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Women, Global Reporting Initiative Standards (GRI), and Carbon Emission Disclosure: Are Women Eco-Friendly? Evidence from Banking in Indonesia

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ABSTRACT

This study aims to examine whether the adoption of the Global Reporting Initiative (GRI) Standards enhances carbon emission disclosure among banks in Indonesia. Furthermore, it provides empirical evidence that the presence of women on boards moderates the relationship between GRI adoption and carbon emission disclosure. The study was conducted on 40 conventional and Islamic banks listed on the Indonesia Stock Exchange (IDX) during the period 2015–2021. The analysis employs Ordinary Least Squares (OLS) regression, with robustness tests conducted using alternative measurement variables to ensure the consistency of the results. The findings consistently demonstrate that the adoption of GRI Standards positively influences carbon emission disclosure in Indonesian banks. The presence of women on boards promotes banks' engagement in global climate change agendas, aligning with the implementation of Sustainable Development Goals (SDGs) 5, 8, and 13. This study reinforces stakeholder theory and Critical Mass Theory, indicating that a minimum threshold of female board members is necessary to influence strategic decisions, particularly in encouraging voluntary disclosures such as carbon emission reporting. Notably, the study also finds that carbon emission disclosure is valued by banking stakeholders in Indonesia. Therefore, policymakers are encouraged to establish regulations that mandate GRI adoption and ensure a minimum representation of women in strategic decision-making positions within the banking sector.

Keywords: GRI, Environmental Disclosure, Carbon Emission Disclosure, Women on Board
JEL Classification: Q5, J16, Q01, Q56

1 Introduction

Over the past few decades, environmental issues on global warming and increasing carbon have drawn a lot of attention (Dong et al., 2023; Donnelly et al., 2023; Rehman et al., 2023). The industrial and manufacturing sectors carrying out their production activities contribute 79% of global carbon emissions and this figure will continue to increase as a result of population growth and increasingly limited available resources (United Nations Environment Programme, 2023). Responding to this, stakeholders at the corporate level are increasingly required to prove their commitment to responding to climate change and other environmental issues through the formulation of transparent and actual corporate regulations and accountability (Dmuchowski et al., 2023; Ferry et al., 2023) financial markets have been hit hard by the Great Financial Crisis of 2008, the acceleration of climate change, and now the COVID-19 pandemic. The result of these events is the acceleration of the implementation of a new model of socioeconomic development of societies referred to as the environmental, social, and governance (ESG). It is not only the industry players, directly related to mass production and massive energy use, but also the financial sectors that should burden a responsibility for handling the environmental and climate change.

In this context, the financial sectors can play an important role in achieving carbon neutrality and responding to climate change issues in several ways: reducing carbon emissions and increasing energy efficiency, transparency on climate change risks/performance, investing in renewable projects, and including the financial industry in the goals of the sustainability agenda (Jung et al., 2018; Khalil & Nimmanunta, 2021). Both the Sustainable Development Goals (SDGs) and the 2015 Paris Climate Agreement clarify that the financial sectors must act and demonstrate leadership on climate change in the realm of sustainable development (Wu & Xu, 2022). In addition to actions such as allocating resources and directing capital to sustainability and climate change issues into market practices, improving risk and performance measurement are essential in this financial sector (Bimha & Nhamo, 2013; Galletta et al., 2021).

Strategy developments to reduce carbon emissions can help banks establish an environmentally friendly reputation. This reputation plays a role in gaining higher market share and increasing access to external financial resources at lower costs (Rehman et al., 2023). Although companies can practice Corporate Social Responsibility (CSR) adequately in disclosing social and environmental responsibilities, various literatures consider that this has not compared the global reporting standards (Abu Al-Haija et al., 2021; Luo et al., 2023; Miklosik & Evans, 2021). In the banking sector further revealed by Nobanee & Ellili (2016) CSR can only influence the performance of Conventional Banks, though not comprehensively, by disclosing their environmental performance. Compared to other CSR reporting standards, it is believed that the Global Reporting Initiative Standards (GRI) can design various sustainability processes that basically ensure environmental conservation, economic balance, and organisational performance to be well-maintained (Miklosik & Evans, 2021; Tóth et al., 2021).

The GRI Guidelines for Financial Institutions are a major initiative that tends to focus on the enhancement of financial sectors' primary responsibility with a view to advancing sustainable development. In fact, GRI is built on the triple bottom line foundation to provide a framework for social reporting and accounting and provides a comprehensive sustainability reporting framework based on a multi-stakeholder process (Khan et al.,

2011). Furthermore, in the context of carbon disclosure, this normative pressure will motivate companies to meet the requirements of internationally standardised greenhouse gas (GHG) indicator disclosure. It can therefore be expected that the magnitude of carbon disclosure will increase following the implementation of the GRI guidelines as a reflection of the normative pressure on companies making the disclosures (de Grosbois & Fennell, 2022). Previous studies have confirmed a positive relationship between GRI adoption and carbon disclosure in the context of oil and gas companies, consumer and automotive sectors, electricity, mining and agriculture (Dan et al., 2023; Kennett et al., 2021; Yuan & Pan, 2022; Mamun, 2023; Elsayih et al., 2021; Tóth et al., 2022; Nasih et al., 2019) inter alia, size and sector membership (Energy, Manufacturing and Primary Industries). Disclosure of environmental performance in Indonesia only focuses on the manufacturing and mining sectors (Nursulistyo et al., 2022; Yuliana & Wedari, 2023). However, most studies addressing bank sustainability consider banking to have not been studied in detail in the literature (Maama & Gani, 2022; Miah et al., 2021; Santos & Rodrigues, 2021).

Reporting on environment or sustainability in the financial and banking industry only constitutes the distribution of low-carbon investment (Wilson & Caldecott, 2023) and green financing (Donnelly et al., 2023; Manurung et al., 2022). Indeed, it does not discuss how to disclose environmental performance and carbon emissions in compliance with the international GRI standards. In the meantime, Banktrack & Rainforest in Bashatweh et al., (2023) in fact stated that the measurement of loans and investments made by banks for projects and companies produces large amounts of GHG, in other words, banks are still financing projects that produce carbon emissions (CO2). The GRI report has conversely stated that financial institutions must estimate the impact of emissions resulting from business operations, especially the financial institutions in Indonesia owing to the fact that Indonesia has been considered among the top 10 countries with the highest carbon emissions worldwide (International Energy Agency, 2022).

When a financial institution provides funding access to high GHG production sectors, this must be disclosed separately from data related to the EN16 indicator in the GRI, namely total direct and indirect greenhouse gas emissions (Global Reporting Initiative, 2019). Research by Gurol & Lagasio, (2023) recommended that the banking sectors, as an important institution in support of sustainable development, provide social, environmental and governance implications through sustainability disclosures guided by GRI reporting that includes such indicators (Istianingsih et al., 2020). This would build motivation for the banking sectors to disclose more detailed climate change information when comparing to the financial institutions which do not make the disclosure complying to GRI guidelines. This particularly may take place in the context of financial institutions in Indonesia that remains fluctuating when providing sustainability disclosures from year to year and prioritises the disclosures of economy better than environment (Gunawan et al., 2022) while environmental disclosures are the lowest. Applying a content analysis method, this study uses the sustainability disclosure guidelines from the global reporting initiatives (GRI, The situation is exceptionally caused by the closely related banking sector in Indonesia to the financing of mining sector, petrochemical industry, and food and beverage industry (International Energy Agency, 2022). This study thus focuses on the carbon emission disclosure in the banking sector in Indonesia which adopts GRI in its environmental performance disclosure.

The United Nation (UN) conference in New York in 2015 then announced that there is increasing pressure from stakeholders demanding companies to demonstrate compliance with the SDGs (Toukabri & Mohamed Youssef, 2023). In this case, reporting of sustainability integrates carbon performance and carbon disclosure, to comply with socially responsible investment and maintain sustainable competitive advantage. So, it is important for stakeholders to provide true disclosure as part of their performance assessment (Román et al., 2021). The board of directors and others responsible for governance have an important role in SDG compliance, because they influence the company's future strategic planning (Toukabri & Mohamed Youssef, 2023). To realise sustainability disclosure in companies the stakeholders demanded, stakeholder theory suggests that board diversity be a valuable corporate resource because it improves problem-solving skills and the company's decision-making process across multiple objectives, including environmental performance and carbon disclosure (Kizys et al., 2023).

The composition of stakeholders currently under debate is revealing the proportion of women holding important positions both in business and government. In Indonesia, the represented seat of government in the department ranks the 108th with a percentage of 21.6% (Inter-Parliamentary Union, 2023). Meanwhile, in the financial industry, the Ministry of State-Owned Enterprises (BUMN) revealed that women's positions on the board of directors are notably contributing 25% higher than that of all financial institutions in Indonesia (Women's World Banking, 2023). It is obvious that there is a reality of gender gaps between male and female professionals in the banking sector in Indonesia. In terms of policy making, this quota can be accounted for female representation and requirements to disclose ethnic diversity on the board of directors which must be considered as a diversity factor in the company sustainability report (Gonenc & Krasnikova, 2022). Critical Mass Theory shows that women are more concerned with the welfare of stakeholders, making them more likely to take action to prevent environmental risks that can harm society (Liu, 2018)greater female board representation and female chief executive officers (CEO). The involvement of women in strategic positions in companies can moderate the relationship between environmental performance and transparency of emission disclosure.

Female directors bring different perspectives and offer broader green solutions in improving board's decision-making on environmental issues (Perkins et al., 2022). Studies by Liu, (2018); Velte, (2019); Volková, (2022) revealed that an even gender composition and the role of women can improve environmental performance, also prevent companies from lawsuits related to social and environmental issues. In addition, in the banking context, a greater level of women on the board will affect sustainability disclosure (Gurol & Lagasio, 2023). Birindelli et al., (2018) showed that there is a relationship between the ratio of female board directors and bank ESG disclosure.

However, the study has not indicated the moderating role of female boards in more detailed sustainability disclosure of GRI global standards for banking sector in Indonesia. So, the empirical results of this study will provide support for the hypothesised relationship regarding the environmental performance of the banking sector that adopts GRI standards on carbon emission disclosure with the role of female boards that have not been previously studied in Indonesia. Furthermore, carbon emission disclosure with GRI adoption has left a debate in Indonesia, as studied by Tóth et al., (2021) and de Grosbois & Fennell, (2022) revealing that GRI adoption was found to be positively related to the likelihood of

disclosure and the level of disclosure, confirming the role of stakeholders and institutional pressures in motivating companies to disclose information related to their climate change. In contrast, research by Abu Abu Al-Haija et al., (2021) in the banking sector found that Islamic banking has not explicitly adopted GRI and merely focused on CSR integrated with sharia compliance while disclosing their carbon performance. This study will further examine the relationship between environmental performance and the position of women in the board of directors of the banking sector in Indonesia in depth by focusing on a two-tier system that separates stakeholders with the moderating role of women both as directors and supervisors. Thus, the role of women in the most strategic positions to influence company's decisions and policies related to the carbon emission disclosure based on GRI in the banking sector in Indonesia can be identified.

The results of this study will contribute to the current literature that debates the environmental performance of banks. Firstly, the use of GRI standards will encourage more comprehensive and transparent carbon emission disclosure (SDGs 13) and meet international standards that are more contributive than CSR forms (Volková, 2022). Secondly, the role of women in the composition of stakeholder ranks will increase corporate awareness to better consider gender aspects in order to improve financial performance (SDGs 5), governance, and environment (SDGs 8) (Galletta et al., 2021). In which this area has been less explored by previous researchers. This paper systematically consists of an introduction, followed with a literature review, data and methodology, results and analysis, conclusions. At the end of this paper, policy recommendations are given as part of the output of this study.

2 Literature Review

2.1 GRI and Carbon Emission Disclosure

There are several frameworks and guidelines for corporate sustainability reporting. This sustainability reporting serves as a benchmark for other stakeholders, such as the media, government, consumers, and academics aiming to evaluate the company's commitment to sustainable development. A company's commitment cannot be assessed solely on whether disclosure is made, stakeholders must ensure that what is disclosed is not just "sweetener". Sustainability reporting can also be part of efforts to manage reputational risks due to company operations (Agung et al., 2023), most companies implement the Global Reporting Initiative (GRI) guidelines which not only provide guidance on content but also implementation. The GRI guidelines are one of the most popular as to a company's economic, social, and environmental performance reporting in the GRI standard version (Khunkaew et al., 2023), GRI is a form of cooperation between the largest reporting standard-setting organisations (Tóth et al., 2022). In 1997, GRI was established to provide standards that could be used as a global reference for sustainability disclosure. During that period, GRI became a reference in setting sustainability reporting standards (Bilbao-Terol et al., 2018; Khunkaew et al., 2023).

Therefore, GRI is more widely applied by businesses worldwide than other frameworks (Gunawan et al., 2022; Sreepriya et al., 2023), as voluntary but prominent guidelines. The Global Reporting Initiative (GRI) provides principles and indicators to disclose GHG efforts and performance but not limited to GHG, also discusses company's alignment in sustainability disclosure (David & Giordano-Spring, 2022). The study by de Grosbois &

Fennell, (2022) found that GRI adoption was positively related to the likelihood of disclosure and the level of sustainability disclosure. This shows the importance of the stakeholders' role in encouraging companies to disclose climate change-related information. The study by Belkhir et al. (2017) stated that there was an average cumulative change within five years for groups of companies implementing GRI guidelines with an actual increase of around 6 percent reducing emission intensity by 15 percent. GRI has provided more comprehensive sustainability disclosure and realised more specific sustainable financial indicators for banks in Indonesia (Gunawan et al., 2022). In addition, Kumar & Prakash, (2019) in the context of sustainability disclosure in banking using the GRI G4 reporting guidelines explained that the highest priority for banking today is the disclosure of sustainability issues directly related to business operations, such as financial inclusion, financial literacy, energy-efficient technology. Thus, banking actions and policies taken must be in line with the welfare of all stakeholders (Boudawara et al., 2023; T. Khan & Badjie, 2022). Based on previous research, the hypothesis proposed in this study is:
H1: Adoption of GRI can improve carbon emission disclosure of banking in Indonesia.

2.2 Women on Board, GRI Adoption, and Carbon Emission Disclosure

Based on stakeholder theory, the presence of women on boards with unique psychological characteristics, leadership styles, diverse backgrounds and professional experiences and ethical values have a strong influence on sustainability issues and are present to better address stakeholders' claims (Issa & Fang, 2019; Nuber & Velte, 2021), showing that women's participation in boards has increased worldwide, the presence of women on boards has been emphasised in several studies (Baalouch et al., 2019; Haque & Jones, 2020; Naeem et al., 2022; Shakil et al., 2020). Corporate governance, including women as board members, is more likely to address strategic issues related to climate change, improve GHG emission disclosure strategies and communicate actions to stakeholders (Fabrício et al., 2022), the presence of women on corporate boards results in increased sensitivity and participatory decision-making styles which in turn increase the strength of corporate responsibility in sustainability reporting (Bear et al., 2010). The presence of female members will also increase the company's competitive advantage in cost efficiency, inspire the company, and improve communication at various levels of the organisation and among board members (Karim, 2020).

The importance of female board members as a moderator for sustainable disclosure has been discussed by previous studies (Gonenc & Krasnikova, 2022; Khunkaew et al., 2023; Lanis & Richardson, 2011; Naeem et al., 2022). The presence of women in corporate governance can interact positively and significantly in sustainability reporting because when there are more female members on the board of a financial company, it will affect the relationship between corporate governance and sustainability disclosure. Theoretically, female representation makes companies pursue targets in fulfilling the sustainability agenda (Naeem et al., 2022), in line with Vacca et al., (2020) noting that female gender moderation on corporate boards on the relationship between tax aggressiveness and the company's corporate social responsibility (CSR) approach, allows companies to disclose CSR activities more accurately in alignment with GRI standards, thus a greater proportion of female board members helps improve corporate social responsibility and promotes the relationship between the board's sustainability committee and corporate social responsibility (Javeed et

al., 2022). The critical mass theory states that the presence of a certain number of individuals in a group can affect the dynamics of the group. In line with this, the presence of the number of women on the board has certain limits to improve the quality of banking decisions to participate in the carbon emission disclosure agenda. Therefore, this study proposes the following hypothesis:

H2: The presence of a certain number of women on the board moderates the relationship between GRI adoption and carbon emission disclosure.

3 Research Methods

This study employs a sample of banks in Indonesia listed on the Indonesia Stock Exchange (IDX). There are 57 banks listed on the IDX, but considering the availability of the required data, only 40 banks under observation years 2015-2021 were used in this study. Data was obtained from the Annual Report of each Bank and OSIRIS.

3.1 Measurement

The dependent variable in this study is Carbon Emission Disclosure (CARBEMDIS). This variable is measured using the carbon emission disclosure score, which is calculated by dividing the number of disclosed items by the total number of items based on the GRI framework (Nasih et al., 2019). For robustness testing, an alternative dependent variable (CARBEMSCO), defined as the total number of carbon emission items disclosed by the company is employed (Kurnia & Ardianto, 2024).

The independent variable is GRI Adoption, referring specifically to GRI 301 through GRI 308, with a maximum of 32 disclosure items. GRI Adoption is measured through environmental disclosure, using a score calculated by dividing the number of disclosed items by the total number of items based on the GRI guidelines (Almaqtari et al., 2024). To test for consistency, the study also employs an environmental score, which reflects the total number of environmental items disclosed by the company.

The moderating variable in this study is women on board (TWBOARD), measured by the total number of women in the board structure (Atif et al., 2020). To verify the robustness of the findings, an alternative measure is used, the proportion of women on board (PRWBOARD), which is calculated as the ratio of female board members to the total number of board members. Additionally, the study includes supplementary analysis by exploring the board system structure, specifically the two-tier board system. In this context, the board is divided into the board of directors and the board of commissioners (Kurnia & Ardianto, 2024). TWBOD represents the total number of women on the board of commissioners, while TWBDIR refers to the total number of women on the board of directors.

The control variables used in this study are total board size (TBOARD), firm size (SIZE), and ownership concentration (CONCENT) (Nasih et al., 2019). TBOARD is measured by the total number of board members, including both the board of commissioners and the board of directors. Firm size (SIZE) is measured as the natural logarithm of total assets.

Table 1. Measurement of Variables

Number	Variables	Measurement	Source
Independent Variable			
1	ENVIDISC	The environmental disclosure score is obtained from the disclosed number of items divided by the number of items based on GRI	Annual Report
2	ENVISCO	Number of environmental items disclosed by the company	Annual Report
Dependent Variable			
1	CARBEMSCO	The number of carbon emission items disclosed by the company	Annual Report
2	CARBEMDIS	The carbon emission disclosure score is obtained from the disclosed number of items divided by the number of items based on GRI	Annual Report
Moderation Variable			
1	TWBOARD	Total women in the board structure	Annual Report
2	PRWBOARD	Total ratio of women divided by total board members	Annual Report
3	TWBOC	Total women in the board of commissioners structure	Annual Report
4	TWBOD	Total women in the board of directors structure	Annual Report
5	WOMEN1	1 If the Company has one woman on the board structure, otherwise it is 0	Annual Report
6	WOMEN2	1 If the Company has two women on the board structure, otherwise it is 0	Annual Report
7	WOMEN3	1 If the Company has three women on the board structure, otherwise it is 0	Annual Report
8	WOMEN4	1 If the Company has four or more women on the board structure, otherwise it is 0	Annual Report
Control Variable			
1	TBOARD	Total number of boards	Annual Report
2	TBOD	Total number of board of directors	Annual Report
3	TBOC	Total number of board of commissioners	Annual Report
4	SIZE	Natural Logarithm of Total Assets	OSIRIS
5	CONCENT	Largest percentage of company ownership	Annual Report

3.2 Testing

This paper proposes the original idea that the adoption of Global Reporting Initiative Standards (GRI) on carbon emission disclosure of Banking in Indonesia. In addition, this study also proves that the presence of female boards tends to have conservative policies on environmental issues. To test the hypotheses, this study applies various univariate and multivariate analysis methods. This study employs descriptive statistics to present basic information related to each variable used to complete the research objectives. In univariate analysis, the correlation matrix is used to investigate the relationship between each variable. Multivariate analysis uses Ordinary Least Square (OLS) regression and applies the right standard error to overcome the problem of heteroscedasticity. This study also applies various models to test the consistency of the research results with different measurements including testing the two-tier system.

The first model proposed in this study is that with increasing banking attention to the adoption of Global Reporting Initiative Standards (GRI), it will increase carbon emission disclosure of banking in Indonesia.

$$CARBEMDIS_t = \alpha + \beta_1 ENDVIDISC_{it} + \beta_2 TBOARD_{it} + \beta_3 CONCENT_{it} + \beta_4 SIZE_{it} + v_t + \varepsilon_{it} \quad (1)$$

The second model proposed in this study is that the presence of women in the board composition will encourage the adoption of the Global Reporting Initiative Standards (GRI) for banking to improve carbon emission disclosure in banking in Indonesia.

$$CARBEMDIS_t = \alpha + \beta_1 ENDVIDISC_{it} + \beta_2 ENDVIDISC \times TWBOARD_{it} + \beta_3 TBOARD_{it} + \beta_4 CONCENT_{it} + \beta_5 SIZE_{it} + v_t + \varepsilon_{it} \quad (2)$$

4 Results and Analysis

Table 2 is a descriptive statistic of all variables used in this study containing the number of observations, mean, median, standard deviation, minimum, and maximum for all variables included in the empirical analysis. The sample consists of 280 annual observations of companies during 2015-2021. The environmental disclosure variable has an average (mean) of 4.98, which shows that overall, the banks as samples of this study voluntarily disclose their environmental performance by adopting GRI reporting standards. The total number of female board members is 1,764 with positions at the board of directors (1.26) and commissioners (0.582). Meanwhile, the average carbon emission disclosure is 1,324, meaning that banks in Indonesia generally also disclose their performance in reducing carbon emissions during the observation period.

Table 2. Descriptive Statistics

Variables	Mean	Std. Dev.	Min	Max
ENVIDISC	4.984	4.351	0.000	1.000
ENVISCO	.283	0.243	0.000	18.000
CARBEMSCO	1.324	1.996	0.000	7.000
CARBEMDIS	0.412	0.292	0.143	1.000
SIZE	223.1418	55.881	0.000	346.360
TWBOD	1.260	1.092	0.000	4.000
TWBOC	0.582	0.614	0.000	2.000
TBOD	6.557	2.699	3.000	13.000
TBOC	4.989	2.276	2.000	11.000
TWBOARD	1.764	1.315	0.000	5.000
TBOARD	11.254	5.004	0.000	24.000
WOMEN1	0.250	0.434	0.000	1.000
WOMEN2	0.171	0.378	0.000	1.000
WOMEN3	0.136	0.343	0.000	1.000
WOMEN4	0.121	0.327	0.000	1.000
CONCENT	73.645	20.500	13.290	100.000
SIZE	223.557	54.568	112.704	344.214

Table 3 shows banking involvement in disclosing environmental performance, carbon emissions and the number of women in the banking structure hierarchy in Indonesia during the observation period. It is noted that banks that adopted GRI in disclosing their environmental performance increased from 2015 to 2021 with a maximum value of 18 and a minimum of 0, likewise the disclosure of carbon emissions. Meanwhile, all samples studied involved women at the top management level of their companies. The composition of the board with a two-tier system then shows that women occupy more positions as

commissioners with a maximum value of 4 while in the position of directors the maximum value is 3.

Table 3. Descriptive Statistics of Environmental Disclosure, Carbon Emission Disclosure, and Total Women on Board by Year

Year	N	Mean	SD	Min	Max
Environmental Disclosure					
2015	14	0.113	0.104	0.000	0.353
2016	15	0.116	0.126	0.000	0.324
2017	15	0.184	0.160	0.000	0.471
2018	15	0.218	0.106	0.000	0.375
2019	16	0.288	0.175	0.000	0.700
2020	25	0.397	0.274	0.000	1.000
2021	25	0.461	0.291	0.000	1.000
Carbon emission disclosure					
2016	15	0.381	0.322	0.143	1.000
2017	15	0.571	0.338	0.286	1.000
2018	15	0.310	0.343	0.143	1.000
2019	16	0.347	0.318	0.143	1.000
2020	25	0.519	0.369	0.143	1.000
2021	25	0.352	0.119	0.143	0.429
Total Women on Board					
2015	40	1.550	1.358	0.000	5.000
2016	40	1.675	1.289	0.000	4.000
2017	40	1.950	1.300	0.000	4.000
2018	40	1.800	1.265	0.000	6.000
2019	40	1.825	1.279	0.000	5.000
2020	40	1.800	1.381	0.000	5.000
2021	40	1.775	1.459	0.000	5.000

Table 4. Pearson Correlation Matrix

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
(1) ENVIDISC	1.000															
(2) ENVISCO	0.811*	1.000														
(3) CARBEMDIS	0.593*	0.504*	1.000													
(4) CARBEMSCO	0.278	0.326	1.000*	1.000												
(5) TWBOD	-0.107	-0.111	0.145	0.096	1.000											
(6) TWBOC	0.130	0.268*	0.148	0.063	0.036	1.000										
(7) TBOD	-0.148	-0.072	-0.098	-0.064	0.391*	0.014	1.000									
(8) TBOC	-0.096	0.014	-0.155	-0.198	0.381*	0.084	0.792*	1.000								
(9) TBOARD	-0.110	-0.007	-0.132	-0.133	0.409*	0.049	0.956*	0.936*	1.000							
(10) TWBOARD	-0.024	0.045	0.206	0.120	0.853*	0.527*	0.369*	0.382*	0.439*	1.000						
(11) WOMEN1	-0.047	-0.070	-0.151	-0.288	-0.379*	-0.134	-0.124	-0.134	-0.092	-0.336*	1.000					
(12) WOMEN2	-0.036	-0.088	-0.137	0.052	0.049	0.032	0.083	0.070	0.104	0.082	-0.263*	1.000				
(13) WOMEN3	-0.039	-0.034	0.190	0.256	0.380*	0.084	0.129	0.049	0.113	0.373*	-0.229*	-0.180*	1.000			
(14) WOMEN4	0.069	0.118	0.146	-0.023	0.612*	0.330*	0.251*	0.358*	0.316*	0.675*	-0.215*	-0.169*	-0.147	1.000		
(15) CONCENT	0.025	-0.013	0.146	0.186	0.200*	0.084	-0.013	0.079	-0.015	0.178*	-0.219*	-0.108	0.169	0.154	1.000	
(16) SIZE	-0.040	0.018	0.015	-0.081	0.367*	0.125	0.847*	0.724*	0.817*	0.396*	-0.068	-0.023	0.196*	0.299*	-0.066	1.000

*** p<0.01, ** p<0.05, * p<0.1

Table 4 provides information on the Pearson correlation coefficient, which is used to check for possible multicollinearity in this study. The test results reveal that all variables do not have a strong correlation exceeding 0.70, which refers to Bilal et al., (2022) This value is the cutoff point indicating no chance of multicollinearity. So, it can be said that the relationship between the main variables in this study does not show any indication of multicollinearity in the regression model built

Table 5. Main Regression

	Model 1	Model 2	Model 3	Model 4	Model 5
	CARBEMSCO	CARBEMDIS	CARBEMDIS	CARBEMDIS	CARBEMDIS
Intercept	0.255	-0.070	-3.896***	-2.152**	-2.665***
	(1.571)	(-0.133)	(-3.881)	(-2.305)	(-3.058)
ENVISCO	0.524***				
	(3.264)				
ENVIDISC		0.289***	0.288***	0.191***	0.193***
		(7.051)	(7.860)	(3.669)	(3.449)
TBOARD			-0.100**	-0.104**	-0.048
			(-2.283)	(-2.618)	(-1.314)
CONCENT			0.010**	0.005	0.003
			(2.265)	(1.106)	(0.690)
SIZE			0.015***	0.011**	0.010**
			(2.916)	(2.195)	(2.178)
ENVIDISC x TWBOARD				0.046***	
				(2.735)	
ENVIDISC x PRWBOARD					0.672***
					(2.638)
Year	Yes	Yes	Yes	Yes	Yes
Industry	Yes	Yes	Yes	Yes	Yes
Adj.R2	0.15	0.34	0.54	0.58	0.59
N	51	111	99	99	99
F-stat	3.492	11.657	9.399	13.755	15.716

t-statistics in parentheses; * p<0.10, ** p<0.05, *** p<0.01

Model 1 shows that environmental performance indicated by the environmental score can increase carbon emission score in banking in Indonesia. This result is in line with research (Widhiastuti & Safitri, 2023). Meanwhile, in Model 2 when environmental performance is measured by the level of GRI adoption, it affects carbon emission disclosure but has a higher Adj.R2 compared to the environmental disclosure. This means that carbon emission disclosure will be more reliable if environmental performance considers the adoption of GRI standards. GRI is a voluntary reporting standard that has been applied by businesses around the world than other frameworks (Gunawan et al., 2022; Sreepriya et al., 2023), as a voluntary guideline, the Global Reporting Initiative (GRI) provides principles and indicators to disclose GHG efforts and performance and company compliance in sustainability disclosure (David & Giordano-Spring, 2022). The study by de Grosbois & Fennell, (2022) found that GRI adoption is positively related to the level of sustainability disclosure. Model 3 makes observations by considering the company's control variables, namely the total board, ownership concentration, and company size. The result can increase the Adj.R2 of the built model.

Total board, ownership concentration and company size have a significant positive effect. This confirms the research conducted by Nasih et al. (2019) that the total board and banking size can determine carbon emission disclosure. Models 4 and 5 are tests of the moderating variable of the presence of women with different measurements. Model 4 proves that the presence of women on the board can improve the relationship between

environmental performance and carbon emission disclosure of banking in Indonesia (Gonenc & Krasnikova, 2022; Khunkaew et al., 2023; Lanis & Richardson, 2011; Naeem et al., 2022). Model 5 is a model built to test the consistency of the results of the presence of women on the board can improve the relationship between environmental performance and carbon emission disclosure. The results remain consistent that the presence of women seen from the percentage of women can improve the relationship between environmental performance and carbon emission disclosure. In line with (Gonenc & Krasnikova, 2022; Khunkaew et al., 2023; Lanis & Richardson, 2011; Naeem et al., 2022).

Table 6. Two Tier Perspective Regression

	Model 6	**Model 7**	**Model 8**	**Model 9**
	CARBEMDIS	CARBEMDIS	CARBEMDIS	CARBEMDIS
Intercept	-2.646**	-3.401***	-3.690***	-3.040***
	(-2.425)	(-3.457)	(-3.791)	(-2.855)
ENVIDISC	0.221***	0.273***	0.283***	0.230***
	(4.288)	(6.297)	(6.884)	(4.579)
TBOD	-0.082	-0.028	-0.041	-0.045
	(-0.645)	(-0.224)	(-0.324)	(-0.340)
TBOC	-0.141	-0.166	-0.144	-0.133
	(-1.282)	(-1.471)	(-1.293)	(-1.216)
CONCENT	0.006	0.012***	0.011**	0.006
	(1.285)	(2.731)	(2.583)	(1.263)
SIZE	0.012**	0.013**	0.014**	0.012**
	(2.147)	(2.403)	(2.626)	(2.101)
ENVIDISC x TWBOD	0.030			
	(0.831)			
ENVIDISC x TWBOC		0.043**		
		(2.145)		
ENVIDISC x PWBOD			0.091	
			(0.491)	
ENVIDISCxPWBOC				0.308**
				(2.078)
Year	Yes	Yes	Yes	Yes
Industry	Yes	Yes	Yes	Yes
Adj.R2	0.57	0.54	0.53	0.57
N	99	99	99	99
F-stat	12.913	7.697	7.534	13.745

t-statistics in parentheses; * p<0.10, ** p<0.05, *** p<0.01

Table 6 is a model development of women's role in the most strategic positions influencing company decisions and policies as of carbon emission disclosure in the banking sector in Indonesia. Companies in Indonesia use a two-tier system that separates stakeholders in the positions of directors and commissioners. Model 5 is built by separating the board of directors from the board of commissioners in the control variable. The results remain consistent, indicating that environmental performance has a significant positive effect on carbon emission disclosure in accordance with research by de Grosbois & Fennell (2022). Models 6 and 7 are to prove the existence of women seen from the number of women on

the board of directors and board of commissioners. Model 6 shows that the number of female board directors cannot moderate environmental performance on carbon emission disclosure. Conversely, the number of female board of commissioners can moderate environmental performance on carbon emission disclosure. Models 8 and 9 are to explain the existence of women seen from the percentage of women on the board of directors and board of commissioners. Model 8 is consistent with Model 6 which shows that the percentage of female board directors cannot moderate environmental performance against carbon emission disclosure. Model 9 is also consistent with model 7 where the percentage of female board commissioners can moderate environmental performance against carbon emission disclosure. This is in line with stakeholder theory viewing that a company is not an entity that only functions effectively for its own interests, the company must also provide benefits to its stakeholders. The board of commissioners in a two-tier system function to suppress agency conflicts to satisfy its stakeholders. Disclosure of carbon emissions is a form of communication between the company and its stakeholders to gain support. Through this disclosure, the banking board of commissioners tries to show its social responsibility to stakeholders (Naeem et al., 2022; Nasih et al., 2019; Nuber & Velte, 2021).

Tables 7 and 8 are the results of the analysis before and after the issuance of POJK Number 51/POJK.03/2017 concerning the implementation of sustainable finance for financial services institutions, issuers, and public companies. Table 7 is divided into panels A and B. Panel A explores the observation years 2015-2017 (before) and 2018-2021 (after). Panel A provides evidence that before the issuance of POJK Number 51 of 2017, environmental performance had no effect on carbon emission disclosure. Likewise, the presence of women on the board has not been able to play a moderating role in the relationship between environmental performance and carbon emission disclosure in banking in Indonesia. After the issuance of POJK Number 51 of 2017, different results were shown. Environmental performance has a significant positive effect on carbon emission disclosure. Likewise, the moderating variable of the presence of women on the board can affect the relationship between environmental performance and carbon emission disclosure. Therefore, this model shows that the research results remain consistent with the main regression results.

Table 7. Before and After Analysis

	PANEL A: BEFORE (2015-2017)				PANEL B: AFTER (2018-2021)			
	Model 10	**Model 11**	**Model 12**	**Model 13**	**Model 14**	**Model 15**	**Model 16**	**Model 17**
	CARBEMDIS	CARBEMDIS	CARBEMDIS	CARBEMDIS	CARBEMDIS	CARBEMDIS	CARBEMDIS	CARBEMDIS
Intercept	0.171	-0.945	-0.662	-1.022	0.111	-3.875***	-1.759	-2.289**
	(0.274)	(-1.178)	(-0.951)	(-1.498)	(0.246)	(-3.432)	(-1.556)	(-2.232)
ENVIDISC	0.034	0.773	0.118	0.104	0.298***	0.293***	0.205***	0.209***
	(0.094)	(1.339)	(1.593)	(1.573)	(6.069)	(6.222)	(3.467)	(3.247)
TBOARD						-0.143***	-0.139***	-0.082*
						(-2.717)	(-2.853)	(-1.692)
CONCENT		0.017***	0.013***	0.013***		0.008	0.002	0.000
		(4.513)	(3.390)	(4.309)		(1.286)	(0.370)	(0.000)
SIZE		-0.002	-0.001	-0.000		0.021***	0.014**	0.014**
		(-0.518)	(-0.423)	(-0.020)		(3.165)	(2.125)	(2.141)
ENVISCO x TWBOARD			3.590				0.047**	
			(1.230)				(2.357)	
ENVIDISC x PRWBOARD				0.645*				0.646**
				(2.037)				(2.251)
Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adj.R2	0.10	0.72	0.74	0.78	0.44	0.54	0.57	0.58
N	30	26	26	26	81	73	73	73
F-stat	5.028	20.107	20.877	35.428	11.557	8.279	13.150	14.221

t-statistics in parentheses; * p<0.10, ** p<0.05, *** p<0.01

Table 8. Before and After Perspective Two-Tier Analysis

	PANEL A: BEFORE (2015-2017)				PANEL B: AFTER (2018-2021)			
	Model 18	**Model 19**	**Model 20**	**Model 21**	**Model 22**	**Model 23**	**Model 24**	**Model 25**
	CARBEMDIS	CARBEMDIS	CARBEMDIS	CARBEMDIS	CARBEMDIS	CARBEMDIS	CARBEMDIS	CARBEMDIS
Intercept	0.171	-0.864	-0.659	-1.006	0.111	-3.782***	-3.188**	-2.831*
	(0.274)	(-1.155)	(-0.981)	(-1.025)	(0.246)	(-3.042)	(-2.392)	(-1.949)
ENVIDISC	0.773	0.540	0.670	0.589	0.298***	0.298***	0.284***	0.247***
	(1.339)	(1.160)	(3.183)	(3.647)	(6.069)	(5.799)	(5.027)	(4.096)
TBOD		-0.045	-0.073	-0.028		-0.085	-0.033	-0.032
		(-0.540)	(-0.873)	(-0.317)		(-0.557)	(-0.219)	(-0.186)
TBOC		-0.021	0.011	-0.029		-0.186	-0.219	-0.193
		(-0.239)	(0.132)	(-0.320)		(-1.413)	(-1.631)	(-1.501)
CONCENT		0.018***	0.013**	0.019***		0.009	0.009	0.004
		(3.969)	(2.663)	(3.259)		(1.557)	(1.513)	(0.732)
SIZE		-0.000	0.001	-0.000		0.020***	0.016**	0.016*
		(-0.002)	(0.177)	(-0.047)		(2.761)	(2.366)	(1.857)
ENVIDISC x TWBOD			-0.193				0.034	
			(-4.386)				(0.876)	
ENVIDISC x TWBOC			0.029				0.313*	
			(1.088)				(1.808)	
ENVIDISC x PWBOD				0.149				0.445
				(0.368)				(1.736)
ENVIDISC#PWBOC				0.053				0.047*
				(1.018)				(1.882)
Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adj.R2	0.10	0.69	0.71	0.68	0.44	0.53	0.53	0.56
N	30	26	26	26	81	73	73	73
F-stat	5.028	14.056	14.658	11.483	11.557	7.097	7.112	12.145

t-statistics in parentheses; * p<0.10, ** p<0.05, *** p<0.01

Next, a before and after analysis is also conducted when viewed from the Two-Tier Perspective in Table 8. Panel A provides results showing that before the issuance of POJK Number 51 of 2017, environmental performance had no effect on carbon emission disclosure. This result is consistent with Table 7 Panel A. This means that before the issuance of POJK Number 51 of 2017, the banking sector's attention to environmental performance and carbon emission disclosure was still low. The same results are also in Table 8 Panel B which provides evidence that environmental performance has a significant positive effect on carbon emission disclosure. Although sustainability reports are still voluntary, after the issuance of POJK Number 51 of 2017, attention to environmental performance and carbon emission disclosure has increased. Banking awareness of sustainability issues is also increasingly encouraged by the issuance of Circular Letter of the Financial Services Authority of the Republic of Indonesia Number 16 / SEOJK.04 / 2021 concerning the form and content of annual reports of issuers or public companies which contain details of sustainable reporting but are not specific to GRI-standard sustainable reporting indicators, especially in financial service reporting standards. However, in the reporting of several banks in Indonesia, they show their commitment and compliance with the implementation of POJK Number 51 of 2017 and SEOJK Number 16 of 2021 by implementing GRI-based sustainable reporting which specifically includes a sub-chapter on the financial sector, one of which is on sustainable products (EN30) which is in line with POJK Number 51 of 2017 and standardised priority sectors with green criteria regulated in the OJK green taxonomy in 2022. This proves that the adoption of GRI standards by banking in Indonesia is increasing.

The results of the exploration of the moderation variable of the female board are also consistent, the presence of women on the board can improve the relationship between environmental performance and carbon emission disclosure. In this study, the female board of commissioners has a significant influence on the relationship between GRI and carbon emission disclosure in line with POJK Number 51 of 2017 that the RAKB is prepared by the board of directors and approved by the board of commissioners. This means that even though the board of directors runs the business, in the end it requires approval in the Banking Sustainable Finance Action Plan by the board of commissioners who also oversee the realisation of the RAKB in the sustainability report to all stakeholders (community, investors, etc.). The female board of commissioners has a positive impact on the disclosure of sustainable reporting, women have high conservatism and concern for environmental issues, thus encouraging banks to participate in the climate change agenda through the adoption of GRI as the main standard for sustainable performance reporting. Moreover, the GRI guidelines also emphasise the importance of the approach of financial institutions in using stock voting rights in the context of environmental and social issues.

Additional analysis was conducted in this study to test the critical mass theory. This theory states that the presence of a certain number of individuals in a group can affect the dynamics of the group (Bluedorn & Kanter, 1980). When the number of women on the board reaches a critical point (critical mass), the board will have significant power to moderate environmental performance on carbon emission disclosure. Women have unique individuals who can provide different perspectives and can have a significant influence on banking decisions in adopting GRI to improve carbon emission disclosure. The difference between Model 1 and Model 2 lies in the board control variables. Model 1 does not consider the two-tier system while Model 2 considers the two-tier system. Model 1 gives the result that

environmental performance increases carbon emission disclosure. The presence of women in the board composition with a number of 1 and 2 can moderate the relationship between environmental performance and carbon emission disclosure, while if the presence of 4 or more women is unable to moderate the relationship between environmental performance and carbon emission disclosure. Women numbering 3 can increase the relationship between environmental performance and carbon emission disclosure. Model 2 tries to analyse the adoption of GRI to improve carbon emission disclosure by considering the two-tier system. The results remain consistent with model 1.

Table 9. Additional Analysis

	Model 26	**Model 27**
	CARBEMDIS	CARBEMDIS
Intercept	-2.678**	-2.638**
	(-2.500)	(-2.537)
ENVIDISC	0.260***	0.260***
	(6.091)	(6.091)
WOMEN1 x ENVIDISC	-0.073*	-0.070*
	(-1.460)	(-0.963)
WOMEN2 x ENVIDISC	-0.125*	-0.113**
	(-1.898)	(-1.958)
WOMEN3 x ENVIDIS	0.105*	0.101*
	(1.875)	(1.782)
WOMEN4 x ENVIDISC	0.055	0.063
	(0.95)	(1.061)
CONCENT	0.003	0.006
	(0.693)	(1.181)
SIZE	0.007**	0.011**
	(3.172)	
TBOARD	-0.079	
	(-1.992)	
TBOC		-0.157*
		(-1.798)
TBOD		-0.131
		(-0.230)
Year	Yes	Yes
Industry	Yes	Yes
Adj.R2	0.57	0.59
N	99	99
F-stat	15.431	15.034

t-statistics in parentheses; * p<0.10, ** p<0.05, *** p<0.01

Furthermore, to confirm that there is no endogeneity problem using the Generalised Method of Moment (GMM) method with the Arellano-Bond serial correlation test to ensure. GMM is an effective tool to eliminate possible homogeneity in the research model (Chijoke-Mgbame et al., 2020). Overall, in table 7, AR1, AR2, and Sargan have values above 0.05, which means that the test results show that there is no strong enough evidence for endogeneity. Therefore, the results of this research analysis are reliable and relevant in understanding the actual direction of causality.

Table 10. Endogeneity

	Dynamic GMM		
	Model 28	**Model 29**	**Model 30**
	CARBEMDIS	CARBEMDIS	CARBEMDIS
Intercept	-2.145	2.223	0.485
	(-0.213)	(0.227)	(0.050)
L.CARBEMDIS	-0.253*	-0.302**	-0.370**
	(-1.391)	(-1.477)	(-1.348)
ENVIDISC	0.297***	0.293***	0.259***
	(4.549)	(4.689)	(4.455)
TBOARD	0.071	0.057	0.139
	(0.491)	(0.408)	(0.979)
CONCENT	0.026	0.003	-0.001
	(0.560)	(0.056)	(-0.029)
SIZE	-0.004	-0.013	-0.010
	(-0.162)	(-0.521)	(-0.422)
ENVIDIS#TWBOARD		0.080*	
		(1.849)	
ENVIDIS#PRWBOARD			1.383**
			(2.207)
Instrument Rank	18	19	19
N	73	73	73
AR1	0.1980	0.2224	0.1454
AR2	0.2418	0.2497	0.4343
Sargan	0.5965	0.5614	0.6606

t-statistics in parentheses; * p<0.10, ** p<0.05, *** p<0.01

4.1 Discussion

This study contributes to providing critical insights into the adoption of GRI for carbon emission disclosure and the influence of gender diversity on the board in moderating the relationship between environmental performance and carbon emission disclosure. The adoption of GRI by the banking sector in Indonesia can potentially improve carbon emission disclosure in a structured, credible, and internationally standardized manner. The adoption of the Global Reporting Initiative (GRI) can improve carbon emission disclosure (de Grosbois & Fennell, 2022; Luo & Tang, 2022) by the banking sector in Indonesia for several important reasons. First, GRI is a trusted measurement standard (Calabrese et al., 2021). GRI offers a structured and tested framework for reporting sustainability information, including carbon emissions. The GRI standards are specifically designed to provide guidance on accurate and reliable measurement, reporting, and disclosure of a company's environmental impacts, including carbon emissions. By adopting this standard, banks in Indonesia can ensure that their carbon emissions measurement and reporting are carried out using a valid and consistent methodology. Second, Transparency and Accountability (Sasse-Werhahn, 2019; Traxler et al., 2020). Adopting GRI will increase the transparency and accountability of banks regarding carbon emissions (de Villiers et al., 2022). By following an internationally recognised framework, banks will provide more detailed and easily understandable information to stakeholders, including investors,

customers, regulators, and the general public. This will create greater trust in banks' carbon emissions reports and provide a basis for the necessary actions to reduce environmental impacts.

Third, it is used as a comparison and compliance. GRI creates consistent and measurable standards (Wahyuningrum et al., 2022) for carbon emission disclosure across sectors and regions. By adopting GRI, banks in Indonesia can compare environmental performance with similar companies globally, which provides insight into the banking position in terms of environmental responsibility. In addition, because GRI is a globally recognised framework, this adoption can help banks meet sustainability reporting requirements that may be imposed by regulators or other institutions. Fourth, it creates environmental responsibility and reputation (Sehgal et al., 2023). In an era of increasing environmental awareness, banks in Indonesia are increasingly expected to contribute to reducing environmental impacts, including carbon emissions. Adopting GRI can send a strong signal that banks in Indonesia take environmental responsibility seriously and are committed to reducing the negative impacts of climate change. This can improve the image and reputation of banking in the eyes of consumers, investors, and the wider community. Moreover, Indonesia is included in the 10 countries with the highest carbon emissions in the world (International Energy Agency, 2022), the role of banking in demonstrating more standardised environmental performance will encourage the net zero emissions mission in 2060. With the GRI guidelines that place environmental aspects with energy indicators, emissions, and investments oriented towards sustainable environmental performance (Global Reporting Initiative, 2019) as part of sustainable managerial compliance will encourage the role of banking in realising this mission. In addition, the adoption of GRI will also provide greater awareness in providing access to funding for industries that have initiatives to provide energy-efficient or renewable energy-based products and services, and reduce energy needs and reduce emission production (Hossain et al., 2017; Velte, 2016).

Furthermore, the presence of women on the board composition plays an important role in moderating the relationship between GRI adoption and carbon emission disclosure. The presence of women will bring diverse perspectives, encourage social and environmental responsibility, and promote transparency and awareness of environmental issues, strengthening the adoption of GRI in encouraging banks to disclose environmental impacts, including carbon emissions. The results of this study indicate that the moderating role of women on the board of commissioners is significant while on the board of directors it is not significant. This implies that a significant board of commissioners or independent board will tend to be more transparent in disclosing environmental disclosure. On the other hand, if the independent board is not large enough, the impact does not seem significant (Liao et al., 2015) which means that women on the board of commissioners can moderate the potentially conflicting expectations of stakeholders with diverse interests. The presence of strong female leaders can increase the attention of leaders and top management to environmental issues (Alhosani & Nobanee, 2023). The presence of an independent board of directors can monitor management performance and stop opportunistic events (Sial et al., 2019) which is in accordance with the characteristics of female boards who are more aware of environmental damage, more active in participating in environmental protection actions and doubting scientific ways to solve environmental problems (Oino & Liu, 2022). This study differs from studies by (García-Sánchez et al., 2023; Konadu et al., 2022; Marchini

et al., 2022) that the position of female board of directors increases the effectiveness of the board better in corporate governance to reduce the carbon footprint, when women become part of the board, the skills of the board of directors will increase. It can be concluded that women have more diverse skills and are more receptive to innovation, new ideas, and the introduction of steps to reduce environmental damage than men do.

Gender diversity on the board plays an important role in creating a control mechanism for every decision and reducing agency conflict. The results of this study imply that the presence of women in strategic positions in banking sector can improve effective governance and encourage banks to participate in the Sustainable Development Goals (SDGs) and Paris Climate Agreement 2015 agendas and demonstrate leadership on climate change in the context of sustainable development, based on the robustness check the ratio of women on the board is also important for environmental disclosure, Birindelli et al., (2018) stated that the relationship between the ratio of female boards and sustainability disclosure in banking is in the form of an inverted U where less than three female members on the board of directors prevent women from being included in the board process (Kramer et al., 2007). This means that women can bring their sensitivity to environmental and social issues to bank management (Gurol & Lagasio, 2023). Women's World Banking, (2023) it was found that female stakeholders in the banking sector in Indonesia showed better performance than male leaders, including in terms of expanding the reach of green financing distribution and promoting transparency of financial and environmental performance. This awareness of female board directors will place greater demands on the management team to carry out comprehensive environmental accountability and reduce public sentiment regarding the increasing role of banks which are increasingly involved in emission-sensitive investments (Fleischer, 2022). Thus, the adoption of GRI is developed through a process in which representatives from various stakeholder groups seek agreement on a uniform framework for reporting on issues of common concern such as greenhouse gas emissions in accordance with the crucial position of women in top-level management (Khan et al., 2011). This finding also confirms the stakeholder theory stating that companies are not only tasked with their own interests as business entities but must also provide benefits to their stakeholders through sustainability disclosure indicating that the company has demonstrated its social responsibility to stakeholders. There are differences in decision-making by female boards that provide values and ethics to make decisions (Naeem et al., 2022; Nuber & Velte, 2021), so they are more concerned about stakeholders outside of shareholders, this also indicates that female boards are more active in stakeholder relations.

5 Conclusion

The adoption of the GRI to measure environmental performance has a significant impact on carbon emission disclosure in the banking sector in Indonesia. These results illustrate the importance of transparent and comprehensive environmental performance measurement and reporting in the context of environmental responsibility. In addition, the findings of this study also reveal that the presence of women on the board plays a significant role in moderating the relationship between GRI adoption and carbon emission disclosure. Women on the board have the unique ability to influence the direction and intensity of carbon emission disclosure, creating an environment that is more responsive to the demands of sustainability disclosure. This conclusion reflects a strategic opportunity for banking

companies in Indonesia to engage more in environmental responsibility through a more rigorous adoption of GRI and a focus on sustainable environmental performance (SDGs 8 & 13). In addition, increasing the presence of women on the board provides an additional dimension in shaping a more holistic and inclusive decision-making environment (SDGs 5). Overall, this study provides an important contribution to the understanding of the linkages between environmental responsibility, the GRI framework, the role of women in decision-making, and carbon emission disclosure in the Indonesian banking sector (SDGs 13).

5.1 Practical Implications

These results provide direction for companies and governments in their efforts to encourage better sustainable practices, as well as stimulate further debate on how these factors can be applied on a broader scale to address global environmental challenges. Several things that need to be done are first, the development of environmental disclosure guidelines: encouraging banking authorities to develop more specific and comprehensive environmental disclosure guidelines for the financial sector. These guidelines should include GRI indicators that are relevant and in accordance with the context of Indonesia, and encourage companies to actively adopt and measure environmental performance. Thus, financial institutions will be active in realising the implementation of inclusive and sustainable finance in accordance with Law Number 4 of 2023 concerning the Development and Strengthening of the Financial Sector and the Financial Services Authority Regulation (POJK) Number 51/POJK.03/2017 concerning the Implementation of Sustainable Finance for Financial Services Institutions, Issuers and Public Companies. Second, improving the quality of sustainability reports: regulators need to create derivative regulations so that banks can improve the quality of sustainability reports by more clearly and in detail detailing relevant environmental performance indicators, as well as steps taken to reduce carbon emissions. However, more comprehensive reports can provide stakeholders with better information. So far, the Financial Services Authority Regulation (POJK) Number 51/POJK.03/2017 and SEOJK Number 16 of 2021 have regulated sustainability reporting guidelines but are still merely reporting, not on materiality and do not provide a description of substantial reporting indicators, especially in the banking sector. Finally, diversification of the board of directors and board of commissioners: encouraging banks to take concrete steps to diversify the board by placing women in strategic positions. This can be done through an inclusive selection and recruitment process, as well as the development of leadership development programs that support women to fill strategic roles in decision-making. This step will encourage the performance and implementation of Sustainable Finance and the achievement of SDGs 5 (Gender Equality) targets.

5.2 Theoretical implications

Theoretically, this research provides an important contribution to the understanding of how the interaction between GRI adoption, the presence of women on the board, environmental performance, and carbon emission disclosure can shape corporate policies, stakeholder relationships, and sustainable business practices in the Indonesian banking sector. This study has successfully confirmed stakeholder theory. The use of stakeholder theory confirms that GRI adoption and carbon emission disclosure can be understood as a response to the demands and needs of non-financial stakeholders, including the general

public and the environment. This study also supports the Critical Mass Theory which explains that the composition of the board of women in a certain number can improve the quality of decisions from the overall board structure. The presence of women on the board can function to influence and shape discussions, decisions, and practices related to the environment. The combination of these two theories has been able to provide in-depth insights into the complexity of the relationship between GRI adoption, the presence of women on the board, environmental performance, and carbon emission disclosure, and how these factors influence each other and shape sustainable policies and practices in the Indonesian banking sector. This study can be a reference for further research by considering women's moderation including age, tenure, experience, and education as factors that influence the qualifications of female leaders on the board of directors and commissioners for banking sustainable reporting disclosure. In addition, it can adopt other sustainable reporting guidelines such as IFRS on environmental disclosure, expand the sample and research period with a different method approach to measure sustainability disclosure in banking, considering that studies with banking objects in the context of environmental sustainability are still limited.

5.3 Policy Recommendations

Based on the conclusions of this study, the following are policy recommendations proposed as a policy brief:

a. **Development of Environmental Disclosure Guidelines:** Encouraging banking authorities or regulators to develop more specific and comprehensive environmental disclosure guidelines for the financial sector. These guidelines should include relevant GRI indicators that are in accordance with the Indonesian context and encourage companies to actively adopt and measure environmental performance. Financial Services Authority Regulation (POJK) Number 51/POJK.03/2017 and SEOJK Number16 of 2021 have regulated sustainability reporting guidelines but are still merely reporting not on materiality and do not specifically provide an explanation of substantial sustainable performance reporting indicators, especially in the aspect of carbon disclosure in the financial sector.
b. **Improvement of Sustainability Report Quality**: Regulators need to create derivative regulations so that banks can improve the quality of sustainable reports by more clearly and in detail detailing relevant environmental performance indicators, as well as steps taken to reduce carbon emissions. More comprehensive reports can provide stakeholders with better information. The financial industry can act as a third party that can reduce the increase in carbon emissions. This is because the activities of the banking industry are not directly related to the environment but can contribute to reducing carbon emissions with investment and lending policies. In addition, the materiality and readability of sustainability reports also need to be considered so that they are not just reports but have a significant effect on reducing carbon emissions in Indonesia.
c. **Board Diversification**: Policy formulation is needed in determining the composition of the board of directors and commissioners. The results of this study confirm the research (Kramer et al., 2007; Moreno-Ureba et al., 2022; Nadeem et al., 2020; Nadia & Hanafi, 2022; Yadav & Jain, 2023) showing that at least 3 women are needed in top management positions in the company to show positive results in the aspect of

disclosing the company's environmental performance. As recommended by IBCWE (Indonesia Business Coalition For Women Empowerment) regarding the Gender Equality Reporting Guidelines for Annual and Sustainability Reports, it encourages women's representation in companies, especially in financial institutions that have not been mentioned in POJK Number 51 / POJK.03 / 2017 and have not been found in financial and employment regulations in Indonesia.

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