Journal of Infrastructure, Policy and Development 2024, 8(8), 4417.
https://doi.org/10.24294/jipd.v8i8.4417

Article

Determinants of voluntary carbon emission disclosure: Does it affect firm value?

Edrianti Rahmatika[1], Dwi Indah Lestari[1], Asokan Vasudevan[2,*], Tania Adialita[1], Sam Toong Hai[2], Manoch Prompanyo[3]

[1] Accounting Program, Faculty Economics and Business, University of Jenderal Achmad Yani, Cimahi 453031, Indonesia
[2] Faculty of Business and Communication, INTI International University, Nilai 71800, Malaysia
[3] Department of Management, Shinawatra University, Pathum Thani 12160, Thailand
*** Corresponding author:** Asokan Vasudevan, asokan.vasudevan@newinti.edu

CITATION

Rahmatika E, Lestari DI, Vasudevan A, et al. (2024). Determinants of voluntary carbon emission disclosure: Does it affect firm value? Journal of Infrastructure, Policy and Development. 8(8): 4417. https://doi.org/10.24294/jipd.v8i8.4417

ARTICLE INFO

Received: 25 January 2024
Accepted: 3 April 2024
Available online: 16 August 2024

Abstract: The purpose of this study is to examine how financial slack and board gender diversity affect carbon emission disclosure and how that disclosure affects firm value in energy sector companies that are listed on the Indonesian stock exchange between 2017 and 2021. Annual reports and sustainability sources provide secondary data for this quantitative study. Purposive sampling was employed in this investigation, including nine companies and a five-year observation period. Thus, 45 samples altogether were employed in the present study. The partial least squares approach is the data analysis strategy used in this investigation. The study's findings indicate that the Gender Diversity Board does not significantly affect carbon emission disclosure and significantly influences firm value. Financial slack significantly affects carbon emission disclosure but does not directly affect firm value. Financial slack and board gender diversity through carbon emission disclosure have no significant effect on firm value.

Keywords: board gender diversity; carbon emission disclosure; financial slack; global warming; firm value

1. Introduction

Climate change is currently a crucial issue discussed by many parties and has even become one of the main focuses of the Sustainable Development Goals. Climate change is a phenomenon that risks both the environment and human existence. According to the sixth report of the IPCC (Intergovernmental Panel on Climate Change) released in 2021, it is stated that there will be an increase in global temperatures of up to 1.5 degrees Celsius in the next two decades (Levin et al., 2021). According to data from the World Research Institute in 2020, it is stated that Indonesia is the eighth-largest global producer of greenhouse gas emissions, with a total emission of 965.3 Mt CO_2e (Friedrich et al., 2020). Indonesia actively participates in several initiatives to lower carbon emissions, including signing the Paris Agreement and the Kyoto Protocol in New York, the United States. The Paris Agreement is an international agreement that intends to fight climate change by limiting global temperature increases to less than 2 °C and 1.5 °C, respectively (from pre-industrial times). Indonesia's commitment to lowering carbon emissions following Presidential Regulation No. 61 of 2011 is further evidenced by the development of an Action Plan. Article 4 of Presidential Order No. 61 specifies that corporate actors must also contribute to lowering greenhouse gas emissions (Indonesia, 2011).

The goal of all companies is to maximize their profits. However, companies often need to pay more attention to environmental factors to achieve profits (Lestari et al.,

2024). Therefore, companies are required to fulfil their responsibilities to shareholders and be socially and environmentally responsible. The public can learn about one type of corporate social and environmental responsibility centered on the problem of global warming through Carbon Emission Disclosure. Disclosure of carbon emissions is one part of CSR (Corporate Social Responsibility) in the type of environmental disclosure (Astari et al., 2020; Witri Astiti and Wirama, 2020). Carbon emission disclosure is a phenomenon that is being highlighted as good news or as an added value for companies. Alfayerds et al. (2021) found that carbon emission disclosure can increase company value. Investors' assessment of a company's reputation can influence the company's share price. Investors can assess a company's ability to manage the environmental impact of its operations by looking at its reputation. Though not many, a few of companies have helped to disclose the carbon emissions from their operating activities. Several previous studies have analyzed the relationship between carbon emission disclosure and company value, and these studies have obtained different results. Hardiyansah et al.'s (2021) research shows that the disclosure of carbon emissions positively and significantly affects company value. Emissions disclosure Carbon is a form of company concern for the environment that the market responds positively to and becomes the basis for investors to consider in assessing the company's sustainability. Meanwhile, research conducted by Kurnia et al. (2020) revealed that carbon emission disclosure does not directly influence company value. This is because the disclosure of carbon emissions is still voluntary, making it difficult to find information related to carbon emissions disclosed in financial reports.

Companies need to have good corporate governance to be responsible for the environment. In its implementation, the role of top-level management is very important because every policy carried out by members of the board of commissioners and directors influences the strategy. Heterogeneity in top-level management needs to be considered because it can provide many solutions to solving problems (Matitaputty and Davianti, 2020). One example is gender diversity on the board of directors. In line with research by Kristanto and Lasdi (2022) board gender diversity can support companies in forming a dynamic governance structure because it involves deliberation between each gender in decision-making and its consequences. Board gender diversity is characterized by the involvement of women in the company's highest ranks, either as board of directors or board of commissioners (Yuliana, 2019). The presence of women as members of the board of directors can overcome environmental problems such as climate change because women tend to have more feminist traits such as empowerment and empathy compared to men (Herinda et al., 2021). Several countries already have policies to provide quotas for women to occupy board positions in companies, such as India, Israel and the United Arab Emirates, which delegate the presence of at least one woman on the board (Kent Baker et al., 2020). Based on research conducted by the International Finance Corporation in 2018, the involvement of women in board members in Indonesia has shown results that are equivalent to the average for ASEAN countries. However, for women who occupy senior management positions, only around 18.3% is still far behind compared to the average for countries in ASEAN of 25.2% (IFC, 2019). Several companies in Malaysia, spanning the period 2011–2013, found that board gender diversity positively and significantly influenced sustainability disclosure (Zahid et al., 2019). Research by Mintah et al. (2017) and

Tingbani et al. (2020) also demonstrates a relationship between board gender diversity and carbon emissions disclosure. A diverse board of directors may serve a broader range of stakeholders. Meanwhile, research by Kılıç et al. (2019) shows that there is no significant relationship between board gender diversity and carbon emission disclosure.

This research also analyses the role of Financial Slack in carbon emission disclosure and its impact on Firm Value. Financial slack, or the company's financial looseness, manifests as excess cash after meeting all of its essential needs (Allam et al., 2020). Companies with financial slack can provide high freedom and protection in dealing with environmental changes (Parida and Örtqvist, 2015). The opinion is in line with the research of Aini et al. (2022) that there is a positive influence between financial slack and carbon emissions disclosure. Apart from that, research conducted by Suryani and Wijayati (2019) also shows an influence between financial slack and disclosure of greenhouse gas emissions. This research explains that companies with high financial slack can allocate financial resources and take the initiative for environmental change.

The aim of this research is to analyze the effect of board gender diversity and financial slack on carbon emission disclosure and how its impact on the firm value in energy sector by starting to answer the following research questions:

1) How do board gender diversity and financial slack influence carbon emission disclosure?

2) How do board gender diversity and financial slack influence firm value?

3) How does carbon emission disclosure affect firm value?

4) How does carbon emission disclosure affect the relationship between board gender diversity and financial slack on firm value?

This research makes several contributions to the literature. Firstly, according to our understanding, research related to board gender diversity and financial slack on environmental issues such as carbon emission disclosure is still limited. Previous research explains the relationship between board gender diversity and financial slack on corporate social responsibility. So, this research is expected to contribute to the limitations of existing literature. Second, through disclosure of carbon emissions, this study also examines the indirect effects of financial slack and board gender diversity on corporate value. The remaining part of the study is organized as follows: In Section 2, pertinent material is reviewed in order to construct the hypothesis. The demographic, sample, and methodology of the study are described in Section 3. The discussion results are presented in Section 4, and the conclusions and suggestions for additional study are presented in Section 5.

2. Literature review

2.1. Resource dependency theory

Resource dependency theory was first put forward by Pfeffer and Salancik in 1978. This theory holds that the board of directors in a company has an important role in connecting the company with external resources (Pfeffer and Salancik, 1978). This theory states that the involvement of women on the board of directors can create strong social relations because gender diversity can have better communication with

shareholders and stakeholders, which is required by sustainable development (Gonenc and Krasnikova, 2022). The board's relationship with the external environment can facilitate the company's access to external resources to help the company engage in desirable initiatives (Ortiz-de-Mandojana et al., 2012).

2.2. Resources—Based view theory

Resource-based view theory is the first proposed by Wernerfelt (1984), which states that company resources help companies improve the efficiency and effectiveness of company operations. This theory explains that companies have extraordinary resources and can use them to gain a competitive advantage. As Silalahi (2015, p. 3) explains, companies that use these resources efficiently and effectively will gain a sustainable competitive advantage and, consequently, generate substantial profits. According to Barner (2001) and Wicaksono (2022, p. 4) states that successful organizations are influenced by internal sources, these internal sources are grouped as follows: (1) Physical resources, including: Equipment, technology, plant, and raw materials. (2) Human Resources, including all employees, experience, intelligence, knowledge, skills, and abilities. (3) Organizational resources, including structure organization, planning resources, systems information, and so on. Based on the definition above, it can be concluded that this theory explains how companies can exploit and use the resources at hand company.

2.3. Signaling theory

Signaling Theory was first put forward by Spence (1973), which states the importance of information on investment decision-making for parties outside the company. As Suryani and Wijayati (2019, p. 104) in their research explained, signaling theory is an action taken by companies to provide guidance to stakeholders in making decisions and reduce the occurrence of asymmetric information so that companies will disclose information both voluntarily and mandatory. According to Kurnia et al. (2020, p. 225) states that published information can signal investors in making decisions. If the information is positive, then market participants are expected to be able to analyze this information as good news. This theory also explains that companies with high quality tend to provide more signals of their competitive advantage to the market. In contrast, a company with low quality will only reveal mandatory information.

2.4. Carbon emission disclosure

Carbon Emission Disclosure, according to Zuhrufiyah et al. (2019, p. 85), is a collection of quantitative and qualitative information relating to past carbon emission levels, and the company estimates exposure and financial implications of risks and opportunities related to climate change. Meanwhile, according to Pitrakkos and Maroun (2020), disclosure of carbon emissions is historical and prospective of the company's carbon performance and contains other climate-related information addressed to stakeholders. Carbon emission disclosure in this study was measured by adopting calculations made by Bae Choi et al. (2013), where 18 more specific items identified five categories relevant to climate change and carbon emissions.

The ratio of carbon emission disclosure is calculated by the total disclosed items divided by 18 items that divided into 5 categories, which are consist of: climate change: risks and opportunities, GHG Emissions Accounting, Energy Consumption Accounting, GHG Reduction and Cost and Carbon Emission Accountability (Bae Choi et al., 2013).

2.5. Firm value

The company's value is a picture of the company, which means that the good and bad values can reflect the good and bad conditions. The company's value can also be represented as the price that potential buyers are willing to pay when the company is sold and in line with the definition of company value, Sawitri and Setiawan (2019, p. 208) concluded that company value is the market value of outstanding company debt and equity securities. Firm value is the perception of capital owners on the company's success level, which has a lot to do with stock prices. From the several explanations above regarding the definition of a firm value or company, it can be concluded that a value company is a condition where the company and its performance are viewed positively by society throughout the operation; this can increase the value of the shares and can benefit investors and shareowners.

Firm value in this study refers to the research of Asyifa and Burhany (2022), which is measured using Tobin's Q ratio. Tobin's Q can be measured by using the following indicators:

$$\text{Tobin's Q} = \frac{\text{Total Market Value} + \text{Total Liabilities}}{\text{Total Aset}} \quad (1)$$

2.6. Board gender diversity

Board gender diversity is one of several characteristics of board members, which include expertise, personality, learning style, background, education, age, and experience. Board gender diversity, according to Coffey and Wang (1998) in Kılıç and Kuzey (2019, p. 40), is a variation in the characteristics of members of the board of directors, which can be seen based on background and character. In this study, the measurement of the Gender Diversity Board refers to the research of Kılıç and Kuzey (2019), which is measured using the Blau Heterogeneity index. This indicator produces a Blau index value from 0 (homogeneous) to 0.5 (heterogeneous), which means the higher the index value, the diversity of the gender of the board of directors is higher and vice versa. The Blau index has the advantage of considering not just one but all categories. The following is the calculation of the Blau heterogeneity index:

$$1 - \sum_{I=1}^{n} Pi^2 \quad (2)$$

Information:

Pi = Percentage of male or female members of the board of directors in each category.

n = The number of categories used is 2 (women and men).

Board gender diversity affects carbon emissions disclosure:

According to resource dependency theory, diversity boards can better provide viewpoints and solve problems arising from their environment (Pfeffer and Salancik, 1978). One way to select direction members is to pay attention to gender diversity.

Companies will gain new perspectives and opinions in the direction of board discussions due to gender diversity. The reason is that gender diversity in the ranks of the direction is considered capable of increasing the possibilities and variety of ideas in making decisions, including in making decisions regarding the disclosure of carbon emissions. Competition, individualism, and hierarchy are motivational factors in masculine environments. Meanwhile, empowerment, empathy and justice are seen as feminine values. Thus, the presence of women is considered capable of better assessing environmental problems (Herinda et al., 2021). Therefore, gender diversity boards are expected to influence decision-making related to carbon emissions. So, the hypothesis in this research is as follows:

H1: Gender diversity on the board affects carbon emission disclosure.

Based on the Resource Dependency Theory, diversity, including gender diversity on the board of directors, is important in organizational resources because it can bring more creativity and innovation (Pfeffer and Salancik, 1978). Including women on the board of directors will bring change to the organization. Women are more likely to listen, inspire and support others, which can create better teamwork (Setiany, 2021). Thus, having more women on the board of directors will result in decision-making that positively impacts the company's reputation. Ultimately, a good company reputation will increase company value. This statement is in line with research conducted by (Agyemang-Mintah and Schadewitz, 2019; Syamsudin et al., 2017) which states that there is an influence of board gender diversity on company value.

H2: Board gender diversity affects firm value.

2.7. Financial slack

Financial slack is a company's financial looseness showing excess cash after it has fulfilled all its basic needs (Allam and Diyanty, 2020). This statement aligns with Carnes et al. (2018), who argue that financial slack is a financial resource remaining in the previous year that can be used for the following year to achieve company goals. Financial slack can protect companies from risky activities. Based on the calculation method carried out by Allam and Diyanty (2020) financial slack can be measured by using the following indicators:

$$\text{FSLACK} = \frac{\text{Cash and Cash Equivalents}}{\text{Total Current Liabilities}} \quad (3)$$

According to resource-based theory, financial slack is a company's financial resource that acts as a shock absorber, conflict solver, and facilitator of innovation (Silalahi, 2015). Financial resources have low liquidity specifications, thus allowing companies to spend their financial resources on activities related to Corporate Social Responsibility issues (Mishina et al., 2004; Zhang et al., 2018). Companies with adequate resource availability will find it easier to spend money to manage and disclose the carbon emissions produced by the company (Kock et al., 2012). Therefore, financial slack is predicted to affect carbon emission disclosure significantly.

H3: Financial slack influences carbon emissions disclosure.

Companies that have good financial slack will manage their resources to be able to compete. The availability of company funds shows that it can use its funds freely to maximize company value (Matsumura et al., 2014). Research related to the relationship between financial slack and firm value has been studied by Malini and

Sukarmanto (2021), who stated that there is a significant influence between financial slack on IPO company value. Therefore, this research formulates that financial slack can influence firm value.

H4: Financial slack affects firm value.

Based on signaling theory, carbon emission disclosure can be a signal for investors. Disclosure of carbon emissions in a sustainability or annual report can signal that the company is serious about solving environmental problems. Research that is consistent with the signal perspective has been conducted by Jiang et al. (2021), who found a positive relationship between carbon emission disclosure and firm value because voluntary carbon emission disclosure has benefits for investors in making decisions so that an increase in carbon emission disclosure as a whole is highly appreciated in the capital market. With companies disclosing carbon emissions, it is hoped that they can provide information indicating that the company has implemented transparency so that stakeholders will respond positively. This provides more value for the company so carbon emission disclosure will affect the increase in company value.

H5: Carbon emission disclosure affects firm value.

2.8. Indirect effect

Carbon emission disclosure in this study can affect the relationship between board gender diversity and firm values. If the company has a board of directors with various genders, disclosure of carbon emissions will be more comprehensive because of the contribution of ideas or opinions from each gender, which varies. Where the involvement of women on the board of directors tends to have a higher level of concern in dealing with social and environmental issues, one of which is disclosing carbon emissions. Based on the Signalling Theory, thus, companies disclosing carbon emission disclosures in their annual or sustainability reports can provide a positive signal for investors involved in making decisions. So, this can increase the value of the company.

H6: Gender diversity board influences firm value through carbon emission disclosure.

Based on signal theory, disclosure of carbon emissions can signal investors to gain profits in the future because it can provide sustainable business information that can attract potential investors (Kurnia et al., 2020). Companies need adequate financial resources to have more freedom in carrying out activities related to carbon emissions because disclosing carbon emissions requires quite large costs (Ayu Laksani et al., 2020). The higher the slack resources, the higher the company's ability to carry out matters related to corporate social responsibility (Lin et al., 2019). The higher the level of disclosure of social and environmental activities, the higher the company value, in line with research by Lee and Cho (2021), which found a significant influence between carbon emission disclosure and firm value. Therefore, financial slack is predicted to influence firm value through carbon emission disclosure.

H7: Financial slack affects firm value through carbon emission disclosure.

Figure 1 below shows the relation between all independent variables with all dependent variables.

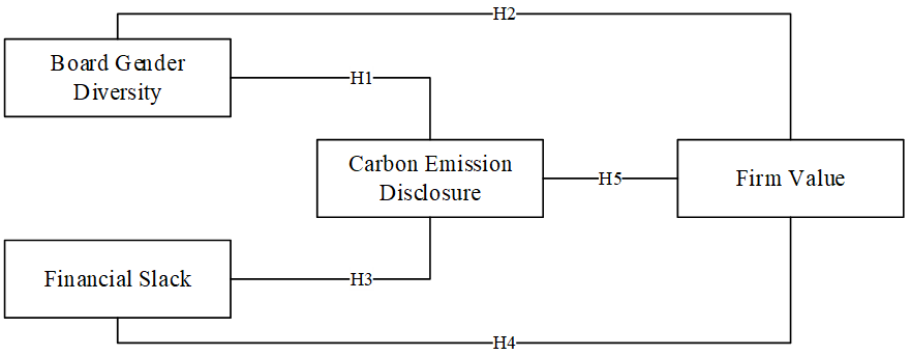

Figure 1. Conceptual framework.

3. Methodology

This study employs path analysis modelling along with quantitative approaches. The analysis performed in this study assesses the outer model, considers the inner model and employs the partial least squares approach to test the hypothesis.

We are concentrating on businesses in the energy industry because their emissions are comparatively higher than those of other business. The documentation from annual reports and sustainability reports is used as secondary data in this study. The research population comprises 76 energy companies registered on the Indonesia Stock Exchange, this is based on data from the Greenhouse Gas Inventory Report published by the ESDM Data and Technology Center in 2019, which states that the energy industry is the sector category that absorbs the effects of greenhouse gases the most with a market share of 43.83%, followed by the transportation industry (24.64%), manufacturing and construction (21.46%), fugitive emissions from petroleum and natural gas (4.81%), fugitive emissions from solid fuels (0.42%), and other sectors (4, 82%) (Sunarti et al., 2020). The observation period in this research was carried out in 2017–2021. This period was chosen to reflect current conditions because previous research used old data, so it was less relevant. The criteria were considered in the purposive sampling technique. The sample was chosen based on the following **Table 1**:

Table 1. Sample selection with purposive sampling.

No.	Description	Total
1	Energy sector companies listed on the Indonesia Stock Exchange in 2017–2021.	76
2	Indonesian Stock Exchange-listed energy businesses whose initial public offerings ended in the period of 2017–2021	(12)
3	Energy sector companies listed on the Indonesia Stock Exchange suspended in 2017–2021.	(6)
4	Energy companies listed on the Indonesia Stock Exchange that did not publish sustainability reports consecutively during 2017–2021.	(48)
5	Energy companies that do not disclose carbon emissions (while maintaining at least one carbon emissions or greenhouse gas policy).	(1)
	Total Sample	9

Source: Data processed.

With nine sample companies and a five-year research period, the election results represent 45 observations.

4. Result and discussion

Table 2 below illustrates each variable's condition in the energy sector companies listed on the Indonesia Stock Exchange used in this study. Board Gender Diversity is still low, with an average of 0.17, of the maximum value of diversity, which is 0.50, with the composition of the male board of directors being more than the female board of directors. Then, the condition of financial slack fluctuates every year with an average of 0.85. Furthermore, Carbon Emission Disclosures tend to increase yearly. However, the level of disclosure of carbon emissions in energy sector companies is still relatively low, with an average of 0.444, which is 7–8 items out of 18 items. Meanwhile, the firm value has fluctuated yearly, averaging 1096 due to the ups and downs of stock prices. According to Tobin's Q ratio, firm value in energy sector companies can be considered good because an excellent firm value exceeds > 1.

Table 2. Statistic description.

	Mean	Median	Min	Max	Standard deviation
Board gender diversity	0.170	0.000	0.000	0.500	0.197
Financial slack	0.851	0.480	0.030	4.550	0.953
Carbon emission disclosure	0.444	0.440	0.110	0.780	0.202
Firm value	1.096	1.040	0.490	2.380	0.378

Source: SmartPLS 3, data processed.

4.1. Evaluation of the measurement model (outer model)

4.1.1. Convergent validity test

Table 3 shows the outer loading, and all construct indicators have a value above the rule of thumb >0.5, which indicates that the indicator is considered valid.

Table 3. Outer loading.

	Board gender diversity	Carbon emission disclosure	Financial slack	Firm value
Board gender diversity	1.000			
Financial slack			1.000	
Carbon emission disclosure		1.000		
Firm value				1.000

Source: SmartPLS 3, data processed.

Table 4. Average Variance Extracted (AVE).

	Cronbach's Alpha	rho_A	Composite Reliability	Average Variance Extracted (AVE)	Description
Board gender diversity	1.000	1.000	1.000	1.000	Valid
Carbon emission disclosure	1.000	1.000	1.000	1.000	Valid
Financial slack	1.000	1.000	1.000	1.000	Valid
Firm value	1.000	1.000	1.000	1.000	Valid

Source: SmartPLS 3, data processed.

From **Table 4**, the AVE value in all constructs or variables already has an AVE value above 0.5. Therefore, all of these variables are valid.

4.1.2. Reliability test

The reliability test is needed to analyze construct's dependability and internal consistency (Hair et al., 2018). The result of reliability test can be seen through **Table 5**.

Table 5. Cronbach's Alpha and composite reliability.

	Cronbach's Alpha	rho_A	Composite Reliability	Criteria	Description
Board gender diversity	1.000	1.000	1.000	>0.70	Reliable
Carbon emission disclosure	1.000	1.000	1.000	>0.70	Reliable
Financial slack	1.000	1.000	1.000	>0.70	Reliable
Firm value	1.000	1.000	1.000	>0.70	Reliable

Source: SmartPLS 3, data processed.

4.1.3. Evaluation of structural model

Through the nonparametric process of bootstrapping, we can assess the statistical significance of different PLS-SEM outcomes, including path coefficients, Cronbach's alpha, HTMT, and R^2 values (Hair et al., 2019). The bootstrapping result can be seen from **Table 6** below.

Table 6. Bootstrapping.

	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (|O/STDEV|)
BGD → CED	−0.074	−0.070	0.131	0.570
BGD → FV	−0.335	−0.344	0.113	2.974
CED → FV	0.070	0.072	0.157	0.443
FS → CED	−0.303	−0.292	0.150	2.013
FS → FV	−0.240	−0.247	0.164	1.461

Source: SmartPLS 3, data processed.

4.1.4. Hypothesis result

If the *t* statistic >1.96, the hypothesis is accepted. **Table 7** below shows the significance test results.

Table 7. Significance test results.

Path	*T*-Statistic (>1.96)	*P*-Value (<0.05)	Description
Direct Effect			
BGD → CED	0.570	0.569	Ha Rejected
BGD → FV	2.974	0.003	Ha Accepted
CED → FV	0.443	0.658	Ha Rejected
FS → CED	2.013	0.045	Ha Accepted
FS → FV	1.461	0.145	Ha Rejected
Indirect Effect			
BGD → CED → FV	0.209	0.834	Ha Rejected
FS → CED → FV	0.380	0.704	Ha Rejected

Source: SmartPLS 3, data processed.

5. Result, recommendation for future studies and conclusion

5.1. Gender diversity board in Indonesia context

The gender diversity of the board of directors in Energy sector companies listed on the Indonesia Stock Exchange is still relatively low; this can be seen based on the results of descriptive statistics, which state that the average value of gender diversity for the board of directors is 17%, where the maximum index value is 50%. So, even though gender diversity on the board of directors in a company has a vital role, it does not have a significant impact.

Indonesia Business Coalition for Women Empowerment (2023) found that comparatively few women are in senior positions. Based on the Women in executive leadership teams census in 200 publicly traded companies with the biggest capitalization and trading activity on the stock exchange (IDX 200). Only 15% of women in senior Executive positions were among 200 listed firms. Only eight or four percent of companies have a female CEO throughout the same period. This figure remains unchanged since 2019.

5.2. Carbon emission disclosure in Indonesia context

In 2017, only 12 companies out of 138 manufacturing sector companies listed on the Indonesia Stock Exchange disclosed carbon emissions. Likewise, in the agricultural sector, which consists of 20 companies listed on the Indonesia Stock Exchange, only 7 companies disclose carbon emissions (Suryani and Wijayati, 2019). The number of companies that disclose their carbon emission is increasing yearly. However, this increase is not significant. In addition, according to research conducted by Lestari (2023), it is known that only 14 companies disclosed their carbon emission from 2013 to 2021 respectively.

In this research, the descriptive statistics show an average value of disclosing carbon emissions of 0.4432. This number shows that the level of disclosure of carbon emissions is still low, which means that the average company sampled in this study only discloses seven to eight items out of the 18 items. Because disclosure of carbon emissions is still voluntary, the degree of disclosure in Indonesia is still relatively low. No laws or regulations require companies to disclose their carbon emissions. In addition, during the research period, policies regarding corporate carbon emissions, such as carbon trading and carbon taxes, were still in the planning and outreach stages. Therefore, investors still consider it in their investment decisions (Asyifa and Burhany, 2022).

5.3. The effect of the gender diversity board on carbon emission disclosure

Based on the significance test results, the influence of board gender diversity on carbon emission disclosure has a *T*-statistics value of 0.570, less than 1.96 and a *P*-value of 0.569, more than 0.05, so the hypothesis is rejected. Diversity does not have a significant effect on carbon emission disclosure directly. The theory by Pfeffer and Salancik (1978) that states gender on the board will give new color because they can create strong social relations is not supported in this research. The findings of this

study contradict the results obtained by Ben-Amar et al. (2017) which explain the positive relationship between Gender Diversity Councils involving women in meeting rooms and disclosure of climate change information. Including women on advisory boards can impact the disclosure of greenhouse gas emissions because women are more sensitive and empathetic to problems raised by stakeholders, such as environmental problem (Valls Martínez et al., 2022). However, the results of this research align with Kılıç and Kuzey (2019), which shows an insignificant correlation between carbon emissions disclosure and gender diversity on the board of directors. Therefore, the high or low number of male and female directors is not a reference for companies in making decisions regarding the disclosure of greenhouse gas emissions (Kristanto and Lasdi, 2021). Compared to other countries, in Indonesia, the number of women on the board is relatively small and tends to be stagnant, so it cannot be seen that the presence of women on the board can influence a company's decision to disclose carbon emissions. Therefore, the results of this study are contradicted to the research conducted by Singhania et al. (2023) that said with a rise in the proportion of female directors and the quantity of independent female directors serving on the board, the quality of sustainability reports should improve.

5.4. The effect of the gender diversity board on firm value

Based on the significance test results, the influence of board gender diversity on carbon emission disclosure has a *T*-statistics value of 2.974, more than 1.96 and a *P*-value of 0.003, less than 0.05, so the hypothesis is accepted. The gender diversity board directly has a significant effect on company value. This result aligns with research conducted by Suciu et al. (2021), which explains that gender diversity among board members positively affects company value. This is because gender diversity concerns the degree of similarity between each gender. Including women on the board of directors might bring about changes in organizations. Women are more likely to listen, inspire, and support others, which can create more excellent teamwork (Setiany, 2021). So, having more women on the board of directors will lead to making decisions that positively influence their reputation. Ultimately, a good company reputation will increase company value. This aligns with the resource dependency theory, which states that diversity will bring creativity and innovation.

5.5. The effect of carbon emission disclosure on firm value

Based on the Significance test results, the influence of carbon emission disclosure on firm value has a *T*-statistics value of 0.443, less than 1.96 and a *P*-value of 0.653, more significant than 0.05, so the hypothesis is rejected. These results show that carbon emission disclosure has no direct impact on firm value. This result aligns with Anggita et al.'s (2022) research, which states that carbon emission disclosures do not affect company value. Companies tend not to disclose carbon emissions because it is costly (Kurnia et al., 2020). Nevertheless, as the disclosure of carbon emissions still needs to be regulated in Indonesia, there is no pressure on businesses to do so, and investors do not believe that there is no pressure to take this information into account when making investment decisions in businesses. This result, however, does not support a study by Sun et al. (2022) that found in China a company's decision to

publish its carbon emissions has a beneficial effect on firm value. The outcome of this research is also inversely proportional to the signal theory; it claims that the disclosure of carbon emissions is a good sign because it delivers investors good news.

5.6. The effect of financial slack on carbon emission disclosure

Based on the significance test results, the influence of financial slack on carbon emission disclosure has a *T*-statistics value of 2.013, more than 1.96 and a *P*-value of 0.045, less than 0.05, so the hypothesis is accepted. Financial slack directly has a significant impact on carbon emissions disclosure. Companies with financial resources are a management factor in carrying out disclosure practices (Allam and Diyanty, 2020). This is consistent with research conducted by Aini et al. (2022), which states that companies with financial slack can engage in more environmental initiatives to expand the scope of information in disclosing carbon emissions and enable the qualification of the data they provide. With adequate financial resources, companies can easily carry out carbon emission reduction strategies without disrupting the company's strategy and operations. Financial slack can protect a company from risky activities, including handling activities related to the risk of carbon emissions produced by the organization.

5.7. The effect of financial slack on firm value

Even though financial slack has a significant effect on carbon emissions disclosure, it does not directly affect company value. Based on the results of the significance test of the influence of financial slack on company value through carbon emission disclosure, the *T*-statistics value is 1.461, which is smaller than 1.96, and the *P*-value is 0.145, which is greater than 0.05, so the hypothesis is rejected. This finding contradicts the resource-based theory, which argues that a company's financial slack is a financial resource that acts as a shock absorber, conflict solver, and innovation facilitator (Silalahi, 2015). Companies with good financial slack will manage their resources to achieve competitive advantage. Investors may pay more attention to other financial aspects than a company's slack. Companies that experience financial slack often invest in projects with high risks, potentially harming the company and thereby affecting company value (Solikhin et al., 2022).

5.8. The effect of board gender diversity on firm value with carbon emission disclosure as an intervening variable

Based on the results of the significance test of the influence of financial slack on company value through carbon emission disclosure, the *T*-statistics value is 0.209, which is smaller than 1.96, and the *P*-value is 0.834, which is greater than 0.05, so the hypothesis is rejected. In this study, the gender diversity board, through carbon emission disclosure, has no significant effect on firm value. According to Ben-Amar et al. (2017), gender diversity can affect the disclosure of carbon emissions if there are two or more female board members. Based on this study, the composition of women is still less than men. The findings of Herinda et al. (2021) show that the board of directors' gender diversity did not impact the company's choice to report carbon

emissions. As a result, the amount of disclosure of carbon emissions is low and does not affect the firm's value.

5.9. The effect of financial slack on firm value with carbon emission disclosure as an intervening variable

Based on the results of the significance test of the influence of financial slack on company value through carbon emission disclosure, the *T*-statistics value is 0.380, which is smaller than 1.96, and the *P*-value is 0.704, which is greater than 0.05, so the hypothesis is rejected. The findings of this study contradict Tingbani et al. (2020), which found that the level of financial slack has a positive effect on the level of emissions disclosure, and companies will utilize these excess resources to increase company value. Companies with financial slack prefer to use the availability of funds to improve the company's economic performance rather than improving social and environmental performance, in this case, the Disclosure of carbon emissions. Investors will be more interested in financial performance than CSR activities related to the environment. This research also contradicts the signal theory, which explains that Disclosure of carbon emissions can signal investors to gain future profits (Kurnia et al., 2020). Therefore, financial slack through carbon emission disclosure does not significantly affect company value.

6. Recommendation and conclusion

According to the results and discussion described above, the conclusion is that (1) Board gender diversity does not influence carbon emissions disclosure but has a direct influence on company value; including women on the board of directors might bring about changes in organizations. Having more women on the board of directors will lead to making decisions that positively influence their reputation. A good company reputation will increase company value. (2) Financial slack influences carbon emission disclosure. However, it does not have a direct influence on company value. A company with adequate financial resources can easily carry out carbon emission reduction strategies without disrupting the company's strategy and operations. (3) Carbon emission disclosure does not influence firm value because there are no laws requiring businesses to disclose their carbon emissions. In addition, during the research period, policies regarding corporate carbon emissions, such as carbon trading and carbon taxes, were still in the planning and outreach stages. (4) Carbon emission disclosure cannot mediate the relationship between board gender diversity and company value; the board of directors' gender diversity did not impact the company's choice to report carbon emissions. As a result, the amount of disclosure of carbon emissions is low and does not affect the firm's value. (5) Carbon emission disclosure cannot mediate the relationship between financial slack and company value because investors will be more interested in financial performance than CSR activities related to the environment.

The limitation of this research is that the sample used is very limited, so it cannot reflect the actual situation; this is because there are still many energy sector companies in Indonesia that do not have sustainability reports. So, further research is suggested to research other sectors to get an overview of the company's overall condition

regarding carbon emission disclosure. Further research is suggested to add or replace other independent variables different from this study. Further research is suggested to add or expand research references supporting the research topic to strengthen the research foundation.

Author contributions: Conceptualization, ER and DIL; methodology, MP; software, TA; validation, TA, AV and MP; formal analysis, DIL; investigation, STH; resources, ER; data curation, STH; writing—original draft preparation, ER; writing—review and editing, DIL; visualization, TA; supervision, AV; project administration, AV; funding acquisition, AV. All authors have read and agreed to the published version of the manuscript.

Acknowledgments: The author would like to thank INTI International University, Nilai, Malaysia, for funding the APC for this article.

Conflict of interest: The authors declare no conflict of interest.

References

Agyemang-Mintah, P., & Schadewitz, H. (2019). Gender diversity and firm value: evidence from UK financial institutions. International Journal of Accounting & Information Management, 27(1), 2–26. https://doi.org/10.1108/ijaim-06-2017-0073

Aini, K. N., Murtiningsih, R., Baroroh, N., et al. (2022). The Effect of Financial Slack, Institutional Ownership, Media Exposure on Carbon Emission Disclosure with Solvability Ratio as a Moderating Variable. Advances in Economics, Business and Management Research. https://doi.org/10.2991/aebmr.k.220104.022

Alfayerds, W. D., & Setiawan, M. A. (2021). The Effect of Carbon Emission Disclosure and Annual Report Readability on Company Value (Indonesian). Journal of Accounting Exploration, 3(2), 349–363. https://doi.org/10.24036/jea.v3i2.363

Allam, G. A., & Diyanty, V. (2020). Determinants of Carbon Emission Disclosure. Journal of Economics, Business, & Accountancy Ventura, 22(3), 333–346. https://doi.org/10.14414/jebav.v22i3.1207

Astari, A., Saraswati, E., & Purwanti, L. (2020). The Role of Corporate Governance as a Moderating Variable on Earnings Management and Carbon Emission Disclosure (Indonesian). Journal of Accounting and Business Dynamics, 7(1), 69–86. https://doi.org/10.24815/jdab.v7i1.15402

Asyifa, D. A., & Burhany, D. I. (2022). Carbon Emission Disclosure and Environmental Performance Effect on Firm Value. International Journal of Arts and Social Science, 5(7), 193–203.

Ayu Laksani, S., Andesto, R., & Kirana, D. J. (2020). Carbon Emission Disclosure Viewed from Company Value, Leverage and Media Exposure (Indonesian). Indonesian Accounting and Finance Studies, 3(2), 145–164. https://doi.org/10.21632/saki.3.2.145-164

Anggita, W., Nugroho, A. A., & Suhaidar. (2022). Carbon Emission Disclosure and Green Accounting Practices on the Firm Value (Indonesian). Accounting Journal, 26(3), 464–481. https://doi.org/10.24912/ja.v26i3.1052

Bae Choi, B., Lee, D., & Psaros, J. (2013). An analysis of Australian company carbon emission disclosures. Pacific Accounting Review, 25(1), 58–79. https://doi.org/10.1108/01140581311318968

Ben-Amar, W., Chang, M., & McIlkenny, P. (2015). Board Gender Diversity and Corporate Response to Sustainability Initiatives: Evidence from the Carbon Disclosure Project. Journal of Business Ethics, 142(2), 369–383. https://doi.org/10.1007/s10551-015-2759-1

Carnes, C. M., Xu, K., Sirmon, D. G., et al. (2018). How Competitive Action Mediates the Resource Slack-Performance Relationship: A Meta-Analytic Approach. Journal of Management Studies, 56(1), 57–90. https://doi.org/10.1111/joms.12391

Coffey, B. S., & Wang, J. (1998). Board Diversity and Managerial Control as Predictors of Corporate Social Performance. Journal of Business Ethics, 17(14), 1595–1603. doi:10.1023/A:1005748230228

Friedrich, J., Ge M., Pickens A. (2020). This Interactive Chart Shows Changes in the World's Top 10 Emitters. Available online: https://wri-indonesia.org/en/blog/interactive-chart-shows-changes-worlds-top-10-emitters (accessed on 12 December 2023).

Gonenc, H., & Krasnikova, A. V. (2022). Board Gender Diversity and Voluntary Carbon Emission Disclosure. Sustainability, 14(21), 14418. https://doi.org/10.3390/su142114418

Hair, J. F., Babin, B. J., Anderson, R. E., & Black, W. C. (2019). Multivariate Data Analysis, 8th Edition. England: Pearson Prentice.

Hair, J. F., Risher, J. J., Sarstedt, M., & Ringle, C. M. (2019). When to use and how to report the results of PLS-SEM. European Business Review, 31(1), 2–24. https://doi.org/10.1108/EBR-11-2018-0203

Herinda, F., Masripah, M., & Wijayanti, A. (2021). The Influence of Profitability, Leverage and Gender Diversity on Carbon Emissions Disclosure (Indonesian). AKUNIDA Journal, 7(2), 139–150. https://doi.org/10.30997/jakd.v7i2.4528

IFC study. (2019). Board Gender Diversity in ASEAN. Available online: https://www.ifc.org/en/insights-reports/2019/board-gender-diversity-in-asean (accessed on 10 December 2023).

Indonesia Business Coalition for Women Empowerment. (2023). The Number of Women in Executive Positions in 200 Listed Companies is still underrepresented. Available online: https://Ibcwe.Id/the-Number-of-Women-in-Executive-Positions-in-200-Listed-Companies-Is-Still-Underrepresented/ (accessed on 6 January 2024).

Indonesia, R. (2011). Presidential Regulation no. 61 of 2011 concerning the National Action Plan for Reducing Greenhouse Gas Emissions (Indonesian). Available online: https://peraturan.bpk.go.id/Details/41199/perpres-no-61-tahun-2011 (accessed on 6 January 2024).

Jiang, Y., Luo, L., Xu, J., et al. (2021). The value relevance of corporate voluntary carbon disclosure: Evidence from the United States and BRIC countries. Journal of Contemporary Accounting & Economics, 17(3), 100279. https://doi.org/10.1016/j.jcae.2021.100279

Kent Baker, H., Pandey, N., Kumar, S., et al. (2020). A bibliometric analysis of board diversity: Current status, development, and future research directions. Journal of Business Research, 108, 232–246. https://doi.org/10.1016/j.jbusres.2019.11.025

Kılıç, M., & Kuzey, C. (2019). The effect of corporate governance on carbon emission disclosures. International Journal of Climate Change Strategies and Management, 11(1), 35–53. https://doi.org/10.1108/ijccsm-07-2017-0144

Kock, C. J., Santaló, J., & Diestre, L. (2012). Corporate Governance and the Environment: What Type of Governance Creates Greener Companies? Journal of Management Studies, 49(3), 492–514. https://doi.org/10.1111/j.1467-6486.2010.00993.x

Kristanto, M. B., & Lasdi, L. (2021). Determinants of The Firm Value in Indonesia (Indonesian). Wiga: Economic Research Journal, 11(1), 63–74. https://doi.org/10.30741/wiga.v11i1.610

Kristanto, M. B., & Lasdi, L. (2022). The Influence of Gender Diversity, Environmental Management Systems, and Environmental Performance on Disclosure of Greenhouse Gas Emissions (Indonesian). Journal of Social Sciences, 9(4), 1483–1490. http://dx.doi.org/10.31604/jips.v9i4.2021.1457-1573.

Kurnia, P., Darlis, E., & Putra, A. A. (2020). Carbon Emission Disclosure, Good Corporate Governance, Financial Performance, and Firm Value. Journal of Asian Finance, Economics and Business, 7(12), 223–231. https://doi.org/10.13106/jafeb.2020.vol7.no12.223

Lee, J. H., & Cho, J. H. (2021). Firm-Value Effects of Carbon Emissions and Carbon Disclosures—Evidence from Korea. International Journal of Environmental Research and Public Health, 18(22), 12166. https://doi.org/10.3390/ijerph182212166.

Lestari, D. I. (2023). Factors Affecting Disclosure of Carbon Emissions in Indonesian Companies 1 (Indonesian). Journal of Accounting and Financial Education, 11(1), 74–86. https://doi.org/10.17509/jpak.v11i1.55742.

Lestari, D. I., Vasudevan, A., Adialita, T., & Rungsuk, A. (2024). Green Practice Motivation in Small Businesses (Portuguese). Social and Environmental Management Magazine, 18(1), e06804. https://doi.org/10.24857/rgsa.v18n1-150

Levin, K., Waskow, D., & Gerholdt, dan R. (2021). 5 Big Findings from the 2021 IPCC Climate Report (Indonesian). Available online: https://wri-indonesia.org/id/wawasan/5-temuan-besar-dari-laporan-iklim-ipcc-2021 (accessed on 16 September 2022).

Lin, W. L., Ho, J. A., Ng, S. I., et al. (2019). Does corporate social responsibility lead to improved firm performance? The hidden role of financial slack. Social Responsibility Journal, 16(7), 957–982. https://doi.org/10.1108/srj-10-2018-0259

Malini, H., & Sukarmanto, E. (2021). The Effect of Financial Slack on IPO Company Value with Financial Reporting Quality as a Moderating Variable (Indonesian). Accounting Proceedings, 96–101. https://doi.org/10.29313/.v7i1.25391

Matitaputty, J. S., & Davianti, A. (2020). Does broad gender diversity affect corporate social responsibility disclosures (Indonesian)? JEMA: Scientific Journal for Accounting and Management, 17(1), 35. https://doi.org/10.31106/jema.v17i1.3612

Matsumura, E. M., Prakash, R., & Vera-Muñoz, S. C. (2014). Firm-Value Effects of Carbon Emissions and Carbon Disclosure. The Accounting Review, 89(2), 695–724. http://www.jstor.org/stable/24468367

Mishina, Y., Pollock, T. G., & Porac, J. F. (2004). Are more resources always better for growth? Resource stickiness in market

and product expansion. Strategic Management Journal, 25(12), 1179–1197. https://doi.org/10.1002/smj.424

Ortiz-de-Mandojana, N., Aragón-Correa, J. A., Delgado-Ceballos, J., et al. (2011). The Effect of Director Interlocks on Firms' Adoption of Proactive Environmental Strategies. Corporate Governance: An International Review, 20(2), 164–178. https://doi.org/10.1111/j.1467-8683.2011.00893.x

Parida, V., & Örtqvist, D. (2015). Interactive Effects of Network Capability, ICT Capability, and Financial Slack on Technology-Based Small Firm Innovation Performance. Journal of Small Business Management, 53, 278–298. https://doi.org/10.1111/jsbm.12191

Pfeffer, J., & Salancik, G. (1978). The External Control of Organizations: A Resource Dependence Perspective. Harper & Row.

Pitrakkos, P., & Maroun, W. (2019). Evaluating the quality of carbon disclosures. Sustainability Accounting, Management and Policy Journal, 11(3), 553–589. https://doi.org/10.1108/sampj-03-2018-0081

Pramesti, A. A., & Nita, R. A. (2022). The Effect of Board of Directors Diversity on Company Value (Indonesian). Scientific Journal of Accounting and Finance (JIAKu), 1(2). https://doi.org/10.24034/jiaku.v1i2.5369

Sawitri, A. P., & Setiawan, N. (2019). Analysis of the Effect of Sustainability Report Disclosure, Financial Performance, Environmental Performance on Company Value (Indonesian). Journal of Business & Banking, 7(2). https://doi.org/10.14414/jbb.v7i2.1397

Setiany, E. (2021). Gender Diversity and Firm Value: A Study on Boards of Public Manufacturing. CPC Business Perspectives.

Silalahi, D. (2015). The influence of financial slack on the performance of study companies in manufacturing companies that have gone public on the Indonesian stock exchange (Indonesian). Journal of Management and Business, 1–11. https://doi.org/10.54367/jmb.v15i2.101.

Singhania, S., Singh, J., Aggrawal, D., et al. (2023). Board gender diversity and sustainability reporting quality: a generalized ordered logit approach. Kybernetes. https://doi.org/10.1108/k-07-2022-0963

Solikhin, A., Khalik, I., & Yuliusman, Y. (2022). The Role of Corporate Social Responsibility in the Relationship between Financial Slack and the Value of BUMN Companies Listed on the IDX for the 2018-202 Period (Indonesian). Journal of Applied Management and Finance, 11(04), 1008–1020. https://doi.org/10.22437/jmk.v11i04.21788

Spence, M. (1973). Job Market Signaling. The Quarterly Journal of Economics, 87(3), 355. https://doi.org/10.2307/1882010

Suciu, A. A.; Păun, D., & Duma, F. S. (2021) Sustainability of Financial Performance in Relation to Gender Diverse Boards: A Comparative Analysis of French and Romanian Listed Companies on Stock Exchanges. Sustainability, 13(18), 10282. https://doi.org/10.3390/su131810282

Sun, Z. Y., Wang, S. N., & Li, D. (2022). The impacts of carbon emissions and voluntary carbon disclosure on firm value. Environmental Science and Pollution Research, 29(40), 60189–60197. https://doi.org/10.1007/s11356-022-20006-6

Sunarti, Sunaryo, F. K., Prasetyo, B. E., Kurniadi, C. B., et al. (2020). Energy Sector GHG Emission Inventory Period 2020 (Indonesian). Available online: https://www.esdm.go.id/assets/media/content/content-inventarisasi-emisi-gas-rumah-kaca-sektor-energi-tahun-2020.pdf (accessed on 12 November 2023).

Suryani, R., & Wijayati, F. L., (2019). Large determinant of greenhouse gas emissions disclosure in Indonesia. Indonesian Accounting and Finance Research (Indonesian), 4(2), 101–117. https://doi.org/10.23917/reaksi.v4i2.8545.

Syamsudin, S., Setiany, E., Sajidah, S. (2017). Gender diversity and firm value: A study on boards of public manufacturing firms in Indonesia. Problems and Perspectives in Management, 15(3), 276–284. https://doi.org/10.21511/ppm

Tingbani, I., Chithambo, L., Tauringana, V., et al. (2020). Board gender diversity, environmental committee and greenhouse gas voluntary disclosures. Business Strategy and the Environment, 29(6), 2194–2210. https://doi.org/10.1002/bse.2495

Valls Martínez, M. del C., Santos-Jaén, J. M., Soriano Román, R., et al. (2022). Are gender and cultural diversities on board related to corporate CO2 emissions? Journal of Cleaner Production, 363, 132638. https://doi.org/10.1016/j.jclepro.2022.132638

Wicaksono, A. P. N. (2022). Gender diversity, financial expertise, CEO duality and firm performance: evidence from Indonesian public listed companies (Indonesian). Asian Business and Economic Scientific Journal.

Witri Astiti, N. N., & Wirama, D. G. (2020). Factors that Influence Carbon Emission Disclosure in Companies Listed on the Indonesian Stock Exchange (Indonesian). E-Journal Accounting, 30(7), 1796. https://doi.org/10.24843/eja.2020.v30.i07.p14

Yuliana, I., & Kholilah, K. (2019). Diversity of the executive board, investment decisions, and firm value: is gender important in Indonesia? 9(3), 387–395. https://doi.org/10.22219/jrak.v9i3.10019

Zahid, M., Rahman, H. U., Ali, W., et al. (2020). Boardroom gender diversity: Implications for corporate sustainability disclosures in Malaysia. Journal of Cleaner Production, 244, 118683. https://doi.org/10.1016/j.jclepro.2019.118683

Zhang, Y., Li, J., Jiang, W., et al. (2018). Organizational structure, slack resources and sustainable corporate socially responsible performance. Corporate Social Responsibility and Environmental Management, 25(6), 1099–1107. https://doi.org/10.1002/csr.1524

Zuhrufiyah, D., & Anggraeni, D. Y. (2019). Disclosure of Carbon Emissions and Company Value (Case Study of Companies in the Southeast Asia Region) (Indonesian). Journal of Technology Management, 18(2), 80–106. https://doi.org/10.12695/jmt.2019.18.2.1