



CLIMATE-RELATED SCENARIO ANALYSIS DISCLOSURES BY JOHANNESBURG STOCK EXCHANGE BASIC RESOURCES COMPANIES – TOO HOT TO HANDLE

Johanna Nel, Leana Esterhuyse*
University of South Africa, Department of Financial Intelligence

*Correspondence: esterl@unisa.ac.za

Abstract

Introduction: This study investigates climate-related scenario analysis (CRSA) disclosures by Johannesburg Stock Exchange (JSE)-listed basic resource companies, focusing on alignment with the Task Force on Climate-related Financial Disclosures (TCFD) and the International Sustainability Standards Board (ISSB)'s IFRS S2 standard.

Methods: A CRSA checklist was developed based on 23 IFRS S2-based disclosure items to evaluate alignment. Content analysis of 32 basic resource companies' 2023 integrated and climate-related reports was conducted.

Results: While nine of the ten largest companies were fully aligned with IFRS S2, only half of the basic resource companies disclosed CRSA information. Smaller companies exhibited inconsistent alignment, reflecting potential resource and skills constraints. Larger companies responded more effectively to stakeholder expectations, using CRSA to signal strategic resilience to climate change.

Discussion: The findings suggest that resources and expertise strongly influence disclosure practices and highlight the need for capacity-building initiatives to support smaller companies in developing economies. This research expands the literature on CRSA by providing unique insights into South Africa and the challenges and opportunities faced by its basic resource companies. It contributes to understanding some of the drivers of CRSA practices and offers practical recommendations to improve alignment with emerging global standards.

Keywords: Climate Change, Corporate Reporting, IFRS S2, Scenario Analysis, South Africa, Basic Resources

Submitted: 4 April 2026, Approved: 13 August 2026, Published: 18 August 2026

Volume 21 Issue 1, October 2026 | Page 259 – 278
<https://ejournal.stiedewantara.ac.id/index.php/001/article/view/1613>

DOI: <https://doi.org/10.26533/eksis.v21i1.1613>

This is an open access article under the CC BY-SA License



A. INTRODUCTION

Human-induced climate change has emerged as a critical global issue which poses a significant threat to society (Intergovernmental Panel on Climate Change 2022; Lombardi et al 2021). Environmental risks are perceived to be one of the most damaging global risks over the next decade (World Economic Forum 2022) and could potentially destabilise the global financial system (Ngo et al 2022). A global understanding of the impending threat leads to intensified efforts to reduce greenhouse gas (GHG) emissions (De Grosbois & Fennell 2021; Kim 2023). The pressing need to transition to a low-carbon economy will significantly impact companies, exposing them to novel strategic, operational, reputational, and financial risks (O'Dwyer & Unerman 2020). In addition to transitional risks, companies are exposed to physical threats posed by climate change, like droughts and floods, which can disrupt supply chains and cause damage to physical assets (O'Dwyer & Unerman 2020).

Investors, communities, and governments show a growing concern over the impact of climate change. Investors' demand for decision-relevant climate information has risen substantially (Brunelli et al 2021) and it has become vital for companies to improve their climate-related reporting (Wichianrak et al 2023). Climate-related disclosures have become strategically important (Alsaifi 2021). Investors are especially concerned about the financial impact of climate change on investment portfolios (Lee et al 2022) and require decision-useful climate-related disclosures enabling them to price climate risk accurately. Consequently, it has become imperative for companies to prioritise climate-related disclosures in their corporate reporting to provide investors with the necessary information to assess a company's resilience to climate-related risks and any potential opportunities (Aversa 2023).

In response to this increasing stakeholder demand for decision-useful climate-related information, the IFRS Foundationⁱ created the International Sustainability Standards Board (ISSB) in November 2021. The ISSB issued two global sustainability standards in June 2023: *IFRS S1 General Requirements for Disclosure of Sustainability-related Financial Information* and *IFRS S2 Climate-related disclosures*. IFRS S2 sets out climate-related disclosure requirements, which include disclosure requirements relating to the climate-resilience of a company's strategy. IFRS S2 uses the Task Force on Climate-Related Financial Disclosures (TCFD) framework as a building block and recommends that companies use scenario analysis to inform investors and other stakeholders on the climate resiliency of a company's strategy and prescribes specific disclosure requirements relating to climate scenario analysis (ISSB 2023:par 22). In June 2022, the Johannesburg Stock Exchange (JSE) published the *JSE Climate Disclosure Guidance*, which was aligned to the Exposure Draft of the IFRS S2 at that time. The *Guidance* clearly states that it is a guidance tool only and can be used by issuers on a voluntary basis (pg. 3). Companies listed on the Johannesburg Stock Exchange (JSE) are not required to comply with the ISSB's sustainability standards. However, as many of the larger JSE-listed companies have international institutional investors, there are shareholder pressure in some cases to comply with the ISSB's IFRS S2. We apply IFRS S2 in our study as an aspirational benchmark.

Climate-related scenario analysis (CRSA) is a developing concept, and as a result, limited empirical studies have been conducted to investigate how companies report on CRSA (ISSB 2023:par B7; O'Dwyer & Unerman 2020). O'Dwyer and Unerman (2020) specifically foresaw that corporate preparers and their investors will have difficulties in reporting about CRSA. In their 2024 survey of the TCFD's recommended disclosures by

the largest listed companies worldwide, the IFRS Foundation reports that “...the resilience of companies’ strategies under different climate-related scenarios remains the least disclosed recommended disclosure for both 2022 and 2023, with 11% of companies reviewed disclosing this information in 2023” (IFRS Foundation 2024:147). The French Prime Minister expressed the desire for the scope of the Corporate Sustainability Reporting Directive (CSRD), aimed at EU companies and their supply chain, to be reduced as it will pose “too much of a burden on business, leaving the EU at a disadvantage in the global market” (McGowan 2024). Seventeen of the 27 EU member states did not yet enact the CSRD requirements into their national laws by September 2024 (the deadline was July 2024 for all member states) (McGowan 2024). These shifts in opinions about sustainability reporting, and specifically, climate reporting, in the global North, will likely have implications for accounting and market regulators in the global South.

Prior research relating to CRSA disclosures in line with the TCFD recommendations has mainly focused on developed countries with a broad focus on overall compliance with the TCFD-recommended disclosures (Aversa 2023; Demaria & Rigot 2021) as well as the importance for energy-intensive industries (Achenbach 2021; Ding et al 2023). Notably, developing countries, including South Africa, have been underrepresented in this research, leaving a critical gap in understanding CRSA disclosures in emerging markets.

The study applied content analysis to 32 Johannesburg Stock Exchange (JSE)-listed basic resources companies’ climate-related disclosures in various corporate documents. A checklist was developed from the 23 CRSA disclosure requirements contained in the ISSB’s IFRS S2 standard. Sixteen companies provided no CRSA information. We find that nine of the largest ten companies align their CRSA disclosures with all the requirements of IFRS S2, confirming that large companies have the resources and skills to comply with onerous disclosure requirements. However, outside the top ten, there is a large variation in the application, although most companies disclose more than half of the information required. This indicates that company size, which affects the availability of resources, does play a role in climate-related disclosures in JSE-listed basic resources companies. Therefore, smaller basic resources companies, especially in developing economies like South Africa, may find it challenging to provide fully aligned IFRS S2 CRSA disclosures because they do not have the necessary resources to devote to CRSA.

This study makes several important contributions to accounting and climate-related research. Firstly, by focusing on CRSA in the resources sector of South Africa, this research highlights a largely overlooked geographical context within climate disclosure literature. From a theoretical perspective, it highlights the importance of stakeholder pressure in improving disclosure quality in contexts where disclosure remains voluntary.

Secondly, the findings make a practical contribution by providing insight into unique regional and basic resources industry challenges and considerations, potentially guiding policymakers and international standard-setting bodies to better support companies in developing economies, operating in all industries, not only the basic resources industry. Additionally, this study adds depth to the understanding of disclosures relating to scenario analysis, a key yet challenging component of the IFRS S2 disclosures. By highlighting the underreported areas, the research will contribute to developing strategies for improving compliance and enhancing transparency in climate reporting.

Thirdly, a methodological contribution is made through the development of the CRSA disclosure checklist that was developed from the 23 disclosure requirements of IFRS S2 relating to CRSA. Companies can use this checklist to check their alignment with the disclosure requirements. Other researchers can also use the checklist for their research on different samples, e.g., in other geographic domains.

Next, we discuss the study's theoretical framework and prior studies on climate disclosures. Thereafter, the methodology is discussed. This is followed by our findings, and then we conclude and pose suggestions for future research.

Prominent socio-political theories applied in studies on sustainability reporting are stakeholder theory and institutional theory (Nasreen et al 2023). We also include signalling theory, an economic information theory (Del Gesso & Lodhi 2024). Each of these will be discussed in more depth below.

Freeman (2010) defines a stakeholder as “any group or individual who can affect or is affected by the achievement of the firm’s objectives”. Stakeholder theory is applied to sustainability disclosure studies as society in general (the larger stakeholder) is affected by the climate change that companies contribute to through their GHG emissions. Companies thus report on their strategies to minimize their environmental impact in response to stakeholders' concerns. Several empirical studies find that stakeholder influence plays a key role in motivating companies' disclosure of carbon-related information (De Grosbois & Fennell 2021; Kim 2023). We propose that if stakeholders demand that companies disclose climate-related scenario analysis in line with IFRS S2, companies will likely disclose accordingly.

Institutional theory uses the concept of “organisational field” to explain similarities among companies (DiMaggio & Powell 1983). Once an organisational field is structured, the process of homogenisation starts. This process can be explained by coercive, mimetic and/or normative isomorphism (DiMaggio & Powell 1983). Coercive isomorphism occurs because of political, legislative or regulatory influence. An example of coercive isomorphism is where companies are forced to comply with IFRS S2 because they operate within a specific jurisdiction which adopted these standards and incorporated them into their regulatory framework. Mimetic isomorphism is a response to uncertainty. The current uncertainty created by climate change and its reporting may lead companies to imitate or mimic successful companies that adopted the TCFD disclosure recommendations. Normative isomorphism results from the influence of professional groups like the professional investment community or professional accountants (DiMaggio & Powell 1983). Normative isomorphism will lead to corporate reporting about climate change, over time, becoming ‘the same’ due to the influence of these professions inside and outside companies. Normative isomorphism was applied to explain the volume of TCFD disclosures by large companies in developed markets (Ding et al 2023) and sustainability reporting practices in general (Jahid et al 2023). Mimetic isomorphism can also explain generic industry-wide climate-related disclosure practices (Abhayawansa & Adams 2022).

Signalling theory proposes that companies will select to send signals to stakeholders if these signals maximise profit and minimise cost (Spence 1973). Thus, if the benefits of climate-related scenario analysis disclosure outweigh the costs of such disclosures, companies will disclose climate-related scenario analysis to signal to stakeholders that they are strategically positioned to manage climate-related risks and opportunities. In line with signalling theory, Ghachem, Bastiy and Zureigat (2022) link corporate social

responsibility (CSR) to financial performance and suggest that climate-related disclosures provide companies with an opportunity to send positive signals to investors. These findings are corroborated by other empirical studies which view climate-related disclosures as a tool to enhance the company's reputation and communicate positive signals to investors (Amin et al 2022) of their commitment to sustainability (Forcadell et al 2022).

To conclude this section, we propose three key theories that explain why companies engage in climate change disclosures. First, stakeholder theory posits that companies disclose climate-related information in response to societal expectations, addressing the concerns of stakeholders impacted by their environmental impact. Second, institutional theory suggests that companies conform to standardized disclosure practices within their industry through mechanisms of isomorphism. Regulatory requirements enforce compliance (coercive), while companies mimic peers in response to uncertainty (mimetic) or adopt practices due to professional influence (normative). Lastly, signalling theory argues that companies strategically disclose climate information to stakeholders to convey their readiness and resilience. Together, these theories provide a framework to understand corporate climate disclosure behaviour as influenced by stakeholder demands, industry norms, and strategic positioning. In the next section, we discuss some of the prior literature.

Various empirical studies have been performed to gauge if companies' climate-related disclosures are responsive to the needs of stakeholders and reported poor reporting practices (Bairagi & Ghosh 2023; Lombardi et al 2021). On the positive side, improvements over time are being observed in general climate disclosures (Braasch & Velte 2022; Friedrich et al 2022). Other empirical studies have focused on the determinants of climate-related disclosures (Achenbach 2021), GHG emissions in OECD countries (Ghachem et al 2022), and the impact of carbon-related disclosure on the financial performance of Chinese companies (Huang et al 2023). However, none of the mentioned studies focused on the detailed disclosure requirements for CRSA as set out by IFRS S2.

To the best of the researchers' knowledge, there are limited empirical studies focused on CRSA disclosures. Most of these studies focused on developed economies. For instance, Aversa (2023) focuses on banks listed on the FTSE Italia All Share Index. The study follows a mixed quantitative/qualitative research design and uses text analytics to analyse if and how listed Italian banks disclose climate change-related scenario analysis in their sustainability reports. Research findings indicate that there are disclosure deficiencies. Aversa (2023) recommends that companies use CRSA to manage climate-related risks and follow the TCFD recommendations on climate-related disclosures.

In a French setting, Demaria and Rigot (2021) assess listed French companies' compliance with the TCFD's recommendations using content analysis of audited reference documents. The study finds that climate-related disclosures can be improved, especially considering disclosures with respect to a 2°C climate change scenario (Demaria & Rigot 2021). The study only allocated three of the 38 checklist items to CRSA.

O'Dwyer and Unerman (2020) highlight the challenges companies experience in providing CRSA disclosures and recommend that academic research is used to build corporate capacity. Huiskamp et al (2022) follow up on this recommendation and use a case study approach combined with a literature review study to address challenges experienced by companies relating to the disclosure of CRSA. They develop a climate

resilience cycle, which companies can use to improve their CRSA disclosures (Huiskamp et al 2022).

Interviews and a survey conducted by Achenbach (2021) elaborate on some of the challenges companies may experience relating to climate-related disclosures and mention that companies approach CRSA with caution due to possible litigation risks. Principale and Pizzi (2023) list the availability of information (for instance, in performing complex scenario analysis) as a possible reason for Italian companies not aligning their disclosures with the TCFD recommendations. However, it may be likely that these challenges will be less in the future as companies gain experience in conducting and disclosing CRSA (Achenbach 2021). Empirical analysis of companies in the fossil fuel industry found that companies disclosed relevant and appropriate climate-related scenarios, including a description of the limitations and uncertainties of the CRSA, as well as an assessment of the resilience of the companies' strategy (Attenborough 2022). However, climate-related risks were still generic, without quantifying assets at risk or specifying locations at risk (Attenborough 2022).

Based on the above discussion, it seems that prior studies mainly focused on overall compliance with regulatory frameworks and lacked an in-depth view of the corporate disclosure of CRSA, especially in developing economies. This study then explores the current state of CRSA disclosures in South African basic resources companies and assesses the extent of alignment with the disclosure requirements of the TCFD and ISSB S2 standards for scenario analysis. We phrase the following two research questions: 1) Do JSE-listed basic resource companies disclose CRSA information? 2) What information are JSE-listed companies in the basic resources industry disclosing regarding CRSA?

C. RESEARCH METHOD

Given the recent implementation of requirements for CRSA disclosures, an exploratory research design was employed. Quantitative analysis was conducted on empirical data, supplemented by qualitative discussions supported by quotations from the reports, where suitable.

Prior studies point to a paucity of research on CRSA disclosures in developing countries. We decided to study this phenomenon in South Africa. Even though South Africa is a developing country, it is deemed a leader in non-financial reporting with a mature corporate governance culture, as the preparation of integrated reports has been mandatory since 2010 (Myeza et al 2024; Pittrakkos & Maroun 2020). Integrated reporting emphasises sustainability-related matters and includes detailed environmental reporting (Pittrakkos & Maroun 2020). South African companies are thus used to reporting on sustainability, including environmental matters. We posit that JSE-listed companies may be early adopters in aligning their CRSA disclosures to IFRS S2, hence a suitable population for this study.

As an exploratory study, it was decided to limit the investigation to one industry. Focusing on one industry ensured similar requirements and operating conditions existed, and industry differences would not confound the findings. Prior studies found that high-polluting industries, such as basic resources (or materials), produce more and/or better-quality voluntary disclosures than low-polluting sectors (Fernandez-Feijoo et al 2014; Rim et al 2019; Zarzycka & Krasodomska 2022). A 2023 review of the largest JSE-listed companies' integrated reports supports this finding in South Africa as it reveals that over 60% of the mining industry companies' integrated reports ranked "excellent" or "good",

which incidentally is the highest of all industries (Ernst & Young 2023). We argue that JSE-listed basic resources companies would thus be an appropriate sub-population for exploring the presentation of CRSA information.

We selected all JSE-listed companies in the basic resources industry on the Main Board as of 28 June 2024 from the IRESS database. Of the 32 companies, 14 were in the industrial metals and mining sub-sector, 16 in the precious metals and mining sub-sector, and two in the industrial materials sub-sector. Next, we obtained each company's market capitalisation from IRESS and ranked the companies from highest to lowest market capitalisation. The weight of each in the portfolio was determined based on the market capitalisation. Ten companies had a weighting larger than 1% each. To allow for comparisons based on company size, we grouped the largest ten companies into the Top Ten group and the rest were classified as Other. The Top Ten companies represent 96% of the sample's market capitalisation. The skewness of the sample can be seen in that the two largest companies accounted for 65% of the market capitalisation.

The study was executed through a manual content analysis of documents. Content analysis of documents is a well-established methodology in sustainability disclosure research (Abhayawansa & Adams 2022; Al Amosh & Mansor 2021; Al Amosh & Khatib 2024; Demaria & Rigot 2021; Erin & Olojede 2024; Gebhardt et al 2024). Annual integrated reports, stand-alone sustainability reports, climate change reports and/or TCFD reports were downloaded from the sample companies' websites. Submissions made by companies to the Carbon Disclosure Project (CDP) were also included as a "stand-alone climate report", as companies referred readers to these submissions for more information on climate-related disclosures. We used the latest reports for the 2023 reporting period, available during the fieldwork, which took place from June to October 2024. Note that IFRS S2 is only effective from reporting periods starting 1 January 2024, but early adoption is allowed (ISSB 2023:par C1). Corporate preparers had access to earlier exposure drafts of IFRS S2 and the TCFD requirements.

To answer research question one, all reports were searched (keystrokes = Control +F) using the keyword "scenario". If the keyword "scenario" was not found in any of the reporting suite documents for the company, a "No, did not disclose climate-related scenario analysis" was recorded. For all documents containing the word "scenario", the researcher scrutinised whether the word "scenario" related to CRSA by reading the surrounding text. If the word "scenario" did not relate to climate change, it was discarded, and a "No, did not disclose climate-related scenario analysis" was recorded.

To answer research question two, for all instances where the word "scenario" related to discussions of climate-related scenarios, the surrounding paragraphs were scrutinised. The researcher used all the information in these paragraphs to record a score against the various items on the checklist. For instance, if the document mentioned any macroeconomic assumptions like gross domestic product, population growth, supply/demand factors, etc., the researcher recorded a "1" on the checklist. In addition to assessing the disclosures against a disclosure checklist, the following were noted: relevant reporting frameworks, type of assurance and the scenarios used. All data were captured in MS Excel 365 and descriptive data analysis was conducted in MS Excel 365.

Ethical clearance for the study was obtained from the faculty research ethics committee before data collection started. It was deemed low risk due to the use of secondary data and no involvement of human or animal subjects. All documents analysed are in the public domain.

A disclosure checklist was developed to measure the companies' compliance with IFRS S2 par 22 (b)(i) to (iii)'s requirements for scenario analysis disclosures. It also contains the requirements of par 29 (f)(i) regarding if and how internal carbon prices are applied in the scenario analysis. Following Demaria and Rigot (2021) questions asked in IFRS S2 were converted to very specific questions in the checklist with positive or negative answers to remove most ambiguity. A pilot study was conducted to test the disclosure checklist and identify possible issues in data collection, capturing and analysis. Ten companies were randomly selected from the 16 companies that disclosed CRSA for the pilot study. A co-coder was trained on the disclosure checklist and conducted an independent content analysis using it. Due to the high specificity of the questions in the checklist, no significant problems were encountered during the pilot phase. For nine companies no differences were found in the coding. For one company two differences were found (from 23) and after discussion the score was agreed upon. The researchers have over ten years of experience in corporate reporting by listed companies and are currently registered as chartered accountants, minimising the risk that information in the reports was interpreted incorrectly (Myeza et al 2024).

The final CRSA checklist contained 23 items (descriptions contained in Table 1 and in Appendix 1). A score of 1 was only given if the text mentioned words relating to the disclosure requirement. If a specific disclosure requirement was absent, a score of 0 was given. Each item on the disclosure checklist had an equal weighting. Using a dichotomous scoring system and unweighted index is a popular approach in disclosure studies (Al Amosh & Khatib 2024; De Grosbois & Fennell 2021; Demaria & Rigot 2021; Erin & Olojede 2024). However, it should be noted that a dichotomous scoring does not account for depth, quality, credibility, or decision-usefulness of the disclosure. The overall CRSA score for a company was obtained by adding its scores on each disclosable item. The maximum potential CRSA score was 23. The CRSA score was converted to a percentage by dividing the total for the company by 23. In the next section, we present the results of our study.

D. RESULTS AND DISCUSSION

Our first research question asked *whether* JSE-listed basic resource companies disclose CRSA information. It was noteworthy that only 16 (50%) of the 32 companies provided disclosures relating to CRSA. Twoⁱⁱ of the 16 companies that did not provide CRSA disclosures indicated that they were planning to do so in future. Nine (90%) of the top ten companies disclosed CRSA information, while only 7 (32%) of the other 22 companies did so. Our findings are consistent with research by the IFRS Foundation (2024), which reported poor disclosure scores on resilience testing of a company's strategy using CRSA. The IFRS Foundation reports that this category was the least disclosed category across all regions and industries, especially for the Africa region, where only 19% of the materials and building sector and 11% of the energy sector provided disclosures in this category (IFRS Foundation 2024).

Our second research question asked *what* information JSE-listed companies in the basic resources industry disclose regarding CRSA. For this part of the analysis, we focus only on the CRSA disclosures of the 16 companies that disclosed this information. The previously developed CRSA checklist is in the first column of Table 1, with the regulation source in column 2. Table 1 shows that company disclosures align more closely with some IFRS S2 requirements than others. All 16 companies indicated that they conducted scenario analysis on a qualitative basis (at least) and named at least one scenario used.

Furthermore, all 16 indicated whether the scenario addressed transition or physical risk, the scope of operations involved in the analysis, and the reporting period for which the analysis was conducted. At the other end, only 11 companies described how the scenario analysis was carried out and the limitations or uncertainties associated with the scenarios. How the scenario analysis was carried out, and the limitations and uncertainties related to the scenario would be important to users and stakeholders as it defines how the risks and opportunities related to the scenario were determined. It might indicate how exposed the stakeholders are.

Table 1: IFRS S2 Climate-related Scenario Analysis (CRSA) Checklist and Disclosures

Does the entity disclose:	Source	Yes[#]	%
If a qualitative scenario analysis was carried out?	S22	16	100%
Which climate-related scenarios it used for the analysis?	S2.22b-i-1	16	100%
If the CRSA used for the analysis are associated with climate-related transition risks or physical risks?	S2.22b-i-3	16	100%
What scope of operations it used in the climate-related scenario analysis?	S2.22b-i-7	16	100%
Reporting period in which the climate-related scenario analysis was carried out?	S2.22b-iii	16	100%
When was scenario analysis carried out?	S2.22b	15	94%
Why it decided that its chosen climate-related scenarios are relevant?	S2.22b-i-5	15	94%
Time horizons it used in the climate-related scenario analysis?	S2.22b-i-6	15	94%
Key assumptions made in the climate-related scenario analysis?	S2.22b-ii	15	94%
Assumptions regarding national/regional-level variables?	S2.22b-ii-3	15	94%
The sources of climate-related scenarios used?	S2.22b-i-1	14	88%
Included a diverse range of climate-related scenarios?	S2.22b-i-2	14	88%
A climate-related scenario aligned with the latest international agreement on climate change?	S2.22b-i-4	14	88%
If a quantitative scenario analysis was carried out?	S22	13	81%
If both a qualitative and quantitative scenario analysis was carried out?	S22	13	81%
Assumptions regarding climate-related policies in the jurisdictions in which the entity operates?	S2.22b-ii-1	13	81%
Assumptions regarding macroeconomic trends?	S2.22b-ii-2	13	81%
Assumptions regarding developments in technology?	S2.22b-ii-5	13	81%
Assumptions regarding energy usage and mix?	S2.22b-ii-4	12	75%
Does the entity disclose if it applies internal carbon prices in scenario-analysis	S2.29f-i	12	75%
Does the entity disclose how it applies internal carbon prices in scenario-analysis	S2.29f-i	12	75%
How was scenario analysis carried out?	S2.22b	11	69%
Limitations/uncertainties relating to climate-related scenarios?	S2.22b-i-5	11	69%
<i># Number of companies that disclosed any information that satisfies this disclosure requirement</i>			

Source: Authors' compilation from the data

Next, we consider the alignment on average with the 23 CRSA disclosure items required by IFRS S2 at the company level. The descriptive statistics are presented in Table 2.

The average CRSA disclosure score for all 16 companies that provided CRSA disclosures was 20 (87%), with the minimum score being 9 and the maximum score

equalling 23. The overall standard deviation was 4.59. The mean CRSA disclosure score for the top ten was 21 (91%), while the mean for the other companies was 18.7 (81%). The minimum score for the top ten companies was 13 compared to 9 for the other companies. This wider distribution in the other group is also seen in the higher standard deviation for the other group than for the top ten. Overall, the 16 companies that provided CRSA information performed well across the 23 checklist criteria. However, this should be contrasted to the 16 companies that provided no CRSA information. The results also indicate that the disclosure scores of companies vary highly, ranging from companies with a maximum disclosure score of 23 to one with a minimum disclosure score of nine, notably in the other group.

Table 2 – Descriptive statistics for company CRSA scores

	Count	Mean	Median	Mode	Min	Max	Std Dev
All	16	20.0	23	23	9	23	4.59
Top ten	9	21.0	23	23	13	23	3.77
Other	7	18.7	22	23	9	23	5.49

Source: Authors' compilation from the data

De Grosbois & Fennell (2022) obtained similar results when analysing climate-related disclosures in the hotel industry. They found that a small number of companies were industry leaders in climate-related disclosures, while the remainder varied in disclosures or did not disclose any climate-related information at all. Similarly, Bairagi and Ghosh (2023) also support these findings. Their analysis of climate-related disclosures by Australian listed companies found that only a few companies aligned their reporting to the TCFD recommendations and that disclosures within the same sector varied greatly. Another study by Principale and Pizzi (2023) corroborates the findings as it reported that most Italian-listed companies had challenges aligning their CRSA disclosures to the TCFD recommendations.

Based on the discussion above, the results of this study confirm that a limited number of companies (nine from 32; 28%) fully align their CRSA disclosures to the TCFD recommendations. One reason for the slow uptake might be that the JSE or other regulators have not yet made climate reporting compulsory, outside of what would fall under the scope of the integrated reporting framework. Investors and other stakeholders who require fuller disclosures would have to engage with companies to improve their disclosures. Full implementation of IFRS S2 is only from reporting periods starting in 2024 in those jurisdictions that prescribe it for reporting. The adoption of this standard will probably increase in the future. Another possible reason for the lack of CRSA disclosures is that companies are challenged by the complex nature of scenario analysis (Huiskamp et al 2022; IFRS Foundation 2024; O'Dwyer & Unerman 2020). Lastly, scenario analysis is a cost-intensive exercise and companies, especially smaller companies, may not have the necessary financial and human resources to conduct scenario analysis (Achenbach 2021). Paragraphs B6 and B7 of the Application Guidance of IFRS S2 (2023) acknowledge that companies might not have all the skills, capabilities and resources during the initial application of the standard. However, it encourages investment in skills acquisition and improvement over time. It is interesting to note that paragraph B7 mentions explicitly that in the extractives and mineral processing industries, CRSA is an established practice (ISSB 2023). This could explain why the larger JSE companies were able to align their CRSA disclosures to IFRS S2.

The availability of resources may be one of the reasons why large companies have better disclosure scores. Another possible reason is that large companies are subject to more scrutiny and pressure from stakeholders. According to stakeholder theory, companies will disclose CRSA based on the disclosure requirements from their stakeholders. Stakeholder theory is supported by the following note in the climate report from one of the two biggest companies: “Reflecting the growing reporting requirements relating to climate and feedback from our stakeholders, we are increasing our disclosures in several areas”. One of the areas in which the company specifically increased their disclosure based on stakeholder demand was its CRSA as illustrated in the following note: “In response to stakeholder feedback, this graph now includes the IEA NZE Net Coal Scenario.” It was noted that the aggregate foreign institutional shareholding in the quoted company exceeded 20% and it is therefore possible that influential stakeholders, like foreign institutional investors, can influence the CRSA disclosures of large companies. This possibility is confirmed by results from Nguyen et al (2022), where a positive relationship was established between foreign institutional ownership and integrated reporting disclosures, as well as findings from Bose et al (2024), which indicated that foreign institutional ownership resulted in a higher quality of climate-related disclosures.

In addition to responding to stakeholder demand, companies are also using CRSA disclosures to signal their resilience to stakeholders. For instance, the biggest company stated in their climate change report that scenario analysis “indicates that our portfolio is resilient and, in fact, many of our commodities would future benefit from an accelerated decarbonization pathway”. By using multiple climate-related scenarios, and specifically including adverse scenarios, the company signalled their climate resilience (in any given scenario) to stakeholders, indicating that the company will continue to operate, even under the worst-case scenario. This is consistent with findings from Attenborough (2022) where it was noted that British fossil fuel producers incorporated multiple severe climate-related scenarios in their climate-related disclosures, including a 2 °C or lower scenario, adding cautionary comments surrounding the limitations or uncertainties of scenario modelling.

Institutional theory also provides some insight into TCFD-aligned CRSA disclosures by companies. Given the uncertainty and complexity of scenario analysis, companies are likely to perform a peer review and use the best performers in the industry as a benchmark for their own disclosures. This is illustrated by one of the companies noting that they “engaged an independent service provider to conduct a gap analysis and peer review, as part of a broader TCFD study, to compare *Company X’s* TCFD maturity against five of our mining peers, using publicly available documents for comparative purposes.” During the peer review, the company identified CRSA disclosure as a reporting gap that needed to be addressed. Based on the results of the peer review, the quoted company included CRSA disclosures in its climate reporting. Hence, many of the CRSA disclosures by companies show some level of conformity, as companies benchmark their disclosures against market leaders in the sector. This supports the mimetic and normative applications of institutional theory in the South African basic resources industry.

In the next section, we provide additional results on reporting channels and frameworks, assurance and the scenarios applied by reporting companies.

ADDITIONAL ANALYSES

D.1 Reporting strategy and frameworks

The study also explored which reporting channels and frameworks companies used when disclosing CRSA. All 16 companies used stand-alone climate reports (CR) and/or sustainability reports (SR) to disclose CRSA. Thirteen of the 16 companies also disclosed via their integrated annual report (IAR). The CRSA disclosures in the stand-alone climate and/or sustainability reports were more in-depth than those in the integrated annual reports. Disclosures in the integrated annual reports mainly stated that the company conducted CRSA and provided references to stand-alone climate reports and/or sustainability reports for further information on CRSA. These findings align with those from Bairagi & Ghosh (2023) who found that companies disclosed significantly more climate-related information in stand-alone reports. In their worldwide sample, the IFRS Foundation (2024) reports that companies were more likely to disclose TCFD-aligned information in climate or sustainability reports than in their financial filings, but noted that across all channels, disclosure about the company's resilience to different climate-related scenarios was the least disclosed item (IFRS Foundation 2024). Some South African basic resource companies seem to already comply with De Bernardi et al (2019), who proposed that companies consider integrating climate-related disclosures in mainstream filings, like annual reports.

In addition to climate-related disclosures being dispersed, companies are also using different reporting frameworks to disclose climate-related information. Figure 1 reflects the results of the most dominant climate-related reporting frameworks that companies considered when reporting on climate-related information.

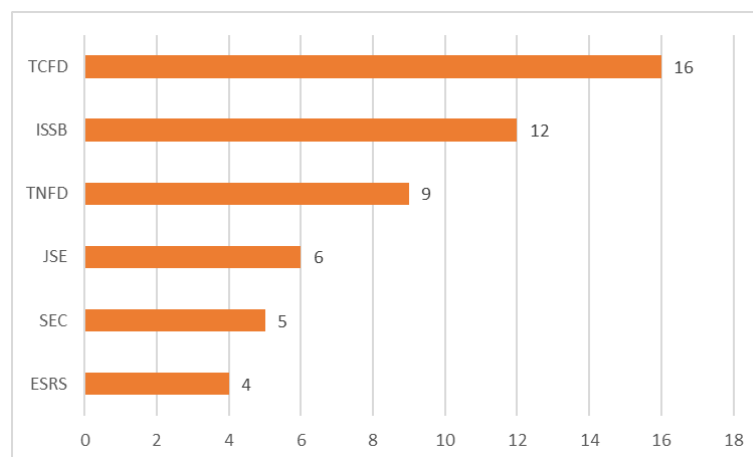


Figure 1: CRSA disclosures – reporting frameworks referenced

Source: Authors' compilation from the data

All 16 companies considered the TCFD recommendations as a climate-reporting framework, indicating that companies may regard the TCFD recommendations as the dominant climate-related reporting framework. Twelve companies referenced the climate-related standard (IFRS S2) issued by the ISSB. Nine companies took note of the nature-related standards proposed by the Taskforce on Nature-related Financial Disclosures (TNFD). It is encouraging that companies are closely monitoring the changes in the reporting landscape and are considering how to incorporate these new standards into their reporting disclosures. This is supported by one of the companies noting that

they established a forum and “Through the forum, we track and analyse emerging climate reporting requirements such as the proposed SEC climate change regulations and the new ISSB Disclosure Standards on climate reporting (IFRS S2) which now has the responsibility for guiding TCFD reporting. This will enable us to develop robust systems for climate-related reporting”. Viewed from this perspective, the introduction of IFRS S2 (and its earlier exposure draft) could have prompted companies to conduct scenario analysis to test their climate resilience and to incorporate CRSA disclosures in their climate reporting. This view is supported by Huiskamp et al (2022), who noted that IFRS S2 might accelerate the conducting of scenario analysis and disclosure of CRSA by companies. The IFRS Foundation (2024) reports that of the 44 South African companies in its sample, 43% mentioned the ISSB in the context of *future* alignment, and 5% did so in terms of *current* alignment (IFRS Foundation 2024). This signals an increasing shift toward the ISSB, which took over the TCFD’s standards.

Only a few companies considered the JSE, SEC and ESRS as reporting frameworks. Unlike the voluntary nature of the TCFD, the SEC and ESRS climate-related reporting frameworks are mandatory frameworks for companies within the jurisdiction of these reporting frameworks. The results may indicate that a limited number of JSE-listed companies in this sector will be affected by the SEC’s climate-related rule or the ESRS, either because they are not operating in these jurisdictions, or they are small enough to be granted an extension as part of a phased-in approach to regulatory reporting requirements.

CRSA assurance

The results show that only the two biggest companies obtained independent external assurance on their CRSA disclosures. These two companies included CRSA in the notes to their financial statements and, as a result, obtained reasonable assurance on their CRSA disclosures. Independent external verification enhances the credibility of information disclosed (Caglio et al 2019) and can be used to assure stakeholders that the key assumptions and inputs used in CRSA are reasonable, given the limitation and uncertainty of the scenario analysis process. Investor confidence in the companies’ disclosures could be increased by assurance of CRSA disclosures. A possible reason for the lack of assurance on CRSA could be that the assurance frameworks have not evolved as fast as climate-related disclosure frameworks. Whereas climate-related disclosure frameworks have progressed into distinctive subject matter, current assurance practices still use existing assurance standards to assure climate-related disclosures. The assurance of climate-related disclosures is, therefore, an area which may create future research opportunities (Zhou 2022).ⁱⁱⁱ

D.2 Physical And Transition Scenarios Used

Companies used the physical scenarios of the IPCC (2022). To analyse the results, the researchers aggregated the number of companies disclosing Representative Concentration Pathways (RCP) scenarios with the number of companies using Shared Socio-Economic Pathways (SSP) scenarios. The aggregation was based on temperature ranges reflected in Table 3. The results show that most companies use a worst-case physical scenario (RCP 8.5 or SSP5-8.5) with a temperature range from 3.0° to 7.2°. This is closely followed by RCP2.6 / SSP1-1.9 with a temperature range of 0.9° to 2.5° and RCP4.5/SSP 1 – 2.6 with a temperature range of 1.8° to 3.1°. The results reflect that companies are attuned to the physical risks climate change poses, as they use the most adverse physical scenarios to inform stakeholders of their risk exposure to acute and chronic physical risks.

Table 3: Physical scenarios used – IPCC scenarios, time horizon 2100

RCP	From	To	SSP	From	To	Number
RCP8.5	3.0°	6.2°	SSP3-7.0	2.7°	6.2°	15
RCP2.6	0.9°	2.3°	SSP1-1.9	1.0°	2.5°	14
RCP4.5	1.8°	3.3°	SSP1-2.6	1.3°	3.1°	12
RCP6.0	2.3°	3.6°	SSP2-4.5	1.9°	4.4°	6
			SSP5-8.5	3.1°	7.2°	6

Source: Authors' compilation from the data

Companies used various transition scenarios, including those from the International Energy Agency (IEA), the Energy Transitions Outlook by Wood Mackenzie, Shell and the UN Principles for Responsible Investment (UN PRI). The most used scenarios in our sample were those from the IEA, including the Net Zero Energy 2050 (NZE), Announced Pledges Scenario (APS), and Stated Policies Scenario (STEPS).

The South African basic resources companies that disclose CRSA are informed by the latest publicly available scenarios published by recognised scientific institutions. This information should also be useful to other companies in the industry that have not yet started to disclose CRSA. Institutional theory supposes that companies will look to leaders in their industry to mimic in the presence of uncertainty. By selecting the most extreme scenarios, the companies also signal their belief that their strategy is resilient to the most threatening scenario. It would be interesting to see whether the compulsory assurance of sustainability information might temper the selection of scenarios. In the next section, we conclude and present our study's limitations and provide recommendations for future research.

E. CONCLUSION, LIMITATIONS AND RECOMMENDATIONS FOR FUTURE RESEARCH

The study explored whether JSE-listed companies in the basic resources sector aligned their CRSA disclosures to IFRS S2. We find that 50% of the JSE-listed basic resources companies disclosed some information about their CRSA. Nine of the top ten companies conducted CRSA and aligned their disclosures to IFRS S2.22 (b). The 16 companies that provided CRSA performed well, with an average score of 87%. However, this should be contrasted to the 16 companies that provided no CRSA information, mostly the smaller companies, indicating that company size could be a determining factor in the disclosure of CRSA information. Companies that provided disclosures on CRSA used the TCFD recommendations and IFRS S2 to guide their CRSA disclosures, which could be a positive indication that they are preparing to fully align their climate-related disclosures to IFRS S2.

The research contributes to theory by showing how stakeholder, institutional and signal theory can be used to explain the complex phenomenon of CRSA disclosures. In domains where disclosure regulation about CRSA, and climate disclosure in general, is still voluntary, the role of stakeholders becomes important to advance the quality and utility of sustainability disclosures and pressure for change in operating conditions in situ. South African companies cannot isolate themselves from the worldwide demand for climate information, and preparers will find increasing pressure from local and foreign institutional shareholders and activists to improve disclosures and operating conditions.

Larger companies, with arguably more resources and experience with CRSA and climate disclosures, will have to serve as public examples for the smaller companies to mimic their reporting until the latter has enough experience. We have already observed that the top ten companies' CRSA disclosures were of the same high quality, and the other companies already provided a decent quantity of disclosures aligned with the IFRS S2. This could already be evidence of normative isomorphism for this industry. Notably, 50% of companies did not provide CRSA. That could be because it was not financially material to their business, or they did not have the skills and resources. Future assurance of sustainability disclosures will remove much of this uncertainty for stakeholders. We further observed how signalling theory prompted companies to provide lengthy CRSA disclosures using various scenarios to signal to stakeholders that their strategies are resilient to climate change.

Secondly, we contribute to the literature on climate reporting by providing evidence of its application in a developing country that relies heavily on its basic resources industry for gross domestic production (GDP), employment and foreign currency. We provide evidence about the application of newly issued international reporting standards that aim for worldwide alignment by providing a snapshot of their application in developing countries and environmentally sensitive industries, such as basic resources. From a practical perspective, we urge regulators and standard-setting bodies to acknowledge that what is feasible in the largest companies in the developed world might take more time to take root in developing countries with limited resources and competing social demands, such as protecting current employment. Capacity building initiatives aimed at smaller companies, might speed up the adoption of voluntary disclosure standards. Furthermore, there seems to be concern in some EU quarters that the scope of these international standards is too onerous to apply even within the EU.

Thirdly, we also make a methodological contribution in the form of the CRSA disclosure checklist, based on the 23 disclosure requirements in the IFRS S2. From a practical point of view, reporting companies can use this checklist as a benchmark to check that their disclosures are aligned to the best practice. From a research perspective, other researchers can also use the checklist in their studies investigating CRSA in different contexts or periods.

Our study has some limitations, but it also offers opportunities for further research. The study was limited to 32 JSE-listed companies in the basic resources sector, and therefore, results cannot be generalised. The study was limited to this sector based on the assumption, informed by multiple prior studies, that highly polluting industries are probably more likely to disclose CRSA, especially as they are highly vulnerable to climate change risks and opportunities. Future studies can include multiple industries to flesh out possible industry differences. Another limitation is that the researchers only scrutinized CRSA disclosures for one year and could, therefore, not identify longitudinal trends. It is possible, and even likely, that CRSA disclosures in the next reporting period may show different results, especially as the effective date for implementing IFRS S1 and IFRS S2 was 1 January 2024. We urge other researchers to extend the analysis horizon to show longitudinal trends and also to see whether the issuance of standards is effective in improving decision-useful disclosures or if it leads to cookie-cutter reporting. Lastly, the search terminology to identify CRSA was based on finding the specific word 'scenario'. Reporting companies could have used synonyms like pathway, resilience, stress testing, or transition modelling. Results are thus likely understated. Future studies could use multiple terms to identify CRSA.

APPENDIX 1

IFRS S2 Climate-related Scenario Analysis (CRSA) Checklist and Disclosures

Does the entity disclose:	Source
If a qualitative scenario analysis was carried out?	S22
Which climate-related scenarios it used for the analysis?	S2.22b-i-1
If the CRSA used for the analysis are associated with climate-related transition risks or physical risks?	S2.22b-i-3
What scope of operations it used in the climate-related scenario analysis?	S2.22b-i-7
Reporting period in which the climate-related scenario analysis was carried out?	S2.22b-iii
When was scenario analysis carried out?	S2.22b
Why it decided that its chosen climate-related scenarios are relevant?	S2.22b-i-5
Time horizons it used in the climate-related scenario analysis?	S2.22b-i-6
Key assumptions made in the climate-related scenario analysis?	S2.22b-ii
Assumptions regarding national/regional-level variables?	S2.22b-ii-3
The sources of climate-related scenarios used?	S2.22b-i-1
Included a diverse range of climate-related scenarios?	S2.22b-i-2
A climate-related scenario aligned with the latest international agreement on climate change?	S2.22b-i-4
If a quantitative scenario analysis was carried out?	S22
If both a qualitative and quantitative scenario analysis was carried out?	S22
Assumptions regarding climate-related policies in the jurisdictions in which the entity operates?	S2.22b-ii-1
Assumptions regarding macroeconomic trends?	S2.22b-ii-2
Assumptions regarding developments in technology?	S2.22b-ii-5
Assumptions regarding energy usage and mix?	S2.22b-ii-4
Does the entity disclose if it applies internal carbon prices in scenario-analysis	S2.29f-i
Does the entity disclose how it applies internal carbon prices in scenario-analysis	S2.29f-i
How was scenario analysis carried out?	S2.22b
Limitations/uncertainties relating to climate-related scenarios?	S2.22b-i-5

Source: Authors' compilation from IFRS S2

REFERENCES

- Abhayawansa, S. & Adams, C. 2022. Towards a conceptual framework for non-financial reporting inclusive of pandemic and climate risk reporting. *Meditari Accountancy Research*, 30(3)<https://doi.org/10.1108/medar-11-2020-1097>
- Achenbach, M. 2021. Transparency of Climate-Related Risks and Opportunities: Determinants Influencing the Disclosure in Line with the Task Force on Climate-Related Financial Disclosures. *Glocality*, 4(1)<https://doi.org/10.5334/glo.32>
- Al Amosh, H. & Khatib, S.F.A. 2024. Cybersecurity Transparency and Firm Success: Insights From the Australian Landscape. *Australian Economic Papers*, In Press:1–16. <https://doi.org/10.1111/1467-8454.12385>
- Al Amosh, H. & Mansor, N. 2021. Disclosure of integrated reporting elements by industrial companies: evidence from Jordan. *Journal of Management and Governance*, 25(1):121–145. <https://doi.org/10.1007/s10997-020-09541-x>

- Alsaifi, K. 2021. Carbon disclosure and carbon performance: Evidence from the UK's listed companies. *Management Science Letters*, 11:117–128. <https://doi.org/10.5267/j.msl.2020.8.023>
- Amin, M.H., Ali, H. & Mohamed, E.K.A. 2022. Corporate social responsibility disclosure on Twitter: Signalling or greenwashing? Evidence from the UK. *International Journal of Finance and Economics*, In press(In press)<https://doi.org/10.1002/ijfe.2762>
- Attenborough, D. 2022. Corporate Disclosures on Climate Change: An Empirical Analysis of FTSE All-Share British Fossil Fuel Producers. *European Business Organization Law Review*, 23(2):313. <https://doi.org/10.1007/s40804-022-00246-2>
- Aversa, D. 2023. Climate change and climate-related financial disclosures in the banking sector. *Risk Governance and Control: Financial Markets and Institutions*, 13(1):70. <https://doi.org/10.22495/rgcv13i1p6>
- Bairagi, R.K. & Ghosh, P.K. 2023. Adoption and Determinants of Task Force on Climate-related Financial Disclosures (TCFD) Reporting Frameworks by Australian Stock Exchange (ASX) Listed Companies. *Indian Journal of Applied Economics and Business*, 5(1):1–18. <https://doi.org/10.47509/IJAEB.2023.v05i01.01>
- Bose, S., Lim, E.K., Minnick, K. & Shams, S. 2024. Do foreign institutional investors influence corporate climate change disclosure quality? International evidence. *Corporate Governance: An International Review*, 32(2):322–347. <https://doi.org/rg/10.1111/corg.12535>
- Braasch, A. & Velte, P. 2022. Climate reporting quality following the recommendations of the task force on climate-related financial disclosures: A Focus on the German capital market. *Sustainable Development*, 31(2):926. <https://doi.org/10.1002/sd.2430>
- Brunelli, S., Falivena, C., Carlino, C. & Venuti, F. 2021. Accountability for climate change: a research synthesis through the lenses of the integrated thinking approach. *Meditari Accountancy Research*, 29(4):1005–1038. <https://doi.org/10.1108/MEDAR-01-2020-0682>
- Caglio, A., Melloni, G. & Perego, P. 2019. Informational Content and Assurance of Textual Disclosures: Evidence on Integrated Reporting. *European Accounting Review*, 29(1):55. <https://doi.org/10.1080/09638180.2019.1677486>
- De Bernardi, P., Venuti, F. & Bertello, A. 2019. The Relevance of Climate Change Related Risks on Corporate Financial and Non-Financial Disclosure in Italian Listed Companies. In: n.a.*The Future of Risk Management, Volume I*. Cham: 77–107. https://doi.org/10.1007/978-3-030-14548-4_4
- De Grosbois, D. & Fennell, D.A. 2021. Determinants of climate change disclosure practices of global hotel companies: Application of institutional and stakeholder theories. *Tourism Management*, 88:104404. <https://doi.org/10.1016/j.tourman.2021.104404>
- Del Gesso, C. & Lodhi, R.N. 2024. Theories underlying environmental, social and governance (ESG) disclosure: a systematic review of accounting studies. *Journal of Accounting Literature*, :In press. <https://doi.org/10.1108/jal-08-2023-0143>
- Demaria, S. & Rigot, S. 2021. Corporate environmental reporting: Are French firms compliant with the Task Force on Climate Financial Disclosures' recommendations? *Business Strategy and the Environment*, 30(1):721–738. <https://doi.org/10.1002/bse.2651>

- DiMaggio, P.J. & Powell, W.W. 1983. The Iron Cage Revisited: Institutional Isomorphism and Collective Rationality in Organizational Fields. *American Sociological Review*, 48(2):147–160. <https://doi.org/10.2307/2095101>
- Ding, D., Liu, B. & Chang, M. 2023. Carbon Emissions and TCFD Aligned Climate-Related Information Disclosures. *Journal of Business Ethics*, 182(4):967–1001. <https://doi.org/10.1007/s10551-022-05292-x>
- Erin, O.A. & Olojede, P. 2024. Do nonfinancial reporting practices matter in SDG disclosure? An exploratory study. *Meditari Accountancy Research*, 32(4):1398–1422. <https://doi.org/10.1108/medar-06-2023-2054>
- Ernst & Young. 2023. *How do you make sure you are measuring the things that matter?* Ernst & Young. Available from: https://assets.ey.com/content/dam/ey-sites/ey-com/en_za/topics/assurance/excellence-in-integrated-reporting-content/ey-com-en-za-ey-excellence-in-integrated-reporting-2023.pdf [Accessed 22 September 2023].
- Fernandez-Feijoo, B., Romero, S. & Ruiz, S. 2014. Effect of Stakeholders' Pressure on Transparency of Sustainability Reports within the GRI Framework. *Journal of Business Ethics*, 122(1):53–63. <https://doi.org/10.1007/s10551-013-1748-5>
- Forcadell, F.J., Lorena, A. & Aracil, E. 2022. The firm under the spotlight: How stakeholder scrutiny shapes corporate social responsibility and its influence on performance. Wiley.
- Freeman, R.E. 2010. *The Stakeholder Concept and Strategic Management*. Cambridge University Press. <https://doi.org/10.1017/CBO9781139192675.005>
- Friedrich, T.J., Velte, P. & Wulf, I. 2022. Corporate climate reporting of European banks: Are these institutions compliant with climate issues? *Business Strategy and the Environment*, 32(6):2817. <https://doi.org/10.1002/bse.3272>
- Gebhardt, M., Schneider, A., Siedler, F., Ottenstein, P. & Zülch, H. 2024. Climate reporting in the fast lane? The impact of corporate governance on the disclosure of climate-related risks and opportunities. *Business Strategy and the Environment*, 33(7):7253–7272. <https://doi.org/10.1002/bse.3852>
- Ghachem, D.A., Basti, N. & Zureigat, Q. 2022. Ownership Structure and Carbon Emissions of SMEs: Evidence from OECD Countries. *Sustainability*, 14(21):14408. <https://doi.org/10.3390/su142114408>
- Huang, H., Zou, Y., Wang, L., Wang, W. & Ren, X. 2023. Impact of carbon information disclosure on corporate financing constraints: Evidence from the Carbon Disclosure Project. *Australian Journal of Management*, In press:1–28. <https://doi.org/10.1177/03128962231180265>
- Huiskamp, U., ten Brinke, B. & Kramer, G.J. 2022. The climate resilience cycle: Using scenario analysis to inform climate-resilient business strategies. *Business Strategy and the Environment*, 31(4)<https://doi.org/10.1002/bse.2982>
- IFRS Foundation. 2024. *Progress on Corporate Climate-related Disclosures-2024 Report*. IFRS Foundation. Available from: <https://www.ifrs.org/news-and-events/news/2024/11/new-report-global-progress-corporate-climate-related-disclosures/> [Accessed November 13, 2024].
- Intergovernmental Panel on Climate Change. 2022. Summary for Policymakers [H.-O. Pörtner, D.C. Roberts, E.S. Poloczanska, K. Mintenbeck, M. Tignor, A. Alegría, M. Craig, S. Langsdorf, S. Löschke, V. Möller, A. Okem (eds.)]. In: *Climate Change 2022: Impacts, Adaptation and Vulnerability*. Contribution of Working Group II to the Sixth Assessment

- Report of the Intergovernmental Panel on Climate Change [H.-O. Pörtner, D.C. Roberts, M. Tignor, E.S. Poloczanska, K. Mintenbeck, A. Alegría, M. Craig, S. Langsdorf, S. Löschke, V. Möller, A. Okem, B. Rama (eds.)]. Cambridge, UK and New York, USA: Cambridge University Press. <https://doi.org/10.1017/9781009325844.001>.
- IPCC. 2022. See Intergovernmental Panel on Climate Change.
- ISSB. 2023. *IFRS S2 Climate-related Disclosures*. IFRS Foundation. Available from: <https://www.ifrs.org/content/dam/ifrs/publications/pdf-standards-issb/english/2023/issued/part-a/issb-2023-a-ifrs-s2-climate-related-disclosures.pdf> [Accessed 28 June 2023].
- Jahid, M.A., Yaya, R., Pratolo, S. & Pribadi, F. 2023. Institutional factors and CSR reporting in a developing country: Evidence from the neo-institutional perspective. *Cogent Business & Management*, 10(1)<https://doi.org/10.1080/23311975.2023.2184227>
- Kim, Y. 2023. The Association between Voluntary Carbon Disclosure and Accounting Comparability: Examining the Moderating Effect of Korean Business Groups. *Sustainability*, 15(6):4830. <https://doi.org/10.3390/su15064830>
- Lee, C., Kuo, S., Hsu, H., Mo, T., Chang, E., et al. 2022. How does the research community contribute to corporate climate-related risk disclosures? The gap between ideals and reality. *Corporate Social Responsibility and Environmental Management*, 30(2):927–940. <https://doi.org/10.1002/csr.2397>
- Lombardi, R., Schimperna, F., Paoloni, P. & Galeotti, M. 2021. The climate-related information in the changing EU directive on non-financial reporting and disclosure: first evidence by Italian large companies. *Journal of Applied Accounting Research*, 23(1):250. <https://doi.org/10.1108/jaar-04-2021-0117>
- McGowan, J. 2024. *French Prime Minister Indicates EU May Roll Back Sustainability Reporting Requirements*. Forbes. Available from: <https://www.forbes.com/sites/jonmcgowan/2024/10/22/french-prime-minister-indicates-eu-may-roll-back-sustainability-reporting-requirements/> [Accessed 15 November 2024].
- Myeza, L., Kok, M., Lange, Y. & Maroun, W. 2024. Stakeholder engagement during the COVID-19 crisis: perspectives from South Africa. *Social Responsibility Journal*, 20(5)<https://doi.org/10.1108/srj-04-2022-0193>
- Nasreen, T., Baker, R. & Rezanian, D. 2023. Sustainability reporting – a systematic review of various dimensions, theoretical and methodological underpinnings. *Journal of Financial Reporting and Accounting*, <https://doi.org/10.1108/jfra-01-2022-0029>
- Ngo, T., Le, T., Ullah, S. & Trinh, H.H. 2022. Climate risk disclosures and global sustainability initiatives: A conceptual analysis and agenda for future research. *Business Strategy and the Environment*, 32(6):3705–3720. <https://doi.org/10.1002/bse.3323>
- Nguyen, H.C., Nguyen, P.M.H., Tran, B.H., Nguyen, T.T.N., Hoang, L.T.T., et al. 2022. Integrated reporting disclosure alignment levels in annual reports by listed firms in Vietnam and influencing factors. *Meditari Accountancy Research*, 30(6):1543–1570. <https://doi.org/10.1108/MEDAR-02-2020-0710>
- O'Dwyer, B. & Unerman, J. 2020. Shifting the focus of sustainability accounting from impacts to risks and dependencies: researching the transformative potential of

- TCFD reporting. *Accounting, Auditing & Accountability Journal*, 33(5)<https://doi.org/10.1108/aaaj-02-2020-4445>
- Pitrakkos, P. & Maroun, W. 2020. 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>
- Principale, S. & Pizzi, S. 2023. The Determinants of TCFD Reporting: A Focus on the Italian Context. *Administrative Sciences*, 13(2)<https://doi.org/10.3390/admsci13020061>
- Rim, H., Kim, J. & Dong, C. 2019. A cross-national comparison of transparency signaling in corporate social responsibility reporting: The United States, South Korea, and China cases. *Corporate Social-Responsibility and Environmental Management*, 26(6):1517–1529. <https://doi.org/10.1002/csr.1766>
- Spence, M. 1973. Job Market Signaling. *The Quarterly Journal of Economics*, 87(3):355–374. <https://doi.org/10.2307/1882010>
- Wichianrak, J., Khan, T., Teh, D. & Dellaportas, S. 2023. Critical Perspectives of NGOs on Voluntary Corporate Environmental Reporting: Thai Public Listed Companies. *Sustainability*, 15(7):6195. <https://doi.org/10.3390/su15076195>
- World Economic Forum. 2022. *The Global Risks Report 2022, 17th Edition*. World Economic Forum. Available from: https://www3.weforum.org/docs/WEF_The_Global_Risks_Report_2022.pdf 25 870 [Accessed 6 April 2023].
- Zarzycka, E. & Krasodomska, J. 2022. Non-financial key performance indicators: what determines the differences in the quality and quantity of the disclosures? *Journal of Applied Accounting Research*, 23(1):139–162. <https://doi.org/10.1108/JAAR-02-2021-0036>
- Zhou, S. 2022. Reporting and Assurance of Climate-Related and Other Sustainability Information: A Review of Research and Practice. *Australian Accounting Review*, 32(3):315. <https://doi.org/10.1111/auar.12387>

ⁱ Examples of regulatory bodies that also issued climate-related reporting standards are the European Financial Reporting Advisory Group (EFRAG), the Securities and Exchange Commission (SEC) in the USA and the Global Reporting Initiative (GRI).

ⁱⁱ Two companies disclosed that they conducted CRSA. However, the CRSA of the one was limited to a joint venture where the joint venture partner was responsible for the CRSA. The other company disclosed they conducted CRSA but provided no additional information. Hence, these companies were allocated to the “No” category.

ⁱⁱⁱ On 12 November 2024, the International Auditing and Assurance Standards Board (IAASA) issued the International Standard on Sustainability Assurance (ISSA) 5000.