT AND DISCUSSION

### *4.1. Data Description*

In our research, we sought to analyze the relationship between financial performance and green bonds, as well as green financing portfolios. However, we faced challenges in finding relevant references related to the use of regression analysis that is commonly used in quantitative research in finance.

When we searched for literature that could be used as a reference to apply regression analysis to the relationship between financial performance and green bonds, we did not find many sources that were relevant and appropriate to our research context. This may be since research on the relationship is still in its infancy and specialized research using regression analysis approaches may not have been conducted. However, we remain committed to presenting our data objectively and explaining the relationship between the variables we examined. To overcome these limitations, we

decided to present our data in the form of content analysis and causality graphs. Through content analysis, we drew in-depth information from relevant sources and identified important patterns or findings that could illustrate the relationship between financial performance and green bonds.

In addition, we use graphs and data visualizations to present our results more clearly and facilitate understanding. Causality graphs help illustrate the relationships between the variables we examine, although they do not use a direct regression analysis approach. This allows readers and stakeholders to visually understand those relationships and identify possible patterns or trends. While the use of regression analysis is not directly applicable in our study, we still try to present our results in a valid and informative way. In Table 1 we illustrate the financial statement data related to the financial performance of Bank Mandiri, Indonesia from 2016 - 2022.

**Table 1. Financial Performance Ratios of Bank Mandiri, Indonesia**

| Year | ROA | ROE | NIM | BOPO |
|---|---|---|---|---|
| 2016 | 1,95 | 11,12 | 6,29 | 80,94 |
| 2017 | 2,72 | 14,53 | 5,63 | 71,78 |
| 2018 | 3,17 | 16,23 | 5,52 | 66,48 |
| 2019 | 3,03 | 15,08 | 5,46 | 67,44 |
| 2020 | 1,64 | 9,36 | 4,48 | 80,03 |
| 2021 | 2,53 | 16,24 | 4,73 | 67,26 |
| 2022 | 3,30 | 22,62 | 5,16 | 57,35 |

In general, the data in Table 1 provides an overview of the financial performance of Bank Mandiri, Indonesia from the perspectives of ROA, ROE, NIM, and BOPO over the time presented. The data can be interpreted that:

1. ROA (Return on Assets): Shows the efficiency with which the company's assets are used to generate profits. The higher the ROA number, the more efficient the company is in utilizing its assets. In the table, ROA increased from 2016 to 2018, peaked in 2018, and then fluctuated in the following years.
2. ROE (Return on Equity): Measures the rate of return on the company owner's equity. A high ROE indicates that the company is successfully generating good returns for its owners. In the table, ROE also increases over time, with annual fluctuations.
3. NIM (Net Interest Margin): This is the difference between the interest income received by the company and the interest paid on loans and funds received from customers. A high NIM indicates that the company is able to maximize interest income. In the table, NIM shows a downward trend from 2016 to 2022.
4. BOPO (Operating Expenses to Operating Income): Shows the extent to which operating expenses affect the company's operating income. A low BOPO indicates efficiency in managing operating costs. In the table, BOPO shows a downward trend over time.

Furthermore, Table 2 presents data in the form of Green Bond Bank Mandiri, Indonesia and CSR allocation of Bank Mandiri, Indonesia since the period 2016-2022.

**Table 2. Green Bond and CSR Allocation Report of Bank Mandiri, Indonesia (In Billion Rupiah)**

| Year | Green Bond | CSR |
|---|---|---|
| 2016 | 131,9 | 63,43 |
| 2017 | 141 | 118,88 |
| 2018 | 182,3 | 114,52 |
| 2019 | 208,9 | 150,17 |
| 2020 | 204 | 133,90 |

| | | |
|---|---|---|
| 2021 | 224,6 | 132,37 |
| 2022 | 250,2 | 137,60 |

Green Bond in table 2 shows a number that reflects the amount of funds obtained from the issuance of Green Bond by companies in certain years. This number reflects the level of investor interest in supporting environmentally friendly projects through Green Bond. The data in the table shows a significant increase from 2016 to 2022, with the amount of funds obtained increasing from 131.9 to 250.2 (in billion rupiah). Meanwhile, CSR (Corporate Social Responsibility) shows numbers that reflect the implementation of CSR by companies in certain years. While it is not explained in detail what this figure represents, a possible assumption is that it reflects the amount invested or allocated by companies for various CSR initiatives. The data in the table shows annual fluctuations, but with a general trend of increase from 2016 to 2022.

During the period of 2016 to 2022, Bank Mandiri Indonesia has allocated funds in Corporate Social Responsibility (CSR) programs for various areas that have a positive impact on society and the environment. Significant CSR allocations have been made in various important sectors, reflecting Bank Mandiri's commitment to contributing to sustainable development and community welfare.

One of the areas that receives special attention in Bank Mandiri's CSR allocation is the Environment/Nature Preservation Sector. To preserve nature, Bank Mandiri has supported projects that focus on reforestation, environmental conservation, carbon emission reduction, and natural resource protection. Through the allocation of CSR funds, Bank Mandiri plays an active role in maintaining biodiversity, reducing negative impacts on the environment, and encouraging awareness about the importance of nature conservation. Health is also an important focus in Bank Mandiri's CSR allocation. Bank Mandiri recognizes that health is a fundamental right of every individual, and through its CSR programs, it supports public health initiatives that include improving access to health services, education on health, development of health infrastructure, and support on disease prevention and treatment efforts. In addition, Bank Mandiri also pays attention to Public Facilities and Worship. To improve the quality of life of the community, Bank Mandiri has contributed to the development of public infrastructure such as the construction of sports facilities, educational facilities, and the improvement of places of worship. Through this, the Bank supports equitable access and quality improvement of public facilities and facilitates religious activities that are important to the community. In situations of natural disasters, Bank Mandiri also pays serious attention through CSR allocations in the Natural Disaster Sector. Bank Mandiri has been involved in disaster management and post-disaster recovery efforts by aiding with disaster victims, supporting infrastructure reconstruction, and developing effective disaster response programs.

Poverty alleviation and social community development are the focus of Bank Mandiri's Social Community Development Program. Through its CSR programs, Bank Mandiri has supported initiatives aimed at reducing poverty levels, improving community welfare, and strengthening the competitiveness of local economies. This includes community economic empowerment through skills training, provision of business capital to vulnerable groups, and support to poverty alleviation programs that include the provision of social assistance, scholarships, and assistance in developing micro and small businesses.

Lastly, the education sector is also a major concern for Bank Mandiri in its CSR allocation. Bank Mandiri recognizes the importance of education in advancing society and creating equal opportunities. Through its CSR programs, Bank Mandiri has committed to support inclusive and quality education. This includes the construction of educational facilities, increasing educational accessibility for children from underprivileged families, developing innovative curricula, and providing scholarships

to outstanding but financially underprivileged students. Furthermore, Table 3 presents the report data on Bank Mandiri's Green Financing allocation portfolio from 2016 to 2022.

**Table 3. Green Financing Portfolio of Bank Mandiri, Indonesia (In Billion Rupiah)**

| Year | Renewable energy | Pollution Prevention & Control | Environmentally sustainable management of living natural resources and land use | Clean transportation | Sustainable water & wastewater management | Eco-efficient/circular economy adapted products, production technologies & processes | Green Buildings | Total Green Financing Portofolio |
|---|---|---|---|---|---|---|---|---|
| 2016 | 2.487 | 0 | 3.186 | 5.622 | 0 | 0 | 0 | 11,295 |
| 2017 | 3.068 | 0 | 3.186 | 6.522 | 0 | 0 | 0 | 12,776 |
| 2018 | 4.372 | 0 | 0 | 6.491 | 0 | 0 | 0 | 10,863 |
| 2019 | 1.350 | 136 | 57.539 | 0 | 245 | 0 | 0 | 59,27 |
| 2020 | 2.540 | 21 | 74.948 | 1.408 | 1.200 | 0 | 307 | 80,424 |
| 2021 | 4.281 | 0 | 88.537 | 2.028 | 1.214 | 0 | 205 | 96,265 |
| 2022 | 6.149 | 92,956 | 3.107 | 867 | 3.307 | 0 | 16 | 13,539 |

Table 3 displays data on the allocation of funds in the Green Financing Portfolio in various sectors that contribute to environmental sustainability. Each column shows the amount of funds allocated in specific years to each sector related to environmental conservation efforts. Below is the interpretation of each column in the table:

1. Renewable energy: This data shows the amount of funding allocated to renewable energy projects. This includes investments in environmentally friendly energy sources such as solar energy, wind energy, biomass energy, and hydroelectric energy. The data in the table shows an increase in funding allocations from 2016 to 2022, indicating a greater commitment to developing the renewable energy sector.
2. Pollution Prevention & Control: This data shows the amount of funding allocated for pollution prevention and control. This can include investments in technologies and systems to reduce pollutant emissions, manage waste, and mitigate negative impacts on the environment. In the table, the data shows the allocation of funds that vary from year to year.
3. Environmentally sustainable management of living natural resources and land use: This column shows the amount of funds allocated for environmentally sustainable management of living natural resources and land use. This includes efforts to conserve biodiversity, sustainable forest management, control deforestation, and environmentally friendly agricultural practices. The data in the table shows fluctuations in the allocation of funds from year to year.
4. Clean transportation: This data shows the amount of funds allocated to clean transportation. This includes investments in sustainable transportation such as electric vehicles, environmentally friendly recharging infrastructure, and the development of more efficient and low-emission transportation systems. The data in the table shows the increase in funding allocation from 2016 to 2022.

5. Sustainable water & wastewater management: This data shows the amount of funding allocated for sustainable water management and wastewater treatment. This includes investments in water management infrastructure, water conservation, waste treatment, and efforts to protect aquatic ecosystems. The data in the table shows an increase in funding allocation from year to year.
6. Eco-efficient/circular economy adapted products, production technologies & processes: This data shows the amount of funds allocated to environmentally friendly and sustainable products, production technologies, and processes. This includes investments in the development of more ecologically efficient products, production technologies that reduce environmental impact, and the application of circular economy principles. The data in the table shows fluctuations in the allocation of funds from year to year.
7. Green Buildings: This data shows the amount of funds allocated for the construction of green buildings. This includes investments in environmentally friendly building design and construction, energy efficiency, use of renewable materials, and reduction of construction waste. The data in the table shows fluctuations in the allocation of funds from year to year.
8. Total Green Financing Portfolio: This data shows the grand total of allocated funds in the green financing portfolio. It covers all the sectors listed above and provides an overall picture of investments in projects that contribute to environmental sustainability. The data in the table shows the fluctuation of total fund allocation from 2016 to 2022.

In interpreting table 3, it can be observed that most sectors saw an increase in funding allocations year-on-year, indicating a greater commitment to environmental sustainability. Some sectors, such as renewable energy and water management, showed significant increases in funding allocations, reflecting a focus on environmentally friendly solutions.

### *4.2. Causality Between BOPO, NIM, ROE, ROA, and CSR*

Although the quantitative research literature that directly analyzes the causality between BOPO, NIM, ROE, ROA, and CSR is limited, there are still ways to illustrate these interrelationships by analyzing the content of financial statements and presenting them in graphical form. This approach can provide insight into how the variables are interrelated and how changes in one variable can affect the others. In financial statement content analysis, we can see trends and patterns emerging from the data recorded in a company's financial statements from year to year. For example, we can see how BOPO, NIM, ROE, ROA, and CSR evolve over time and whether there is a link between changes in these values.

In Figure 1, BOPO, NIM, ROE, ROA, and CSR can be represented as a timeline showing the change in values from year to year. Using this graph, we can compare the changes in these variables and see if there is a discernible pattern. The graph can provide a clearer visual picture of the interrelationship between BOPO, NIM, ROE, ROA, and CSR and how changes in one variable can affect the other. While it cannot provide direct causal inferences, analyzing financial statement content in graphical form can help identify trends and patterns and gain initial insights into the relationships between these variables.

Theory states that the higher the BOPO, the less efficient the company is in managing its operating costs. This can have a negative impact on the company's profitability, such as ROE and ROA. However, there is no direct causal relationship between BOPO and CSR. Furthermore, theoretically the higher the NIM, the higher the profitability of the company. The increase in profitability can have a positive impact on ROE and ROA, but there is no direct causal relationship between NIM and CSR. In theory, however, good financial performance reflected in ROE may provide companies with greater resources to allocate funds for CSR. However, ROE can also be influenced by other factors beyond CSR.

In theory, if ROA increases, companies have the potential to allocate more resources to CSR. However, like ROE, ROA is also affected by other factors that are not directly related to CSR.

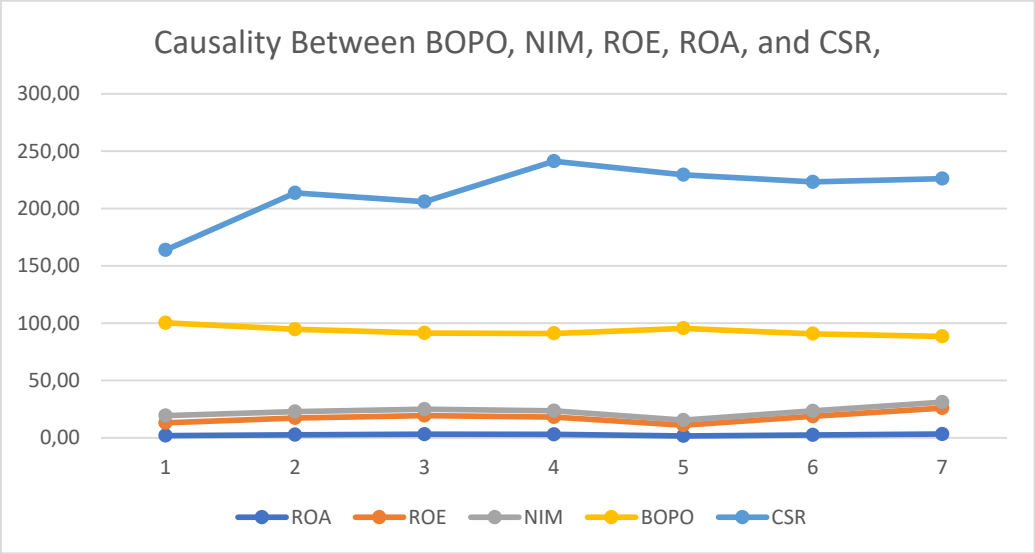


**Figure 1. Causality Between BOPO, NIM, ROE, ROA, and CSR**

In the context of the relationship between ROA, ROE, NIM, BOPO, and CSR, it is important to remember that the causality and relationship between these variables can be very complex and influenced by various external and internal factors. There is no definitive conclusion on the direct relationship between these variables as it can vary between different companies and industry sectors. However, in general, it is argued that good financial performance, such as high ROA and ROE, can provide companies with greater resources to allocate funds for CSR. If companies can generate high profits and are efficient in the use of their assets, they have a greater financial ability to set aside funds for CSR initiatives. However, based on the illustrated explanation, it can be assumed that companies that perform well financially may gain a better reputation in the eyes of stakeholders and society. In this case, companies may feel the need to participate in CSR activities as an effort to maintain a good image and gain support from society.

### *4.3. Causality Between Green Bond, Green Financing Portofolio and CO2 Emmision in Transportation*

Figure 2 illustrates the causality between Green Bond, Green Financing Portfolio of Bank Mandiri from 2016 to 2022 and compares the progress of CO2 Emissions in transportation nationally in the same period. The graph aims to see the extent to which ESG effects have an impact on reducing carbon emissions in the transportation sector in Indonesia.

Figure 2 shows the development of Green Bond and Green Financing Portfolio issued by Bank Mandiri from 2016 to 2022. The Green Bond and Green Financing Portfolio reflects Bank Mandiri's commitment in supporting sustainable and environmentally friendly projects, including projects in the transportation sector that contribute to the reduction of CO2 emissions. In addition, the graph also shows the development of CO2 emissions in the transportation sector in Indonesia during the same period. This data reflects the amount of CO2 emissions generated by the transportation sector nationwide. By looking at Figure 2, it can be observed whether there is a relationship between the increase in Green Bond, Green Financing Portfolio, and changes in CO2 emissions in the transportation sector. If there is a significant relationship between the increase in Green Bond and Green Financing

Portfolio and the decrease in CO2 emissions in the transportation sector, this will show that the efforts of banks in supporting sustainable projects have had a positive impact in reducing carbon emissions.

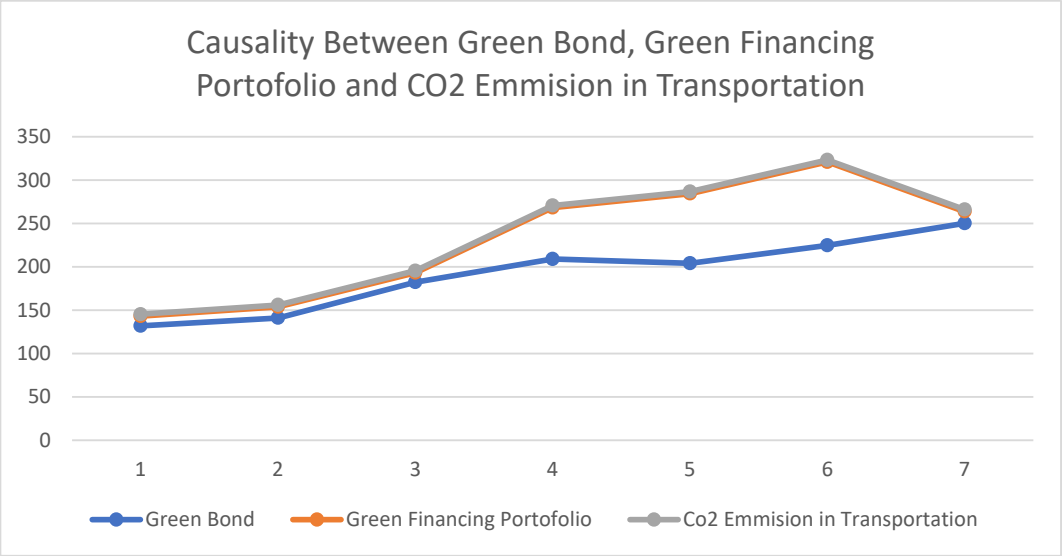


**Figure 2. Causality Between Green Bond, Green Financing Portofolio and CO2 Emmision in Transportation**

From the data generated in Figure 2, there is a significant relationship between the increase in Green Bond and the increase in allocation of Green Financing Portfolio by Bank Mandiri, Indonesia. The graph shows that as the number of Green Bonds issued since 2016 increased, there was also a significant increase in the allocation of funds for Green Financing Portfolio by Bank Mandiri. This shows the strong awareness and commitment of Bank Mandiri in supporting sustainable and environmentally friendly projects through Green Bond issuance. Green Bond provides the necessary funding source to support projects that contribute to the reduction of CO2 emissions and environmental protection. In addition, the data on the graph also shows that the increase in Green Financing Portfolio follows the same trend as the resulting Green Financing effect. That is, the more Green-Bond issued by Bank Mandiri, the greater the allocation of funds allocated to the Green Financing Portfolio. This indicates that an increase in Green Bond directly impacts the increase in funds available to finance sustainable projects in the transportation sector and other sectors. In this context, an increase in the Green Financing Portfolio also means an increase in investment in projects aimed at reducing CO2 emissions in the transportation sector. This reflects Bank Mandiri's significant role in supporting carbon emission reduction efforts and driving the shift towards greener transportation in Indonesia.

In conclusion, the data in Figure 2 shows a close relationship between the increase in Green Bond, Green Financing Portfolio allocation, and CO2 emission reduction efforts in the transportation sector. Bank Mandiri as a financial institution has played an important role in supporting sustainable projects through the issuance of Green Bond and allocation of funds for Green Financing Portfolio. By doing so, they contribute significantly to reducing carbon emissions and driving positive change in the transportation sector towards a cleaner and more sustainable environment.

### *4.4. Discussion*

Green Bonds are financial instruments issued to finance sustainable and environmentally friendly projects. The Green Financing Portfolio reflects the allocation of funds allocated to these projects. The

causality between Green Bond and Green Financing Portfolio can be seen from the cause-and-effect relationship formed between the two. The issuance of Green Bonds by financial institutions, such as Bank Mandiri in Indonesia, provides the necessary resources to support sustainable projects in the transportation sector. Green Bond attracts investors who are concerned about environmental issues to invest in projects that contribute to the reduction of CO2 emissions, such as the development of electric vehicles or environmentally friendly recharging infrastructure. In this sense, the Green Bond serves as a catalyst in increasing the allocation of funds to sustainable projects in the Green Financing Portfolio.

In the context of Bank Mandiri, the results of the data demonstration show that the increase in Green Bond, which began in 2016, has a significant impact on increasing the allocation of funds for the Green Financing Portfolio. In other words, the more Green-Bond issued, the greater the allocation of funds allocated for sustainable projects to reduce CO2 Emission in the transportation sector. This shows that Green Bond has a positive causality on Green Financing Portfolio. In this case, the causality between Green Financing Portfolio and CO2 Emission can be explained through the influence of investment in green technology and sustainable practices. With significant funds allocated through the Green Financing Portfolio, companies and institutions can implement projects that aim to reduce CO2 emissions in the transportation sector. For example, investments in the development of electric vehicles, environmentally friendly recharging infrastructure, or the use of cleaner alternative fuels. Through these projects, a significant reduction in CO2 emissions in the transportation sector is expected.

What Bank Mandiri is doing as one of the three state-owned banks in Indonesia that is currently a pioneer in terms of ESG provides an indication that the increase in Green Financing Portfolio goes hand in hand with the downward trend in CO2 emissions in transportation. From 2016 to 2022, along with the increased allocation of funds for sustainable projects, there has been progress in reducing CO2 emissions in the transportation sector in Indonesia. This suggests a positive causality between the Green Financing Portfolio and the reduction of CO2 emissions in transportation. In this context, the Green Financing Portfolio acts as a key driver in allocating funds to sustainable projects that contribute to the reduction of CO2 emissions. Investments made through the Green Financing Portfolio encourage the adoption of green technologies, sustainable innovations, and greener practices in the transportation sector. Thus, there is a positive causality between the Green Financing Portfolio and CO2 emission reduction.

Managerial Implications: The causality established between Green Bond, Green Financing Portfolio, and CO2 Emissions in transportation has significant implications for environmental sustainability. First, through Green Bond issuance, financial institutions such as Bank Mandiri can mobilize the necessary resources to support sustainable projects in the transportation sector. This strengthens the commitment to accelerate the shift to greener transportation. Second, the increased allocation of funds through the Green Financing Portfolio provides opportunities for companies and institutions to implement sustainable projects. Investments in green technologies and sustainable practices in the transportation sector have the potential to significantly reduce CO2 emissions. In addition, it can also encourage innovation and development of more efficient and environmentally friendly transportation solutions. Third, the positive causality between the Green Financing Portfolio and CO2 emission reductions suggests that efforts to reduce the environmental impact of the transportation sector can be successful through proper allocation of funds. By increasing investment in sustainable projects, such as green infrastructure development or the use of renewable energy in transportation, significant reductions in CO2 emissions can be achieved.

In the context of Green Bond, there is a positive causality between the issuance of Green Bond by Bank Mandiri and the increased allocation of funds for sustainable projects in the Green Financing Portfolio. This suggests that the Green Bond serves as a catalyst in increasing investment in sustainable

projects in the transportation sector. In addition, the adoption of Green Bond and Green Financing Portfolio also has a broader positive impact. Investment in sustainable projects in the transportation sector can drive sustainable economic growth, create new jobs, and increase innovation in the transportation industry. This is in line with the concept of sustainable development that integrates environmental, social, and economic aspects.

## V. Conclusion, Limitations and Future Research Agenda

In the Indonesian context, Bank Mandiri's adoption of the Green Bond and Green Financing Portfolio is a positive step in supporting environmental sustainability in the transportation sector. However, to achieve greater change, more involvement of other financial institutions and the private sector is required. The causality between Green Bond, Green Financing Portfolio, and CO2 Emissions in transportation provides a strong foundation in supporting environmental sustainability in the transportation sector. Through Green Bond issuance and increased allocation of funds in the Green Financing Portfolio, investments in sustainable projects can reduce CO2 emissions, advance green technologies, and drive innovation in transportation. However, to ensure the sustainability and effectiveness of efforts in reducing CO2 emissions in transportation, further steps are needed. First, it is important to continue to increase the number of Green Bonds issued and the allocation of funds in the Green Financing Portfolio. This can be done through collaboration between financial institutions, government, and the private sector to mobilize investment in sustainable projects in the transportation sector. Furthermore, there needs to be transparent monitoring and reporting regarding the use of funds in the Green Financing Portfolio. Financial reports and information related to projects funded by Green Bonds should be easily accessible and verifiable. This will provide confidence to investors and the public about the effectiveness of the use of funds in reducing CO2 emissions in transportation.

In addition, it is important to continue innovating green technologies and sustainable solutions in the transportation sector. The development of more efficient electric vehicles, wider recharging infrastructure, and the implementation of policies that support the use of environmentally friendly public transportation can make a significant contribution to reducing CO2 emissions. Furthermore, there is a need for cross-sector and cross-country cooperation in promoting and encouraging the adoption of Green Bonds and Green Financing Portfolios. Experience exchange, technology transfer, and training on best practices in supporting sustainable projects in the transportation sector can accelerate the shift towards greener transportation at the global level. In addition, public education and awareness also play an important role in creating environmental sustainability in the transportation sector. Easy-to-understand information about the benefits of using sustainable transportation and individual contributions to reducing CO2 emissions can motivate people to adopt greener travel habits. Finally, it is important to continue to evaluate and research the impact of Green Bond and Green Financing Portfolios on reducing CO2 emissions in transportation. In-depth quantitative and qualitative studies can provide better insights into the effectiveness of policies and measures that have been implemented, as well as assist in better decision-making for the future.

While our study has provided an initial understanding of the causality between Green Bond, CSR, Financial Performance, Green Financing Portfolio, and their effects on CO2 Emissions in Transportation nationwide, we realize that there are several shortcomings in this study that limit the interpretations and conclusions that can be drawn. First, this study relies on data interpretation based on visual graphs of financial statements and sustainability reports. While this provides a rough idea of the relationship between the observed variables, a more comprehensive study still has enormous opportunities to be implemented. Secondly, in the context of sustainability reporting, there are

challenges in terms of consistency and assessment standards. In our study, we relied on a limited number of sustainability reports available from companies. In addition, there are no consistent standards in sustainability reporting in Indonesia, which limits uniformity and comparability between companies. For future research, it is important to consider using more consistent frameworks and standards to facilitate cross-company analysis. Third, this study is also limited to one banking subject in Indonesia. Although Bank Mandiri is one of the largest banks in Indonesia and has a commitment to sustainability, it cannot be considered representative of the entire banking sector and its influence on reducing CO2 emissions in the transportation sector nationwide. Research involving more companies in different sectors is needed to gain a more comprehensive understanding of the impact of ESG and sustainable fund allocation on CO2 emission reduction in transportation.

In the face of these limitations, our study proposes several recommendations for future research. First, the use of more advanced quantitative analysis methods, such as panel regression or path analysis, can help measure the causal impact between the variables studied more accurately. Second, it is important to expand the scope of companies involved in the study to obtain more representative data and represent various industry sectors. Third, standardization and harmonization efforts in sustainability reporting should be encouraged, allowing for easier benchmarking and cross-company analysis.

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# IJEEP_SUBS_Causality of Bank Financial Performance, Green Bond, CSR, Green Financing Portofolio and CO2 Emissions in Trans

by Aditya TroJhan

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# IJEEP_SUBS_Causality of Bank Financial Performance, Green Bond, CSR, Green Financing Portofolio and CO2 Emissions in Trans

Causality of Bank Financial Performance, Green Bond, CSR, Green Financing Portofolio and CO2 Emissions in Transportation: Evidence from Indonesia

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Abstract

This study aims to identify the causality between bank financial performance measured by Return on Assets (ROA), Return on Equity (ROE), Net Interest Margin (NIM), and Operating Expenses to Operating Income (BOPO) with Green Financing Portfolio and CO2 emissions in the transportation sector. This study uses descriptive quantitative research methods and content analysis of the Sustainability Report of Bank Mandiri, Indonesia for the period 2016 to 2022. In this study, we collected data from Bank Mandiri's financial statements which included information on ROA, ROE, NIM, and BOPO. In addition, we also collected CO2 emission data available from 2016 to 2022. The research sample is Bank Mandiri as one of the state-owned banks in Indonesia. We used purposive sampling technique to select samples that meet the inclusion criteria. The collected data was then analyzed using statistical methods to test the relationship between the variables involved, namely the bank's financial

performance (ROA, ROE, NIM, and BOPO), Green Financing Portfolio, and CO2 emissions in the transportation sector. We use content analysis to illustrate the results of Bank Mandiri's financial statements in graphical form. The results of the analysis show that the increase in Green Bond that started in 2016 has a significant impact on the increase in fund allocation for Green Financing Portfolio. This indicates a positive causality between Green Bond and Green Financing Portfolio. In this context, the causality between Green Financing Portfolio and CO2 emissions can be explained through the influence of investment in green technology and sustainable practices. With significant funds allocated through the Green Financing Portfolio, companies and institutions can implement projects that aim to reduce CO2 emissions in the transportation sector. This means that the use of Green Bond as a sustainable funding source has the potential to reduce the negative impact of transportation on the environment.

Keywords: Green Bond, Green Financing Portofolio, Financial Performance, CO2 Emision In Transportation.

## INTRODUCTION

In an increasingly environmentally conscious era, green finance has emerged as a financial initiative that focuses on sustainable and environmentally friendly investments. The green finance narrative illustrates how the financial sector can be a positive force in promoting sustainable economic growth and protecting the environment (Wang et al., 2023). Green finance encompasses a wide range of financial instruments designed to support environmentally friendly projects, such as renewable energy, energy efficiency, good water

management, forest protection, and sustainable transportation (Falcone, 2020) . In this study, we can see how green finance provides solutions to today's environmental challenges, while creating profitable business opportunities. Green finance plays a key role in driving a paradigm shift in how we view investment and economic growth (Ainou et al., 2023). With increasing awareness of the negative impact of human activity on the environment, financial market participants are increasingly recognizing the importance of considering environmental, social, and governance (ESG) factors in their investment decisions (Serrano-García et al., 2023). The green finance narrative also highlights the importance of collaboration between governments, financial institutions, companies, and communities to create an ecosystem that supports sustainable investments. Initiatives such as the issuance of green bonds, whose proceeds will be used for environmental projects, as well as the establishment of financial institutions that specialize in funding sustainable projects, are examples of successful collaboration in advancing green finance (Asiri et al., 2020).

Phenomena dan Research Gap

In particular, the Government of Indonesia encourages the development of ESG through relevant policies and regulations. For example, the Indonesian government launched the Green Finance Initiative and created the Sustainable Financial Reporting Guidelines. This aims to provide guidance and a framework for companies to report on their performance in terms of environmental, social, and corporate governance (Liebman et al., 2019). In addition, there is also the development of institutions and initiatives that support ESG development in Indonesia. For example, the establishment of the Indonesian Sustainable Finance Initiative (ISFI) which is a consortium of banks and financial institutions to promote sustainable finance practices in Indonesia (Setyowati,

2023); (Volz, 2018) . ISFI works with various parties, including the government, companies, and civil society, to increase understanding and awareness of ESG. The Indonesian government has also encouraged more transparent and comprehensive ESG reporting. In 2020, the Indonesia Stock Exchange (IDX) introduced mandatory guidelines for listed companies to report ESG information periodically. The move aims to provide stakeholders with a clearer picture of companies' ESG performance and encourage companies to improve their business practices. However, of the 10 state-owned banks in Indonesia, only 3 banks have implemented ESG reporting, namely Bank BNI, Bank BRI, and Bank Mandiri until 2023. So it can be assumed that in the midst of the world program on ESG to support sustainability, Indonesia until 2023 is still in the stage of development and improvement (OJK, 2021).

There are various key issues that need to be addressed in the development of green finance in Indonesia, for example, first, many market participants do not fully understand the concepts and benefits of green finance (Katadata Center Insight, 2022), so there needs to be wider education to encourage the adoption and implementation of sustainable practices (Nikitina et al., 2022). Second, inconsistent ESG performance measurement and reporting standards are still a challenge in Indonesia (Prihandono & Yuniarti, 2023); (Kamil et al., 2021). Third, there is a lack of availability of sustainable financial instruments, such as sustainable loans and sustainable mutual funds, that can support the financing of green projects (Guild, 2020). Fourth, Indonesia has a great need for sustainable infrastructure development, such as renewable energy, environmentally friendly transportation, and waste management which is certainly not cheap (Ronaldo & Suryanto, 2022). Fifth, greater awareness and incentives are needed for companies to integrate ESG factors in their decision-making and daily operations (Maniora, 2017). Therefore, to address these

challenges, cooperation between the government, financial institutions, companies, and civil society is needed. Measures that can be taken include the provision of greater fiscal incentives for sustainable projects, increased awareness and education on green finance, the development of clear standards and frameworks, and increased collaboration and partnerships between different stakeholders (Hafner et al., 2020); (Clark et al., 2018).

This study aims to identify the relationship between bank financial performance as measured by Return on Assets (ROA), Return on Equity (ROE), Net Interest Margin (NIM), and Operating Expenses to Operating Income (BOPO) with Green Financing Portfolio and CO2 emissions in the transportation sector. This research has significant relevance given the challenges faced by the financial and transportation sectors in achieving sustainable development goals (Schroeder et al., 2019); (Zhan & Santos-Paulino, 2021); (Litvinenko et al., 2022). There are several research gaps that need to be filled in this context. First, the relationship between bank financial performance and sustainable funding portfolios is still not fully understood (Badía et al., 2019); (Iazzolino et al., 2023); (Atz et al., 2023); (Mirza et al., 2023). While several studies have investigated the impact of financial performance on sustainable funding decisions, there is still a lack of understanding on how ROA, ROE, NIM, and BOPO specifically relate to sustainable funding portfolios.

Second, the effect of financial performance on CO2 emissions in the transportation sector has not been widely studied (Abid et al., 2022). While banks and financial institutions are increasingly interested in minimizing the environmental impact of their funding portfolios, the relationship between financial performance and CO2 emissions in the transportation sector remains unclear. This study will investigate whether banks' financial performance has an impact on investment decisions in environmentally friendly transportation

and to what extent it can reduce CO2 emissions. In addition, this study will also examine the role of financial intermediation in promoting sustainable financing and CO2 emission reduction in the transportation sector. This relates to the influence of NIM and BOPO on sustainable funding portfolios as well as CO2 emissions (Nugrahaeni & Muharam, 2023). Through this analysis, this research will contribute a new understanding of how banks' financial performance can impact responsible and sustainable financial practices, as well as their impact on the environment.

The research methodology will involve the analysis of secondary data from banks' financial statements as well as transportation sector data related to CO2 emissions. The use of statistical regression will enable the identification of causal relationships between ROA, ROE, NIM, BOPO, and sustainable funding portfolio and CO2 emissions. The research may also include a case study of bank Mandiri as an Indonesian state-owned bank that has implemented a sustainable funding strategy and reduced CO2 emissions in the transportation sector. By filling this research gap, it is hoped that this research can provide important insights for the financial and transportation sectors in driving the transition to a low-carbon and sustainable economy. The results of this study can serve as a basis for banks and financial institutions to develop more effective policies and strategies in integrating environmental aspects in their funding decisions.

In addition, the findings of this study may also benefit regulators and governments in developing policies that encourage the adoption of sustainable finance and the reduction of CO2 emissions in the transportation sector. With a better understanding of the relationship between financial performance and environmental impact, more effective policy measures can be taken to encourage positive changes in the financial and transportation sectors. The

research can also identify potential obstacles or barriers that may be faced in implementing sustainable finance and reducing CO2 emissions in the transportation sector. In this regard, the research can provide recommendations and solutions to address these challenges, such as the development of financial instruments that support sustainable investment, the engagement of key actors in the industry, and government policies that encourage the transition to greener transportation. Overall, this research will fill an important knowledge gap in relation to the linkages between bank financial performance (ROA, ROE, NIM, BOPO), sustainable financing portfolio, and CO2 emissions in the transportation sector. Through this research, a more comprehensive understanding of the role of the financial sector in promoting sustainable development and reducing greenhouse gas emissions in the transportation sector is expected.

State of the art and Novelty

In our research, we sought to analyze the relationship between financial performance and green bonds, as well as green financing portfolios. However, we realized that there was limited relevant data and information that we could find in the available literature and sources. While there have been studies addressing financial performance and sustainable financial instruments such as green bonds, we conclude that ours is the first study that attempts to comprehensively examine this aspect by involving the comparison of banking performance ratios through Sustainability reports to the effect of carbon emission reduction on the transportation sector nationwide in Indonesia. We did not find enough relevant fundamentals that address the specific relationship between financial performance and green bonds in the context we studied. The unavailability of specific data and information in the literature suggests that this topic is still relatively new or has not been extensively

researched. Therefore, our study makes an important contribution to further understanding and thinking in the relationship between financial performance and green bonds. Our study provides a strong foundation for future research in this domain. We hope that our findings and research methods will inspire other researchers to further explore the relationship between financial performance and sustainable financial instruments such as green bonds, as well as its practical implications in the context of sustainable investment. Although we did not find many studies related to this topic, it is important to continue to explore knowledge and expand understanding of the relationship between financial performance and green bonds. As such, it can inform more sustainable and responsible investment decision-making in the future.

## LITERATURE REVIEW

The relationship between financial performance metrics and sustainable financing practices has gained significant attention in recent years. This literature review aims to explore the existing body of research on the association between Return on Assets (ROA), Green Financing Portfolio, and CO2 emissions in the transportation sector. Understanding this relationship is crucial for promoting sustainable financial decision-making and reducing environmental impacts.

### Return on Assets (ROA)

Return on Assets (ROA) is a fundamental financial metric that provides insights into a company's ability to generate profits in relation to its total assets (Malikah, 2021); (Tangngisalu, 2022); (Allo et al., 2021). It is widely used by investors, analysts, and financial institutions to evaluate a firm's efficiency and

effectiveness in utilizing its available resources (Olarewaju & Msomi, 2021). In recent years, the concept of sustainable finance has gained traction, emphasizing the integration of environmental, social, and governance (ESG) factors into financial decision-making (Huang, 2021); (Clementino & Perkins, 2021). Several research studies have explored the relationship between ROA and sustainable finance, with a specific focus on green lending and investment practices (Xu et al., 2020); (Banker et al., 2014). These studies have revealed a positive association between a bank's ROA and its engagement in green financing activities (Xu et al., 2020); (Banker et al., 2014). Banks with higher ROA tend to demonstrate a greater propensity to allocate funds toward sustainable initiatives, including green projects, renewable energy ventures, energy-efficient technologies, and environmentally responsible businesses (Bohora, 2018); (Hodge, 2002). The findings of these studies underscore the significance of financial performance in shaping a bank's commitment to sustainable portfolio allocation. Higher profitability, as indicated by a strong ROA, provides financial institutions with the capacity to expand their green financing activities (Hodge, 2002). This positive association between ROA and green financing highlights the potential for financial institutions to align their profitability goals with sustainability objectives (Hodge, 2002).

The positive correlation between ROA and green financing can be attributed to various factors. Firstly, banks with higher profitability have greater financial resources at their disposal, enabling them to invest in sustainable projects and initiatives (Sahoo & Nayak, 2007). Moreover, engaging in green financing can enhance a bank's reputation, attract socially conscious investors, and foster long-term relationships with environmentally responsible clients (Zhang et al., 2022). These factors contribute to increased profitability and a positive feedback loop, wherein higher ROA enables further expansion of green

financing activities. Furthermore, the integration of sustainability into financial decision-making processes aligns with the growing regulatory frameworks and global initiatives aimed at addressing climate change and promoting sustainable development (Clark et al., 2018). Banks that prioritize sustainable finance not only contribute to a greener economy but also mitigate risks associated with climate change and environmental degradation (Blazquez et al., 2021). Consequently, the positive association between ROA and green financing supports the notion that financial performance and sustainable practices are not mutually exclusive but rather mutually reinforcing. In conclusion, the existing literature highlights the positive relationship between ROA and sustainable finance, particularly in the context of green lending and investment. Financial institutions with higher ROA demonstrate a greater propensity to allocate funds toward sustainable projects, thereby fostering environmental sustainability (Fatica & Panzica, 2021); (Guo et al., 2022). This connection emphasizes the potential for financial institutions to integrate profitability goals with sustainable portfolio allocation.

Green Financing Portfolio

Green financing plays a pivotal role in promoting environmentally friendly projects and initiatives by providing financial support through specialized products and services (Chen et al., 2022). It encompasses various forms of investments, including but not limited to renewable energy, energy efficiency, sustainable infrastructure, and other sectors that prioritize environmental responsibility (Tang et al., 2021). Research studies have consistently highlighted the positive impact of green financing on mitigating climate change and fostering sustainable development. The company that actively engage in green financing and have a larger portfolio dedicated to environmentally

friendly projects contribute significantly to reducing carbon emissions and promoting a low-carbon economy (Tian et al., 2022). By directing their financial resources towards green initiatives, these banks facilitate the transition to renewable energy sources, encourage energy efficiency practices, and support sustainable infrastructure development. One significant advantage of expanding green financing portfolios is the enhancement of a bank's reputation and credibility (Akomea-Frimpong et al., 2022); (Bal et al., 2013). By actively supporting environmentally responsible projects, financial institutions signal their commitment to sustainability and position themselves as key players in the transition to a greener future. This fosters trust among stakeholders, including customers, investors, and regulatory bodies, and may result in increased business opportunities and market share (Fieseler, 2011).

In addition to reputational benefits, green financing aligns with evolving regulatory requirements and policy frameworks. Governments and regulatory bodies worldwide have recognized the urgent need to address climate change and have implemented measures to incentivize and regulate sustainable finance practices (Falcone, 2020). Banks with a larger green financing portfolio are better positioned to meet these regulatory obligations, thereby reducing compliance risks, and ensuring long-term sustainability in their operations (Dikau & Volz, 2021). Moreover, the expansion of green financing portfolios attracts environmentally conscious investors. In recent years, there has been a growing trend of investors seeking financial opportunities that align with their sustainability values (Azman & Ali, 2019). By offering green financial products and services, banks can tap into this investor demand, expanding their customer base and potentially accessing additional sources of capital for future investments (Clark et al., 2018). This not only strengthens the financial

position of the bank but also provides a platform for fostering sustainable economic growth.

In conclusion, green financing is a crucial component of sustainable finance, supporting environmentally friendly projects and initiatives. Banks with a larger green financing portfolio actively contribute to reducing carbon emissions, promoting sustainable development, and aligning with regulatory requirements. The benefits extend beyond environmental impact, encompassing reputational advantages, investor appeal, and regulatory compliance. As the importance of sustainability grows, expanding green financing portfolios becomes a strategic imperative for financial institutions seeking to align profitability with environmental responsibility.

CO2 Emission in Transportation

The transportation sector stands as a major contributor to global carbon dioxide (CO2) emissions, largely attributed to its heavy reliance on fossil fuels and inefficient transport systems. Recognizing the urgent need to address climate change, several studies have explored the role of financial institutions in reducing CO2 emissions within the transportation sector (Ballot & Fontane, 2010); (Timilsina & Shrestha, 2009). Several of prior Research has indicated a positive association between financial institutions with a strong focus on sustainable financing and their support for low-carbon transportation projects (Kong, 2022). Banks that prioritize sustainable finance are more inclined to allocate funds towards initiatives that promote environmentally friendly transportation alternatives. This includes investments in electric vehicles, public transportation systems, and the development of sustainable mobility infrastructure. One area where financial institutions play a crucial role is in supporting the adoption of electric vehicles (EVs) (Tabelin et al., 2021). By

providing financing options and incentives for the purchase and use of EVs, banks contribute to the reduction of CO2 emissions from traditional gasoline-powered vehicles. This support helps accelerate the transition to cleaner transportation and encourages individuals and businesses to choose more sustainable alternatives.

Furthermore, financial institutions can play a vital role in supporting the development and improvement of public transportation systems. Investments in efficient, affordable, and sustainable public transportation infrastructure can significantly reduce the number of private vehicles on the road, leading to lower overall emissions (Patil, 2021); (Shah et al., 2021). By providing financial backing for such projects, banks can contribute to the expansion and improvement of public transportation networks, making them more accessible and appealing to commuters. Sustainable mobility infrastructure is another area where financial institutions can make a difference. Investments in infrastructure projects that facilitate walking, cycling, and other forms of sustainable transportation help reduce the reliance on carbon-intensive modes of transportation (Mittal & Woodside, 2022). By allocating funds towards the development of bike lanes, pedestrian-friendly walkways, and integrated transportation systems, financial institutions contribute to creating more sustainable and environmentally friendly urban environments (Mittal & Woodside, 2022) .. The allocation of funds towards these sustainable transportation initiatives by financial institutions can result in a significant reduction in CO2 emissions within the transportation sector. By supporting the shift towards low-carbon alternatives and promoting the adoption of sustainable transportation practices, banks actively contribute to mitigating climate change and fostering a greener future.

In conclusion, financial institutions have a vital role to play in reducing CO2 emissions in the transportation sector. By prioritizing sustainable financing and allocating funds towards low-carbon transportation projects, such as electric vehicles, public transportation systems, and sustainable mobility infrastructure, banks can help drive the transition to cleaner and more environmentally friendly transportation options (Rodríguez-García et al., 2022). Through their support, financial institutions actively contribute to the global efforts to combat climate change and create a more sustainable future.

Existing Research

Several studies have explored the connection between ROA, green financing portfolios, and CO2 emissions in the transportation sector. For example, research has shown that banks with higher ROA are more inclined to allocate funds to sustainable transportation projects, resulting in reduced CO2 emissions. These findings suggest that financial performance and sustainable finance are interconnected, with positive financial outcomes supporting green portfolio expansion and carbon reduction efforts. Furthermore, studies have identified various factors influencing the association between ROA, green financing portfolios, and CO2 emissions in transportation. These factors include regulatory frameworks, government policies, stakeholder pressures, and institutional factors. Understanding these factors can help policymakers and financial institutions develop strategies to encourage sustainable financing and mitigate CO2 emissions in the transportation sector.

RESEARCH METHOD

This study aims to analyze the effect of the Green Financing Portfolio on Return on Assets (ROA), Return on Equity (ROE), Net Interest Margin (NIM), and Operating Costs to Operating Income (BOPO), and examine the level of CO2 emissions in the transportation sector. This research uses descriptive quantitative research methods. The data used will be analyzed statistically to test the relationship between the variables involved. The sample in this study is a company that implements a sustainable funding portfolio (Green Financing Portfolio) in this case is PT Bank Mandiri as one of the state-owned banks in Indonesia. The research sample will be selected using purposive sampling technique, with the inclusion criteria of transportation companies that actively use sustainable funding and have complete financial data. The data used in this study will be sourced from the financial statements of transportation companies and CO2 emissions data available from 2016 to 2022. Financial statement data includes information on ROA, ROE, NIM, and BOPO, while CO2 emissions data is obtained from reliable sources such as official reports or related research. The collected data will be analyzed using content analysis in the form of the results of Bank Mandiri's financial statements from 2016 to 2022 which are then illustrated in the form of graphs.

## RESULT AND DISCUSSION

### Data Description

In our research, we sought to analyze the relationship between financial performance and green bonds, as well as green financing portfolios. However, we faced challenges in finding relevant references related to the use of regression analysis that is commonly used in quantitative research in finance.

When we searched for literature that could be used as a reference to apply regression analysis to the relationship between financial performance and green bonds, we did not find many sources that were relevant and appropriate to our research context. This may be since research on the relationship is still in its infancy and specialized research using regression analysis approaches may not have been conducted. However, we remain committed to presenting our data objectively and explaining the relationship between the variables we examined. To overcome these limitations, we decided to present our data in the form of content analysis and causality graphs. Through content analysis, we drew in-depth information from relevant sources and identified important patterns or findings that could illustrate the relationship between financial performance and green bonds.

In addition, we use graphs and data visualizations to present our results more clearly and facilitate understanding. Causality graphs help illustrate the relationships between the variables we examine, although they do not use a direct regression analysis approach. This allows readers and stakeholders to visually understand those relationships and identify possible patterns or trends. While the use of regression analysis is not directly applicable in our study, we still try to present our results in a valid and informative way. In Table 1 we illustrate the financial statement data related to the financial performance of Bank Mandiri, Indonesia from 2016 - 2022.

Table 1. Financial Performance Ratios of Bank Mandiri, Indonesia

Year

ROA

ROE

NIM

BOPO

2016

1,95

11,12

6,29

80,94

2017

2,72

14,53

5,63

71,78

2018

3,17

16,23

5,52

66,48

2019

3,03

15,08

5,46

67,44

2020

1,64

9,36

4,48

80,03

2021

2,53

16,24

4,73

67,26

2022

3,30

22,62

5,16

57,35

In general, the data in Table 1 provides an overview of the financial performance of Bank Mandiri, Indonesia from the perspectives of ROA, ROE, NIM, and BOPO over the time presented. The data can be interpreted that:

ROA (Return on Assets): Shows the efficiency with which the company's assets are used to generate profits. The higher the ROA number, the more efficient the company is in utilizing its assets. In the table, ROA increased from 2016 to 2018, peaked in 2018, and then fluctuated in the following years.

ROE (Return on Equity): Measures the rate of return on the company owner's equity. A high ROE indicates that the company is successfully generating good returns for its owners. In the table, ROE also increases over time, with annual fluctuations.

NIM (Net Interest Margin): This is the difference between the interest income received by the company and the interest paid on loans and funds received from customers. A high NIM indicates that the company is able to maximize interest income. In the table, NIM shows a downward trend from 2016 to 2022.

BOPO (Operating Expenses to Operating Income): Shows the extent to which operating expenses affect the company's operating income. A low BOPO

indicates efficiency in managing operating costs. In the table, BOPO shows a downward trend over time.

Furthermore, Table 2 presents data in the form of Green Bond Bank Mandiri, Indonesia and CSR allocation of Bank Mandiri, Indonesia since the period 2016-2022.

Table 2. Green Bond and CSR Allocation Report of Bank Mandiri, Indonesia (In Billion Rupiah)

Year

Green Bond

CSR

2016

131,9

63,43

2017

141

118,88

2018

182,3

114,52

2019

208,9

150,17

2020

204

133,90

2021

224,6

132,37

2022

250,2

137,60

Green Bond in table 2 shows a number that reflects the amount of funds obtained from the issuance of Green Bond by companies in certain years. This number reflects the level of investor interest in supporting environmentally friendly projects through Green Bond. The data in the table shows a significant increase from 2016 to 2022, with the amount of funds obtained increasing from 131.9 to 250.2 (in billion rupiah). Meanwhile, CSR (Corporate Social Responsibility) shows numbers that reflect the implementation of CSR by companies in certain years. While it is not explained in detail what this figure represents, a possible assumption is that it reflects the amount invested or allocated by companies for various CSR initiatives. The data in the table shows annual fluctuations, but with a general trend of increase from 2016 to 2022. During the period of 2016 to 2022, Bank Mandiri Indonesia has allocated funds in Corporate Social Responsibility (CSR) programs for various areas that have a positive impact on society and the environment. Significant CSR allocations have been made in various important sectors, reflecting Bank Mandiri's commitment to contributing to sustainable development and community welfare.

One of the areas that receives special attention in Bank Mandiri's CSR allocation is the Environment/Nature Preservation Sector. To preserve nature, Bank Mandiri has supported projects that focus on reforestation, environmental conservation, carbon emission reduction, and natural resource protection. Through the allocation of CSR funds, Bank Mandiri plays an active

role in maintaining biodiversity, reducing negative impacts on the environment, and encouraging awareness about the importance of nature conservation. Health is also an important focus in Bank Mandiri's CSR allocation. Bank Mandiri recognizes that health is a fundamental right of every individual, and through its CSR programs, it supports public health initiatives that include improving access to health services, education on health, development of health infrastructure, and support on disease prevention and treatment efforts. In addition, Bank Mandiri also pays attention to Public Facilities and Worship. To improve the quality of life of the community, Bank Mandiri has contributed to the development of public infrastructure such as the construction of sports facilities, educational facilities, and the improvement of places of worship. Through this, the Bank supports equitable access and quality improvement of public facilities and facilitates religious activities that are important to the community. In situations of natural disasters, Bank Mandiri also pays serious attention through CSR allocations in the Natural Disaster Sector. Bank Mandiri has been involved in disaster management and post-disaster recovery efforts by aiding with disaster victims, supporting infrastructure reconstruction, and developing effective disaster response programs.

Poverty alleviation and social community development are the focus of Bank Mandiri's Social Community Development Program. Through its CSR programs, Bank Mandiri has supported initiatives aimed at reducing poverty levels, improving community welfare, and strengthening the competitiveness of local economies. This includes community economic empowerment through skills training, provision of business capital to vulnerable groups, and support to poverty alleviation programs that include the provision of social assistance, scholarships, and assistance in developing micro and small businesses.

Lastly, the education sector is also a major concern for Bank Mandiri in its CSR allocation. Bank Mandiri recognizes the importance of education in advancing society and creating equal opportunities. Through its CSR programs, Bank Mandiri has committed to support inclusive and quality education. This includes the construction of educational facilities, increasing educational accessibility for children from underprivileged families, developing innovative curricula, and providing scholarships to outstanding but financially underprivileged students. Furthermore, Table 3 presents the report data on Bank Mandiri's Green Financing allocation portfolio from 2016 to 2022.

Table 3. Green Financing Portfolio of Bank Mandiri, Indonesia (In Billion Rupiah)

Year

Renewable energy

Pollution Prevention & Control

Environmentally sustainable management of living natural resources and land use

Clean transportation

Sustainable water & wastewater management

Eco-efficient/circular economy adapted products, production technologies & processes

Green Buildings

Total Green Financing Portofolio[211]

2016

2.487

0

3.186

5.622

0

0

0

11,295

2017

3.068

0

3.186

6.522

0

0

0

12,776

2018

4.372

0

0

6.491

0

0

0

10,863

2019

1.350

136

57.539

0

245

0

0

59,27

2020

2.540

21

74.948

1.408

1.200

0

307

80,424

2021

4.281

0

88.537

2.028

1.214

0

205

96,265

2022

6.149

92,956

3.107

867

3.307

0

16

13,539

Table 3 displays data on the allocation of funds in the Green Financing Portfolio in various sectors that contribute to environmental sustainability. Each column shows the amount of funds allocated in specific years to each sector related to environmental conservation efforts. Below is the interpretation of each column in the table:

Renewable energy: This data shows the amount of funding allocated to renewable energy projects. This includes investments in environmentally friendly energy sources such as solar energy, wind energy, biomass energy, and hydroelectric energy. The data in the table shows an increase in funding allocations from 2016 to 2022, indicating a greater commitment to developing the renewable energy sector.

Pollution Prevention & Control: This data shows the amount of funding allocated for pollution prevention and control. This can include investments in technologies and systems to reduce pollutant emissions, manage waste, and

mitigate negative impacts on the environment. In the table, the data shows the allocation of funds that vary from year to year.

Environmentally sustainable management of living natural resources and land use: This column shows the amount of funds allocated for environmentally sustainable management of living natural resources and land use. This includes efforts to conserve biodiversity, sustainable forest management, control deforestation, and environmentally friendly agricultural practices. The data in the table shows fluctuations in the allocation of funds from year to year.

Clean transportation: This data shows the amount of funds allocated to clean transportation. This includes investments in sustainable transportation such as electric vehicles, environmentally friendly recharging infrastructure, and the development of more efficient and low-emission transportation systems. The data in the table shows the increase in funding allocation from 2016 to 2022.

Sustainable water & wastewater management: This data shows the amount of funding allocated for sustainable water management and wastewater treatment. This includes investments in water management infrastructure, water conservation, waste treatment, and efforts to protect aquatic ecosystems. The data in the table shows an increase in funding allocation from year to year.

Eco-efficient/circular economy adapted products, production technologies & processes: This data shows the amount of funds allocated to environmentally friendly and sustainable products, production technologies, and processes. This includes investments in the development of more ecologically efficient products, production technologies that reduce environmental impact, and the application of circular economy principles. The data in the table shows fluctuations in the allocation of funds from year to year.

Green Buildings: This data shows the amount of funds allocated for the construction of green buildings. This includes investments in environmentally friendly building design and construction, energy efficiency, use of renewable materials, and reduction of construction waste. The data in the table shows fluctuations in the allocation of funds from year to year.

Total Green Financing Portfolio: This data shows the grand total of allocated funds in the green financing portfolio. It covers all the sectors listed above and provides an overall picture of investments in projects that contribute to environmental sustainability. The data in the table shows the fluctuation of total fund allocation from 2016 to 2022.

In interpreting table 3, it can be observed that most sectors saw an increase in funding allocations year-on-year, indicating a greater commitment to environmental sustainability. Some sectors, such as renewable energy and water management, showed significant increases in funding allocations, reflecting a focus on environmentally friendly solutions.

Causality Between BOPO, NIM, ROE, ROA, and CSR

Although the quantitative research literature that directly analyzes the causality between BOPO, NIM, ROE, ROA, and CSR is limited, there are still ways to illustrate these interrelationships by analyzing the content of financial statements and presenting them in graphical form. This approach can provide insight into how the variables are interrelated and how changes in one variable can affect the others. In financial statement content analysis, we can see trends and patterns emerging from the data recorded in a company's financial statements from year to year. For example, we can see how BOPO, NIM, ROE, ROA, and CSR evolve over time and whether there is a link between changes in these values.

In Figure 1, BOPO, NIM, ROE, ROA, and CSR can be represented as a timeline showing the change in values from year to year. Using this graph, we can compare the changes in these variables and see if there is a discernible pattern. The graph can provide a clearer visual picture of the interrelationship between BOPO, NIM, ROE, ROA, and CSR and how changes in one variable can affect the other. While it cannot provide direct causal inferences, analyzing financial statement content in graphical form can help identify trends and patterns and gain initial insights into the relationships between these variables.

Theory states that the higher the BOPO, the less efficient the company is in managing its operating costs. This can have a negative impact on the company's profitability, such as ROE and ROA. However, there is no direct causal relationship between BOPO and CSR. Furthermore, theoretically the higher the NIM, the higher the profitability of the company. The increase in profitability can have a positive impact on ROE and ROA, but there is no direct causal relationship between NIM and CSR. In theory, however, good financial performance reflected in ROE may provide companies with greater resources to allocate funds for CSR. However, ROE can also be influenced by other factors beyond CSR. In theory, if ROA increases, companies have the potential to allocate more resources to CSR. However, like ROE, ROA is also affected by other factors that are not directly related to CSR.

Figure 1. Causality Between BOPO, NIM, ROE, ROA, and CSR

In the context of the relationship between ROA, ROE, NIM, BOPO, and CSR, it is important to remember that the causality and relationship between these

variables can be very complex and influenced by various external and internal factors. There is no definitive conclusion on the direct relationship between these variables as it can vary between different companies and industry sectors. However, in general, it is argued that good financial performance, such as high ROA and ROE, can provide companies with greater resources to allocate funds for CSR. If companies can generate high profits and are efficient in the use of their assets, they have a greater financial ability to set aside funds for CSR initiatives. However, based on the illustrated explanation, it can be assumed that companies that perform well financially may gain a better reputation in the eyes of stakeholders and society. In this case, companies may feel the need to participate in CSR activities as an effort to maintain a good image and gain support from society.

Causality Between Green Bond, Green Financing Portofolio and CO2 Emmision in Transportation

Figure 2 illustrates the causality between Green Bond, Green Financing Portfolio of Bank Mandiri from 2016 to 2022 and compares the progress of CO2 Emissions in transportation nationally in the same period. The graph aims to see the extent to which ESG effects have an impact on reducing carbon emissions in the transportation sector in Indonesia.

Figure 2 shows the development of Green Bond and Green Financing Portfolio issued by Bank Mandiri from 2016 to 2022. The Green Bond and Green Financing Portfolio reflects Bank Mandiri's commitment in supporting sustainable and environmentally friendly projects, including projects in the transportation sector that contribute to the reduction of CO2 emissions. In addition, the graph also shows the development of CO2 emissions in the

transportation sector in Indonesia during the same period. This data reflects the amount of CO2 emissions generated by the transportation sector nationwide. By looking at Figure 2, it can be observed whether there is a relationship between the increase in Green Bond, Green Financing Portfolio, and changes in CO2 emissions in the transportation sector. If there is a significant relationship between the increase in Green Bond and Green Financing Portfolio and the decrease in CO2 emissions in the transportation sector, this will show that the efforts of banks in supporting sustainable projects have had a positive impact in reducing carbon emissions.

Figure 2. Causality Between Green Bond, Green Financing Portofolio and CO2 Emmision in Transportation

From the data generated in Figure 2, there is a significant relationship between the increase in Green Bond and the increase in allocation of Green Financing Portfolio by Bank Mandiri, Indonesia. The graph shows that as the number of Green Bonds issued since 2016 increased, there was also a significant increase in the allocation of funds for Green Financing Portfolio by Bank Mandiri. This shows the strong awareness and commitment of Bank Mandiri in supporting sustainable and environmentally friendly projects through Green Bond issuance. Green Bond provides the necessary funding source to support projects that contribute to the reduction of CO2 emissions and environmental protection. In addition, the data on the graph also shows that the increase in Green Financing Portfolio follows the same trend as the resulting Green Financing effect. That is, the more Green-Bond issued by Bank Mandiri, the greater the allocation of funds allocated to the Green Financing Portfolio. This

indicates that an increase in Green Bond directly impacts the increase in funds available to finance sustainable projects in the transportation sector and other sectors. In this context, an increase in the Green Financing Portfolio also means an increase in investment in projects aimed at reducing CO2 emissions in the transportation sector. This reflects Bank Mandiri's significant role in supporting carbon emission reduction efforts and driving the shift towards greener transportation in Indonesia.

In conclusion, the data in Figure 2 shows a close relationship between the increase in Green Bond, Green Financing Portfolio allocation, and CO2 emission reduction efforts in the transportation sector. Bank Mandiri as a financial institution has played an important role in supporting sustainable projects through the issuance of Green Bond and allocation of funds for Green Financing Portfolio. By doing so, they contribute significantly to reducing carbon emissions and driving positive change in the transportation sector towards a cleaner and more sustainable environment.

Discussion

Green Bonds are financial instruments issued to finance sustainable and environmentally friendly projects. The Green Financing Portfolio reflects the allocation of funds allocated to these projects. The causality between Green Bond and Green Financing Portfolio can be seen from the cause-and-effect relationship formed between the two. The issuance of Green Bonds by financial institutions, such as Bank Mandiri in Indonesia, provides the necessary resources to support sustainable projects in the transportation sector. Green Bond attracts investors who are concerned about environmental issues to invest in projects that contribute to the reduction of CO2 emissions, such as the development of electric vehicles or environmentally friendly recharging

infrastructure. In this sense, the Green Bond serves as a catalyst in increasing the allocation of funds to sustainable projects in the Green Financing Portfolio. In the context of Bank Mandiri, the results of the data demonstration show that the increase in Green Bond, which began in 2016, has a significant impact on increasing the allocation of funds for the Green Financing Portfolio. In other words, the more Green-Bond issued, the greater the allocation of funds allocated for sustainable projects to reduce CO2 Emission in the transportation sector. This shows that Green Bond has a positive causality on Green Financing Portfolio. In this case, the causality between Green Financing Portfolio and CO2 Emission can be explained through the influence of investment in green technology and sustainable practices. With significant funds allocated through the Green Financing Portfolio, companies and institutions can implement projects that aim to reduce CO2 emissions in the transportation sector. For example, investments in the development of electric vehicles, environmentally friendly recharging infrastructure, or the use of cleaner alternative fuels. Through these projects, a significant reduction in CO2 emissions in the transportation sector is expected.

What Bank Mandiri is doing as one of the three state-owned banks in Indonesia that is currently a pioneer in terms of ESG provides an indication that the increase in Green Financing Portfolio goes hand in hand with the downward trend in CO2 emissions in transportation. From 2016 to 2022, along with the increased allocation of funds for sustainable projects, there has been progress in reducing CO2 emissions in the transportation sector in Indonesia. This suggests a positive causality between the Green Financing Portfolio and the reduction of CO2 emissions in transportation. In this context, the Green Financing Portfolio acts as a key driver in allocating funds to sustainable projects that contribute to the reduction of CO2 emissions. Investments made

through the Green Financing Portfolio encourage the adoption of green technologies, sustainable innovations, and greener practices in the transportation sector. Thus, there is a positive causality between the Green Financing Portfolio and CO2 emission reduction.

Managerial Implications: The causality established between Green Bond, Green Financing Portfolio, and CO2 Emissions in transportation has significant implications for environmental sustainability. First, through Green Bond issuance, financial institutions such as Bank Mandiri can mobilize the necessary resources to support sustainable projects in the transportation sector. This strengthens the commitment to accelerate the shift to greener transportation. Second, the increased allocation of funds through the Green Financing Portfolio provides opportunities for companies and institutions to implement sustainable projects. Investments in green technologies and sustainable practices in the transportation sector have the potential to significantly reduce CO2 emissions. In addition, it can also encourage innovation and development of more efficient and environmentally friendly transportation solutions. Third, the positive causality between the Green Financing Portfolio and CO2 emission reductions suggests that efforts to reduce the environmental impact of the transportation sector can be successful through proper allocation of funds. By increasing investment in sustainable projects, such as green infrastructure development or the use of renewable energy in transportation, significant reductions in CO2 emissions can be achieved.

In the context of Green Bond, there is a positive causality between the issuance of Green Bond by Bank Mandiri and the increased allocation of funds for sustainable projects in the Green Financing Portfolio. This suggests that the Green Bond serves as a catalyst in increasing investment in sustainable

projects in the transportation sector. In addition, the adoption of Green Bond and Green Financing Portfolio also has a broader positive impact. Investment in sustainable projects in the transportation sector can drive sustainable economic growth, create new jobs, and increase innovation in the transportation industry. This is in line with the concept of sustainable development that integrates environmental, social, and economic aspects.

Conclusion

In the Indonesian context, Bank Mandiri's adoption of the Green Bond and Green Financing Portfolio is a positive step in supporting environmental sustainability in the transportation sector. However, to achieve greater change, more involvement of other financial institutions and the private sector is required. The causality between Green Bond, Green Financing Portfolio, and CO2 Emissions in transportation provides a strong foundation in supporting environmental sustainability in the transportation sector. Through Green Bond issuance and increased allocation of funds in the Green Financing Portfolio, investments in sustainable projects can reduce CO2 emissions, advance green technologies, and drive innovation in transportation. However, to ensure the sustainability and effectiveness of efforts in reducing CO2 emissions in transportation, further steps are needed. First, it is important to continue to increase the number of Green Bonds issued and the allocation of funds in the Green Financing Portfolio. This can be done through collaboration between financial institutions, government, and the private sector to mobilize investment in sustainable projects in the transportation sector. Furthermore, there needs to be transparent monitoring and reporting regarding the use of funds in the Green Financing Portfolio. Financial reports and information

related to projects funded by Green Bonds should be easily accessible and verifiable. This will provide confidence to investors and the public about the effectiveness of the use of funds in reducing CO2 emissions in transportation. In addition, it is important to continue innovating green technologies and sustainable solutions in the transportation sector. The development of more efficient electric vehicles, wider recharging infrastructure, and the implementation of policies that support the use of environmentally friendly public transportation can make a significant contribution to reducing CO2 emissions. Furthermore, there is a need for cross-sector and cross-country cooperation in promoting and encouraging the adoption of Green Bonds and Green Financing Portfolios. Experience exchange, technology transfer, and training on best practices in supporting sustainable projects in the transportation sector can accelerate the shift towards greener transportation at the global level. In addition, public education and awareness also play an important role in creating environmental sustainability in the transportation sector. Easy-to-understand information about the benefits of using sustainable transportation and individual contributions to reducing CO2 emissions can motivate people to adopt greener travel habits. Finally, it is important to continue to evaluate and research the impact of Green Bond and Green Financing Portfolios on reducing CO2 emissions in transportation. In-depth quantitative and qualitative studies can provide better insights into the effectiveness of policies and measures that have been implemented, as well as assist in better decision-making for the future.

Limitations and Future Research Agenda

While our study has provided an initial understanding of the causality between Green Bond, CSR, Financial Performance, Green Financing Portfolio, and their effects on CO2 Emissions in Transportation nationwide, we realize that there are several shortcomings in this study that limit the interpretations and conclusions that can be drawn. First, this study relies on data interpretation based on visual graphs of financial statements and sustainability reports. While this provides a rough idea of the relationship between the observed variables, a more comprehensive study still has enormous opportunities to be implemented. Secondly, in the context of sustainability reporting, there are challenges in terms of consistency and assessment standards. In our study, we relied on a limited number of sustainability reports available from companies. In addition, there are no consistent standards in sustainability reporting in Indonesia, which limits uniformity and comparability between companies. For future research, it is important to consider using more consistent frameworks and standards to facilitate cross-company analysis. Third, this study is also limited to one banking subject in Indonesia. Although Bank Mandiri is one of the largest banks in Indonesia and has a commitment to sustainability, it cannot be considered representative of the entire banking sector and its influence on reducing CO2 emissions in the transportation sector nationwide. Research involving more companies in different sectors is needed to gain a more comprehensive understanding of the impact of ESG and sustainable fund allocation on CO2 emission reduction in transportation.

In the face of these limitations, our study proposes several recommendations for future research. First, the use of more advanced quantitative analysis methods, such as panel regression or path analysis, can help measure the causal impact between the variables studied more accurately. Second, it is important to expand the scope of companies involved in the study to obtain

more representative data and represent various industry sectors. Third, standardization and harmonization efforts in sustainability reporting should be encouraged, allowing for easier benchmarking and cross-company analysis.

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|---|---|---|---|
| 1. | ~~Portofolio~~ → Portfolio | Misspelled words | Correctness |
| 2. | *. Email; . This; . In; . The; . We; . With; . Green; . Initiatives; . For; . ISFI; . However; . So; . Second; . Third; . Fourth; . Fifth; . Therefore; . Measures; . There; . First; . While; . Through; . By; . Overall; . Our; . Although; . As; . Understanding; . It; . Several; . These; . Banks; . Hi...* | Text inconsistencies | Correctness |
| 3. | , for | Punctuation in compound/complex sentences | Correctness |
| 4. | , which | Punctuation in compound/complex sentences | Correctness |
| 5. | *In this study, we collected data from Bank Mandiri's financial statements which included information on ROA, ROE, NIM, and BOPO.* | Unclear sentences | Clarity |
| 6. | ~~as~~ | Wrong or missing prepositions | Correctness |
| 7. | , one | Punctuation in compound/complex sentences | Correctness |
| 8. | *The research sample is Bank Mandiri as one of the state-owned banks in Indonesia.* | Unclear sentences | Clarity |
| 9. | a purposive | Determiner use (a/an/the/this, etc.) | Correctness |
| 10. | ~~samples~~ → pieces, models | Word choice | Engagement |
| 11. | *bank's; bank; Bank* | Text inconsistencies | Correctness |
| 12. | analysis results | Wordy sentences | Clarity |
| 13. | ~~analysis~~ → study, research | Word choice | Engagement |
| 14. | ~~increase~~ → rise | Word choice | Engagement |
| 15. | the Green | Determiner use (a/an/the/this, etc.) | Correctness |

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|---|---|---|---|
| 16. | *This* | Intricate text | Clarity |
| 17. | ~~causality~~ → reason | Word choice | Engagement |
| 18. | the Green | Determiner use (a/an/the/this, etc.) | Correctness |
| 19. | *the causality between Green Financing Portfolio and CO2 emissions can be explained* | Passive voice misuse | Clarity |
| 20. | *This* | Intricate text | Clarity |
| 21. | ~~Bond~~ → Bonds | Incorrect noun number | Correctness |
| 22. | *This means that the use of Green Bond as a sustainable funding source has the potential to reduce the negative impact of transportation on the environment.* | Unclear sentences | Clarity |
| 23. | ~~Portofolio~~ → Portfolio | Misspelled words | Correctness |
| 24. | ~~Emision~~ → Emission | Misspelled words | Correctness |
| 25. | ~~that focuses~~ → focusing | Wordy sentences | Clarity |
| 26. | *(Wang et al., 2023); (Falcone, 2020); (Ainou et al., 2023); (Serrano-García et al., 2023); (Asiri et al., 2020); (Liebman et al., 2019); (Setyowati, 2023); (Volz, 2018); (Ņikitina et al., 2022); (Prihandono & Yuniarti, 2023); (Kamil et al., 2021); (Guild, 2020); (Ronaldo & Suryanto, 2022); (Maniora...* | Citation style options | Correctness |
| 27. | ~~a wide range of~~ → various | Wordy sentences | Clarity |
| 28. | challenges, | Punctuation in compound/complex sentences | Correctness |
| 29. | ~~key~~ → crucial | Word choice | Engagement |
| 30. | ~~plays a key role~~ → is key | Wordy sentences | Clarity |
| 31. | increasingly recognise | Wordy sentences | Clarity |

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|---|---|---|---|
| 32. | *be used* | Passive voice misuse | Clarity |
| 33. | ~~as well as~~ → and | Wordy sentences | Clarity |
| 34. | *This* | Intricate text | Clarity |
| 35. | *For example, the establishment of the Indonesian Sustainable Finance Initiative (ISFI) which is a consortium of banks and financial institutions to promote sustainable finance practices in Indonesia (Setyowati, 2023); (Volz, 2018).* | Incomplete sentences | Delivery |
| 36. | ~~10~~ → ten | Improper formatting | Correctness |
| 37. | ~~3~~ → three | Improper formatting | Correctness |
| 38. | , until | Punctuation in compound/complex sentences | Correctness |
| 39. | ~~until~~ | Wrong or missing prepositions | Correctness |
| 40. | ~~key~~ → vital | Word choice | Engagement |
| 41. | ~~wider~~ → more comprehensive, broader | Word choice | Engagement |
| 42. | ~~a challenge~~ → challenging | Wordy sentences | Clarity |
| 43. | *Third, there is a lack of availability of sustainable financial instruments, such as sustainable loans and sustainable mutual funds, that can support the financing of green projects (Guild, 2020).* | Unclear sentences | Clarity |
| 44. | ~~certainly~~ → undoubtedly | Word choice | Engagement |
| 45. | *Fourth, Indonesia has a great need for sustainable infrastructure development, such as renewable energy, environmentally friendly transportation, and waste management which is certainly not cheap (Ronaldo & Suryanto, 2022).* | Unclear sentences | Clarity |

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|---|---|---|---|
| 46. | *Therefore, to address these challenges, cooperation between the government, financial institutions, companies, and civil society is needed.* | Unclear sentences | Clarity |
| 47. | *can be taken* | Passive voice misuse | Clarity |
| 48. | ~~greater~~ → more significant | Word choice | Engagement |
| 49. | ~~sectors~~ → industries | Word choice | Engagement |
| 50. | *be filled* | Passive voice misuse | Clarity |
| 51. | ~~on~~ → of | Wrong or missing prepositions | Correctness |
| 52. | | Tone suggestions | Delivery |
| 53. | ~~financial~~ → economic | Word choice | Engagement |
| 54. | | Tone suggestions | Delivery |
| 55. | ~~has an impact on~~ → impacts | Wordy sentences | Clarity |
| 56. | *This* | Intricate text | Clarity |
| 57. | ~~as well as~~ → and | Wordy sentences | Clarity |
| 58. | ~~Muharam~~ → Muharram | Misspelled words | Correctness |
| 59. | ~~financial~~ → economic | Word choice | Engagement |
| 60. | ~~as well as~~ → and | Wordy sentences | Clarity |
| 61. | ~~The use of~~ → Using | Wordy sentences | Clarity |
| 62. | ~~and~~ | Conjunction use | Correctness |
| 63. | ~~bank~~ → Bank | Confused words | Correctness |
| 64. | ~~as~~ | Wrong or missing prepositions | Correctness |
| 65. | as, | Punctuation in | Correctness |

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|---|---|---|---|
| | | compound/complex sentences | |
| 66. | *The research may also include a case study of bank Mandiri as an Indonesian state-owned bank that has implemented a sustainable funding strategy and reduced CO2 emissions in the transportation sector.* | Unclear sentences | Clarity |
| 67. | *is hoped* | Passive voice misuse | Clarity |
| 68. | ~~sectors~~ → industries | Word choice | Engagement |
| 69. | | Tone suggestions | Delivery |
| 70. | ~~in~~ → for | Wrong or missing prepositions | Correctness |
| 71. | *more effective policy measures can be taken* | Passive voice misuse | Clarity |
| 72. | ~~financial~~ → economic | Word choice | Engagement |
| 73. | *may be faced* | Passive voice misuse | Clarity |
| 74. | *The research can also identify potential obstacles or barriers that may be faced in implementing sustainable finance and reducing CO2 emissions in the transportation sector.* | Unclear sentences | Clarity |
| 75. | ~~key~~ → critical | Word choice | Engagement |
| 76. | ~~an important~~ → a significant, a critical | Word choice | Engagement |
| 77. | *is expected* | Passive voice misuse | Clarity |
| 78. | *In our research, we sought to analyze the relationship between financial performance and green bonds, as well as green financing portfolios.* | Unclear sentences | Clarity |
| 79. | | Tone suggestions | Delivery |
| 80. | *However, we realized that there was limited relevant data and information that we could find in the available literature and sources.* | Unclear sentences | Clarity |

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|---|---|---|---|
| 81. | *in the context* | Misplaced words or phrases | Correctness |
| 82. | | Tone suggestions | Delivery |
| 83. | ~~specific~~ → particular | Word choice | Engagement |
| 84. | *been extensively researched* | Passive voice misuse | Clarity |
| 85. | | Tone suggestions | Delivery |
| 86. | ~~important~~ → essential | Word choice | Engagement |
| 87. | ~~in~~ → about | Wrong or missing prepositions | Correctness |
| 88. | | Tone suggestions | Delivery |
| 89. | *We hope that our findings and research methods will inspire other researchers to further explore the relationship between financial performance and sustainable financial instruments such as green bonds, as well as its practical implications in the context of sustainable investment.* | Unclear sentences | Clarity |
| 90. | ~~important~~ → essential, vital, crucial | Word choice | Engagement |
| 91. | our understanding | Pronoun use | Correctness |
| 92. | | Tone suggestions | Delivery |
| 93. | *As such, it can inform more sustainable and responsible investment decision-making in the future.* | Unclear sentences | Clarity |
| 94. | *The relationship between financial performance metrics and sustainable financing practices has gained significant attention in recent years.* | Unclear sentences | Clarity |
| 95. | ~~in relation to~~ → about, to, with, concerning | Wordy sentences | Clarity |
| 96. | *is widely used* | Passive voice misuse | Clarity |
| 97. | specifically focusing | Wordy sentences | Clarity |

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|---|---|---|---|
| 98. | *be attributed* | Passive voice misuse | Clarity |
| 99. | ~~greater~~ → more significant, more excellent | Word choice | Engagement |
| 100. | ~~at their disposal~~ | Wordy sentences | Clarity |
| 101. | ~~engaging in~~ | Wordy sentences | Clarity |
| 102. | ~~the integration of~~ → integrating | Wordy sentences | Clarity |
| 103. | *Banks that prioritize sustainable finance not only contribute to a greener economy but also mitigate risks associated with climate change and environmental degradation (Blazquez et al., 2021).* | Unclear sentences | Clarity |
| 104. | ~~Consequently~~ → ¶ Consequently | Intricate text | Clarity |
| 105. | ~~In conclusion~~ → ¶ In conclusion | Intricate text | Clarity |
| 106. | ~~plays a pivotal role~~ → is pivotal | Wordy sentences | Clarity |
| 107. | ~~engage~~ → engages | Faulty subject-verb agreement | Correctness |
| 108. | ~~green financing~~ → funding green, green funding | Word choice | Engagement |
| 109. | ~~have~~ → has | Faulty subject-verb agreement | Correctness |
| 110. | ~~larger~~ → more extensive | Word choice | Engagement |
| 111. | ~~the transition~~ → transitioning | Wordy sentences | Clarity |
| 112. | *This* | Intricate text | Clarity |
| 113. | ~~result in increased~~ → increase | Wordy sentences | Clarity |
| 114. | ~~larger~~ → more extensive | Word choice | Engagement |
| 115. | risks, | Punctuation in compound/complex sentences | Correctness |

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|---|---|---|---|
| 116. | *This* | Intricate text | Clarity |
| 117. | *This not only strengthens the financial position of the bank but also provides a platform for fostering sustainable economic growth.* | Unclear sentences | Clarity |
| 118. | *In conclusion, green financing is a crucial component of sustainable finance, supporting environmentally friendly projects and initiatives.* | Unclear sentences | Clarity |
| 119. | ~~larger~~ → more extensive | Word choice | Engagement |
| 120. | ~~stands as~~ → is | Wordy sentences | Clarity |
| 121. | ~~major~~ → significant | Word choice | Engagement |
| 122. | ~~largely~~ → primarily | Word choice | Engagement |
| 123. | *Recognizing the urgent need to address climate change* | Misplaced words or phrases | Correctness |
| 124. | ~~of~~ | Wrong or missing prepositions | Correctness |
| 125. | ~~has~~ → studies have | Incorrect verb forms | Correctness |
| 126. | *Banks that prioritize sustainable finance are more inclined to allocate funds towards initiatives that promote environmentally friendly transportation alternatives.* | Unclear sentences | Clarity |
| 127. | *This* | Intricate text | Clarity |
| 128. | *One area where financial institutions play a crucial role is in supporting the adoption of electric vehicles (EVs) (Tabelin et al., 2021).* | Unclear sentences | Clarity |
| 129. | ~~the reduction of~~ → reducing | Wordy sentences | Clarity |
| 130. | *By providing financial backing for such projects, banks can contribute to the expansion and improvement of public transportation networks, making them more accessible and appealing to commuters.* | Unclear sentences | Clarity |

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| 131. | ~~..~~ → ., ... | Closing punctuation | Correctness |
| 132. | *The allocation of funds towards these sustainable transportation initiatives by financial institutions can result in a significant reduction in CO2 emissions within the transportation sector.* | Unclear sentences | Clarity |
| 133. | ~~to play~~ | Wordy sentences | Clarity |
| 134. | ~~the~~ global | Determiner use (a/an/the/this, etc.) | Correctness |
| 135. | ~~financial~~ → economic | Word choice | Engagement |
| 136. | ), | Punctuation in compound/complex sentences | Correctness |
| 137. | ~~used~~ | Wordy sentences | Clarity |
| 138. | *The data used will be analyzed* | Passive voice misuse | Clarity |
| 139. | ~~in~~ → . In, ; in | Punctuation in compound/complex sentences | Correctness |
| 140. | ~~as~~ | Wrong or missing prepositions | Correctness |
| 141. | , one | Punctuation in compound/complex sentences | Correctness |
| 142. | *be selected* | Passive voice misuse | Clarity |
| 143. | a purposive | Determiner use (a/an/the/this, etc.) | Correctness |
| 144. | ~~technique~~ | Wordy sentences | Clarity |
| 145. | *be sourced* | Passive voice misuse | Clarity |
| 146. | *is obtained* | Passive voice misuse | Clarity |
| 147. | , which | Punctuation in | Correctness |

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|---|---|---|---|
| | | compound/complex sentences | |
| 148. | *are then illustrated* | Passive voice misuse | Clarity |
| 149. | ~~the form of~~ | Wordy sentences | Clarity |
| 150. | *In our research, we sought to analyze the relationship between financial performance and green bonds, as well as green financing portfolios.* | Unclear sentences | Clarity |
| 151. | analysis, | Punctuation in compound/complex sentences | Correctness |
| 152. | ~~that is~~ → which is | Pronoun use | Correctness |
| 153. | ~~that is~~ | Wordy sentences | Clarity |
| 154. | *is commonly used* | Passive voice misuse | Clarity |
| 155. | | Tone suggestions | Delivery |
| 156. | *be used* | Passive voice misuse | Clarity |
| 157. | *This* | Intricate text | Clarity |
| 158. | ~~since~~ → because | Wrong or missing prepositions | Correctness |
| 159. | , and | Punctuation in compound/complex sentences | Correctness |
| 160. | *specialized research using regression analysis approaches may not have been conducted* | Passive voice misuse | Clarity |
| 161. | | Tone suggestions | Delivery |
| 162. | ~~present~~ → give, offer | Word choice | Engagement |
| 163. | ~~in the form of~~ → through | Wordy sentences | Clarity |
| 164. | *This* | Intricate text | Clarity |

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| 165. | to understand those relationships and identify possible patterns or trends visually | Inappropriate colloquialisms | Delivery |
| 166. | ~~the use of~~ | Wordy sentences | Clarity |
| 167. | ~~in~~ → to | Wrong or missing prepositions | Correctness |
| 168. | | Tone suggestions | Delivery |
| 169. | 1, | Punctuation in compound/complex sentences | Correctness |
| 170. | , from | Punctuation in compound/complex sentences | Correctness |
| 171. | , from | Punctuation in compound/complex sentences | Correctness |
| 172. | *be interpreted* | Passive voice misuse | Clarity |
| 173. | *are used* | Passive voice misuse | Clarity |
| 174. | ~~is in utilizing~~ → utilises | Wordy sentences | Clarity |
| 175. | ~~then~~ | Wordy sentences | Clarity |
| 176. | ~~is able to~~ → can | Wordy sentences | Clarity |
| 177. | ~~operating~~ → active | Word choice | Engagement |
| 178. | *BOPO (Operating Expenses to Operating Income): Shows the extent to which operating expenses affect the company's operating income.* | Unclear sentences | Clarity |
| 179. | , since | Punctuation in compound/complex sentences | Correctness |
| 180. | ~~the period~~ | Wordy sentences | Clarity |
| 181. | ~~table~~ → Table | Confused words | Correctness |
| 182. | ~~certain~~ → specific | Word choice | Engagement |

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|---|---|---|---|
| 183. | ~~the level of~~ | Wordy sentences | Clarity |
| 184. | ~~certain~~ → specific | Word choice | Engagement |
| 185. | | Tone suggestions | Delivery |
| 186. | fluctuations, | Comma misuse within clauses | Correctness |
| 187. | *During the period of 2016 to 2022, Bank Mandiri Indonesia has allocated funds in Corporate Social Responsibility (CSR) programs for various areas that have a positive impact on society and the environment.* | Unclear sentences | Clarity |
| 188. | ~~During the period of~~ → From | Wordy sentences | Clarity |
| 189. | ~~in~~ → to | Wrong or missing prepositions | Correctness |
| 190. | ~~various~~ → multiple | Word choice | Engagement |
| 191. | ~~important~~ → vital, essential | Word choice | Engagement |
| 192. | ~~to contributing~~ | Wordy sentences | Clarity |
| 193. | ~~receives~~ → receive | Faulty subject-verb agreement | Correctness |
| 194. | ~~important~~ → essential | Word choice | Engagement |
| 195. | ~~, and through~~ → . Through | Hard-to-read text | Clarity |
| 196. | , such | Punctuation in compound/complex sentences | Correctness |
| 197. | *To improve the quality of life of the community, Bank Mandiri has contributed to the development of public infrastructure such as the construction of sports facilities, educational facilities, and the improvement of places of worship.* | Unclear sentences | Clarity |
| 198. | ~~situations of~~ | Wordy sentences | Clarity |

| | | | |
|---|---|---|---|
| 199. | *been involved* | Passive voice misuse | Clarity |
| 200. | ~~with~~ | Wrong or missing prepositions | Correctness |
| 201. | *Poverty alleviation and social community development are the focus of Bank Mandiri's Social Community Development Program.* | Unclear sentences | Clarity |
| 202. | *Through its CSR programs, Bank Mandiri has supported initiatives aimed at reducing poverty levels, improving community welfare, and strengthening the competitiveness of local economies.* | Unclear sentences | Clarity |
| 203. | *This* | Intricate text | Clarity |
| 204. | ~~the provision of~~ | Wordy sentences | Clarity |
| 205. | ~~major~~ → significant | Word choice | Engagement |
| 206. | *Through its CSR programs, Bank Mandiri has committed to support inclusive and quality education.* | Unclear sentences | Clarity |
| 207. | ~~support~~ → supporting | Incorrect verb forms | Correctness |
| 208. | *This* | Intricate text | Clarity |
| 209. | constructing | Wordy sentences | Clarity |
| 210. | ~~economy adapted~~ → economy-adapted | Misspelled words | Correctness |
| 211. | ~~Portofolio~~ → Portfolio | Misspelled words | Correctness |
| 212. | ~~the allocation of~~ → allocating | Wordy sentences | Clarity |
| 213. | ~~sector~~ → industry | Word choice | Engagement |
| 214. | ~~amount of~~ | Wordy sentences | Clarity |
| 215. | *This* | Intricate text | Clarity |
| 216. | *This includes investments in environmentally* | Unclear sentences | Clarity |

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|---|---|---|---|
| | *friendly energy sources such as solar energy, wind energy, biomass energy, and hydroelectric energy.* | | |
| 217. | ~~greater~~ → more significant, more outstanding | Word choice | Engagement |
| 218. | *This* | Intricate text | Clarity |
| 219. | environmental impacts | Wordy sentences | Clarity |
| 220. | ~~environmentally~~ → ecologically | Word choice | Engagement |
| 221. | *Environmentally sustainable management of living natural resources and land use: This column shows the amount of funds allocated for environmentally sustainable management of living natural resources and land use.* | Unclear sentences | Clarity |
| 222. | *This* | Intricate text | Clarity |
| 223. | of deforestation | Wrong or missing prepositions | Correctness |
| 224. | ~~amount of~~ | Wordy sentences | Clarity |
| 225. | *This* | Intricate text | Clarity |
| 226. | ~~transportation~~ → transport | Word choice | Engagement |
| 227. | ~~the development of~~ → developing | Wordy sentences | Clarity |
| 228. | ~~amount of~~ | Wordy sentences | Clarity |
| 229. | *This* | Intricate text | Clarity |
| 230. | ~~amount of~~ | Wordy sentences | Clarity |
| 231. | ~~processes~~ → procedures, operations | Word choice | Engagement |
| 232. | *This* | Intricate text | Clarity |
| 233. | *This includes investments in the development of more ecologically efficient products, production technologies that reduce environmental impact,* | Unclear sentences | Clarity |

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| | *and the application of circular economy principles.* | | |
| 234. | to construct | Wordy sentences | Clarity |
| 235. | *This* | Intricate text | Clarity |
| 236. | *This includes investments in environmentally friendly building design and construction, energy efficiency, use of renewable materials, and reduction of construction waste.* | Unclear sentences | Clarity |
| 237. | ~~grand~~ | Wordy sentences | Clarity |
| 238. | abovementioned sectors | Wordy sentences | Clarity |
| 239. | ~~table~~ → Table | Confused words | Correctness |
| 240. | *it can be observed* | Passive voice misuse | Clarity |
| 241. | ~~greater~~ → more significant, more outstanding | Word choice | Engagement |
| 242. | *be represented* | Passive voice misuse | Clarity |
| 243. | ~~changes~~ → differences | Word choice | Engagement |
| 244. | ~~graph~~ → chart | Word choice | Engagement |
| 245. | ~~visual~~ | Wordy sentences | Clarity |
| 246. | The theory | Determiner use (a/an/the/this, etc.) | Correctness |
| 247. | ~~is in managing~~ → manages | Wordy sentences | Clarity |
| 248. | *This* | Intricate text | Clarity |
| 249. | ~~have a negative impact on~~ → hurt, harm | Wordy sentences | Clarity |
| 250. | , the | Punctuation in compound/complex sentences | Correctness |

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|---|---|---|---|
| 251. | company's profitability | Wordy sentences | Clarity |
| 252. | | Tone suggestions | Delivery |
| 253. | *The increase in profitability can have a positive impact on ROE and ROA, but there is no direct causal relationship between NIM and CSR.* | Unclear sentences | Clarity |
| 254. | ~~good~~ → sound | Word choice | Engagement |
| 255. | ~~greater~~ → more significant, more excellent | Word choice | Engagement |
| 256. | *be influenced* | Passive voice misuse | Clarity |
| 257. | ~~have the potential to~~ → can | Wordy sentences | Clarity |
| 258. | ~~important~~ → essential | Word choice | Engagement |
| 259. | ~~very~~ | Wordy sentences | Clarity |
| 260. | ~~it~~ → they | Pronoun use | Correctness |
| 261. | ~~different~~ | Wordy sentences | Clarity |
| 262. | it is generally | Wordy sentences | Clarity |
| 263. | ~~greater~~ → more significant, more excellent | Word choice | Engagement |
| 264. | | Tone suggestions | Delivery |
| 265. | ~~greater~~ → more extraordinary, more remarkable | Word choice | Engagement |
| 266. | *If companies can generate high profits and are efficient in the use of their assets, they have a greater financial ability to set aside funds for CSR initiatives.* | Unclear sentences | Clarity |
| 267. | *it can be assumed* | Passive voice misuse | Clarity |
| 268. | | Tone suggestions | Delivery |
| 269. | | Tone suggestions | Delivery |

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| 270. | ~~as~~ → in | Wrong or missing prepositions | Correctness |
| 271. | ~~as an effort~~ | Wordy sentences | Clarity |
| 272. | ~~society~~ → community | Word choice | Engagement |
| 273. | ~~Portofolio~~ → Portfolio | Misspelled words | Correctness |
| 274. | the Green | Determiner use (a/an/the/this, etc.) | Correctness |
| 275. | Bond, | Punctuation in compound/complex sentences | Correctness |
| 276. | and Green | Conjunction use | Correctness |
| 277. | ~~have an impact on~~ → impact | Wordy sentences | Clarity |
| 278. | the Green | Determiner use (a/an/the/this, etc.) | Correctness |
| 279. | ~~in~~ → to | Wrong or missing prepositions | Correctness |
| 280. | *The Green Bond and Green Financing Portfolio reflects Bank Mandiri's commitment in supporting sustainable and environmentally friendly projects, including projects in the transportation sector that contribute to the reduction of CO2 emissions.* | Unclear sentences | Clarity |
| 281. | *By looking at Figure 2, it can be observed whether there is a relationship between the increase in Green Bond, Green Financing Portfolio, and changes in CO2 emissions in the transportation sector.* | Unclear sentences | Clarity |
| 282. | *be observed* | Passive voice misuse | Clarity |
| 283. | ~~increase~~ → rise | Word choice | Engagement |
| 284. | ~~in~~ → on | Wrong or missing prepositions | Correctness |
| 285. | *If there is a significant relationship between the* | Hard-to-read text | Clarity |

*increase in Green Bond and Green Financing Portfolio and the decrease in CO2 emissions in the transportation sector, this will show that the efforts of banks in supporting sustainable projects have had a positive impact in reducing carbon emissions.*

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| 286. | ~~Portofolio~~ → Portfolio | Misspelled words | Correctness |
| 287. | ~~Bond~~ → Bonds | Incorrect noun number | Correctness |
| 288. | ~~increase in~~ | Wordy sentences | Clarity |
| 289. | the allocation | Determiner use (a/an/the/this, etc.) | Correctness |
| 290. | the Green | Determiner use (a/an/the/this, etc.) | Correctness |
| 291. | *This* | Intricate text | Clarity |
| 292. | ~~in~~ → to | Wrong or missing prepositions | Correctness |
| 293. | ~~the reduction of~~ → reducing | Wordy sentences | Clarity |
| 294. | the Green | Determiner use (a/an/the/this, etc.) | Correctness |
| 295. | *This* | Intricate text | Clarity |
| 296. | ~~Bond~~ → Bonds | Incorrect noun number | Correctness |
| 297. | ~~aimed at reducing~~ → to reduce | Wordy sentences | Clarity |
| 298. | *This* | Intricate text | Clarity |
| 299. | , as | Punctuation in compound/complex sentences | Correctness |
| 300. | institution, | Punctuation in compound/complex sentences | Correctness |
| 301. | ~~important~~ → essential | Word choice | Engagement |

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| 302. | the Green | Determiner use (a/an/the/this, etc.) | Correctness |
| 303. | *Bank Mandiri as a financial institution has played an important role in supporting sustainable projects through the issuance of Green Bond and allocation of funds for Green Financing Portfolio.* | Unclear sentences | Clarity |
| 304. | *be seen* | Passive voice misuse | Clarity |
| 305. | ~~formed~~ | Wordy sentences | Clarity |
| 306. | ~~who are~~ | Wordy sentences | Clarity |
| 307. | catalyzes | Wordy sentences | Clarity |
| 308. | ~~allocation~~ → distribution | Word choice | Engagement |
| 309. | ~~Emission~~ → Emissions | Incorrect noun number | Correctness |
| 310. | *This* | Intricate text | Clarity |
| 311. | the Green | Determiner use (a/an/the/this, etc.) | Correctness |
| 312. | ~~causality~~ → reason, basis, cause | Word choice | Engagement |
| 313. | the Green | Determiner use (a/an/the/this, etc.) | Correctness |
| 314. | *the causality between Green Financing Portfolio and CO2 Emission can be explained* | Passive voice misuse | Clarity |
| 315. | ~~the use of~~ → using | Wordy sentences | Clarity |
| 316. | *For example, investments in the development of electric vehicles, environmentally friendly recharging infrastructure, or the use of cleaner alternative fuels.* | Incomplete sentences | Delivery |
| 317. | *is expected* | Passive voice misuse | Clarity |

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| 318. | *currently* | Misplaced words or phrases | Correctness |
| 319. | indicates | Wordy sentences | Clarity |
| 320. | the Green | Determiner use (a/an/the/this, etc.) | Correctness |
| 321. | *This* | Intricate text | Clarity |
| 322. | ~~key~~ → critical | Word choice | Engagement |
| 323. | ~~the reduction of~~ → reducing | Wordy sentences | Clarity |
| 324. | *Thus, there is a positive causality between the Green Financing Portfolio and CO2 emission reduction.* | Unclear sentences | Clarity |
| 325. | *This* | Intricate text | Clarity |
| 326. | to reduce CO2 emissions significantly | Inappropriate colloquialisms | Delivery |
| 327. | the development | Determiner use (a/an/the/this, etc.) | Correctness |
| 328. | the proper | Determiner use (a/an/the/this, etc.) | Correctness |
| 329. | *Third, the positive causality between the Green Financing Portfolio and CO2 emission reductions suggests that efforts to reduce the environmental impact of the transportation sector can be successful through proper allocation of funds.* | Unclear sentences | Clarity |
| 330. | ~~the use of~~ → using | Wordy sentences | Clarity |
| 331. | *significant reductions in CO2 emissions can be achieved* | Passive voice misuse | Clarity |
| 332. | ~~Bond~~ → Bonds | Incorrect noun number | Correctness |
| 333. | ~~Bond~~ → Bonds | Incorrect noun number | Correctness |

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| 334. | *This* | Intricate text | Clarity |
| 335. | catalyzes | Wordy sentences | Clarity |
| 336. | ~~in~~ → for | Wrong or missing prepositions | Correctness |
| 337. | *This* | Intricate text | Clarity |
| 338. | ~~is in line~~ → aligns | Wordy sentences | Clarity |
| 339. | ~~greater~~ → more significant, more remarkable, more tremendous | Word choice | Engagement |
| 340. | *However, to achieve greater change, more involvement of other financial institutions and the private sector is required.* | Unclear sentences | Clarity |
| 341. | ~~transportation~~ → Transportation | Confused words | Correctness |
| 342. | ~~transportation~~ → transport, vehicle | Word choice | Engagement |
| 343. | *However, to ensure the sustainability and effectiveness of efforts in reducing CO2 emissions in transportation, further steps are needed.* | Unclear sentences | Clarity |
| 344. | ~~important~~ → essential, vital, crucial | Word choice | Engagement |
| 345. | *First, it is important to continue to increase the number of Green Bonds issued and the allocation of funds in the Green Financing Portfolio.* | Unclear sentences | Clarity |
| 346. | *This* | Intricate text | Clarity |
| 347. | *This can be done* | Passive voice misuse | Clarity |
| 348. | the government | Determiner use (a/an/the/this, etc.) | Correctness |
| 349. | ~~Furthermore~~ → ¶ Furthermore | Intricate text | Clarity |

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| 350. | *This* | Intricate text | Clarity |
| 351. | ~~the use of~~ → using | Wordy sentences | Clarity |
| 352. | ~~important~~ → essential | Word choice | Engagement |
| 353. | ~~wider~~ → broader, more expansive, more comprehensive | Word choice | Engagement |
| 354. | significantly contribute | Wordy sentences | Clarity |
| 355. | *Furthermore, there is a need for cross-sector and cross-country cooperation in promoting and encouraging the adoption of Green Bonds and Green Financing Portfolios.* | Unclear sentences | Clarity |
| 356. | ~~important~~ → essential | Word choice | Engagement |
| 357. | ~~important~~ → essential, vital, crucial | Word choice | Engagement |
| 358. | *In-depth quantitative and qualitative studies can provide better insights into the effectiveness of policies and measures that have been implemented, as well as assist in better decision-making for the future.* | Unclear sentences | Clarity |
| 359. | ~~Bond~~ → Bonds | Incorrect noun number | Correctness |
| 360. | *can be drawn* | Passive voice misuse | Clarity |
| 361. | *While our study has provided an initial understanding of the causality between Green Bond, CSR, Financial Performance, Green Financing Portfolio, and their effects on CO2 Emissions in Transportation nationwide, we realize that there are several shortcomings in this study that limit the interpretati...* | Unclear sentences | Clarity |
| 362. | implementation opportunities | Wordy sentences | Clarity |
| 363. | *be implemented* | Passive voice misuse | Clarity |
| 364. | ~~the context of~~ | Wordy sentences | Clarity |

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| 365. | ~~important~~ → essential, vital, crucial | Word choice | Engagement |
| 366. | *Although Bank Mandiri is one of the largest banks in Indonesia and has a commitment to sustainability, it cannot be considered representative of the entire banking sector and its influence on reducing CO2 emissions in the transportation sector nationwide.* | Unclear sentences | Clarity |
| 367. | ~~the use of~~ | Wordy sentences | Clarity |
| 368. | ~~important~~ → essential, crucial, vital | Word choice | Engagement |
| 369. | *Second, it is important to expand the scope of companies involved in the study to obtain more representative data and represent various industry sectors.* | Unclear sentences | Clarity |
| 370. | ~~review~~ → Review | Improper formatting | Correctness |
| 371. | ~~Kathamandu~~ → Kathmandu | Misspelled words | Correctness |
| 372. | ~~the selection of~~ → selecting | Wordy sentences | Clarity |
| 373. | ~~really~~ | Wordy sentences | Clarity |
| 374. | ~~the integration of~~ → integrating | Wordy sentences | Clarity |
| 375. | *Current Ratio, Return on Asset, and Debt-to-Equity-Ratio on Stock-Price of Sector Property and Real Estate.* | Unclear sentences | Clarity |
| 376. | I was untangling, or I am untangling | Incomplete sentences | Delivery |
| 377. | ~~channeling~~ → channelling | Mixed dialects of English | Correctness |
| 378. | *Return on Assets (ROA), Return on Equity (ROE), Net Interest Margin (NIM), and* | Profitability Determinants of Financial Institutions: Evidence from Banks in Pakistan | Originality |
| 379. | *The collected data was then analyzed using statistical* | A two-year survey on the effect of temperature changes on the incidence of myocardial infarction | Originality |

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| | | in patients referred to the Ali-ibn Abi Talib Hospital Rafsanjan Iran in 2013-2014 - Journal of Occupational Health and Epidemiology https://johe.rums.ac.ir/browse.php?a_id=115&sid=1&slc_lang=fa | |
| 380. | *to reduce the negative impact of transportation on the environment.* | Advances in Vibroacoustics and Aeroacustics of Marine, Aerospace and Automotive Systems | Originality |
| 381. | *With increasing awareness of the negative impact of* | The Rise of Lab Grown Diamond Jewellery: An Affordable and Sustainable Alternative - Co~Forbes https://coforbes.com/the-rise-of-lab-grown-diamond-jewellery-an-affordable-and-sustainable-alternative/ | Originality |
| 382. | *environmental, social, and governance (ESG) factors in their investment decisions* | Spain : Ferrovial Celebrates 17 Years in a Row on the FTSE4Good Sustainability Index | Originality |
| 383. | *framework for companies to report on their performance in terms of environmental, social, and* | AKEUROPA \| Challenges of the new European Sustainability Reporting Standards (ESRS) https://www.akeuropa.eu/en/challenges-new-european-sustainability-reporting-standards-esrs | Originality |
| 384. | *Return on Assets (ROA), Return on Equity (ROE), Net Interest Margin (NIM), and* | Profitability Determinants of Financial Institutions: Evidence from Banks in Pakistan | Originality |
| 385. | *the role of the financial sector in promoting sustainable development* | IMPCTRS Podcast: Innovative financial instruments that enhance sustainability \| IDB Invest https://www.idbinvest.org/en/news-media/impctrs-podcast-innovative-financial-instruments-enhance-sustainability | Originality |

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| 386. | *will inspire other researchers to further explore the relationship between* | Gentrification in Latin America: Overview and Critical Analysis | Originality |
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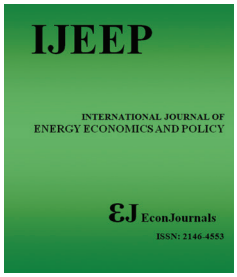


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# Causality of Bank Financial Performance, Green Bond, CSR, Green Financing Portfolio and $CO_2$ Emissions in Transportation: Evidence from Indonesia

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**ABSTRACT**

This study aims to identify the causality between bank financial performance measured by Return on Assets (ROA), Return on Equity (ROE), Net Interest Margin (NIM), and Operating Expenses to Operating Income (BOPO) with Green Financing Portfolio and $CO_2$ emissions in the transportation sector. This study uses descriptive quantitative research methods and content analysis of the Sustainability Report of Bank Mandiri, Indonesia for the period 2016 to 2022. In this study, we collected data from Bank Mandiri's financial statements which included information on ROA, ROE, NIM, and BOPO. In addition, we also collected $CO_2$ emission data available from 2016 to 2022. The research sample is Bank Mandiri as one of the state-owned banks in Indonesia. We used purposive sampling technique to select samples that meet the inclusion criteria. The collected data was then analyzed using statistical methods to test the relationship between the variables involved, namely the bank's financial performance (ROA, ROE, NIM, and BOPO), Green Financing Portfolio, and $CO_2$ emissions in the transportation sector. We use content analysis to illustrate the results of Bank Mandiri's financial statements in graphical form. The results of the analysis show that the increase in Green Bond that started in 2016 has a significant impact on the increase in fund allocation for Green Financing Portfolio. This indicates a positive causality between Green Bond and Green Financing Portfolio. In this context, the causality between Green Financing Portfolio and $CO_2$ emissions can be explained through the influence of investment in green technology and sustainable practices. With significant funds allocated through the Green Financing Portfolio, companies and institutions can implement projects that aim to reduce $CO_2$ emissions in the transportation sector. This means that the use of Green Bond as a sustainable funding source has the potential to reduce the negative impact of transportation on the environment.

**Keywords:** Green Bond, Green Financing Portofolio, Financial Performance, $CO_2$ Emision in Transportation
**JEL Classifications:** ???

## 1. INTRODUCTION

In an increasingly environmentally conscious era, green finance has emerged as a financial initiative that focuses on sustainable and environmentally friendly investments. The green finance narrative illustrates how the financial sector can be a positive force in promoting sustainable economic growth and protecting the environment (Wang et al., 2023). Green finance encompasses a wide range of financial instruments designed to support environmentally friendly projects, such as renewable energy, energy efficiency, good water management, forest protection, and sustainable transportation (Falcone, 2020). In this study, we can see how green finance provides solutions to today's environmental challenges, while creating profitable business opportunities. Green finance plays a key role in driving a paradigm shift in how we view investment and economic growth (Ainou et al., 2023). With increasing awareness of the negative impact of human activity on the environment, financial market participants are increasingly recognizing the importance of considering environmental, social, and governance (ESG) factors in their investment decisions

(Serrano-García et al., 2023). The green finance narrative also highlights the importance of collaboration between governments, financial institutions, companies, and communities to create an ecosystem that supports sustainable investments. Initiatives such as the issuance of green bonds, whose proceeds will be used for environmental projects, as well as the establishment of financial institutions that specialize in funding sustainable projects, are examples of successful collaboration in advancing green finance (Asiri et al., 2020).

In particular, the Government of Indonesia encourages the development of ESG through relevant policies and regulations. For example, the Indonesian government launched the Green Finance Initiative and created the Sustainable Financial Reporting Guidelines. This aims to provide guidance and a framework for companies to report on their performance in terms of environmental, social, and corporate governance (Liebman et al., 2019). In addition, there is also the development of institutions and initiatives that support ESG development in Indonesia. For example, the establishment of the Indonesian Sustainable Finance Initiative (ISFI) which is a consortium of banks and financial institutions to promote sustainable finance practices in Indonesia (Setyowati, 2023); (Volz, 2018). ISFI works with various parties, including the government, companies, and civil society, to increase understanding and awareness of ESG. The Indonesian government has also encouraged more transparent and comprehensive ESG reporting. In 2020, the Indonesia Stock Exchange (IDX) introduced mandatory guidelines for listed companies to report ESG information periodically. The move aims to provide stakeholders with a clearer picture of companies' ESG performance and encourage companies to improve their business practices. However, of the 10 state-owned banks in Indonesia, only 3 banks have implemented ESG reporting, namely Bank BNI, Bank BRI, and Bank Mandiri until 2023. So it can be assumed that in the midst of the world program on ESG to support sustainability, Indonesia until 2023 is still in the stage of development and improvement (OJK, 2021).

There are various key issues that need to be addressed in the development of green finance in Indonesia, for example, first, many market participants do not fully understand the concepts and benefits of green finance (Katadata Center Insight, 2022), so there needs to be wider education to encourage the adoption and implementation of sustainable practices (Ņikitina et al., 2022). Second, inconsistent ESG performance measurement and reporting standards are still a challenge in Indonesia (Prihandono and Yuniarti, 2023); (Kamil et al., 2021). Third, there is a lack of availability of sustainable financial instruments, such as sustainable loans and sustainable mutual funds, that can support the financing of green projects (Guild, 2020). Fourth, Indonesia has a great need for sustainable infrastructure development, such as renewable energy, environmentally friendly transportation, and waste management which is certainly not cheap (Ronaldo and Suryanto, 2022). Fifth, greater awareness and incentives are needed for companies to integrate ESG factors in their decision-making and daily operations (Maniora, 2017). Therefore, to address these challenges, cooperation between the government, financial institutions, companies, and civil society is needed. Measures that can be taken include the provision of greater fiscal incentives for sustainable projects, increased awareness and education on green finance, the development of clear standards and frameworks, and increased collaboration and partnerships between different stakeholders (Hafner et al., 2020); (Clark et al., 2018).

This study aims to identify the relationship between bank financial performance as measured by Return on Assets (ROA), Return on Equity (ROE), Net Interest Margin (NIM), and Operating Expenses to Operating Income (BOPO) with Green Financing Portfolio and $CO_2$ emissions in the transportation sector. This research has significant relevance given the challenges faced by the financial and transportation sectors in achieving sustainable development goals (Schroeder et al., 2019); (Zhan and Santos-Paulino, 2021); (Litvinenko et al., 2022). There are several research gaps that need to be filled in this context. First, the relationship between bank financial performance and sustainable funding portfolios is still not fully understood (Badía et al., 2019); (Iazzolino et al., 2023); (Atz et al., 2023); (Mirza et al., 2023). While several studies have investigated the impact of financial performance on sustainable funding decisions, there is still a lack of understanding on how ROA, ROE, NIM, and BOPO specifically relate to sustainable funding portfolios.

Second, the effect of financial performance on $CO_2$ emissions in the transportation sector has not been widely studied (Abid et al., 2022). While banks and financial institutions are increasingly interested in minimizing the environmental impact of their funding portfolios, the relationship between financial performance and $CO_2$ emissions in the transportation sector remains unclear. This study will investigate whether banks' financial performance has an impact on investment decisions in environmentally friendly transportation and to what extent it can reduce $CO_2$ emissions. In addition, this study will also examine the role of financial intermediation in promoting sustainable financing and $CO_2$ emission reduction in the transportation sector. This relates to the influence of NIM and BOPO on sustainable funding portfolios as well as $CO_2$ emissions (Nugrahaeni and Muharam, 2023). Through this analysis, this research will contribute a new understanding of how banks' financial performance can impact responsible and sustainable financial practices, as well as their impact on the environment.

The research methodology will involve the analysis of secondary data from banks' financial statements as well as transportation sector data related to $CO_2$ emissions. The use of statistical regression will enable the identification of causal relationships between ROA, ROE, NIM, BOPO, and sustainable funding portfolio and $CO_2$ emissions. The research may also include a case study of bank Mandiri as an Indonesian state-owned bank that has implemented a sustainable funding strategy and reduced $CO_2$ emissions in the transportation sector. By filling this research gap, it is hoped that this research can provide important insights for the financial and transportation sectors in driving the transition to a low-carbon and sustainable economy. The results of this study can serve as a basis for banks and financial institutions to develop more effective policies and strategies in integrating environmental aspects in their funding decisions.

In addition, the findings of this study may also benefit regulators and governments in developing policies that encourage the adoption of sustainable finance and the reduction of $CO_2$ emissions in the transportation sector. With a better understanding of the relationship between financial performance and environmental impact, more effective policy measures can be taken to encourage positive changes in the financial and transportation sectors. The research can also identify potential obstacles or barriers that may be faced in implementing sustainable finance and reducing $CO_2$ emissions in the transportation sector. In this regard, the research can provide recommendations and solutions to address these challenges, such as the development of financial instruments that support sustainable investment, the engagement of key actors in the industry, and government policies that encourage the transition to greener transportation. Overall, this research will fill an important knowledge gap in relation to the linkages between bank financial performance (ROA, ROE, NIM, BOPO), sustainable financing portfolio, and $CO_2$ emissions in the transportation sector. Through this research, a more comprehensive understanding of the role of the financial sector in promoting sustainable development and reducing greenhouse gas emissions in the transportation sector is expected.

In our research, we sought to analyze the relationship between financial performance and green bonds, as well as green financing portfolios. However, we realized that there was limited relevant data and information that we could find in the available literature and sources. While there have been studies addressing financial performance and sustainable financial instruments such as green bonds, we conclude that ours is the first study that attempts to comprehensively examine this aspect by involving the comparison of banking performance ratios through Sustainability reports to the effect of carbon emission reduction on the transportation sector nationwide in Indonesia. We did not find enough relevant fundamentals that address the specific relationship between financial performance and green bonds in the context we studied. The unavailability of specific data and information in the literature suggests that this topic is still relatively new or has not been extensively researched. Therefore, our study makes an important contribution to further understanding and thinking in the relationship between financial performance and green bonds. Our study provides a strong foundation for future research in this domain. We hope that our findings and research methods will inspire other researchers to further explore the relationship between financial performance and sustainable financial instruments such as green bonds, as well as its practical implications in the context of sustainable investment. Although we did not find many studies related to this topic, it is important to continue to explore knowledge and expand understanding of the relationship between financial performance and green bonds. As such, it can inform more sustainable and responsible investment decision-making in the future.

## 2. LITERATURE REVIEW

The relationship between financial performance metrics and sustainable financing practices has gained significant attention in recent years. This literature review aims to explore the existing body of research on the association between Return on Assets (ROA), Green Financing Portfolio, and $CO_2$ emissions in the transportation sector. Understanding this relationship is crucial for promoting sustainable financial decision-making and reducing environmental impacts.

### 2.1. Return on Assets (ROA)

Return on Assets (ROA) is a fundamental financial metric that provides insights into a company's ability to generate profits in relation to its total assets (Malikah, 2021); (Tangngisalu, 2022); (Allo et al., 2021). It is widely used by investors, analysts, and financial institutions to evaluate a firm's efficiency and effectiveness in utilizing its available resources (Olarewaju and Msomi, 2021). In recent years, the concept of sustainable finance has gained traction, emphasizing the integration of environmental, social, and governance (ESG) factors into financial decision-making (Huang, 2021); (Clementino and Perkins, 2021). Several research studies have explored the relationship between ROA and sustainable finance, with a specific focus on green lending and investment practices (Xu et al., 2020); (Banker et al., 2014). These studies have revealed a positive association between a bank's ROA and its engagement in green financing activities (Xu et al., 2020); (Banker et al., 2014). Banks with higher ROA tend to demonstrate a greater propensity to allocate funds toward sustainable initiatives, including green projects, renewable energy ventures, energy-efficient technologies, and environmentally responsible businesses (Bohora, 2018); (Hodge, 2002). The findings of these studies underscore the significance of financial performance in shaping a bank's commitment to sustainable portfolio allocation. Higher profitability, as indicated by a strong ROA, provides financial institutions with the capacity to expand their green financing activities (Hodge, 2002). This positive association between ROA and green financing highlights the potential for financial institutions to align their profitability goals with sustainability objectives (Hodge, 2002).

The positive correlation between ROA and green financing can be attributed to various factors. Firstly, banks with higher profitability have greater financial resources at their disposal, enabling them to invest in sustainable projects and initiatives (Sahoo and Nayak, 2007). Moreover, engaging in green financing can enhance a bank's reputation, attract socially conscious investors, and foster long-term relationships with environmentally responsible clients (Zhang et al., 2022). These factors contribute to increased profitability and a positive feedback loop, wherein higher ROA enables further expansion of green financing activities. Furthermore, the integration of sustainability into financial decision-making processes aligns with the growing regulatory frameworks and global initiatives aimed at addressing climate change and promoting sustainable development (Clark et al., 2018). Banks that prioritize sustainable finance not only contribute to a greener economy but also mitigate risks associated with climate change and environmental degradation (Blazquez et al., 2021). Consequently, the positive association between ROA and green financing supports the notion that financial performance and sustainable practices are not mutually exclusive but rather mutually reinforcing. In conclusion, the existing literature highlights the positive relationship between ROA and sustainable finance, particularly in

the context of green lending and investment. Financial institutions with higher ROA demonstrate a greater propensity to allocate funds toward sustainable projects, thereby fostering environmental sustainability (Fatica and Panzica, 2021); (Guo et al., 2022). This connection emphasizes the potential for financial institutions to integrate profitability goals with sustainable portfolio allocation.

## 2.2. Green Financing Portfolio

Green financing plays a pivotal role in promoting environmentally friendly projects and initiatives by providing financial support through specialized products and services (Chen et al., 2022). It encompasses various forms of investments, including but not limited to renewable energy, energy efficiency, sustainable infrastructure, and other sectors that prioritize environmental responsibility (Tang et al., 2021). Research studies have consistently highlighted the positive impact of green financing on mitigating climate change and fostering sustainable development. The company that actively engage in green financing and have a larger portfolio dedicated to environmentally friendly projects contribute significantly to reducing carbon emissions and promoting a low-carbon economy (Tian et al., 2022). By directing their financial resources towards green initiatives, these banks facilitate the transition to renewable energy sources, encourage energy efficiency practices, and support sustainable infrastructure development. One significant advantage of expanding green financing portfolios is the enhancement of a bank's reputation and credibility (Akomea-Frimpong et al., 2022); (Bal et al., 2013). By actively supporting environmentally responsible projects, financial institutions signal their commitment to sustainability and position themselves as key players in the transition to a greener future. This fosters trust among stakeholders, including customers, investors, and regulatory bodies, and may result in increased business opportunities and market share (Fieseler, 2011).

In addition to reputational benefits, green financing aligns with evolving regulatory requirements and policy frameworks. Governments and regulatory bodies worldwide have recognized the urgent need to address climate change and have implemented measures to incentivize and regulate sustainable finance practices (Falcone, 2020). Banks with a larger green financing portfolio are better positioned to meet these regulatory obligations, thereby reducing compliance risks, and ensuring long-term sustainability in their operations (Dikau and Volz, 2021). Moreover, the expansion of green financing portfolios attracts environmentally conscious investors. In recent years, there has been a growing trend of investors seeking financial opportunities that align with their sustainability values (Azman and Ali, 2019). By offering green financial products and services, banks can tap into this investor demand, expanding their customer base and potentially accessing additional sources of capital for future investments (Clark et al., 2018). This not only strengthens the financial position of the bank but also provides a platform for fostering sustainable economic growth.

In conclusion, green financing is a crucial component of sustainable finance, supporting environmentally friendly projects and initiatives. Banks with a larger green financing portfolio actively contribute to reducing carbon emissions, promoting sustainable development, and aligning with regulatory requirements. The benefits extend beyond environmental impact, encompassing reputational advantages, investor appeal, and regulatory compliance. As the importance of sustainability grows, expanding green financing portfolios becomes a strategic imperative for financial institutions seeking to align profitability with environmental responsibility.

## 2.3. $CO_2$ Emission in Transportation

The transportation sector stands as a major contributor to global carbon dioxide ($CO_2$) emissions, largely attributed to its heavy reliance on fossil fuels and inefficient transport systems. Recognizing the urgent need to address climate change, several studies have explored the role of financial institutions in reducing $CO_2$ emissions within the transportation sector (Ballot and Fontane, 2010); (Timilsina and Shrestha, 2009). Several of prior Research has indicated a positive association between financial institutions with a strong focus on sustainable financing and their support for low-carbon transportation projects (Kong, 2022). Banks that prioritize sustainable finance are more inclined to allocate funds towards initiatives that promote environmentally friendly transportation alternatives. This includes investments in electric vehicles, public transportation systems, and the development of sustainable mobility infrastructure. One area where financial institutions play a crucial role is in supporting the adoption of electric vehicles (EVs) (Tabelin et al., 2021). By providing financing options and incentives for the purchase and use of EVs, banks contribute to the reduction of $CO_2$ emissions from traditional gasoline-powered vehicles. This support helps accelerate the transition to cleaner transportation and encourages individuals and businesses to choose more sustainable alternatives.

Furthermore, financial institutions can play a vital role in supporting the development and improvement of public transportation systems. Investments in efficient, affordable, and sustainable public transportation infrastructure can significantly reduce the number of private vehicles on the road, leading to lower overall emissions (Patil, 2021); (Shah et al., 2021). By providing financial backing for such projects, banks can contribute to the expansion and improvement of public transportation networks, making them more accessible and appealing to commuters. Sustainable mobility infrastructure is another area where financial institutions can make a difference. Investments in infrastructure projects that facilitate walking, cycling, and other forms of sustainable transportation help reduce the reliance on carbon-intensive modes of transportation (Mittal and Woodside, 2022). By allocating funds towards the development of bike lanes, pedestrian-friendly walkways, and integrated transportation systems, financial institutions contribute to creating more sustainable and environmentally friendly urban environments (Mittal and Woodside, 2022). The allocation of funds towards these sustainable transportation initiatives by financial institutions can result in a significant reduction in $CO_2$ emissions within the transportation sector. By supporting the shift towards low-carbon alternatives and promoting the adoption of sustainable transportation practices, banks actively contribute to mitigating climate change and fostering a greener future.

In conclusion, financial institutions have a vital role to play in reducing $CO_2$ emissions in the transportation sector. By

prioritizing sustainable financing and allocating funds towards low-carbon transportation projects, such as electric vehicles, public transportation systems, and sustainable mobility infrastructure, banks can help drive the transition to cleaner and more environmentally friendly transportation options (Rodríguez-García et al., 2022). Through their support, financial institutions actively contribute to the global efforts to combat climate change and create a more sustainable future.

### 2.4. Existing Research

Several studies have explored the connection between ROA, green financing portfolios, and $CO_2$ emissions in the transportation sector. For example, research has shown that banks with higher ROA are more inclined to allocate funds to sustainable transportation projects, resulting in reduced $CO_2$ emissions. These findings suggest that financial performance and sustainable finance are interconnected, with positive financial outcomes supporting green portfolio expansion and carbon reduction efforts. Furthermore, studies have identified various factors influencing the association between ROA, green financing portfolios, and $CO_2$ emissions in transportation. These factors include regulatory frameworks, government policies, stakeholder pressures, and institutional factors. Understanding these factors can help policymakers and financial institutions develop strategies to encourage sustainable financing and mitigate $CO_2$ emissions in the transportation sector.

## 3. RESEARCH METHOD AND DATA

This study aims to analyze the effect of the Green Financing Portfolio on Return on Assets (ROA), Return on Equity (ROE), Net Interest Margin (NIM), and Operating Costs to Operating Income (BOPO), and examine the level of $CO_2$ emissions in the transportation sector. This research uses descriptive quantitative research methods. The data used will be analyzed statistically to test the relationship between the variables involved. The sample in this study is a company that implements a sustainable funding portfolio (Green Financing Portfolio) in this case is PT Bank Mandiri as one of the state-owned banks in Indonesia. The research sample will be selected using purposive sampling technique, with the inclusion criteria of transportation companies that actively use sustainable funding and have complete financial data.

The data used in this study will be sourced from the financial statements of transportation companies and $CO_2$ emissions data available from 2016 to 2022. Financial statement data includes information on ROA, ROE, NIM, and BOPO, while $CO_2$ emissions data is obtained from reliable sources such as official reports or related research. The collected data will be analyzed using content analysis in the form of the results of Bank Mandiri's financial statements from 2016 to 2022 which are then illustrated in the form of graphs.

## 4. RESULTS AND DISCUSSION

### 4.1. Data Description

In our research, we sought to analyze the relationship between financial performance and green bonds, as well as green financing portfolios. However, we faced challenges in finding relevant references related to the use of regression analysis that is commonly used in quantitative research in finance.

When we searched for literature that could be used as a reference to apply regression analysis to the relationship between financial performance and green bonds, we did not find many sources that were relevant and appropriate to our research context. This may be since research on the relationship is still in its infancy and specialized research using regression analysis approaches may not have been conducted. However, we remain committed to presenting our data objectively and explaining the relationship between the variables we examined. To overcome these limitations, we decided to present our data in the form of content analysis and causality graphs. Through content analysis, we drew in-depth information from relevant sources and identified important patterns or findings that could illustrate the relationship between financial performance and green bonds.

In addition, we use graphs and data visualizations to present our results more clearly and facilitate understanding. Causality graphs help illustrate the relationships between the variables we examine, although they do not use a direct regression analysis approach. This allows readers and stakeholders to visually understand those relationships and identify possible patterns or trends. While the use of regression analysis is not directly applicable in our study, we still try to present our results in a valid and informative way. In Table 1 we illustrate the financial statement data related to the financial performance of Bank Mandiri, Indonesia from 2016 to 2022.

In general, the data in Table 1 provides an overview of the financial performance of Bank Mandiri, Indonesia from the perspectives of ROA, ROE, NIM, and BOPO over the time presented. The data can be interpreted that:

1. ROA (Return on Assets): Shows the efficiency with which the company's assets are used to generate profits. The higher the ROA number, the more efficient the company is in utilizing its assets. In the table, ROA increased from 2016 to 2018, peaked in 2018, and then fluctuated in the following years.
2. ROE (Return on Equity): Measures the rate of return on the company owner's equity. A high ROE indicates that the company is successfully generating good returns for its owners. In the table, ROE also increases over time, with annual fluctuations.
3. NIM (Net Interest Margin): This is the difference between the interest income received by the company and the interest paid on loans and funds received from customers. A high

**Table 1: Financial Performance Ratios of Bank Mandiri, Indonesia**

| Year | ROA | ROE | NIM | BOPO |
|---|---|---|---|---|
| 2016 | 1.95 | 11.12 | 6.29 | 80.94 |
| 2017 | 2.72 | 14.53 | 5.63 | 71.78 |
| 2018 | 3.17 | 16.23 | 5.52 | 66.48 |
| 2019 | 3.03 | 15.08 | 5.46 | 67.44 |
| 2020 | 1.64 | 9.36 | 4.48 | 80.03 |
| 2021 | 2.53 | 16.24 | 4.73 | 67.26 |
| 2022 | 3.30 | 22.62 | 5.16 | 57.35 |

NIM indicates that the company is able to maximize interest income. In the table, NIM shows a downward trend from 2016 to 2022.

4. BOPO (Operating Expenses to Operating Income): Shows the extent to which operating expenses affect the company's operating income. A low BOPO indicates efficiency in managing operating costs. In the table, BOPO shows a downward trend over time.

Furthermore, Table 2 presents data in the form of Green Bond Bank Mandiri, Indonesia and CSR allocation of Bank Mandiri, Indonesia since the period 2016-2022.

Green Bond in Table 2 shows a number that reflects the amount of funds obtained from the issuance of Green Bond by companies in certain years. This number reflects the level of investor interest in supporting environmentally friendly projects through Green Bond. The data in the table shows a significant increase from 2016 to 2022, with the amount of funds obtained increasing from 131.9 to 250.2 (in billion rupiah). Meanwhile, CSR (Corporate Social Responsibility) shows numbers that reflect the implementation of CSR by companies in certain years. While it is not explained in detail what this figure represents, a possible assumption is that it reflects the amount invested or allocated by companies for various CSR initiatives. The data in the table shows annual fluctuations, but with a general trend of increase from 2016 to 2022.

During the period of 2016 to 2022, Bank Mandiri Indonesia has allocated funds in Corporate Social Responsibility (CSR) programs for various areas that have a positive impact on society and the environment. Significant CSR allocations have been made in various important sectors, reflecting Bank Mandiri's commitment to contributing to sustainable development and community welfare.

One of the areas that receives special attention in Bank Mandiri's CSR allocation is the Environment/Nature Preservation Sector. To preserve nature, Bank Mandiri has supported projects that focus on reforestation, environmental conservation, carbon emission reduction, and natural resource protection. Through the allocation of CSR funds, Bank Mandiri plays an active role in maintaining biodiversity, reducing negative impacts on the environment, and encouraging awareness about the importance of nature conservation. Health is also an important focus in Bank Mandiri's CSR allocation. Bank Mandiri recognizes that health is a fundamental right of every individual, and through its CSR programs, it supports public health initiatives that include improving access to health services, education on health, development of health infrastructure, and support on disease prevention and treatment efforts. In addition, Bank Mandiri also pays attention to Public Facilities and Worship. To improve the quality of life of the community, Bank Mandiri has contributed to the development of public infrastructure such as the construction of sports facilities, educational facilities, and the improvement of places of worship. Through this, the Bank supports equitable access and quality improvement of public facilities and facilitates religious activities that are important to the community. In situations of natural disasters, Bank Mandiri also pays serious attention through CSR allocations in the Natural Disaster Sector. Bank Mandiri has been involved in disaster management and post-disaster recovery efforts by aiding with disaster victims, supporting infrastructure reconstruction, and developing effective disaster response programs.

**Table 2: Green Bond and CSR Allocation Report of Bank Mandiri, Indonesia (In Billion Rupiah)**

| Year | Green Bond | CSR |
|---|---|---|
| 2016 | 131.9 | 63.43 |
| 2017 | 141 | 118.88 |
| 2018 | 182.3 | 114.52 |
| 2019 | 208.9 | 150.17 |
| 2020 | 204 | 133.90 |
| 2021 | 224.6 | 132.37 |
| 2022 | 250.2 | 137.60 |

Poverty alleviation and social community development are the focus of Bank Mandiri's Social Community Development Program. Through its CSR programs, Bank Mandiri has supported initiatives aimed at reducing poverty levels, improving community welfare, and strengthening the competitiveness of local economies. This includes community economic empowerment through skills training, provision of business capital to vulnerable groups, and support to poverty alleviation programs that include the provision of social assistance, scholarships, and assistance in developing micro and small businesses.

Lastly, the education sector is also a major concern for Bank Mandiri in its CSR allocation. Bank Mandiri recognizes the importance of education in advancing society and creating equal opportunities. Through its CSR programs, Bank Mandiri has committed to support inclusive and quality education. This includes the construction of educational facilities, increasing educational accessibility for children from underprivileged families, developing innovative curricula, and providing scholarships to outstanding but financially underprivileged students. Furthermore, Table 3 presents the report data on Bank Mandiri's Green Financing allocation portfolio from 2016 to 2022.

Table 3 displays data on the allocation of funds in the Green Financing Portfolio in various sectors that contribute to environmental sustainability. Each column shows the amount of funds allocated in specific years to each sector related to environmental conservation efforts. Below is the interpretation of each column in the table:

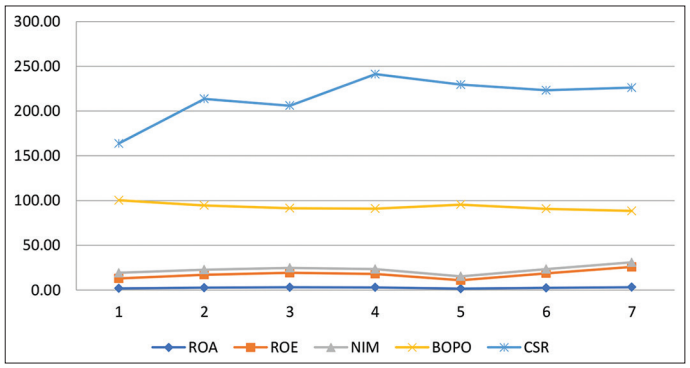
1. Renewable energy: This data shows the amount of funding allocated to renewable energy projects. This includes investments in environmentally friendly energy sources such as solar energy, wind energy, biomass energy, and hydroelectric energy. The data in the table shows an increase in funding allocations from 2016 to 2022, indicating a greater commitment to developing the renewable energy sector.
2. Pollution Prevention and Control: This data shows the amount of funding allocated for pollution prevention and control. This can include investments in technologies and systems to reduce pollutant emissions, manage waste, and mitigate negative impacts on the environment. In the table, the data shows the allocation of funds that vary from year to year.

**Table 3: Green financing portfolio of Bank Mandiri, Indonesia (In Billion Rupiah)**

| Year | Renewable energy | Pollution prevention and control | Environmentally sustainable management of living natural resources and land use | Clean transportation | Sustainable water and wastewater management | Eco-efficient/ circular economy adapted products, production technologies and processes | Green Buildings | Total Green Financing Portofolio |
|---|---|---|---|---|---|---|---|---|
| 2016 | 2.487 | 0 | 3.186 | 5.622 | 0 | 0 | 0 | 11,295 |
| 2017 | 3.068 | 0 | 3.186 | 6.522 | 0 | 0 | 0 | 12,776 |
| 2018 | 4.372 | 0 | 0 | 6.491 | 0 | 0 | 0 | 10,863 |
| 2019 | 1.350 | 136 | 57.539 | 0 | 245 | 0 | 0 | 59,27 |
| 2020 | 2.540 | 21 | 74.948 | 1.408 | 1.200 | 0 | 307 | 80,424 |
| 2021 | 4.281 | 0 | 88.537 | 2.028 | 1.214 | 0 | 205 | 96,265 |
| 2022 | 6.149 | 92.956 | 3.107 | 867 | 3.307 | 0 | 16 | 13,539 |

3. Environmentally sustainable management of living natural resources and land use: This column shows the amount of funds allocated for environmentally sustainable management of living natural resources and land use. This includes efforts to conserve biodiversity, sustainable forest management, control deforestation, and environmentally friendly agricultural practices. The data in the table shows fluctuations in the allocation of funds from year to year.
4. Clean transportation: This data shows the amount of funds allocated to clean transportation. This includes investments in sustainable transportation such as electric vehicles, environmentally friendly recharging infrastructure, and the development of more efficient and low-emission transportation systems. The data in the table shows the increase in funding allocation from 2016 to 2022.
5. Sustainable water and wastewater management: This data shows the amount of funding allocated for sustainable water management and wastewater treatment. This includes investments in water management infrastructure, water conservation, waste treatment, and efforts to protect aquatic ecosystems. The data in the table shows an increase in funding allocation from year to year.
6. Eco-efficient/circular economy adapted products, production technologies and processes: This data shows the amount of funds allocated to environmentally friendly and sustainable products, production technologies, and processes. This includes investments in the development of more ecologically efficient products, production technologies that reduce environmental impact, and the application of circular economy principles. The data in the table shows fluctuations in the allocation of funds from year to year.
7. Green Buildings: This data shows the amount of funds allocated for the construction of green buildings. This includes investments in environmentally friendly building design and construction, energy efficiency, use of renewable materials, and reduction of construction waste. The data in the table shows fluctuations in the allocation of funds from year to year.
8. Total Green Financing Portfolio: This data shows the grand total of allocated funds in the green financing portfolio. It covers all the sectors listed above and provides an overall picture of investments in projects that contribute to environmental sustainability. The data in the table shows the fluctuation of total fund allocation from 2016 to 2022.

**Figure 1:** Causality between BOPO, NIM, ROE, ROA, and CSR




In interpreting Table 3, it can be observed that most sectors saw an increase in funding allocations year-on-year, indicating a greater commitment to environmental sustainability. Some sectors, such as renewable energy and water management, showed significant increases in funding allocations, reflecting a focus on environmentally friendly solutions.

## 4.2. Causality between BOPO, NIM, ROE, ROA, and CSR

Although the quantitative research literature that directly analyzes the causality between BOPO, NIM, ROE, ROA, and CSR is limited, there are still ways to illustrate these interrelationships by analyzing the content of financial statements and presenting them in graphical form. This approach can provide insight into how the variables are interrelated and how changes in one variable can affect the others. In financial statement content analysis, we can see trends and patterns emerging from the data recorded in a company's financial statements from year to year. For example, we can see how BOPO, NIM, ROE, ROA, and CSR evolve over time and whether there is a link between changes in these values.

In Figure 1, BOPO, NIM, ROE, ROA, and CSR can be represented as a timeline showing the change in values from year to year. Using this graph, we can compare the changes in these variables and see if there is a discernible pattern. The graph can provide a clearer visual picture of the interrelationship between BOPO, NIM, ROE, ROA, and CSR and how changes in one variable can affect the other. While it cannot provide direct causal inferences, analyzing financial statement content in graphical form can help identify

trends and patterns and gain initial insights into the relationships between these variables.

Theory states that the higher the BOPO, the less efficient the company is in managing its operating costs. This can have a negative impact on the company's profitability, such as ROE and ROA. However, there is no direct causal relationship between BOPO and CSR. Furthermore, theoretically the higher the NIM, the higher the profitability of the company. The increase in profitability can have a positive impact on ROE and ROA, but there is no direct causal relationship between NIM and CSR. In theory, however, good financial performance reflected in ROE may provide companies with greater resources to allocate funds for CSR. However, ROE can also be influenced by other factors beyond CSR. In theory, if ROA increases, companies have the potential to allocate more resources to CSR. However, like ROE, ROA is also affected by other factors that are not directly related to CSR.

In the context of the relationship between ROA, ROE, NIM, BOPO, and CSR, it is important to remember that the causality and relationship between these variables can be very complex and influenced by various external and internal factors. There is no definitive conclusion on the direct relationship between these variables as it can vary between different companies and industry sectors. However, in general, it is argued that good financial performance, such as high ROA and ROE, can provide companies with greater resources to allocate funds for CSR. If companies can generate high profits and are efficient in the use of their assets, they have a greater financial ability to set aside funds for CSR initiatives. However, based on the illustrated explanation, it can be assumed that companies that perform well financially may gain a better reputation in the eyes of stakeholders and society. In this case, companies may feel the need to participate in CSR activities as an effort to maintain a good image and gain support from society.

### 4.3. Causality between Green Bond, Green Financing Portofolio and $CO_2$ Emmision in Transportation

Figure 2 illustrates the causality between Green Bond, Green Financing Portfolio of Bank Mandiri from 2016 to 2022 and compares the progress of $CO_2$ Emissions in transportation nationally in the same period. The graph aims to see the extent to which ESG effects have an impact on reducing carbon emissions in the transportation sector in Indonesia.

**Figure 2:** Causality between green bond, green financing portofolio and $CO_2$ emmision in transportation

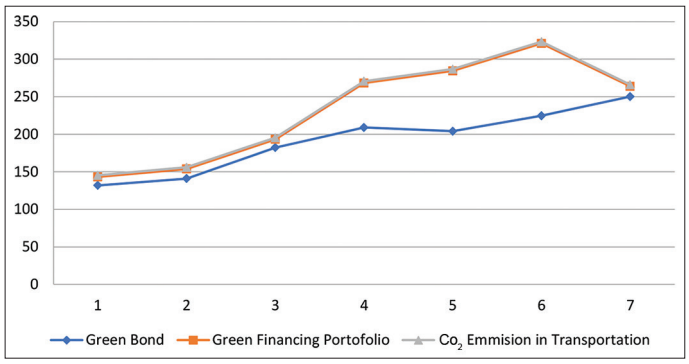



Figure 2 shows the development of Green Bond and Green Financing Portfolio issued by Bank Mandiri from 2016 to 2022. The Green Bond and Green Financing Portfolio reflects Bank Mandiri's commitment in supporting sustainable and environmentally friendly projects, including projects in the transportation sector that contribute to the reduction of $CO_2$ emissions. In addition, the graph also shows the development of $CO_2$ emissions in the transportation sector in Indonesia during the same period. This data reflects the amount of $CO_2$ emissions generated by the transportation sector nationwide. By looking at Figure 2, it can be observed whether there is a relationship between the increase in Green Bond, Green Financing Portfolio, and changes in $CO_2$ emissions in the transportation sector. If there is a significant relationship between the increase in Green Bond and Green Financing Portfolio and the decrease in $CO_2$ emissions in the transportation sector, this will show that the efforts of banks in supporting sustainable projects have had a positive impact in reducing carbon emissions.

From the data generated in Figure 2, there is a significant relationship between the increase in Green Bond and the increase in allocation of Green Financing Portfolio by Bank Mandiri, Indonesia. The graph shows that as the number of Green Bonds issued since 2016 increased, there was also a significant increase in the allocation of funds for Green Financing Portfolio by Bank Mandiri. This shows the strong awareness and commitment of Bank Mandiri in supporting sustainable and environmentally friendly projects through Green Bond issuance. Green Bond provides the necessary funding source to support projects that contribute to the reduction of $CO_2$ emissions and environmental protection. In addition, the data on the graph also shows that the increase in Green Financing Portfolio follows the same trend as the resulting Green Financing effect. That is, the more Green-Bond issued by Bank Mandiri, the greater the allocation of funds allocated to the Green Financing Portfolio. This indicates that an increase in Green Bond directly impacts the increase in funds available to finance sustainable projects in the transportation sector and other sectors. In this context, an increase in the Green Financing Portfolio also means an increase in investment in projects aimed at reducing $CO_2$ emissions in the transportation sector. This reflects Bank Mandiri's significant role in supporting carbon emission reduction efforts and driving the shift towards greener transportation in Indonesia.

In conclusion, the data in Figure 2 shows a close relationship between the increase in Green Bond, Green Financing Portfolio allocation, and $CO_2$ emission reduction efforts in the transportation sector. Bank Mandiri as a financial institution has played an important role in supporting sustainable projects through the issuance of Green Bond and allocation of funds for Green Financing Portfolio. By doing so, they contribute significantly to reducing carbon emissions and driving positive change in the transportation sector towards a cleaner and more sustainable environment.

### 4.4. Discussion

Green Bonds are financial instruments issued to finance sustainable and environmentally friendly projects. The Green Financing

Portfolio reflects the allocation of funds allocated to these projects. The causality between Green Bond and Green Financing Portfolio can be seen from the cause-and-effect relationship formed between the two. The issuance of Green Bonds by financial institutions, such as Bank Mandiri in Indonesia, provides the necessary resources to support sustainable projects in the transportation sector. Green Bond attracts investors who are concerned about environmental issues to invest in projects that contribute to the reduction of $CO_2$ emissions, such as the development of electric vehicles or environmentally friendly recharging infrastructure. In this sense, the Green Bond serves as a catalyst in increasing the allocation of funds to sustainable projects in the Green Financing Portfolio.

In the context of Bank Mandiri, the results of the data demonstration show that the increase in Green Bond, which began in 2016, has a significant impact on increasing the allocation of funds for the Green Financing Portfolio. In other words, the more Green-Bond issued, the greater the allocation of funds allocated for sustainable projects to reduce $CO_2$ Emission in the transportation sector. This shows that Green Bond has a positive causality on Green Financing Portfolio. In this case, the causality between Green Financing Portfolio and $CO_2$ Emission can be explained through the influence of investment in green technology and sustainable practices. With significant funds allocated through the Green Financing Portfolio, companies and institutions can implement projects that aim to reduce $CO_2$ emissions in the transportation sector. For example, investments in the development of electric vehicles, environmentally friendly recharging infrastructure, or the use of cleaner alternative fuels. Through these projects, a significant reduction in $CO_2$ emissions in the transportation sector is expected.

What Bank Mandiri is doing as one of the three state-owned banks in Indonesia that is currently a pioneer in terms of ESG provides an indication that the increase in Green Financing Portfolio goes hand in hand with the downward trend in $CO_2$ emissions in transportation. From 2016 to 2022, along with the increased allocation of funds for sustainable projects, there has been progress in reducing $CO_2$ emissions in the transportation sector in Indonesia. This suggests a positive causality between the Green Financing Portfolio and the reduction of $CO_2$ emissions in transportation. In this context, the Green Financing Portfolio acts as a key driver in allocating funds to sustainable projects that contribute to the reduction of $CO_2$ emissions. Investments made through the Green Financing Portfolio encourage the adoption of green technologies, sustainable innovations, and greener practices in the transportation sector. Thus, there is a positive causality between the Green Financing Portfolio and $CO_2$ emission reduction.

Managerial Implications: The causality established between Green Bond, Green Financing Portfolio, and $CO_2$ Emissions in transportation has significant implications for environmental sustainability. First, through Green Bond issuance, financial institutions such as Bank Mandiri can mobilize the necessary resources to support sustainable projects in the transportation sector. This strengthens the commitment to accelerate the shift to greener transportation. Second, the increased allocation of funds through the Green Financing Portfolio provides opportunities for companies and institutions to implement sustainable projects. Investments in green technologies and sustainable practices in the transportation sector have the potential to significantly reduce $CO_2$ emissions. In addition, it can also encourage innovation and development of more efficient and environmentally friendly transportation solutions. Third, the positive causality between the Green Financing Portfolio and $CO_2$ emission reductions suggests that efforts to reduce the environmental impact of the transportation sector can be successful through proper allocation of funds. By increasing investment in sustainable projects, such as green infrastructure development or the use of renewable energy in transportation, significant reductions in $CO_2$ emissions can be achieved.

In the context of Green Bond, there is a positive causality between the issuance of Green Bond by Bank Mandiri and the increased allocation of funds for sustainable projects in the Green Financing Portfolio. This suggests that the Green Bond serves as a catalyst in increasing investment in sustainable projects in the transportation sector. In addition, the adoption of Green Bond and Green Financing Portfolio also has a broader positive impact. Investment in sustainable projects in the transportation sector can drive sustainable economic growth, create new jobs, and increase innovation in the transportation industry. This is in line with the concept of sustainable development that integrates environmental, social, and economic aspects.

## 5. CONCLUSION, LIMITATIONS AND FUTURE RESEARCH AGENDA

In the Indonesian context, Bank Mandiri's adoption of the Green Bond and Green Financing Portfolio is a positive step in supporting environmental sustainability in the transportation sector. However, to achieve greater change, more involvement of other financial institutions and the private sector is required. The causality between Green Bond, Green Financing Portfolio, and $CO_2$ Emissions in transportation provides a strong foundation in supporting environmental sustainability in the transportation sector. Through Green Bond issuance and increased allocation of funds in the Green Financing Portfolio, investments in sustainable projects can reduce $CO_2$ emissions, advance green technologies, and drive innovation in transportation. However, to ensure the sustainability and effectiveness of efforts in reducing $CO_2$ emissions in transportation, further steps are needed. First, it is important to continue to increase the number of Green Bonds issued and the allocation of funds in the Green Financing Portfolio. This can be done through collaboration between financial institutions, government, and the private sector to mobilize investment in sustainable projects in the transportation sector. Furthermore, there needs to be transparent monitoring and reporting regarding the use of funds in the Green Financing Portfolio. Financial reports and information related to projects funded by Green Bonds should be easily accessible and verifiable. This will provide confidence to

investors and the public about the effectiveness of the use of funds in reducing $CO_2$ emissions in transportation.

In addition, it is important to continue innovating green technologies and sustainable solutions in the transportation sector. The development of more efficient electric vehicles, wider recharging infrastructure, and the implementation of policies that support the use of environmentally friendly public transportation can make a significant contribution to reducing $CO_2$ emissions. Furthermore, there is a need for cross-sector and cross-country cooperation in promoting and encouraging the adoption of Green Bonds and Green Financing Portfolios. Experience exchange, technology transfer, and training on best practices in supporting sustainable projects in the transportation sector can accelerate the shift towards greener transportation at the global level. In addition, public education and awareness also play an important role in creating environmental sustainability in the transportation sector. Easy-to-understand information about the benefits of using sustainable transportation and individual contributions to reducing $CO_2$ emissions can motivate people to adopt greener travel habits. Finally, it is important to continue to evaluate and research the impact of Green Bond and Green Financing Portfolios on reducing $CO_2$ emissions in transportation. In-depth quantitative and qualitative studies can provide better insights into the effectiveness of policies and measures that have been implemented, as well as assist in better decision-making for the future.

While our study has provided an initial understanding of the causality between Green Bond, CSR, Financial Performance, Green Financing Portfolio, and their effects on $CO_2$ Emissions in Transportation nationwide, we realize that there are several shortcomings in this study that limit the interpretations and conclusions that can be drawn. First, this study relies on data interpretation based on visual graphs of financial statements and sustainability reports. While this provides a rough idea of the relationship between the observed variables, a more comprehensive study still has enormous opportunities to be implemented. Secondly, in the context of sustainability reporting, there are challenges in terms of consistency and assessment standards. In our study, we relied on a limited number of sustainability reports available from companies. In addition, there are no consistent standards in sustainability reporting in Indonesia, which limits uniformity and comparability between companies. For future research, it is important to consider using more consistent frameworks and standards to facilitate cross-company analysis. Third, this study is also limited to one banking subject in Indonesia. Although Bank Mandiri is one of the largest banks in Indonesia and has a commitment to sustainability, it cannot be considered representative of the entire banking sector and its influence on reducing $CO_2$ emissions in the transportation sector nationwide. Research involving more companies in different sectors is needed to gain a more comprehensive understanding of the impact of ESG and sustainable fund allocation on $CO_2$ emission reduction in transportation.

In the face of these limitations, our study proposes several recommendations for future research. First, the use of more advanced quantitative analysis methods, such as panel regression or path analysis, can help measure the causal impact between the variables studied more accurately. Second, it is important to expand the scope of companies involved in the study to obtain more representative data and represent various industry sectors. Third, standardization and harmonization efforts in sustainability reporting should be encouraged, allowing for easier benchmarking and cross-company analysis.

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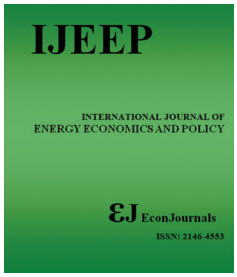

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# Causality of Bank Financial Performance, Green Bond, CSR, Green Financing Portfolio and $CO_2$ Emissions in Transportation: Evidence from Indonesia

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**ABSTRACT**

This study aims to identify the causality between bank financial performance measured by Return on Assets (ROA), Return on Equity (ROE), Net Interest Margin (NIM), and Operating Expenses to Operating Income (BOPO) with Green Financing Portfolio and $CO_2$ emissions in the transportation sector. This study uses descriptive quantitative research methods and content analysis of the Sustainability Report of Bank Mandiri, Indonesia for the period 2016 to 2022. In this study, we collected data from Bank Mandiri's financial statements which included information on ROA, ROE, NIM, and BOPO. In addition, we also collected $CO_2$ emission data available from 2016 to 2022. The research sample is Bank Mandiri as one of the state-owned banks in Indonesia. We used purposive sampling technique to select samples that meet the inclusion criteria. The collected data was then analyzed using statistical methods to test the relationship between the variables involved, namely the bank's financial performance (ROA, ROE, NIM, and BOPO), Green Financing Portfolio, and $CO_2$ emissions in the transportation sector. We use content analysis to illustrate the results of Bank Mandiri's financial statements in graphical form. The results of the analysis show that the increase in Green Bond that started in 2016 has a significant impact on the increase in fund allocation for Green Financing Portfolio. This indicates a positive causality between Green Bond and Green Financing Portfolio. In this context, the causality between Green Financing Portfolio and $CO_2$ emissions can be explained through the influence of investment in green technology and sustainable practices. With significant funds allocated through the Green Financing Portfolio, companies and institutions can implement projects that aim to reduce $CO_2$ emissions in the transportation sector. This means that the use of Green Bond as a sustainable funding source has the potential to reduce the negative impact of transportation on the environment.

**Keywords:** Green Bond, Green Financing Portofolio, Financial Performance, $CO_2$ Emision in Transportation
**JEL Classifications:** Q56, G21, G32, M14

## 1. INTRODUCTION

In an increasingly environmentally conscious era, green finance has emerged as a financial initiative that focuses on sustainable and environmentally friendly investments. The green finance narrative illustrates how the financial sector can be a positive force in promoting sustainable economic growth and protecting the environment (Wang et al., 2023). Green finance encompasses a wide range of financial instruments designed to support environmentally friendly projects, such as renewable energy, energy efficiency, good water management, forest protection, and sustainable transportation (Falcone, 2020). In this study, we can see how green finance provides solutions to today's environmental challenges, while creating profitable business opportunities. Green finance plays a key role in driving a paradigm shift in how we view investment and economic growth (Ainou et al., 2023). With increasing awareness of the negative impact of human activity on the environment, financial market participants are increasingly recognizing the importance of considering environmental, social, and governance (ESG) factors in their investment decisions

(Serrano-García et al., 2023). The green finance narrative also highlights the importance of collaboration between governments, financial institutions, companies, and communities to create an ecosystem that supports sustainable investments. Initiatives such as the issuance of green bonds, whose proceeds will be used for environmental projects, as well as the establishment of financial institutions that specialize in funding sustainable projects, are examples of successful collaboration in advancing green finance (Asiri et al., 2020).

In particular, the Government of Indonesia encourages the development of ESG through relevant policies and regulations. For example, the Indonesian government launched the Green Finance Initiative and created the Sustainable Financial Reporting Guidelines. This aims to provide guidance and a framework for companies to report on their performance in terms of environmental, social, and corporate governance (Liebman et al., 2019). In addition, there is also the development of institutions and initiatives that support ESG development in Indonesia. For example, the establishment of the Indonesian Sustainable Finance Initiative (ISFI) which is a consortium of banks and financial institutions to promote sustainable finance practices in Indonesia (Setyowati, 2023); (Volz, 2018). ISFI works with various parties, including the government, companies, and civil society, to increase understanding and awareness of ESG. The Indonesian government has also encouraged more transparent and comprehensive ESG reporting. In 2020, the Indonesia Stock Exchange (IDX) introduced mandatory guidelines for listed companies to report ESG information periodically. The move aims to provide stakeholders with a clearer picture of companies' ESG performance and encourage companies to improve their business practices. However, of the 10 state-owned banks in Indonesia, only 3 banks have implemented ESG reporting, namely Bank BNI, Bank BRI, and Bank Mandiri until 2023. So it can be assumed that in the midst of the world program on ESG to support sustainability, Indonesia until 2023 is still in the stage of development and improvement (OJK, 2021).

There are various key issues that need to be addressed in the development of green finance in Indonesia, for example, first, many market participants do not fully understand the concepts and benefits of green finance (Katadata Center Insight, 2022), so there needs to be wider education to encourage the adoption and implementation of sustainable practices (Ņikitina et al., 2022). Second, inconsistent ESG performance measurement and reporting standards are still a challenge in Indonesia (Prihandono and Yuniarti, 2023); (Kamil et al., 2021). Third, there is a lack of availability of sustainable financial instruments, such as sustainable loans and sustainable mutual funds, that can support the financing of green projects (Guild, 2020). Fourth, Indonesia has a great need for sustainable infrastructure development, such as renewable energy, environmentally friendly transportation, and waste management which is certainly not cheap (Ronaldo and Suryanto, 2022). Fifth, greater awareness and incentives are needed for companies to integrate ESG factors in their decision-making and daily operations (Maniora, 2017). Therefore, to address these challenges, cooperation between the government, financial institutions, companies, and civil society is needed. Measures that can be taken include the provision of greater fiscal incentives for sustainable projects, increased awareness and education on green finance, the development of clear standards and frameworks, and increased collaboration and partnerships between different stakeholders (Hafner et al., 2020); (Clark et al., 2018).

This study aims to identify the relationship between bank financial performance as measured by Return on Assets (ROA), Return on Equity (ROE), Net Interest Margin (NIM), and Operating Expenses to Operating Income (BOPO) with Green Financing Portfolio and $CO_2$ emissions in the transportation sector. This research has significant relevance given the challenges faced by the financial and transportation sectors in achieving sustainable development goals (Schroeder et al., 2019); (Zhan and Santos-Paulino, 2021); (Litvinenko et al., 2022). There are several research gaps that need to be filled in this context. First, the relationship between bank financial performance and sustainable funding portfolios is still not fully understood (Badía et al., 2019); (Iazzolino et al., 2023); (Atz et al., 2023); (Mirza et al., 2023). While several studies have investigated the impact of financial performance on sustainable funding decisions, there is still a lack of understanding on how ROA, ROE, NIM, and BOPO specifically relate to sustainable funding portfolios.

Second, the effect of financial performance on $CO_2$ emissions in the transportation sector has not been widely studied (Abid et al., 2022). While banks and financial institutions are increasingly interested in minimizing the environmental impact of their funding portfolios, the relationship between financial performance and $CO_2$ emissions in the transportation sector remains unclear. This study will investigate whether banks' financial performance has an impact on investment decisions in environmentally friendly transportation and to what extent it can reduce $CO_2$ emissions. In addition, this study will also examine the role of financial intermediation in promoting sustainable financing and $CO_2$ emission reduction in the transportation sector. This relates to the influence of NIM and BOPO on sustainable funding portfolios as well as $CO_2$ emissions (Nugrahaeni and Muharam, 2023). Through this analysis, this research will contribute a new understanding of how banks' financial performance can impact responsible and sustainable financial practices, as well as their impact on the environment.

The research methodology will involve the analysis of secondary data from banks' financial statements as well as transportation sector data related to $CO_2$ emissions. The use of statistical regression will enable the identification of causal relationships between ROA, ROE, NIM, BOPO, and sustainable funding portfolio and $CO_2$ emissions. The research may also include a case study of bank Mandiri as an Indonesian state-owned bank that has implemented a sustainable funding strategy and reduced $CO_2$ emissions in the transportation sector. By filling this research gap, it is hoped that this research can provide important insights for the financial and transportation sectors in driving the transition to a low-carbon and sustainable economy. The results of this study can serve as a basis for banks and financial institutions to develop more effective policies and strategies in integrating environmental aspects in their funding decisions.

In addition, the findings of this study may also benefit regulators and governments in developing policies that encourage the adoption of sustainable finance and the reduction of $CO_2$ emissions in the transportation sector. With a better understanding of the relationship between financial performance and environmental impact, more effective policy measures can be taken to encourage positive changes in the financial and transportation sectors. The research can also identify potential obstacles or barriers that may be faced in implementing sustainable finance and reducing $CO_2$ emissions in the transportation sector. In this regard, the research can provide recommendations and solutions to address these challenges, such as the development of financial instruments that support sustainable investment, the engagement of key actors in the industry, and government policies that encourage the transition to greener transportation. Overall, this research will fill an important knowledge gap in relation to the linkages between bank financial performance (ROA, ROE, NIM, BOPO), sustainable financing portfolio, and $CO_2$ emissions in the transportation sector. Through this research, a more comprehensive understanding of the role of the financial sector in promoting sustainable development and reducing greenhouse gas emissions in the transportation sector is expected.

In our research, we sought to analyze the relationship between financial performance and green bonds, as well as green financing portfolios. However, we realized that there was limited relevant data and information that we could find in the available literature and sources. While there have been studies addressing financial performance and sustainable financial instruments such as green bonds, we conclude that ours is the first study that attempts to comprehensively examine this aspect by involving the comparison of banking performance ratios through Sustainability reports to the effect of carbon emission reduction on the transportation sector nationwide in Indonesia. We did not find enough relevant fundamentals that address the specific relationship between financial performance and green bonds in the context we studied. The unavailability of specific data and information in the literature suggests that this topic is still relatively new or has not been extensively researched. Therefore, our study makes an important contribution to further understanding and thinking in the relationship between financial performance and green bonds. Our study provides a strong foundation for future research in this domain. We hope that our findings and research methods will inspire other researchers to further explore the relationship between financial performance and sustainable financial instruments such as green bonds, as well as its practical implications in the context of sustainable investment. Although we did not find many studies related to this topic, it is important to continue to explore knowledge and expand understanding of the relationship between financial performance and green bonds. As such, it can inform more sustainable and responsible investment decision-making in the future.

## 2. LITERATURE REVIEW

The relationship between financial performance metrics and sustainable financing practices has gained significant attention in recent years. This literature review aims to explore the existing body of research on the association between Return on Assets (ROA), Green Financing Portfolio, and $CO_2$ emissions in the transportation sector. Understanding this relationship is crucial for promoting sustainable financial decision-making and reducing environmental impacts.

### 2.1. Return on Assets (ROA)

Return on Assets (ROA) is a fundamental financial metric that provides insights into a company's ability to generate profits in relation to its total assets (Malikah, 2021); (Tangngisalu, 2022); (Allo et al., 2021). It is widely used by investors, analysts, and financial institutions to evaluate a firm's efficiency and effectiveness in utilizing its available resources (Olarewaju and Msomi, 2021). In recent years, the concept of sustainable finance has gained traction, emphasizing the integration of environmental, social, and governance (ESG) factors into financial decision-making (Huang, 2021); (Clementino and Perkins, 2021). Several research studies have explored the relationship between ROA and sustainable finance, with a specific focus on green lending and investment practices (Xu et al., 2020); (Banker et al., 2014). These studies have revealed a positive association between a bank's ROA and its engagement in green financing activities (Xu et al., 2020); (Banker et al., 2014). Banks with higher ROA tend to demonstrate a greater propensity to allocate funds toward sustainable initiatives, including green projects, renewable energy ventures, energy-efficient technologies, and environmentally responsible businesses (Bohora, 2018); (Hodge, 2002). The findings of these studies underscore the significance of financial performance in shaping a bank's commitment to sustainable portfolio allocation. Higher profitability, as indicated by a strong ROA, provides financial institutions with the capacity to expand their green financing activities (Hodge, 2002). This positive association between ROA and green financing highlights the potential for financial institutions to align their profitability goals with sustainability objectives (Hodge, 2002).

The positive correlation between ROA and green financing can be attributed to various factors. Firstly, banks with higher profitability have greater financial resources at their disposal, enabling them to invest in sustainable projects and initiatives (Sahoo and Nayak, 2007). Moreover, engaging in green financing can enhance a bank's reputation, attract socially conscious investors, and foster long-term relationships with environmentally responsible clients (Zhang et al., 2022). These factors contribute to increased profitability and a positive feedback loop, wherein higher ROA enables further expansion of green financing activities. Furthermore, the integration of sustainability into financial decision-making processes aligns with the growing regulatory frameworks and global initiatives aimed at addressing climate change and promoting sustainable development (Clark et al., 2018). Banks that prioritize sustainable finance not only contribute to a greener economy but also mitigate risks associated with climate change and environmental degradation (Blazquez et al., 2021). Consequently, the positive association between ROA and green financing supports the notion that financial performance and sustainable practices are not mutually exclusive but rather mutually reinforcing. In conclusion, the existing literature highlights the positive relationship between ROA and sustainable finance, particularly in

the context of green lending and investment. Financial institutions with higher ROA demonstrate a greater propensity to allocate funds toward sustainable projects, thereby fostering environmental sustainability (Fatica and Panzica, 2021); (Guo et al., 2022). This connection emphasizes the potential for financial institutions to integrate profitability goals with sustainable portfolio allocation.

## 2.2. Green Financing Portfolio

Green financing plays a pivotal role in promoting environmentally friendly projects and initiatives by providing financial support through specialized products and services (Chen et al., 2022). It encompasses various forms of investments, including but not limited to renewable energy, energy efficiency, sustainable infrastructure, and other sectors that prioritize environmental responsibility (Tang et al., 2021). Research studies have consistently highlighted the positive impact of green financing on mitigating climate change and fostering sustainable development. The company that actively engage in green financing and have a larger portfolio dedicated to environmentally friendly projects contribute significantly to reducing carbon emissions and promoting a low-carbon economy (Tian et al., 2022). By directing their financial resources towards green initiatives, these banks facilitate the transition to renewable energy sources, encourage energy efficiency practices, and support sustainable infrastructure development. One significant advantage of expanding green financing portfolios is the enhancement of a bank's reputation and credibility (Akomea-Frimpong et al., 2022); (Bal et al., 2013). By actively supporting environmentally responsible projects, financial institutions signal their commitment to sustainability and position themselves as key players in the transition to a greener future. This fosters trust among stakeholders, including customers, investors, and regulatory bodies, and may result in increased business opportunities and market share (Fieseler, 2011).

In addition to reputational benefits, green financing aligns with evolving regulatory requirements and policy frameworks. Governments and regulatory bodies worldwide have recognized the urgent need to address climate change and have implemented measures to incentivize and regulate sustainable finance practices (Falcone, 2020). Banks with a larger green financing portfolio are better positioned to meet these regulatory obligations, thereby reducing compliance risks, and ensuring long-term sustainability in their operations (Dikau and Volz, 2021). Moreover, the expansion of green financing portfolios attracts environmentally conscious investors. In recent years, there has been a growing trend of investors seeking financial opportunities that align with their sustainability values (Azman and Ali, 2019). By offering green financial products and services, banks can tap into this investor demand, expanding their customer base and potentially accessing additional sources of capital for future investments (Clark et al., 2018). This not only strengthens the financial position of the bank but also provides a platform for fostering sustainable economic growth.

In conclusion, green financing is a crucial component of sustainable finance, supporting environmentally friendly projects and initiatives. Banks with a larger green financing portfolio actively contribute to reducing carbon emissions, promoting sustainable development, and aligning with regulatory requirements. The benefits extend beyond environmental impact, encompassing reputational advantages, investor appeal, and regulatory compliance. As the importance of sustainability grows, expanding green financing portfolios becomes a strategic imperative for financial institutions seeking to align profitability with environmental responsibility.

## 2.3. $CO_2$ Emission in Transportation

The transportation sector stands as a major contributor to global carbon dioxide ($CO_2$) emissions, largely attributed to its heavy reliance on fossil fuels and inefficient transport systems. Recognizing the urgent need to address climate change, several studies have explored the role of financial institutions in reducing $CO_2$ emissions within the transportation sector (Ballot and Fontane, 2010); (Timilsina and Shrestha, 2009). Several of prior Research has indicated a positive association between financial institutions with a strong focus on sustainable financing and their support for low-carbon transportation projects (Kong, 2022). Banks that prioritize sustainable finance are more inclined to allocate funds towards initiatives that promote environmentally friendly transportation alternatives. This includes investments in electric vehicles, public transportation systems, and the development of sustainable mobility infrastructure. One area where financial institutions play a crucial role is in supporting the adoption of electric vehicles (EVs) (Tabelin et al., 2021). By providing financing options and incentives for the purchase and use of EVs, banks contribute to the reduction of $CO_2$ emissions from traditional gasoline-powered vehicles. This support helps accelerate the transition to cleaner transportation and encourages individuals and businesses to choose more sustainable alternatives.

Furthermore, financial institutions can play a vital role in supporting the development and improvement of public transportation systems. Investments in efficient, affordable, and sustainable public transportation infrastructure can significantly reduce the number of private vehicles on the road, leading to lower overall emissions (Patil, 2021); (Shah et al., 2021). By providing financial backing for such projects, banks can contribute to the expansion and improvement of public transportation networks, making them more accessible and appealing to commuters. Sustainable mobility infrastructure is another area where financial institutions can make a difference. Investments in infrastructure projects that facilitate walking, cycling, and other forms of sustainable transportation help reduce the reliance on carbon-intensive modes of transportation (Mittal and Woodside, 2022). By allocating funds towards the development of bike lanes, pedestrian-friendly walkways, and integrated transportation systems, financial institutions contribute to creating more sustainable and environmentally friendly urban environments (Mittal and Woodside, 2022). The allocation of funds towards these sustainable transportation initiatives by financial institutions can result in a significant reduction in $CO_2$ emissions within the transportation sector. By supporting the shift towards low-carbon alternatives and promoting the adoption of sustainable transportation practices, banks actively contribute to mitigating climate change and fostering a greener future.

In conclusion, financial institutions have a vital role to play in reducing $CO_2$ emissions in the transportation sector. By

prioritizing sustainable financing and allocating funds towards low-carbon transportation projects, such as electric vehicles, public transportation systems, and sustainable mobility infrastructure, banks can help drive the transition to cleaner and more environmentally friendly transportation options (Rodríguez-García et al., 2022). Through their support, financial institutions actively contribute to the global efforts to combat climate change and create a more sustainable future.

### 2.4. Existing Research

Several studies have explored the connection between ROA, green financing portfolios, and $CO_2$ emissions in the transportation sector. For example, research has shown that banks with higher ROA are more inclined to allocate funds to sustainable transportation projects, resulting in reduced $CO_2$ emissions. These findings suggest that financial performance and sustainable finance are interconnected, with positive financial outcomes supporting green portfolio expansion and carbon reduction efforts. Furthermore, studies have identified various factors influencing the association between ROA, green financing portfolios, and $CO_2$ emissions in transportation. These factors include regulatory frameworks, government policies, stakeholder pressures, and institutional factors. Understanding these factors can help policymakers and financial institutions develop strategies to encourage sustainable financing and mitigate $CO_2$ emissions in the transportation sector.

## 3. RESEARCH METHOD AND DATA

This study aims to analyze the effect of the Green Financing Portfolio on Return on Assets (ROA), Return on Equity (ROE), Net Interest Margin (NIM), and Operating Costs to Operating Income (BOPO), and examine the level of $CO_2$ emissions in the transportation sector. This research uses descriptive quantitative research methods. The data used will be analyzed statistically to test the relationship between the variables involved. The sample in this study is a company that implements a sustainable funding portfolio (Green Financing Portfolio) in this case is PT Bank Mandiri as one of the state-owned banks in Indonesia. The research sample will be selected using purposive sampling technique, with the inclusion criteria of transportation companies that actively use sustainable funding and have complete financial data.

The data used in this study will be sourced from the financial statements of transportation companies and $CO_2$ emissions data available from 2016 to 2022. Financial statement data includes information on ROA, ROE, NIM, and BOPO, while $CO_2$ emissions data is obtained from reliable sources such as official reports or related research. The collected data will be analyzed using content analysis in the form of the results of Bank Mandiri's financial statements from 2016 to 2022 which are then illustrated in the form of graphs.

## 4. RESULTS AND DISCUSSION

### 4.1. Data Description

In our research, we sought to analyze the relationship between financial performance and green bonds, as well as green financing portfolios. However, we faced challenges in finding relevant references related to the use of regression analysis that is commonly used in quantitative research in finance.

When we searched for literature that could be used as a reference to apply regression analysis to the relationship between financial performance and green bonds, we did not find many sources that were relevant and appropriate to our research context. This may be since research on the relationship is still in its infancy and specialized research using regression analysis approaches may not have been conducted. However, we remain committed to presenting our data objectively and explaining the relationship between the variables we examined. To overcome these limitations, we decided to present our data in the form of content analysis and causality graphs. Through content analysis, we drew in-depth information from relevant sources and identified important patterns or findings that could illustrate the relationship between financial performance and green bonds.

In addition, we use graphs and data visualizations to present our results more clearly and facilitate understanding. Causality graphs help illustrate the relationships between the variables we examine, although they do not use a direct regression analysis approach. This allows readers and stakeholders to visually understand those relationships and identify possible patterns or trends. While the use of regression analysis is not directly applicable in our study, we still try to present our results in a valid and informative way. In Table 1 we illustrate the financial statement data related to the financial performance of Bank Mandiri, Indonesia from 2016 to 2022.

In general, the data in Table 1 provides an overview of the financial performance of Bank Mandiri, Indonesia from the perspectives of ROA, ROE, NIM, and BOPO over the time presented. The data can be interpreted that:

1. ROA (Return on Assets): Shows the efficiency with which the company's assets are used to generate profits. The higher the ROA number, the more efficient the company is in utilizing its assets. In the table, ROA increased from 2016 to 2018, peaked in 2018, and then fluctuated in the following years.
2. ROE (Return on Equity): Measures the rate of return on the company owner's equity. A high ROE indicates that the company is successfully generating good returns for its owners. In the table, ROE also increases over time, with annual fluctuations.
3. NIM (Net Interest Margin): This is the difference between the interest income received by the company and the interest paid on loans and funds received from customers. A high

**Table 1: Financial Performance Ratios of Bank Mandiri, Indonesia**

| Year | ROA | ROE | NIM | BOPO |
|---|---|---|---|---|
| 2016 | 1.95 | 11.12 | 6.29 | 80.94 |
| 2017 | 2.72 | 14.53 | 5.63 | 71.78 |
| 2018 | 3.17 | 16.23 | 5.52 | 66.48 |
| 2019 | 3.03 | 15.08 | 5.46 | 67.44 |
| 2020 | 1.64 | 9.36 | 4.48 | 80.03 |
| 2021 | 2.53 | 16.24 | 4.73 | 67.26 |
| 2022 | 3.30 | 22.62 | 5.16 | 57.35 |

NIM indicates that the company is able to maximize interest income. In the table, NIM shows a downward trend from 2016 to 2022.

4. BOPO (Operating Expenses to Operating Income): Shows the extent to which operating expenses affect the company's operating income. A low BOPO indicates efficiency in managing operating costs. In the table, BOPO shows a downward trend over time.

Furthermore, Table 2 presents data in the form of Green Bond Bank Mandiri, Indonesia and CSR allocation of Bank Mandiri, Indonesia since the period 2016-2022.

Green Bond in Table 2 shows a number that reflects the amount of funds obtained from the issuance of Green Bond by companies in certain years. This number reflects the level of investor interest in supporting environmentally friendly projects through Green Bond. The data in the table shows a significant increase from 2016 to 2022, with the amount of funds obtained increasing from 131.9 to 250.2 (in billion rupiah). Meanwhile, CSR (Corporate Social Responsibility) shows numbers that reflect the implementation of CSR by companies in certain years. While it is not explained in detail what this figure represents, a possible assumption is that it reflects the amount invested or allocated by companies for various CSR initiatives. The data in the table shows annual fluctuations, but with a general trend of increase from 2016 to 2022.

During the period of 2016 to 2022, Bank Mandiri Indonesia has allocated funds in Corporate Social Responsibility (CSR) programs for various areas that have a positive impact on society and the environment. Significant CSR allocations have been made in various important sectors, reflecting Bank Mandiri's commitment to contributing to sustainable development and community welfare.

One of the areas that receives special attention in Bank Mandiri's CSR allocation is the Environment/Nature Preservation Sector. To preserve nature, Bank Mandiri has supported projects that focus on reforestation, environmental conservation, carbon emission reduction, and natural resource protection. Through the allocation of CSR funds, Bank Mandiri plays an active role in maintaining biodiversity, reducing negative impacts on the environment, and encouraging awareness about the importance of nature conservation. Health is also an important focus in Bank Mandiri's CSR allocation. Bank Mandiri recognizes that health is a fundamental right of every individual, and through its CSR programs, it supports public health initiatives that include improving access to health services, education on health, development of health infrastructure, and support on disease prevention and treatment efforts. In addition, Bank Mandiri also pays attention to Public Facilities and Worship. To improve the quality of life of the community, Bank Mandiri has contributed to the development of public infrastructure such as the construction of sports facilities, educational facilities, and the improvement of places of worship. Through this, the Bank supports equitable access and quality improvement of public facilities and facilitates religious activities that are important to the community. In situations of natural disasters, Bank Mandiri also pays serious attention through CSR allocations in the Natural Disaster Sector. Bank Mandiri has been involved in disaster management and post-disaster recovery efforts by aiding with disaster victims, supporting infrastructure reconstruction, and developing effective disaster response programs.

**Table 2: Green Bond and CSR Allocation Report of Bank Mandiri, Indonesia (In Billion Rupiah)**

| Year | Green Bond | CSR |
|---|---|---|
| 2016 | 131.9 | 63.43 |
| 2017 | 141 | 118.88 |
| 2018 | 182.3 | 114.52 |
| 2019 | 208.9 | 150.17 |
| 2020 | 204 | 133.90 |
| 2021 | 224.6 | 132.37 |
| 2022 | 250.2 | 137.60 |

Poverty alleviation and social community development are the focus of Bank Mandiri's Social Community Development Program. Through its CSR programs, Bank Mandiri has supported initiatives aimed at reducing poverty levels, improving community welfare, and strengthening the competitiveness of local economies. This includes community economic empowerment through skills training, provision of business capital to vulnerable groups, and support to poverty alleviation programs that include the provision of social assistance, scholarships, and assistance in developing micro and small businesses.

Lastly, the education sector is also a major concern for Bank Mandiri in its CSR allocation. Bank Mandiri recognizes the importance of education in advancing society and creating equal opportunities. Through its CSR programs, Bank Mandiri has committed to support inclusive and quality education. This includes the construction of educational facilities, increasing educational accessibility for children from underprivileged families, developing innovative curricula, and providing scholarships to outstanding but financially underprivileged students. Furthermore, Table 3 presents the report data on Bank Mandiri's Green Financing allocation portfolio from 2016 to 2022.

Table 3 displays data on the allocation of funds in the Green Financing Portfolio in various sectors that contribute to environmental sustainability. Each column shows the amount of funds allocated in specific years to each sector related to environmental conservation efforts. Below is the interpretation of each column in the table:

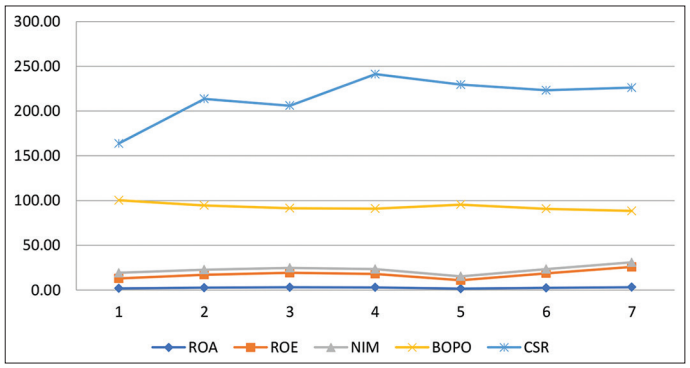
1. Renewable energy: This data shows the amount of funding allocated to renewable energy projects. This includes investments in environmentally friendly energy sources such as solar energy, wind energy, biomass energy, and hydroelectric energy. The data in the table shows an increase in funding allocations from 2016 to 2022, indicating a greater commitment to developing the renewable energy sector.
2. Pollution Prevention and Control: This data shows the amount of funding allocated for pollution prevention and control. This can include investments in technologies and systems to reduce pollutant emissions, manage waste, and mitigate negative impacts on the environment. In the table, the data shows the allocation of funds that vary from year to year.

**Table 3: Green financing portfolio of Bank Mandiri, Indonesia (In Billion Rupiah)**

| Year | Renewable energy | Pollution prevention and control | Environmentally sustainable management of living natural resources and land use | Clean transportation | Sustainable water and wastewater management | Eco-efficient/ circular economy adapted products, production technologies and processes | Green Buildings | Total Green Financing Portofolio |
|---|---|---|---|---|---|---|---|---|
| 2016 | 2.487 | 0 | 3.186 | 5.622 | 0 | 0 | 0 | 11,295 |
| 2017 | 3.068 | 0 | 3.186 | 6.522 | 0 | 0 | 0 | 12,776 |
| 2018 | 4.372 | 0 | 0 | 6.491 | 0 | 0 | 0 | 10,863 |
| 2019 | 1.350 | 136 | 57.539 | 0 | 245 | 0 | 0 | 59,27 |
| 2020 | 2.540 | 21 | 74.948 | 1.408 | 1.200 | 0 | 307 | 80,424 |
| 2021 | 4.281 | 0 | 88.537 | 2.028 | 1.214 | 0 | 205 | 96,265 |
| 2022 | 6.149 | 92.956 | 3.107 | 867 | 3.307 | 0 | 16 | 13,539 |

3. Environmentally sustainable management of living natural resources and land use: This column shows the amount of funds allocated for environmentally sustainable management of living natural resources and land use. This includes efforts to conserve biodiversity, sustainable forest management, control deforestation, and environmentally friendly agricultural practices. The data in the table shows fluctuations in the allocation of funds from year to year.
4. Clean transportation: This data shows the amount of funds allocated to clean transportation. This includes investments in sustainable transportation such as electric vehicles, environmentally friendly recharging infrastructure, and the development of more efficient and low-emission transportation systems. The data in the table shows the increase in funding allocation from 2016 to 2022.
5. Sustainable water and wastewater management: This data shows the amount of funding allocated for sustainable water management and wastewater treatment. This includes investments in water management infrastructure, water conservation, waste treatment, and efforts to protect aquatic ecosystems. The data in the table shows an increase in funding allocation from year to year.
6. Eco-efficient/circular economy adapted products, production technologies and processes: This data shows the amount of funds allocated to environmentally friendly and sustainable products, production technologies, and processes. This includes investments in the development of more ecologically efficient products, production technologies that reduce environmental impact, and the application of circular economy principles. The data in the table shows fluctuations in the allocation of funds from year to year.
7. Green Buildings: This data shows the amount of funds allocated for the construction of green buildings. This includes investments in environmentally friendly building design and construction, energy efficiency, use of renewable materials, and reduction of construction waste. The data in the table shows fluctuations in the allocation of funds from year to year.
8. Total Green Financing Portfolio: This data shows the grand total of allocated funds in the green financing portfolio. It covers all the sectors listed above and provides an overall picture of investments in projects that contribute to environmental sustainability. The data in the table shows the fluctuation of total fund allocation from 2016 to 2022.

**Figure 1:** Causality between BOPO, NIM, ROE, ROA, and CSR




In interpreting Table 3, it can be observed that most sectors saw an increase in funding allocations year-on-year, indicating a greater commitment to environmental sustainability. Some sectors, such as renewable energy and water management, showed significant increases in funding allocations, reflecting a focus on environmentally friendly solutions.

## 4.2. Causality between BOPO, NIM, ROE, ROA, and CSR

Although the quantitative research literature that directly analyzes the causality between BOPO, NIM, ROE, ROA, and CSR is limited, there are still ways to illustrate these interrelationships by analyzing the content of financial statements and presenting them in graphical form. This approach can provide insight into how the variables are interrelated and how changes in one variable can affect the others. In financial statement content analysis, we can see trends and patterns emerging from the data recorded in a company's financial statements from year to year. For example, we can see how BOPO, NIM, ROE, ROA, and CSR evolve over time and whether there is a link between changes in these values.

In Figure 1, BOPO, NIM, ROE, ROA, and CSR can be represented as a timeline showing the change in values from year to year. Using this graph, we can compare the changes in these variables and see if there is a discernible pattern. The graph can provide a clearer visual picture of the interrelationship between BOPO, NIM, ROE, ROA, and CSR and how changes in one variable can affect the other. While it cannot provide direct causal inferences, analyzing financial statement content in graphical form can help identify

trends and patterns and gain initial insights into the relationships between these variables.

Theory states that the higher the BOPO, the less efficient the company is in managing its operating costs. This can have a negative impact on the company's profitability, such as ROE and ROA. However, there is no direct causal relationship between BOPO and CSR. Furthermore, theoretically the higher the NIM, the higher the profitability of the company. The increase in profitability can have a positive impact on ROE and ROA, but there is no direct causal relationship between NIM and CSR. In theory, however, good financial performance reflected in ROE may provide companies with greater resources to allocate funds for CSR. However, ROE can also be influenced by other factors beyond CSR. In theory, if ROA increases, companies have the potential to allocate more resources to CSR. However, like ROE, ROA is also affected by other factors that are not directly related to CSR.

In the context of the relationship between ROA, ROE, NIM, BOPO, and CSR, it is important to remember that the causality and relationship between these variables can be very complex and influenced by various external and internal factors. There is no definitive conclusion on the direct relationship between these variables as it can vary between different companies and industry sectors. However, in general, it is argued that good financial performance, such as high ROA and ROE, can provide companies with greater resources to allocate funds for CSR. If companies can generate high profits and are efficient in the use of their assets, they have a greater financial ability to set aside funds for CSR initiatives. However, based on the illustrated explanation, it can be assumed that companies that perform well financially may gain a better reputation in the eyes of stakeholders and society. In this case, companies may feel the need to participate in CSR activities as an effort to maintain a good image and gain support from society.

### 4.3. Causality between Green Bond, Green Financing Portofolio and $CO_2$ Emmision in Transportation

Figure 2 illustrates the causality between Green Bond, Green Financing Portfolio of Bank Mandiri from 2016 to 2022 and compares the progress of $CO_2$ Emissions in transportation nationally in the same period. The graph aims to see the extent to which ESG effects have an impact on reducing carbon emissions in the transportation sector in Indonesia.

**Figure 2:** Causality between green bond, green financing portofolio and $CO_2$ emmision in transportation

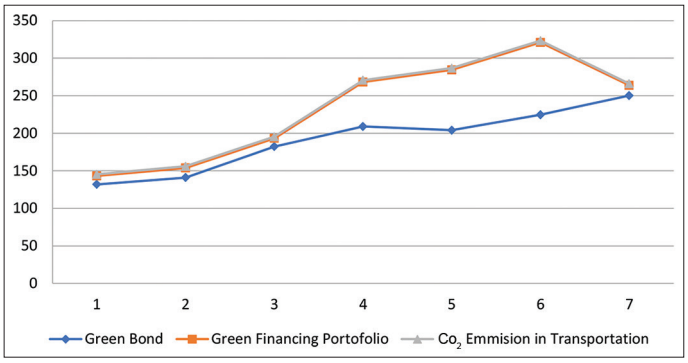



Figure 2 shows the development of Green Bond and Green Financing Portfolio issued by Bank Mandiri from 2016 to 2022. The Green Bond and Green Financing Portfolio reflects Bank Mandiri's commitment in supporting sustainable and environmentally friendly projects, including projects in the transportation sector that contribute to the reduction of $CO_2$ emissions. In addition, the graph also shows the development of $CO_2$ emissions in the transportation sector in Indonesia during the same period. This data reflects the amount of $CO_2$ emissions generated by the transportation sector nationwide. By looking at Figure 2, it can be observed whether there is a relationship between the increase in Green Bond, Green Financing Portfolio, and changes in $CO_2$ emissions in the transportation sector. If there is a significant relationship between the increase in Green Bond and Green Financing Portfolio and the decrease in $CO_2$ emissions in the transportation sector, this will show that the efforts of banks in supporting sustainable projects have had a positive impact in reducing carbon emissions.

From the data generated in Figure 2, there is a significant relationship between the increase in Green Bond and the increase in allocation of Green Financing Portfolio by Bank Mandiri, Indonesia. The graph shows that as the number of Green Bonds issued since 2016 increased, there was also a significant increase in the allocation of funds for Green Financing Portfolio by Bank Mandiri. This shows the strong awareness and commitment of Bank Mandiri in supporting sustainable and environmentally friendly projects through Green Bond issuance. Green Bond provides the necessary funding source to support projects that contribute to the reduction of $CO_2$ emissions and environmental protection. In addition, the data on the graph also shows that the increase in Green Financing Portfolio follows the same trend as the resulting Green Financing effect. That is, the more Green-Bond issued by Bank Mandiri, the greater the allocation of funds allocated to the Green Financing Portfolio. This indicates that an increase in Green Bond directly impacts the increase in funds available to finance sustainable projects in the transportation sector and other sectors. In this context, an increase in the Green Financing Portfolio also means an increase in investment in projects aimed at reducing $CO_2$ emissions in the transportation sector. This reflects Bank Mandiri's significant role in supporting carbon emission reduction efforts and driving the shift towards greener transportation in Indonesia.

In conclusion, the data in Figure 2 shows a close relationship between the increase in Green Bond, Green Financing Portfolio allocation, and $CO_2$ emission reduction efforts in the transportation sector. Bank Mandiri as a financial institution has played an important role in supporting sustainable projects through the issuance of Green Bond and allocation of funds for Green Financing Portfolio. By doing so, they contribute significantly to reducing carbon emissions and driving positive change in the transportation sector towards a cleaner and more sustainable environment.

### 4.4. Discussion

Green Bonds are financial instruments issued to finance sustainable and environmentally friendly projects. The Green Financing

Portfolio reflects the allocation of funds allocated to these projects. The causality between Green Bond and Green Financing Portfolio can be seen from the cause-and-effect relationship formed between the two. The issuance of Green Bonds by financial institutions, such as Bank Mandiri in Indonesia, provides the necessary resources to support sustainable projects in the transportation sector. Green Bond attracts investors who are concerned about environmental issues to invest in projects that contribute to the reduction of $CO_2$ emissions, such as the development of electric vehicles or environmentally friendly recharging infrastructure. In this sense, the Green Bond serves as a catalyst in increasing the allocation of funds to sustainable projects in the Green Financing Portfolio.

In the context of Bank Mandiri, the results of the data demonstration show that the increase in Green Bond, which began in 2016, has a significant impact on increasing the allocation of funds for the Green Financing Portfolio. In other words, the more Green-Bond issued, the greater the allocation of funds allocated for sustainable projects to reduce $CO_2$ Emission in the transportation sector. This shows that Green Bond has a positive causality on Green Financing Portfolio. In this case, the causality between Green Financing Portfolio and $CO_2$ Emission can be explained through the influence of investment in green technology and sustainable practices. With significant funds allocated through the Green Financing Portfolio, companies and institutions can implement projects that aim to reduce $CO_2$ emissions in the transportation sector. For example, investments in the development of electric vehicles, environmentally friendly recharging infrastructure, or the use of cleaner alternative fuels. Through these projects, a significant reduction in $CO_2$ emissions in the transportation sector is expected.

What Bank Mandiri is doing as one of the three state-owned banks in Indonesia that is currently a pioneer in terms of ESG provides an indication that the increase in Green Financing Portfolio goes hand in hand with the downward trend in $CO_2$ emissions in transportation. From 2016 to 2022, along with the increased allocation of funds for sustainable projects, there has been progress in reducing $CO_2$ emissions in the transportation sector in Indonesia. This suggests a positive causality between the Green Financing Portfolio and the reduction of $CO_2$ emissions in transportation. In this context, the Green Financing Portfolio acts as a key driver in allocating funds to sustainable projects that contribute to the reduction of $CO_2$ emissions. Investments made through the Green Financing Portfolio encourage the adoption of green technologies, sustainable innovations, and greener practices in the transportation sector. Thus, there is a positive causality between the Green Financing Portfolio and $CO_2$ emission reduction.

Managerial Implications: The causality established between Green Bond, Green Financing Portfolio, and $CO_2$ Emissions in transportation has significant implications for environmental sustainability. First, through Green Bond issuance, financial institutions such as Bank Mandiri can mobilize the necessary resources to support sustainable projects in the transportation sector. This strengthens the commitment to accelerate the shift to greener transportation. Second, the increased allocation of funds through the Green Financing Portfolio provides opportunities for companies and institutions to implement sustainable projects. Investments in green technologies and sustainable practices in the transportation sector have the potential to significantly reduce $CO_2$ emissions. In addition, it can also encourage innovation and development of more efficient and environmentally friendly transportation solutions. Third, the positive causality between the Green Financing Portfolio and $CO_2$ emission reductions suggests that efforts to reduce the environmental impact of the transportation sector can be successful through proper allocation of funds. By increasing investment in sustainable projects, such as green infrastructure development or the use of renewable energy in transportation, significant reductions in $CO_2$ emissions can be achieved.

In the context of Green Bond, there is a positive causality between the issuance of Green Bond by Bank Mandiri and the increased allocation of funds for sustainable projects in the Green Financing Portfolio. This suggests that the Green Bond serves as a catalyst in increasing investment in sustainable projects in the transportation sector. In addition, the adoption of Green Bond and Green Financing Portfolio also has a broader positive impact. Investment in sustainable projects in the transportation sector can drive sustainable economic growth, create new jobs, and increase innovation in the transportation industry. This is in line with the concept of sustainable development that integrates environmental, social, and economic aspects.

## 5. CONCLUSION, LIMITATIONS AND FUTURE RESEARCH AGENDA

In the Indonesian context, Bank Mandiri's adoption of the Green Bond and Green Financing Portfolio is a positive step in supporting environmental sustainability in the transportation sector. However, to achieve greater change, more involvement of other financial institutions and the private sector is required. The causality between Green Bond, Green Financing Portfolio, and $CO_2$ Emissions in transportation provides a strong foundation in supporting environmental sustainability in the transportation sector. Through Green Bond issuance and increased allocation of funds in the Green Financing Portfolio, investments in sustainable projects can reduce $CO_2$ emissions, advance green technologies, and drive innovation in transportation. However, to ensure the sustainability and effectiveness of efforts in reducing $CO_2$ emissions in transportation, further steps are needed. First, it is important to continue to increase the number of Green Bonds issued and the allocation of funds in the Green Financing Portfolio. This can be done through collaboration between financial institutions, government, and the private sector to mobilize investment in sustainable projects in the transportation sector. Furthermore, there needs to be transparent monitoring and reporting regarding the use of funds in the Green Financing Portfolio. Financial reports and information related to projects funded by Green Bonds should be easily accessible and verifiable. This will provide confidence to

investors and the public about the effectiveness of the use of funds in reducing $CO_2$ emissions in transportation.

In addition, it is important to continue innovating green technologies and sustainable solutions in the transportation sector. The development of more efficient electric vehicles, wider recharging infrastructure, and the implementation of policies that support the use of environmentally friendly public transportation can make a significant contribution to reducing $CO_2$ emissions. Furthermore, there is a need for cross-sector and cross-country cooperation in promoting and encouraging the adoption of Green Bonds and Green Financing Portfolios. Experience exchange, technology transfer, and training on best practices in supporting sustainable projects in the transportation sector can accelerate the shift towards greener transportation at the global level. In addition, public education and awareness also play an important role in creating environmental sustainability in the transportation sector. Easy-to-understand information about the benefits of using sustainable transportation and individual contributions to reducing $CO_2$ emissions can motivate people to adopt greener travel habits. Finally, it is important to continue to evaluate and research the impact of Green Bond and Green Financing Portfolios on reducing $CO_2$ emissions in transportation. In-depth quantitative and qualitative studies can provide better insights into the effectiveness of policies and measures that have been implemented, as well as assist in better decision-making for the future.

While our study has provided an initial understanding of the causality between Green Bond, CSR, Financial Performance, Green Financing Portfolio, and their effects on $CO_2$ Emissions in Transportation nationwide, we realize that there are several shortcomings in this study that limit the interpretations and conclusions that can be drawn. First, this study relies on data interpretation based on visual graphs of financial statements and sustainability reports. While this provides a rough idea of the relationship between the observed variables, a more comprehensive study still has enormous opportunities to be implemented. Secondly, in the context of sustainability reporting, there are challenges in terms of consistency and assessment standards. In our study, we relied on a limited number of sustainability reports available from companies. In addition, there are no consistent standards in sustainability reporting in Indonesia, which limits uniformity and comparability between companies. For future research, it is important to consider using more consistent frameworks and standards to facilitate cross-company analysis. Third, this study is also limited to one banking subject in Indonesia. Although Bank Mandiri is one of the largest banks in Indonesia and has a commitment to sustainability, it cannot be considered representative of the entire banking sector and its influence on reducing $CO_2$ emissions in the transportation sector nationwide. Research involving more companies in different sectors is needed to gain a more comprehensive understanding of the impact of ESG and sustainable fund allocation on $CO_2$ emission reduction in transportation.

In the face of these limitations, our study proposes several recommendations for future research. First, the use of more advanced quantitative analysis methods, such as panel regression or path analysis, can help measure the causal impact between the variables studied more accurately. Second, it is important to expand the scope of companies involved in the study to obtain more representative data and represent various industry sectors. Third, standardization and harmonization efforts in sustainability reporting should be encouraged, allowing for easier benchmarking and cross-company analysis.

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# Causality of Bank Financial Performance, Green Bond, CSR, Green Financing Portofolio and CO2 Emissions in Transportation: Evidence from Indonesia

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**Abstract**

This study aims to identify the causality between bank financial performance measured by Return on Assets (ROA), Return on Equity (ROE), Net Interest Margin (NIM), and Operating Expenses to Operating Income (BOPO) with Green Financing Portfolio and CO2 emissions in the transportation sector. This study uses descriptive quantitative research methods and content analysis of the Sustainability Report of Bank Mandiri, Indonesia for the period 2016 to 2022. In this study, we collected data from Bank Mandiri's financial statements which included information on ROA, ROE, NIM, and BOPO. In addition, we also collected CO2 emission data available from 2016 to 2022. The research sample is Bank Mandiri as one of the state-owned banks in Indonesia. We used purposive sampling technique to select samples that meet the inclusion criteria. The collected data was then analyzed using statistical methods to test the relationship between the variables involved, namely the bank's financial performance (ROA, ROE, NIM, and BOPO), Green Financing Portfolio, and CO2 emissions in the transportation sector. We use content analysis to illustrate the results of Bank Mandiri's financial statements in graphical form. The results of the analysis show that the increase in Green Bond that started in 2016 has a significant impact on the increase in fund allocation for Green Financing Portfolio. This indicates a positive causality between Green Bond and Green Financing Portfolio. In this context, the causality between Green Financing Portfolio and CO2 emissions can be explained through the influence of investment in green technology and sustainable practices. With significant funds allocated through the Green Financing Portfolio, companies and institutions can implement projects that aim to reduce CO2 emissions in the transportation sector. This means that the use of Green Bond as a sustainable funding source has the potential to reduce the negative impact of transportation on the environment.

**Keywords:** Green Bond, Green Financing Portofolio, Financial Performance, CO2 Emision In Transportation.

## I. INTRODUCTION

In an increasingly environmentally conscious era, green finance has emerged as a financial initiative that focuses on sustainable and environmentally friendly investments. The green finance narrative illustrates how the financial sector can be a positive force in promoting sustainable economic

growth and protecting the environment (Wang et al., 2023). Green finance encompasses a wide range of financial instruments designed to support environmentally friendly projects, such as renewable energy, energy efficiency, good water management, forest protection, and sustainable transportation (Falcone, 2020). In this study, we can see how green finance provides solutions to today's environmental challenges, while creating profitable business opportunities. Green finance plays a key role in driving a paradigm shift in how we view investment and economic growth (Ainou et al., 2023). With increasing awareness of the negative impact of human activity on the environment, financial market participants are increasingly recognizing the importance of considering environmental, social, and governance (ESG) factors in their investment decisions (Serrano-García et al., 2023). The green finance narrative also highlights the importance of collaboration between governments, financial institutions, companies, and communities to create an ecosystem that supports sustainable investments. Initiatives such as the issuance of green bonds, whose proceeds will be used for environmental projects, as well as the establishment of financial institutions that specialize in funding sustainable projects, are examples of successful collaboration in advancing green finance (Asiri et al., 2020).

*Phenomena dan Research Gap*

In particular, the Government of Indonesia encourages the development of ESG through relevant policies and regulations. For example, the Indonesian government launched the Green Finance Initiative and created the Sustainable Financial Reporting Guidelines. This aims to provide guidance and a framework for companies to report on their performance in terms of environmental, social, and corporate governance (Liebman et al., 2019). In addition, there is also the development of institutions and initiatives that support ESG development in Indonesia. For example, the establishment of the Indonesian Sustainable Finance Initiative (ISFI) which is a consortium of banks and financial institutions to promote sustainable finance practices in Indonesia (Setyowati, 2023); (Volz, 2018). ISFI works with various parties, including the government, companies, and civil society, to increase understanding and awareness of ESG. The Indonesian government has also encouraged more transparent and comprehensive ESG reporting. In 2020, the Indonesia Stock Exchange (IDX) introduced mandatory guidelines for listed companies to report ESG information periodically. The move aims to provide stakeholders with a clearer picture of companies' ESG performance and encourage companies to improve their business practices. However, of the 10 state-owned banks in Indonesia, only 3 banks have implemented ESG reporting, namely Bank BNI, Bank BRI, and Bank Mandiri until 2023. So it can be assumed that in the midst of the world program on ESG to support sustainability, Indonesia until 2023 is still in the stage of development and improvement (OJK, 2021).

There are various key issues that need to be addressed in the development of green finance in Indonesia, for example, first, many market participants do not fully understand the concepts and benefits of green finance (Katadata Center Insight, 2022), so there needs to be wider education to encourage the adoption and implementation of sustainable practices (Ņikitina et al., 2022). Second, inconsistent ESG performance measurement and reporting standards are still a challenge in Indonesia (Prihandono & Yuniarti, 2023); (Kamil et al., 2021). Third, there is a lack of availability of sustainable financial instruments, such as sustainable loans and sustainable mutual funds, that can support the financing of green projects (Guild, 2020). Fourth, Indonesia has a great need for sustainable infrastructure development, such as renewable energy, environmentally friendly transportation, and waste management which is certainly not cheap (Ronaldo & Suryanto, 2022). Fifth, greater awareness and incentives are needed for companies to integrate ESG factors in their decision-making and daily operations (Maniora, 2017). Therefore, to address these challenges, cooperation between the government, financial institutions, companies, and civil society is needed. Measures that can be taken include the provision of greater fiscal incentives for sustainable projects, increased awareness and

education on green finance, the development of clear standards and frameworks, and increased collaboration and partnerships between different stakeholders (Hafner et al., 2020); (Clark et al., 2018).

This study aims to identify the relationship between bank financial performance as measured by Return on Assets (ROA), Return on Equity (ROE), Net Interest Margin (NIM), and Operating Expenses to Operating Income (BOPO) with Green Financing Portfolio and CO2 emissions in the transportation sector. This research has significant relevance given the challenges faced by the financial and transportation sectors in achieving sustainable development goals (Schroeder et al., 2019); (Zhan & Santos-Paulino, 2021); (Litvinenko et al., 2022). There are several research gaps that need to be filled in this context. First, the relationship between bank financial performance and sustainable funding portfolios is still not fully understood (Badía et al., 2019); (Iazzolino et al., 2023); (Atz et al., 2023); (Mirza et al., 2023). While several studies have investigated the impact of financial performance on sustainable funding decisions, there is still a lack of understanding on how ROA, ROE, NIM, and BOPO specifically relate to sustainable funding portfolios.

Second, the effect of financial performance on CO2 emissions in the transportation sector has not been widely studied (Abid et al., 2022). While banks and financial institutions are increasingly interested in minimizing the environmental impact of their funding portfolios, the relationship between financial performance and CO2 emissions in the transportation sector remains unclear. This study will investigate whether banks' financial performance has an impact on investment decisions in environmentally friendly transportation and to what extent it can reduce CO2 emissions. In addition, this study will also examine the role of financial intermediation in promoting sustainable financing and CO2 emission reduction in the transportation sector. This relates to the influence of NIM and BOPO on sustainable funding portfolios as well as CO2 emissions (Nugrahaeni & Muharam, 2023). Through this analysis, this research will contribute a new understanding of how banks' financial performance can impact responsible and sustainable financial practices, as well as their impact on the environment.

The research methodology will involve the analysis of secondary data from banks' financial statements as well as transportation sector data related to CO2 emissions. The use of statistical regression will enable the identification of causal relationships between ROA, ROE, NIM, BOPO, and sustainable funding portfolio and CO2 emissions. The research may also include a case study of bank Mandiri as an Indonesian state-owned bank that has implemented a sustainable funding strategy and reduced CO2 emissions in the transportation sector. By filling this research gap, it is hoped that this research can provide important insights for the financial and transportation sectors in driving the transition to a low-carbon and sustainable economy. The results of this study can serve as a basis for banks and financial institutions to develop more effective policies and strategies in integrating environmental aspects in their funding decisions.

In addition, the findings of this study may also benefit regulators and governments in developing policies that encourage the adoption of sustainable finance and the reduction of CO2 emissions in the transportation sector. With a better understanding of the relationship between financial performance and environmental impact, more effective policy measures can be taken to encourage positive changes in the financial and transportation sectors. The research can also identify potential obstacles or barriers that may be faced in implementing sustainable finance and reducing CO2 emissions in the transportation sector. In this regard, the research can provide recommendations and solutions to address these challenges, such as the development of financial instruments that support sustainable investment, the engagement of key actors in the industry, and government policies that encourage the transition to greener transportation. Overall, this research will fill an important knowledge gap in relation to the linkages between bank financial performance (ROA, ROE, NIM, BOPO), sustainable financing portfolio, and CO2 emissions in the transportation sector. Through this research, a more

comprehensive understanding of the role of the financial sector in promoting sustainable development and reducing greenhouse gas emissions in the transportation sector is expected.

*State of the art and Novelty*

In our research, we sought to analyze the relationship between financial performance and green bonds, as well as green financing portfolios. However, we realized that there was limited relevant data and information that we could find in the available literature and sources. While there have been studies addressing financial performance and sustainable financial instruments such as green bonds, we conclude that ours is the first study that attempts to comprehensively examine this aspect by involving the comparison of banking performance ratios through Sustainability reports to the effect of carbon emission reduction on the transportation sector nationwide in Indonesia. We did not find enough relevant fundamentals that address the specific relationship between financial performance and green bonds in the context we studied. The unavailability of specific data and information in the literature suggests that this topic is still relatively new or has not been extensively researched. Therefore, our study makes an important contribution to further understanding and thinking in the relationship between financial performance and green bonds. Our study provides a strong foundation for future research in this domain. We hope that our findings and research methods will inspire other researchers to further explore the relationship between financial performance and sustainable financial instruments such as green bonds, as well as its practical implications in the context of sustainable investment. Although we did not find many studies related to this topic, it is important to continue to explore knowledge and expand understanding of the relationship between financial performance and green bonds. As such, it can inform more sustainable and responsible investment decision-making in the future.

## II. LITERATURE REVIEW

The relationship between financial performance metrics and sustainable financing practices has gained significant attention in recent years. This literature review aims to explore the existing body of research on the association between Return on Assets (ROA), Green Financing Portfolio, and CO2 emissions in the transportation sector. Understanding this relationship is crucial for promoting sustainable financial decision-making and reducing environmental impacts.

### *2.1. Return on Assets (ROA)*

Return on Assets (ROA) is a fundamental financial metric that provides insights into a company's ability to generate profits in relation to its total assets (Malikah, 2021); (Tangngisalu, 2022); (Allo et al., 2021). It is widely used by investors, analysts, and financial institutions to evaluate a firm's efficiency and effectiveness in utilizing its available resources (Olarewaju & Msomi, 2021). In recent years, the concept of sustainable finance has gained traction, emphasizing the integration of environmental, social, and governance (ESG) factors into financial decision-making (Huang, 2021); (Clementino & Perkins, 2021). Several research studies have explored the relationship between ROA and sustainable finance, with a specific focus on green lending and investment practices (Xu et al., 2020); (Banker et al., 2014). These studies have revealed a positive association between a bank's ROA and its engagement in green financing activities (Xu et al., 2020); (Banker et al., 2014). Banks with higher ROA tend to demonstrate a greater propensity to allocate funds toward sustainable initiatives, including green projects, renewable energy ventures, energy-efficient technologies, and environmentally responsible businesses (Bohora, 2018); (Hodge, 2002). The findings of these studies underscore the significance of financial performance in shaping a bank's commitment to sustainable

portfolio allocation. Higher profitability, as indicated by a strong ROA, provides financial institutions with the capacity to expand their green financing activities (Hodge, 2002). This positive association between ROA and green financing highlights the potential for financial institutions to align their profitability goals with sustainability objectives (Hodge, 2002).

The positive correlation between ROA and green financing can be attributed to various factors. Firstly, banks with higher profitability have greater financial resources at their disposal, enabling them to invest in sustainable projects and initiatives (Sahoo & Nayak, 2007). Moreover, engaging in green financing can enhance a bank's reputation, attract socially conscious investors, and foster long-term relationships with environmentally responsible clients (Zhang et al., 2022). These factors contribute to increased profitability and a positive feedback loop, wherein higher ROA enables further expansion of green financing activities. Furthermore, the integration of sustainability into financial decision-making processes aligns with the growing regulatory frameworks and global initiatives aimed at addressing climate change and promoting sustainable development (Clark et al., 2018). Banks that prioritize sustainable finance not only contribute to a greener economy but also mitigate risks associated with climate change and environmental degradation (Blazquez et al., 2021). Consequently, the positive association between ROA and green financing supports the notion that financial performance and sustainable practices are not mutually exclusive but rather mutually reinforcing. In conclusion, the existing literature highlights the positive relationship between ROA and sustainable finance, particularly in the context of green lending and investment. Financial institutions with higher ROA demonstrate a greater propensity to allocate funds toward sustainable projects, thereby fostering environmental sustainability (Fatica & Panzica, 2021); (Guo et al., 2022). This connection emphasizes the potential for financial institutions to integrate profitability goals with sustainable portfolio allocation.

### 2.2. *Green Financing Portfolio*

Green financing plays a pivotal role in promoting environmentally friendly projects and initiatives by providing financial support through specialized products and services (Chen et al., 2022). It encompasses various forms of investments, including but not limited to renewable energy, energy efficiency, sustainable infrastructure, and other sectors that prioritize environmental responsibility (Tang et al., 2021). Research studies have consistently highlighted the positive impact of green financing on mitigating climate change and fostering sustainable development. The company that actively engage in green financing and have a larger portfolio dedicated to environmentally friendly projects contribute significantly to reducing carbon emissions and promoting a low-carbon economy (Tian et al., 2022). By directing their financial resources towards green initiatives, these banks facilitate the transition to renewable energy sources, encourage energy efficiency practices, and support sustainable infrastructure development. One significant advantage of expanding green financing portfolios is the enhancement of a bank's reputation and credibility (Akomea-Frimpong et al., 2022); (Bal et al., 2013). By actively supporting environmentally responsible projects, financial institutions signal their commitment to sustainability and position themselves as key players in the transition to a greener future. This fosters trust among stakeholders, including customers, investors, and regulatory bodies, and may result in increased business opportunities and market share (Fieseler, 2011).

In addition to reputational benefits, green financing aligns with evolving regulatory requirements and policy frameworks. Governments and regulatory bodies worldwide have recognized the urgent need to address climate change and have implemented measures to incentivize and regulate sustainable finance practices (Falcone, 2020). Banks with a larger green financing portfolio are better positioned to meet these regulatory obligations, thereby reducing compliance risks, and ensuring long-term sustainability in their operations (Dikau & Volz, 2021). Moreover, the expansion of green financing portfolios attracts environmentally conscious investors. In recent years, there has been a

growing trend of investors seeking financial opportunities that align with their sustainability values (Azman & Ali, 2019). By offering green financial products and services, banks can tap into this investor demand, expanding their customer base and potentially accessing additional sources of capital for future investments (Clark et al., 2018). This not only strengthens the financial position of the bank but also provides a platform for fostering sustainable economic growth.

In conclusion, green financing is a crucial component of sustainable finance, supporting environmentally friendly projects and initiatives. Banks with a larger green financing portfolio actively contribute to reducing carbon emissions, promoting sustainable development, and aligning with regulatory requirements. The benefits extend beyond environmental impact, encompassing reputational advantages, investor appeal, and regulatory compliance. As the importance of sustainability grows, expanding green financing portfolios becomes a strategic imperative for financial institutions seeking to align profitability with environmental responsibility.

### 2.3. *CO2 Emission in Transportation*

The transportation sector stands as a major contributor to global carbon dioxide (CO2) emissions, largely attributed to its heavy reliance on fossil fuels and inefficient transport systems. Recognizing the urgent need to address climate change, several studies have explored the role of financial institutions in reducing CO2 emissions within the transportation sector (Ballot & Fontane, 2010); (Timilsina & Shrestha, 2009). Several of prior Research has indicated a positive association between financial institutions with a strong focus on sustainable financing and their support for low-carbon transportation projects (Kong, 2022). Banks that prioritize sustainable finance are more inclined to allocate funds towards initiatives that promote environmentally friendly transportation alternatives. This includes investments in electric vehicles, public transportation systems, and the development of sustainable mobility infrastructure. One area where financial institutions play a crucial role is in supporting the adoption of electric vehicles (EVs) (Tabelin et al., 2021). By providing financing options and incentives for the purchase and use of EVs, banks contribute to the reduction of CO2 emissions from traditional gasoline-powered vehicles. This support helps accelerate the transition to cleaner transportation and encourages individuals and businesses to choose more sustainable alternatives.

Furthermore, financial institutions can play a vital role in supporting the development and improvement of public transportation systems. Investments in efficient, affordable, and sustainable public transportation infrastructure can significantly reduce the number of private vehicles on the road, leading to lower overall emissions (Patil, 2021); (Shah et al., 2021). By providing financial backing for such projects, banks can contribute to the expansion and improvement of public transportation networks, making them more accessible and appealing to commuters. Sustainable mobility infrastructure is another area where financial institutions can make a difference. Investments in infrastructure projects that facilitate walking, cycling, and other forms of sustainable transportation help reduce the reliance on carbon-intensive modes of transportation (Mittal & Woodside, 2022). By allocating funds towards the development of bike lanes, pedestrian-friendly walkways, and integrated transportation systems, financial institutions contribute to creating more sustainable and environmentally friendly urban environments (Mittal & Woodside, 2022).. The allocation of funds towards these sustainable transportation initiatives by financial institutions can result in a significant reduction in CO2 emissions within the transportation sector. By supporting the shift towards low-carbon alternatives and promoting the adoption of sustainable transportation practices, banks actively contribute to mitigating climate change and fostering a greener future.

In conclusion, financial institutions have a vital role to play in reducing CO2 emissions in the transportation sector. By prioritizing sustainable financing and allocating funds towards low-carbon transportation projects, such as electric vehicles, public transportation systems, and sustainable mobility infrastructure, banks can help drive the transition to cleaner and more environmentally

friendly transportation options (Rodríguez-García et al., 2022). Through their support, financial institutions actively contribute to the global efforts to combat climate change and create a more sustainable future.

*2.4. Existing Research*

Several studies have explored the connection between ROA, green financing portfolios, and CO2 emissions in the transportation sector. For example, research has shown that banks with higher ROA are more inclined to allocate funds to sustainable transportation projects, resulting in reduced CO2 emissions. These findings suggest that financial performance and sustainable finance are interconnected, with positive financial outcomes supporting green portfolio expansion and carbon reduction efforts. Furthermore, studies have identified various factors influencing the association between ROA, green financing portfolios, and CO2 emissions in transportation. These factors include regulatory frameworks, government policies, stakeholder pressures, and institutional factors. Understanding these factors can help policymakers and financial institutions develop strategies to encourage sustainable financing and mitigate CO2 emissions in the transportation sector.

## III. RESEARCH METHOD

This study aims to analyze the effect of the Green Financing Portfolio on Return on Assets (ROA), Return on Equity (ROE), Net Interest Margin (NIM), and Operating Costs to Operating Income (BOPO), and examine the level of CO2 emissions in the transportation sector. This research uses descriptive quantitative research methods. The data used will be analyzed statistically to test the relationship between the variables involved. The sample in this study is a company that implements a sustainable funding portfolio (Green Financing Portfolio) in this case is PT Bank Mandiri as one of the state-owned banks in Indonesia. The research sample will be selected using purposive sampling technique, with the inclusion criteria of transportation companies that actively use sustainable funding and have complete financial data. The data used in this study will be sourced from the financial statements of transportation companies and CO2 emissions data available from 2016 to 2022. Financial statement data includes information on ROA, ROE, NIM, and BOPO, while CO2 emissions data is obtained from reliable sources such as official reports or related research. The collected data will be analyzed using content analysis in the form of the results of Bank Mandiri's financial statements from 2016 to 2022 which are then illustrated in the form of graphs.

## IV. RESULT AND DISCUSSION

*4.1. Data Description*

In our research, we sought to analyze the relationship between financial performance and green bonds, as well as green financing portfolios. However, we faced challenges in finding relevant references related to the use of regression analysis that is commonly used in quantitative research in finance.

When we searched for literature that could be used as a reference to apply regression analysis to the relationship between financial performance and green bonds, we did not find many sources that were relevant and appropriate to our research context. This may be since research on the relationship is still in its infancy and specialized research using regression analysis approaches may not have been conducted. However, we remain committed to presenting our data objectively and explaining the relationship between the variables we examined. To overcome these limitations, we decided to present our data in the form of content analysis and causality graphs. Through content

analysis, we drew in-depth information from relevant sources and identified important patterns or findings that could illustrate the relationship between financial performance and green bonds.

In addition, we use graphs and data visualizations to present our results more clearly and facilitate understanding. Causality graphs help illustrate the relationships between the variables we examine, although they do not use a direct regression analysis approach. This allows readers and stakeholders to visually understand those relationships and identify possible patterns or trends. While the use of regression analysis is not directly applicable in our study, we still try to present our results in a valid and informative way. In Table 1 we illustrate the financial statement data related to the financial performance of Bank Mandiri, Indonesia from 2016 - 2022.

**Table 1. Financial Performance Ratios of Bank Mandiri, Indonesia**

| Year | ROA | ROE | NIM | BOPO |
|---|---|---|---|---|
| 2016 | 1,95 | 11,12 | 6,29 | 80,94 |
| 2017 | 2,72 | 14,53 | 5,63 | 71,78 |
| 2018 | 3,17 | 16,23 | 5,52 | 66,48 |
| 2019 | 3,03 | 15,08 | 5,46 | 67,44 |
| 2020 | 1,64 | 9,36 | 4,48 | 80,03 |
| 2021 | 2,53 | 16,24 | 4,73 | 67,26 |
| 2022 | 3,30 | 22,62 | 5,16 | 57,35 |

In general, the data in Table 1 provides an overview of the financial performance of Bank Mandiri, Indonesia from the perspectives of ROA, ROE, NIM, and BOPO over the time presented. The data can be interpreted that:

1. ROA (Return on Assets): Shows the efficiency with which the company's assets are used to generate profits. The higher the ROA number, the more efficient the company is in utilizing its assets. In the table, ROA increased from 2016 to 2018, peaked in 2018, and then fluctuated in the following years.
2. ROE (Return on Equity): Measures the rate of return on the company owner's equity. A high ROE indicates that the company is successfully generating good returns for its owners. In the table, ROE also increases over time, with annual fluctuations.
3. NIM (Net Interest Margin): This is the difference between the interest income received by the company and the interest paid on loans and funds received from customers. A high NIM indicates that the company is able to maximize interest income. In the table, NIM shows a downward trend from 2016 to 2022.
4. BOPO (Operating Expenses to Operating Income): Shows the extent to which operating expenses affect the company's operating income. A low BOPO indicates efficiency in managing operating costs. In the table, BOPO shows a downward trend over time.

Furthermore, Table 2 presents data in the form of Green Bond Bank Mandiri, Indonesia and CSR allocation of Bank Mandiri, Indonesia since the period 2016-2022.

**Table 2. Green Bond and CSR Allocation Report of Bank Mandiri, Indonesia (In Billion Rupiah)**

| Year | Green Bond | CSR |
|---|---|---|
| 2016 | 131,9 | 63,43 |
| 2017 | 141 | 118,88 |
| 2018 | 182,3 | 114,52 |
| 2019 | 208,9 | 150,17 |
| 2020 | 204 | 133,90 |
| 2021 | 224,6 | 132,37 |

| | | |
|---|---|---|
| 2022 | 250,2 | 137,60 |

Green Bond in table 2 shows a number that reflects the amount of funds obtained from the issuance of Green Bond by companies in certain years. This number reflects the level of investor interest in supporting environmentally friendly projects through Green Bond. The data in the table shows a significant increase from 2016 to 2022, with the amount of funds obtained increasing from 131.9 to 250.2 (in billion rupiah). Meanwhile, CSR (Corporate Social Responsibility) shows numbers that reflect the implementation of CSR by companies in certain years. While it is not explained in detail what this figure represents, a possible assumption is that it reflects the amount invested or allocated by companies for various CSR initiatives. The data in the table shows annual fluctuations, but with a general trend of increase from 2016 to 2022.

During the period of 2016 to 2022, Bank Mandiri Indonesia has allocated funds in Corporate Social Responsibility (CSR) programs for various areas that have a positive impact on society and the environment. Significant CSR allocations have been made in various important sectors, reflecting Bank Mandiri's commitment to contributing to sustainable development and community welfare.

One of the areas that receives special attention in Bank Mandiri's CSR allocation is the Environment/Nature Preservation Sector. To preserve nature, Bank Mandiri has supported projects that focus on reforestation, environmental conservation, carbon emission reduction, and natural resource protection. Through the allocation of CSR funds, Bank Mandiri plays an active role in maintaining biodiversity, reducing negative impacts on the environment, and encouraging awareness about the importance of nature conservation. Health is also an important focus in Bank Mandiri's CSR allocation. Bank Mandiri recognizes that health is a fundamental right of every individual, and through its CSR programs, it supports public health initiatives that include improving access to health services, education on health, development of health infrastructure, and support on disease prevention and treatment efforts. In addition, Bank Mandiri also pays attention to Public Facilities and Worship. To improve the quality of life of the community, Bank Mandiri has contributed to the development of public infrastructure such as the construction of sports facilities, educational facilities, and the improvement of places of worship. Through this, the Bank supports equitable access and quality improvement of public facilities and facilitates religious activities that are important to the community. In situations of natural disasters, Bank Mandiri also pays serious attention through CSR allocations in the Natural Disaster Sector. Bank Mandiri has been involved in disaster management and post-disaster recovery efforts by aiding with disaster victims, supporting infrastructure reconstruction, and developing effective disaster response programs.

Poverty alleviation and social community development are the focus of Bank Mandiri's Social Community Development Program. Through its CSR programs, Bank Mandiri has supported initiatives aimed at reducing poverty levels, improving community welfare, and strengthening the competitiveness of local economies. This includes community economic empowerment through skills training, provision of business capital to vulnerable groups, and support to poverty alleviation programs that include the provision of social assistance, scholarships, and assistance in developing micro and small businesses.

Lastly, the education sector is also a major concern for Bank Mandiri in its CSR allocation. Bank Mandiri recognizes the importance of education in advancing society and creating equal opportunities. Through its CSR programs, Bank Mandiri has committed to support inclusive and quality education. This includes the construction of educational facilities, increasing educational accessibility for children from underprivileged families, developing innovative curricula, and providing scholarships to outstanding but financially underprivileged students. Furthermore, Table 3 presents the report data on Bank Mandiri's Green Financing allocation portfolio from 2016 to 2022.

**Table 3. Green Financing Portfolio of Bank Mandiri, Indonesia (In Billion Rupiah)**

| Year | Renewable energy | Pollution Prevention & Control | Environmentally sustainable management of living natural resources and land use | Clean transportation | Sustainable water & wastewater management | Eco-efficient/circular economy adapted products, production technologies & processes | Green Buildings | Total Green Financing Portofolio |
|---|---|---|---|---|---|---|---|---|
| 2016 | 2.487 | 0 | 3.186 | 5.622 | 0 | 0 | 0 | 11,295 |
| 2017 | 3.068 | 0 | 3.186 | 6.522 | 0 | 0 | 0 | 12,776 |
| 2018 | 4.372 | 0 | 0 | 6.491 | 0 | 0 | 0 | 10,863 |
| 2019 | 1.350 | 136 | 57.539 | 0 | 245 | 0 | 0 | 59,27 |
| 2020 | 2.540 | 21 | 74.948 | 1.408 | 1.200 | 0 | 307 | 80,424 |
| 2021 | 4.281 | 0 | 88.537 | 2.028 | 1.214 | 0 | 205 | 96,265 |
| 2022 | 6.149 | 92,956 | 3.107 | 867 | 3.307 | 0 | 16 | 13,539 |

Table 3 displays data on the allocation of funds in the Green Financing Portfolio in various sectors that contribute to environmental sustainability. Each column shows the amount of funds allocated in specific years to each sector related to environmental conservation efforts. Below is the interpretation of each column in the table:

1. Renewable energy: This data shows the amount of funding allocated to renewable energy projects. This includes investments in environmentally friendly energy sources such as solar energy, wind energy, biomass energy, and hydroelectric energy. The data in the table shows an increase in funding allocations from 2016 to 2022, indicating a greater commitment to developing the renewable energy sector.
2. Pollution Prevention & Control: This data shows the amount of funding allocated for pollution prevention and control. This can include investments in technologies and systems to reduce pollutant emissions, manage waste, and mitigate negative impacts on the environment. In the table, the data shows the allocation of funds that vary from year to year.
3. Environmentally sustainable management of living natural resources and land use: This column shows the amount of funds allocated for environmentally sustainable management of living natural resources and land use. This includes efforts to conserve biodiversity, sustainable forest management, control deforestation, and environmentally friendly agricultural practices. The data in the table shows fluctuations in the allocation of funds from year to year.
4. Clean transportation: This data shows the amount of funds allocated to clean transportation. This includes investments in sustainable transportation such as electric vehicles, environmentally friendly recharging infrastructure, and the development of more efficient and low-emission transportation systems. The data in the table shows the increase in funding allocation from 2016 to 2022.
5. Sustainable water & wastewater management: This data shows the amount of funding allocated for sustainable water management and wastewater treatment. This includes investments in water management infrastructure, water conservation, waste treatment, and

efforts to protect aquatic ecosystems. The data in the table shows an increase in funding allocation from year to year.

6. Eco-efficient/circular economy adapted products, production technologies & processes: This data shows the amount of funds allocated to environmentally friendly and sustainable products, production technologies, and processes. This includes investments in the development of more ecologically efficient products, production technologies that reduce environmental impact, and the application of circular economy principles. The data in the table shows fluctuations in the allocation of funds from year to year.
7. Green Buildings: This data shows the amount of funds allocated for the construction of green buildings. This includes investments in environmentally friendly building design and construction, energy efficiency, use of renewable materials, and reduction of construction waste. The data in the table shows fluctuations in the allocation of funds from year to year.
8. Total Green Financing Portfolio: This data shows the grand total of allocated funds in the green financing portfolio. It covers all the sectors listed above and provides an overall picture of investments in projects that contribute to environmental sustainability. The data in the table shows the fluctuation of total fund allocation from 2016 to 2022.

In interpreting table 3, it can be observed that most sectors saw an increase in funding allocations year-on-year, indicating a greater commitment to environmental sustainability. Some sectors, such as renewable energy and water management, showed significant increases in funding allocations, reflecting a focus on environmentally friendly solutions.

### *4.2. Causality Between BOPO, NIM, ROE, ROA, and CSR*

Although the quantitative research literature that directly analyzes the causality between BOPO, NIM, ROE, ROA, and CSR is limited, there are still ways to illustrate these interrelationships by analyzing the content of financial statements and presenting them in graphical form. This approach can provide insight into how the variables are interrelated and how changes in one variable can affect the others. In financial statement content analysis, we can see trends and patterns emerging from the data recorded in a company's financial statements from year to year. For example, we can see how BOPO, NIM, ROE, ROA, and CSR evolve over time and whether there is a link between changes in these values.

In Figure 1, BOPO, NIM, ROE, ROA, and CSR can be represented as a timeline showing the change in values from year to year. Using this graph, we can compare the changes in these variables and see if there is a discernible pattern. The graph can provide a clearer visual picture of the interrelationship between BOPO, NIM, ROE, ROA, and CSR and how changes in one variable can affect the other. While it cannot provide direct causal inferences, analyzing financial statement content in graphical form can help identify trends and patterns and gain initial insights into the relationships between these variables.

Theory states that the higher the BOPO, the less efficient the company is in managing its operating costs. This can have a negative impact on the company's profitability, such as ROE and ROA. However, there is no direct causal relationship between BOPO and CSR. Furthermore, theoretically the higher the NIM, the higher the profitability of the company. The increase in profitability can have a positive impact on ROE and ROA, but there is no direct causal relationship between NIM and CSR. In theory, however, good financial performance reflected in ROE may provide companies with greater resources to allocate funds for CSR. However, ROE can also be influenced by other factors beyond CSR. In theory, if ROA increases, companies have the potential to allocate more resources to CSR. However, like ROE, ROA is also affected by other factors that are not directly related to CSR.

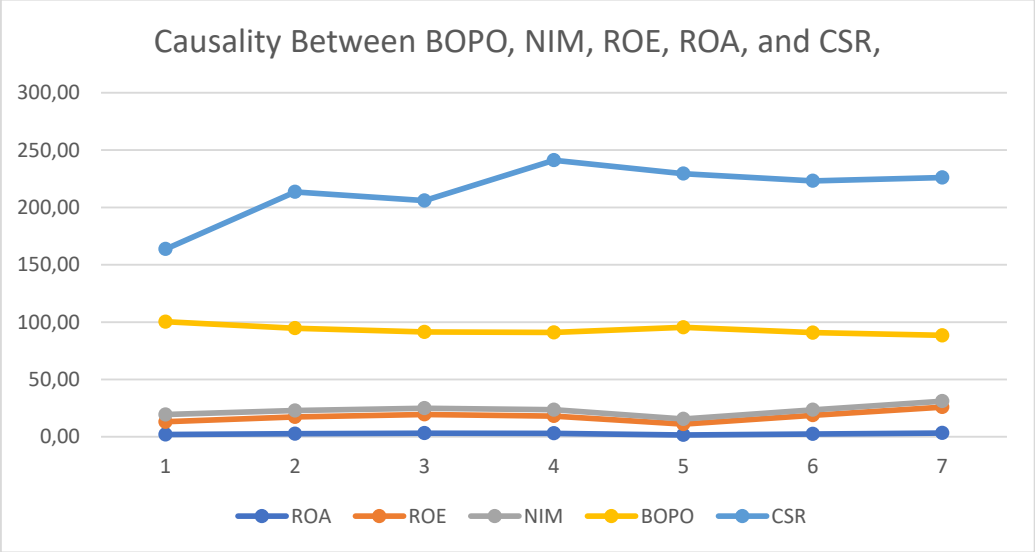


**Figure 1. Causality Between BOPO, NIM, ROE, ROA, and CSR**

In the context of the relationship between ROA, ROE, NIM, BOPO, and CSR, it is important to remember that the causality and relationship between these variables can be very complex and influenced by various external and internal factors. There is no definitive conclusion on the direct relationship between these variables as it can vary between different companies and industry sectors. However, in general, it is argued that good financial performance, such as high ROA and ROE, can provide companies with greater resources to allocate funds for CSR. If companies can generate high profits and are efficient in the use of their assets, they have a greater financial ability to set aside funds for CSR initiatives. However, based on the illustrated explanation, it can be assumed that companies that perform well financially may gain a better reputation in the eyes of stakeholders and society. In this case, companies may feel the need to participate in CSR activities as an effort to maintain a good image and gain support from society.

### *4.3. Causality Between Green Bond, Green Financing Portofolio and CO2 Emmision in Transportation*

Figure 2 illustrates the causality between Green Bond, Green Financing Portfolio of Bank Mandiri from 2016 to 2022 and compares the progress of CO2 Emissions in transportation nationally in the same period. The graph aims to see the extent to which ESG effects have an impact on reducing carbon emissions in the transportation sector in Indonesia.

Figure 2 shows the development of Green Bond and Green Financing Portfolio issued by Bank Mandiri from 2016 to 2022. The Green Bond and Green Financing Portfolio reflects Bank Mandiri's commitment in supporting sustainable and environmentally friendly projects, including projects in the transportation sector that contribute to the reduction of CO2 emissions. In addition, the graph also shows the development of CO2 emissions in the transportation sector in Indonesia during the same period. This data reflects the amount of CO2 emissions generated by the transportation sector nationwide. By looking at Figure 2, it can be observed whether there is a relationship between the increase in Green Bond, Green Financing Portfolio, and changes in CO2 emissions in the transportation sector. If there is a significant relationship between the increase in Green Bond and Green Financing Portfolio and the decrease in CO2 emissions in the transportation sector, this will show that the efforts of banks in supporting sustainable projects have had a positive impact in reducing carbon emissions.

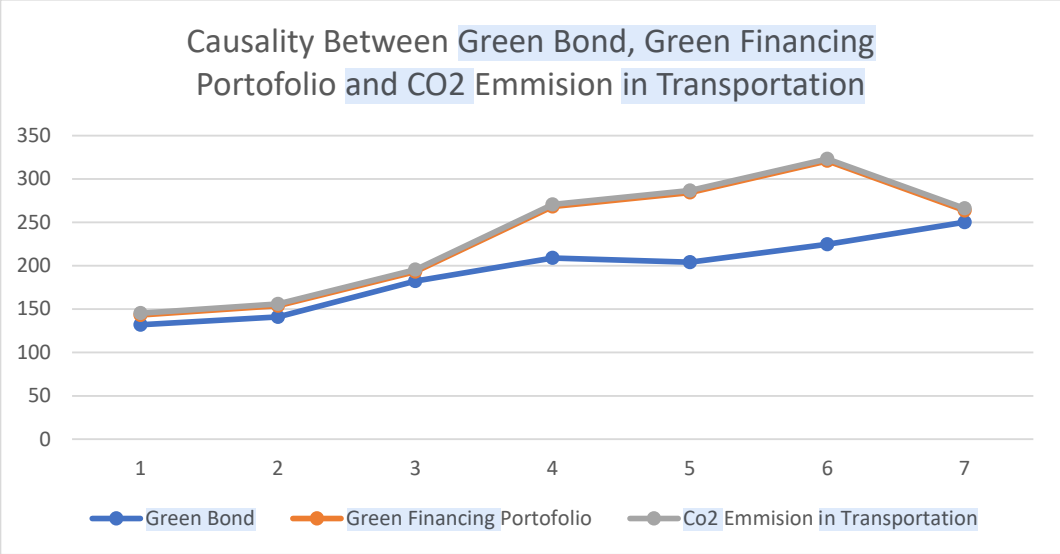


**Figure 2. Causality Between Green Bond, Green Financing Portofolio and CO2 Emmision in Transportation**

From the data generated in Figure 2, there is a significant relationship between the increase in Green Bond and the increase in allocation of Green Financing Portfolio by Bank Mandiri, Indonesia. The graph shows that as the number of Green Bonds issued since 2016 increased, there was also a significant increase in the allocation of funds for Green Financing Portfolio by Bank Mandiri. This shows the strong awareness and commitment of Bank Mandiri in supporting sustainable and environmentally friendly projects through Green Bond issuance. Green Bond provides the necessary funding source to support projects that contribute to the reduction of CO2 emissions and environmental protection. In addition, the data on the graph also shows that the increase in Green Financing Portfolio follows the same trend as the resulting Green Financing effect. That is, the more Green-Bond issued by Bank Mandiri, the greater the allocation of funds allocated to the Green Financing Portfolio. This indicates that an increase in Green Bond directly impacts the increase in funds available to finance sustainable projects in the transportation sector and other sectors. In this context, an increase in the Green Financing Portfolio also means an increase in investment in projects aimed at reducing CO2 emissions in the transportation sector. This reflects Bank Mandiri's significant role in supporting carbon emission reduction efforts and driving the shift towards greener transportation in Indonesia.

In conclusion, the data in Figure 2 shows a close relationship between the increase in Green Bond, Green Financing Portfolio allocation, and CO2 emission reduction efforts in the transportation sector. Bank Mandiri as a financial institution has played an important role in supporting sustainable projects through the issuance of Green Bond and allocation of funds for Green Financing Portfolio. By doing so, they contribute significantly to reducing carbon emissions and driving positive change in the transportation sector towards a cleaner and more sustainable environment.

### *4.4. Discussion*

Green Bonds are financial instruments issued to finance sustainable and environmentally friendly projects. The Green Financing Portfolio reflects the allocation of funds allocated to these projects. The causality between Green Bond and Green Financing Portfolio can be seen from the cause-and-effect relationship formed between the two. The issuance of Green Bonds by financial institutions, such as Bank Mandiri in Indonesia, provides the necessary resources to support sustainable projects in the

transportation sector. Green Bond attracts investors who are concerned about environmental issues to invest in projects that contribute to the reduction of CO2 emissions, such as the development of electric vehicles or environmentally friendly recharging infrastructure. In this sense, the Green Bond serves as a catalyst in increasing the allocation of funds to sustainable projects in the Green Financing Portfolio.

In the context of Bank Mandiri, the results of the data demonstration show that the increase in Green Bond, which began in 2016, has a significant impact on increasing the allocation of funds for the Green Financing Portfolio. In other words, the more Green-Bond issued, the greater the allocation of funds allocated for sustainable projects to reduce CO2 Emission in the transportation sector. This shows that Green Bond has a positive causality on Green Financing Portfolio. In this case, the causality between Green Financing Portfolio and CO2 Emission can be explained through the influence of investment in green technology and sustainable practices. With significant funds allocated through the Green Financing Portfolio, companies and institutions can implement projects that aim to reduce CO2 emissions in the transportation sector. For example, investments in the development of electric vehicles, environmentally friendly recharging infrastructure, or the use of cleaner alternative fuels. Through these projects, a significant reduction in CO2 emissions in the transportation sector is expected.

What Bank Mandiri is doing as one of the three state-owned banks in Indonesia that is currently a pioneer in terms of ESG provides an indication that the increase in Green Financing Portfolio goes hand in hand with the downward trend in CO2 emissions in transportation. From 2016 to 2022, along with the increased allocation of funds for sustainable projects, there has been progress in reducing CO2 emissions in the transportation sector in Indonesia. This suggests a positive causality between the Green Financing Portfolio and the reduction of CO2 emissions in transportation. In this context, the Green Financing Portfolio acts as a key driver in allocating funds to sustainable projects that contribute to the reduction of CO2 emissions. Investments made through the Green Financing Portfolio encourage the adoption of green technologies, sustainable innovations, and greener practices in the transportation sector. Thus, there is a positive causality between the Green Financing Portfolio and CO2 emission reduction.

Managerial Implications: The causality established between Green Bond, Green Financing Portfolio, and CO2 Emissions in transportation has significant implications for environmental sustainability. First, through Green Bond issuance, financial institutions such as Bank Mandiri can mobilize the necessary resources to support sustainable projects in the transportation sector. This strengthens the commitment to accelerate the shift to greener transportation. Second, the increased allocation of funds through the Green Financing Portfolio provides opportunities for companies and institutions to implement sustainable projects. Investments in green technologies and sustainable practices in the transportation sector have the potential to significantly reduce CO2 emissions. In addition, it can also encourage innovation and development of more efficient and environmentally friendly transportation solutions. Third, the positive causality between the Green Financing Portfolio and CO2 emission reductions suggests that efforts to reduce the environmental impact of the transportation sector can be successful through proper allocation of funds. By increasing investment in sustainable projects, such as green infrastructure development or the use of renewable energy in transportation, significant reductions in CO2 emissions can be achieved.

In the context of Green Bond, there is a positive causality between the issuance of Green Bond by Bank Mandiri and the increased allocation of funds for sustainable projects in the Green Financing Portfolio. This suggests that the Green Bond serves as a catalyst in increasing investment in sustainable projects in the transportation sector. In addition, the adoption of Green Bond and Green Financing Portfolio also has a broader positive impact. Investment in sustainable projects in the transportation sector can drive sustainable economic growth, create new jobs, and increase innovation in the

transportation industry. This is in line with the concept of sustainable development that integrates environmental, social, and economic aspects.

## V. Conclusion

In the Indonesian context, Bank Mandiri's adoption of the Green Bond and Green Financing Portfolio is a positive step in supporting environmental sustainability in the transportation sector. However, to achieve greater change, more involvement of other financial institutions and the private sector is required. The causality between Green Bond, Green Financing Portfolio, and CO2 Emissions in transportation provides a strong foundation in supporting environmental sustainability in the transportation sector. Through Green Bond issuance and increased allocation of funds in the Green Financing Portfolio, investments in sustainable projects can reduce CO2 emissions, advance green technologies, and drive innovation in transportation. However, to ensure the sustainability and effectiveness of efforts in reducing CO2 emissions in transportation, further steps are needed. First, it is important to continue to increase the number of Green Bonds issued and the allocation of funds in the Green Financing Portfolio. This can be done through collaboration between financial institutions, government, and the private sector to mobilize investment in sustainable projects in the transportation sector. Furthermore, there needs to be transparent monitoring and reporting regarding the use of funds in the Green Financing Portfolio. Financial reports and information related to projects funded by Green Bonds should be easily accessible and verifiable. This will provide confidence to investors and the public about the effectiveness of the use of funds in reducing CO2 emissions in transportation.

In addition, it is important to continue innovating green technologies and sustainable solutions in the transportation sector. The development of more efficient electric vehicles, wider recharging infrastructure, and the implementation of policies that support the use of environmentally friendly public transportation can make a significant contribution to reducing CO2 emissions. Furthermore, there is a need for cross-sector and cross-country cooperation in promoting and encouraging the adoption of Green Bonds and Green Financing Portfolios. Experience exchange, technology transfer, and training on best practices in supporting sustainable projects in the transportation sector can accelerate the shift towards greener transportation at the global level. In addition, public education and awareness also play an important role in creating environmental sustainability in the transportation sector. Easy-to-understand information about the benefits of using sustainable transportation and individual contributions to reducing CO2 emissions can motivate people to adopt greener travel habits. Finally, it is important to continue to evaluate and research the impact of Green Bond and Green Financing Portfolios on reducing CO2 emissions in transportation. In-depth quantitative and qualitative studies can provide better insights into the effectiveness of policies and measures that have been implemented, as well as assist in better decision-making for the future.

## VI. Limitations and Future Research Agenda

While our study has provided an initial understanding of the causality between Green Bond, CSR, Financial Performance, Green Financing Portfolio, and their effects on CO2 Emissions in Transportation nationwide, we realize that there are several shortcomings in this study that limit the interpretations and conclusions that can be drawn. First, this study relies on data interpretation based on visual graphs of financial statements and sustainability reports. While this provides a rough idea of the relationship between the observed variables, a more comprehensive study still has enormous opportunities to be implemented. Secondly, in the context of sustainability reporting, there are challenges in terms of consistency and assessment standards. In our study, we relied on a limited

number of sustainability reports available from companies. In addition, there are no consistent standards in sustainability reporting in Indonesia, which limits uniformity and comparability between companies. For future research, it is important to consider using more consistent frameworks and standards to facilitate cross-company analysis. Third, this study is also limited to one banking subject in Indonesia. Although Bank Mandiri is one of the largest banks in Indonesia and has a commitment to sustainability, it cannot be considered representative of the entire banking sector and its influence on reducing CO2 emissions in the transportation sector nationwide. Research involving more companies in different sectors is needed to gain a more comprehensive understanding of the impact of ESG and sustainable fund allocation on CO2 emission reduction in transportation.

In the face of these limitations, our study proposes several recommendations for future research. First, the use of more advanced quantitative analysis methods, such as panel regression or path analysis, can help measure the causal impact between the variables studied more accurately. Second, it is important to expand the scope of companies involved in the study to obtain more representative data and represent various industry sectors. Third, standardization and harmonization efforts in sustainability reporting should be encouraged, allowing for easier benchmarking and cross-company analysis.

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