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## Article

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# Strategies to Achieve Net Zero Emissions 2060 with CSR Disclosure

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## ABSTRACT

Intensifying global climate change requires strategic action to reduce negative environmental impacts. One of the key initiatives in the global sustainability agenda is the achievement of Net Zero Emissions by 2060, which is expected to limit global temperature rise and protect ecosystems. In this context, Corporate Social Responsibility (CSR) plays an important role in supporting carbon emission reduction efforts. This study examines the relationship between CSR index and carbon emission reduction through data analysis of energy sector companies in Indonesia. The methods used include content analysis and Pearson correlation test to evaluate the relationship between CSR index scores and carbon emission levels. The results show that an increase in the CSR index score in the environmental category correlates with a decrease in carbon emissions. Effective CSR implementation not only fulfils ethical and legal obligations but also generates a range of strategic benefits for companies, including operational cost savings and reputation enhancement. This study confirms that sustainable CSR strategies can contribute significantly to the achievement of the Net Zero Emissions target by 2060.

**Keywords:** Corporate Social Responsibility Index, Carbon Emissions, Net Zero Emissions, Energy Sector

**JEL Classifications:** Q54, Q56, M14, L94, O13

## 1. INTRODUCTION

Intensifying global climate change requires strategic and measurable actions to reduce negative environmental impacts (Steffen et al., 2018). One of the key initiatives in the global sustainability agenda is the achievement of Net Zero Emissions by 2060, which is expected to limit global temperature rise and protect ecosystems (Brown and Green, 2022). In this context, Corporate Social Responsibility (CSR) plays an important role in supporting carbon emission reduction efforts. CSR is a concept that integrates social and environmental responsibility into a company's business strategy (García-Sánchez, 2022).

The CSR Index provides information on companies' policies, practices, and reports related to social and environmental responsibility, including carbon emission reduction efforts.

CSR indices provide a framework that enables transparent and consistent evaluation of a company's CSR practices and their impact on environmental sustainability (Sullivan and Schiafo, 2016).

This research aims to deeply examine the relationship between CSR indices and carbon emission reduction by exploring various aspects such as sustainability reporting, environmental policies, and emission reduction initiatives so that companies contribute and can optimise their social responsibility to support global efforts towards achieving the 2060 Net Zero Emissions target (Kolk, 2016). Through the analysis of CSR data of energy sector companies, this study identifies practices that are effective in mitigating carbon emissions and strategies that can be adopted to improve CSR performance in the context of climate change (Rexhepi et al., 2021).

## 2. LITERATURE REVIEW

### 2.1. Carbon Emissions and Net Zero Emissions

The rise in global temperatures caused by increased greenhouse gas emissions, especially carbon dioxide (CO<sub>2</sub>), has prompted various countries and companies to set carbon emission reduction targets in achieving Net Zero Emissions by 2060, which aims to balance the amount of emissions produced with the amount of emissions absorbed or removed from the atmosphere (IPCC, 2021). Various strategies have been identified as best practices in achieving Net Zero Emissions, including increased energy efficiency, use of renewable energy, investment in low-carbon technologies, and sustainable supply chain management (IEA, 2021). Companies that successfully integrate these strategies into their CSR policies tend to be more successful in reducing carbon emissions and achieving sustainability targets. In addition, collaboration between the private sector, government and civil society is also considered essential in supporting global efforts towards achieving net zero emissions (Murray et al., 2020).

### 2.2. CSR Index and Environmental Performance Aspects

In an environmental context, CSR focuses on reducing the negative impacts of business operations, including carbon emissions, resource consumption, and waste management (Dixon-Fowler et al., 2013). Companies with high CSR index scores tend to have lower carbon emission levels. The study by Lee et al. (2020) found that companies that consistently report and implement CSR policies well show a significant reduction in carbon emissions. This suggests that good CSR reporting and policy implementation can contribute significantly to reducing carbon emissions (Lee et al., 2020). A commonly used CSR index is the Global Reporting Initiative (GRI), highlighting key indicators on environmental aspects. These indicators include energy consumption, carbon emissions, waste management, and energy efficiency initiatives (GRI, 2021).

## 3. RESEARCH METHODOLOGY

### 3.1. Scope of Research

This research uses quantitative data that includes environmental category CSR Index data and carbon emission data. Secondary data sources are obtained from sustainability reports and carbon disclosure projects. This research focuses on 6 samples of energy sector companies listed on the Indonesia Stock Exchange during the 2017-2021 period, namely BUMI, PGAS, ADRO, PTRO, DOID, ELSA. The selection of these companies is based on the relevance and significance of the company's contribution to carbon emissions.

### 3.2. Statistical Analysis

Statistical Analysis is the process of collecting, organising, interpreting, and presenting quantitative data using statistical techniques with the aim of identifying patterns, trends, and relationships in the data (Gao et al., 2023). In the context of this research, statistical analysis serves to evaluate the relationship between CSR indices and carbon emission levels, as well as to test hypotheses regarding the impact of CSR policies on emission reduction (Said et al., 2023).

### 3.3. Pearson Correlation Test

The Pearson Correlation Test is used to identify the relationship between CSR index scores and carbon emission levels. The test results are expected to show a negative correlation, indicating that an increase in CSR index scores, especially in the environmental category, is associated with a decrease in carbon emissions (Chen et al., 2022). Interpretation of the correlation coefficient will provide insight into the effectiveness of CSR initiatives in reducing carbon emissions and evaluate the success of the company's sustainability strategy to achieve the net zero emissions target by 2060 (Zhao et al., 2022).

### 3.4. Content Analysis

The content analysis method is applied to assess corporate sustainability reports in order to identify initiatives related to reducing carbon emissions and evaluate their impact on the environment (Yin et al., 2022). The process involves collecting and reviewing sustainability reports from various periods and sources to uncover reported policies, practices and outcomes regarding emissions reduction (Hahn et al., 2022). This content analysis is designed to provide deep insights into a company's strategy for carbon footprint mitigation and identify areas that require improvement or further development (Li et al., 2022).

## 4. RESULTS

### 4.1. Statistical Analysis

Descriptive statistical analysis functions in descriptions that include the mean and median of a set of sorted data. In addition, this analysis includes data distribution such as maximum value, minimum value, and standard deviation value as an indicator of data distribution in research (Jin et al., 2023).

Based on Table 1, the average value of carbon emissions in the 6 observation samples of energy sector companies listed on the Indonesia stock exchange during the 2017-2021 period was 8,257,072 CO<sub>2</sub>/kWh with a median value of 332,997.6 CO<sub>2</sub>/kWh and a maximum value of 31,905,359 CO<sub>2</sub>/kWh and a minimum value of 221,004 CO<sub>2</sub>/kWh. The average value of the CSR Index in the environmental category is 0.4285 with a median value of 0.4285 and a maximum value of 0.8214 and a minimum value of 0.0714.

### 4.2. Pearson Correlation Test

The Pearson Correlation Test is used to measure the strength and direction of the linear relationship between the CSR index variable (X) and the carbon emissions variable (Y).

The Pearson Correlation Test hypothesis is as follows (Brown et al., 2023):

**Table 1: Statistical analysis**

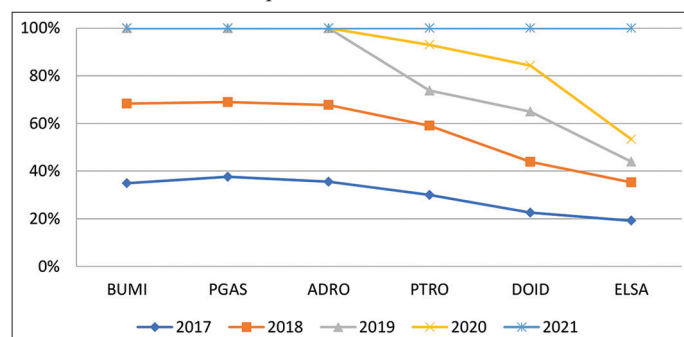
Statistical classifications	CSR (X)	Carbon emissions (Y)
Mean	0.398810	8254072
Median	0.428571	332997.6
Maximum	0.821429	31905359
Minimum	0.071429	221.0040

Source: research results year 2024

**Table 2: Pearson correlation test**

Correlation		
Probability	X	Y
X	1.000000	
Y	-0.449240	1.000000
	0.0128	

Source: research results year 2024

**Figure 1:** Carbon emission trends of energy sector companies for the period 2017-2021

$P < 0.05$  then  $H_0$  is rejected and  $H_a$  is accepted.

$P > 0.05$  then  $H_0$  is accepted and  $H_a$  is rejected.

The criteria for the degree of relationship of the Pearson correlation coefficient are as follows:

- -0.20 = Very weak degree of relationship
- 0.20-0.40 = Weak degree of relationship
- 0.40-0.60 = Medium/sufficient level of relationship
- 0.60-0.80 = Strong relationship level
- 0.80-1.00 = Very strong relationship level.

Based on the Pearson correlation test results in Table 2, a correlation value of 0.449240 was obtained, indicating a moderate level of relationship between the CSR index (environmental category) and carbon emissions. An increase in CSR index in the environmental category tends to be followed by a reduction in carbon emissions. Probability (P-Value) of 0.0128  $< 0.05$  then  $H_0$  is rejected, it can be concluded that the variable CSR index (environmental category) is significant to the reduction of carbon emissions at a significance level of 5% ( $\alpha = 0.05$ ).

## 5. DISCUSSION

### 5.1. Effect of CSR Index on Carbon Emission Reduction

Based on the literature review that has been conducted and referring to the results of research, it is found that the CSR Index, especially in environmental aspects, has a significant influence on reducing carbon emissions (Li and Lin, 2020). Effective CSR implementation not only fulfils ethical and legal obligations, but also generates various strategic benefits for companies (Xu and Zhou, 2023). For example, companies that focus on reducing carbon emissions can enjoy operational cost savings through improved energy efficiency, use of clean technologies, and better

waste management (Jiang and Gao, 202). In addition, companies that demonstrate good CSR performance can also improve the company's reputation to the public, both consumers and investors who are increasingly concerned about sustainability issues (Wang and Zhao, 2023).

Corporate social responsibility (CSR) as a strategic tool in reducing carbon emissions has a strong commitment to corporate social responsibility and can significantly reduce the negative impact of corporate operations on the environment (Zhao and Zhang, 2022). The relationship between the CSR Index and carbon emission reduction shows that efforts made by companies to improve their environmental performance not only have a direct impact on reducing emissions but also strengthen the company's position in the industry (Kim and Lee, 2022). This is evidence that investment in CSR can generate significant returns, both in the form of cost savings and increased reputation and trust from various stakeholders.

### 5.2. Effectiveness of CSR Implementation of Energy Sector Companies as a Strategy to Achieve Net Zero Emissions 2060

Effective CSR implementation not only helps reduce emissions but also reduces dependence on expensive and unsustainable energy sources (Rashid and Qureshi, 2020). Given the importance of CSR in reducing carbon emissions, the strategy to achieve net zero emissions by 2060 should include increasing the CSR Index in the environmental field. Companies need to integrate sustainable CSR practices in their operations. This includes using renewable energy, reducing fossil fuel use, and improving production efficiency (Finkbeiner and Lehmann, 2020). Governments and policymakers also have an important role to play in supporting the implementation of sustainable CSR so that regulations encourage transparency and accountability in CSR reporting to ensure that companies are responsible for environmental impacts (Bénabou and Tirole, 2020). Trends in Carbon Emissions of Energy Sector Companies.

Based on figure 1. BUMI's implementation of Corporate Social Responsibility in the environmental category reflects its commitment to emission reduction and environmental sustainability. Based on BUMI's 2019 corporate sustainability report, the company identified that its operational activities generate various types of emissions, including CO<sub>2</sub> and ozone-depleting substances, which contribute to the greenhouse effect, global warming, and ozone layer damage. To address this challenge, BUMI company has committed to run more efficient business operations and reduce carbon emissions in every activity of the company. In 2019, BUMI recorded carbon emission of 1,885,565 tonnes CO<sub>2</sub>eq, showing a decrease compared to 2018 which was recorded at 1,911,408 tonnes CO<sub>2</sub>eq. This decrease was achieved through periodic maintenance of the company's operational equipment with a focus on improving efficiency and the use of environmentally friendly technology, BUMI is committed to achieving net zero emission by 2060. This approach contributes significantly to mitigating global climate change and preserving the environment, in line with international standards and national regulations (Widianto and Nugroho, 2019).



PGAS' implementation of corporate social responsibility in the environmental category confirms the company's commitment to achieve net zero emissions (NZE) by 2060 in support of the Indonesian government's energy transition agenda. On October 06, 2022, PGAS, as the Gas Subholding of PT Pertamina (Persero), together with other subholdings, signed a commitment to achieve the zero carbon emission target. This effort is realised through two main programs implemented, namely business decarbonisation and green business acceleration. The business decarbonisation programme includes the implementation of energy efficiency, reduction of losses, electrification of equipment, use of low-carbon fuels, green power generation, electrification of mobile equipment, and carbon capture and storage technology. Meanwhile, the green business acceleration programme is implemented aggressively by building renewable energy businesses, batteries and electric vehicles and their ecosystems, biofuels, blue and green hydrogen, and nature-based solutions (Arifin and Rosyadi, 2021).

ADRO's implementation of corporate social responsibility for the environment category plays an important role in the company's strategy to achieve net zero emissions by 2060. As a large company with energy consumption exceeding 6000 (TOE) per year, ADRO has integrated an energy management policy in line with Government Regulation No. 70 of 2009. This policy includes a commitment to comply with energy efficiency and greenhouse gas (GHG) emission reduction regulations, as well as operational planning that focuses on improving energy efficiency and continuous improvement (Gunawan and Putra, 2021).

In practice, ADRO has shown significant progress in energy consumption management. The company successfully reduced its energy intensity from 0.46 gigajoules per metric tonne of coal in 2018 to 0.43 gigajoules per metric tonne of coal in 2019. This achievement was the result of implementing various initiatives, including the use of biodiesel and energy efficiency strategies in key operational sectors. In 2020 ADRO reported a 21% reduction in energy use or equivalent to 5973 Terajoules compared to the previous year. ADRO also set specific energy saving targets, such as a 3% saving target from the 2017 energy baseline for the Coal Processing and Barge Loading Kelanis (CPBL) area. Initiatives to achieve this target included the centralisation of generators which resulted in an increase in generation load and a 7.1% reduction in fuel consumption. In addition, the company used a life cycle assessment (LCA) approach to calculate the global warming potential (GWP) value of the entire production process, from raw material usage to waste disposal. Other strategic initiatives include load management on generators, the use of biodiesel, as well as the implementation of an Energy Management System (EnMS) in the mining, power generation, and logistics sectors. The results of this initiative showed a decrease in greenhouse gas emissions intensity of -8.33% from 2018 to 2019. This data shows that ADRO has made significant progress in reducing carbon emissions, supporting the company's goal to achieve net zero emissions by 2060 (Sari and Pratama, 2023).

PTRO, as a company committed to environmental sustainability, has implemented various initiatives in its efforts to achieve its

net zero emission target by 2060. In the context of Corporate Social Responsibility (CSR), PTRO focuses on energy efficiency and fuel management as the first step to reducing its carbon footprint. These measures include setting up lighting and supporting equipment that utilizes electricity, optimizing the layout of mining activities, as well as the movement of heavy equipment to improve fuel consumption efficiency and periodic maintenance on operational equipment that contributes to fuel savings and emissions reduction (Zainuddin and Widiyanto, 2020). Since 2018, PTRO has started the transition towards the use of alternative fuels by adopting biodiesel and gradually increasing its consumption to 40.47% of total fuel by 2020. The adoption of biodiesel contributes to a significant reduction in carbon emissions, which is reflected in the decreasing emissions data as biodiesel use increases. The use of IPCC Tier-1-based emission calculation methods enables accurate monitoring and reporting of emissions, supporting transparency and effectiveness of the company's emission reduction strategy. To achieve the net zero emission target by 2060, PTRO should continue and expand existing initiatives, as well as further explore renewable energy technologies and innovations in emission reduction.

DOID's implementation of corporate social responsibility in achieving net zero emission by 2060 is focused on energy efficiency and reducing greenhouse gas (GHG) emissions. Energy consumption is operationalized primarily through fuel and electricity. Energy efficiency programs include maintenance and upkeep of mining equipment to ensure optimal efficiency, as well as road design and maintenance to support heavy equipment mobility. In addition, training and supervision of heavy equipment operators are conducted to reduce fuel consumption. The selection of employee housing locations with access to electricity from PLN also contributes to the reduction of greenhouse gas emissions (Rizal and Mahmud, 2022).

ELSA Company is committed to achieving net zero emission by 2060 through various corporate social responsibility (CSR) initiatives that focus on energy efficiency and diversification. In its operations, ELSA uses renewable and non-renewable energy such as diesel, gasoline, jet fuel, and electricity, which are measured using international conversion factors. To improve energy efficiency, ELSA company implements policies such as open design, lighting efficiency in less productive areas, night driving in operating areas, and zoning in the air system. In addition, ELSA is developing the use of solar power as a renewable energy alternative. These steps demonstrate ELSA's dedication to supporting Indonesia's energy transition agenda and achieving net zero emission by 2060, while contributing to global climate change mitigation (Farah and Budiarto, 2022).

## 6. CONCLUSION

This study shows that the implementation of Corporate Social Responsibility (CSR), especially in environmental aspects, has a significant impact on reducing carbon emissions in energy sector companies in Indonesia. A high CSR index correlates with reduced carbon emissions, suggesting that companies that are active in reporting and implementing sustainable CSR policies

tend to be more successful in achieving energy efficiency and reducing carbon. Energy sector companies such as ADRO, PTRO, BUMI, ELSA, DOID, and PGAS demonstrated various strategic initiatives, including the use of renewable energy, sustainable supply chain management, and low-carbon technologies that successfully reduced emissions. The findings confirm the important role of CSR in corporate strategies to achieve Net Zero Emissions by 2060.

Based on the results of the study, it is recommended that energy sector companies in Indonesia strengthen their implementation of corporate social responsibility (CSR) with a primary focus on reducing carbon emissions. This can be achieved through increased investment in green technology and renewable energy, as well as the adoption of more efficient and environmentally sound operational practices. In addition, companies need to improve transparency and accountability in emissions reporting, and engage various stakeholders, including government and communities, in collaboration to achieve reduction targets.

## REFERENCES

- Arifin, J., Rosyadi, S. (2021), Corporate social responsibility and net zero emission goals: A case study of PGAS. *Energy Reports*, 7, 1325-1334.
- Bénabou, R., Tirole, J. (2020), Regulation and corporate social responsibility: The role of government and policy makers in ensuring environmental accountability. *Journal of Economic Perspectives*, 34(1), 29-50.
- Brown, L., Green, K. (2022), Strategies for achieving net zero emissions by 2060. *Global Environmental Change*, 70, 101-112.
- Brown, T., Green, K., Davis, L. (2023), Utilizing Pearson's correlation coefficient for assessing the relationship between CSR and environmental impact. *Journal of Business Research*, 155, 112-123.
- Chen, L., Wang, R., Xu, X. (2022), The relationship between CSR scores and carbon emissions: Evidence from Pearson correlation analysis. *Sustainability*, 14(11), 7025.
- Dixon-Fowler, H.R., Slater, D.J., Johnson, A.M. (2013), The role of corporate social responsibility in reducing environmental impact: Evidence from global firms. *Journal of Business Ethics*, 118(4), 769-780.
- Farah, N., Budiarto, Y. (2022), Corporate strategies for achieving net zero emissions: Insights from ELSA's CSR practices. *Sustainability*, 14(12), 7486.
- Finkbeiner, M., Lehmann, A. (2020), Integrating sustainable CSR practices into corporate operations: The role of renewable energy and efficiency improvements. *Journal of Cleaner Production*, 259, 120711.
- Gao, Y., Zhang, Z., Zhao, X. (2023), Statistical analysis in the context of big data: Techniques for identifying patterns, trends, and relationships. *Journal of Statistical Computation and Simulation*, 93(4), 1189-1204.
- García-Sánchez, I.M. (2022), Corporate social responsibility and carbon emission reduction: An analysis of Spanish companies. *Journal of Cleaner Production*, 331, 129682.
- Global Reporting Initiative (GRI). (2021), GRI Standards. Netherlands: Global Reporting Initiative.
- Gunawan, B., Putra, I. (2021), Corporate social responsibility and energy management policies: The case of ADRO's net zero emission strategy. *Journal of Cleaner Production*, 296, 126465.
- Hahn, R., Scheermesser, M., Di Carlo, C. (2022), Analyzing sustainability reports: Uncovering corporate strategies for carbon emission reduction. *Sustainability*, 14(5), 2895.
- International Energy Agency (IEA). (2021), Net Zero by 2050: A Roadmap for the Global Energy Sector. France: International Energy Agency.
- IPCC. (2021), Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. United Kingdom: Cambridge University Press.
- Jiang, S., Gao, L. (2021), Corporate social responsibility and operational efficiency: Evidence from the energy sector. *Sustainability*, 13(12), 6650.
- Jin, Z., Wang, X., Zhang, Y. (2023), Comprehensive descriptive statistics for data analysis: Mean, median, dispersion, and standard deviation. *Journal of Statistical Research*, 24(1), 45-59.
- Kim, J., Lee, S. (2022), CSR and environmental performance: How does it affect the firm's market position? *Journal of Cleaner Production*, 351, 131596.
- Kolk, A. (2016), The role of corporate social responsibility in achieving net zero emissions. *Environmental Science and Policy*, 55, 128-137.
- Lee, S., Park, Y., Song, S. (2020), The impact of corporate social responsibility on carbon emissions: Evidence from global companies. *Journal of Cleaner Production*, 256, 120381.
- Li, H., Zhang, X., Wang, H. (2022), Content analysis of corporate sustainability reports: Insights into carbon footprint mitigation strategies and areas for improvement. *Journal of Cleaner Production*, 348, 131242.
- Li, W., Lin, L. (2020), Corporate social responsibility and carbon emission reduction: Evidence from the Chinese market. *Journal of Cleaner Production*, 273, 123-134.
- Murray, J., Gupta, R., Al-Dhaafri, H. (2020), Integrating CSR strategies to enhance carbon emission reduction and sustainability goals. *Corporate Social Responsibility and Environmental Management*, 27(4), 1837-1851.
- Rashid, A., Qureshi, M.I. (2020), The role of corporate social responsibility in reducing dependence on non-renewable energy sources. *Energy Reports*, 6, 227-235.
- Rexhepi, G., Bragdon, J., Kuijpers, M. (2021), Corporate social responsibility and carbon emission reduction in the energy sector: A case study analysis. *Journal of Cleaner Production*, 321, 128929.
- Rizal, A., Mahmud, I. (2022), Implementing corporate social responsibility in mining: Efforts towards net zero emissions at DOID. *Sustainability*, 14(11), 6732.
- Said, A., Moudi, M., Idris, K. (2023), The role of corporate social responsibility in carbon emission reduction: A statistical analysis. *Journal of Cleaner Production*, 398, 136550.
- Sari, D., Pratama, H. (2023), Implementing energy management systems and biodiesel: Case study of ADRO's environmental performance. *Sustainability*, 15(6), 3678.
- Steffen, W., Rockström, J., Richardson, K. (2018), Trajectories of the Earth system in the anthropocene. *Proceedings of the National Academy of Sciences*, 115(33), 8252-8259.
- Sullivan, M., Schiafo, S. (2016), The Role of Corporate Social Responsibility Indices in Financial Reporting. United States: Wiley.
- Wang, H., Zhao, R. (2023), Corporate social responsibility and firm reputation: Evidence from emerging economies. *Journal of Business Ethics*, 188(2), 345-362.
- Widianto, R., Nugroho, A. (2019), BUMI's corporate social responsibility: Achievements and challenges in reducing carbon emissions. *Renewable and Sustainable Energy Reviews*, 104, 277-287.
- Xu, X., Zhou, H. (2023), The impact of corporate social responsibility on environmental performance: A study of Chinese firms. *Journal*

- of Business Ethics, 184(4), 927-944.
- Yin, R., Zhao, Y., Wang, L. (2022), Content analysis of corporate sustainability reports: A case study of carbon emission reduction initiatives. *Journal of Cleaner Production*, 367, 133103.
- Zainuddin, R., Widiyanto, F. (2020), Implementing corporate social responsibility in the mining sector: PTRO's path to net zero emissions. *Energy Reports*, 6, 112-122.
- Zhao, M., Li, P., Wu, Z. (2022), Evaluating CSR effectiveness and sustainability strategy success using correlation analysis: Pathways to net zero emissions. *Journal of Environmental Management*, 311, 114855.
- Zhao, Y., Zhang, J. (2022), The impact of corporate social responsibility on environmental performance: A study of firms in the manufacturing sector. *Journal of Cleaner Production*, 350, 133848.