

ENVIRONMENTAL SAFETY IN ESG REPORTING

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Abstract: The concept of environmental safety has become an integral part of contemporary discussions on corporate sustainability and related regulatory frameworks, such as the CSRD directive and its ESRS standards. They have significantly expanded corporate responsibility for environmental risk management and transparency. Within the evolving framework of ESG reporting, environmental safety reflects not only compliance with regulations but also a broader commitment to responsible, transparent management of environmental impacts. From a systemic perspective, ESRS standards operationalize environmental safety at company level. Thus, the article investigates the compliance of companies' reports - relating solely to the environmental dimension of ESG reporting - with the new ESRS standards, which may reflect the level of environmental safety within companies. The findings may prove valuable for small and medium-sized enterprises that will become subject to reporting obligations in the coming years.

Keywords: sustainability, reporting, environmental safety, standards.

1. INTRODUCTION

Changing societal expectations, increasing investor pressure, and the challenges posed by climate change and sustainable development have made sustainability reporting a key component of risk management, environmental safety, and organisational value creation (Schramade, 2017). Environmental safety constitutes an essential element of sustainability reporting, as it reflects how an organisation manages the risks and impacts of its activities on the natural environment (Bebbington & Unerman, 2018; Lundgren & McMakin, 2018). It includes actions aimed at preventing pollution, reducing emissions, managing resources efficiently, and minimizing the impact of industrial accidents on people and the natural environment (Brockett & Rezaee, 2012). Accurate reporting of environmental safety aspects in sustainability reports emphasizes corporate responsibility and helps build stakeholder trust (Adams, 2020).

In contemporary sustainability frameworks, environmental safety is not only a technical or operational concern but also a strategic indicator of corporate responsibility and resilience to climate-related and ecological challenges (Adams, 2020). The growing recognition of sustainability disclosure as a strategic element of organisational management has contributed to the emergence of the ESG (Environmental, Social, Governance) framework, which provides a comprehensive approach to evaluating corporate



sustainability and accountability (Eccles & Klimenko, 2019). ESG matters are also being recognized as increasingly important by companies and industry sectors, especially in the face of growing requirements for non-financial disclosure related to ESG (Brandon et al., 2021; Dyck et al., 2019). By integrating these metrics into ESG reports, companies not only comply with regulatory requirements, such as the CSRD and ESRS standards in Europe, but also demonstrate accountability and proactive stewardship of natural resources (Commission Delegated Regulation 2023; EFRAG, 2023).

In the context of reporting in accordance with the CSRD Directive and the new European Sustainability Reporting Standards (ESRS), environmental safety issues fall within the Environmental (E) dimension, serving to assess an organisation's resilience to climate change and its ability to protect ecosystems (Commission Delegated Regulation, 2023). The new ESRS standards are significant not only because of their mandatory scope but also due to their exceptionally holistic approach to compliance. ESRS standards require the disclosure of the anticipated effects of environmental risks. This means that environmental threats are no longer "external" - they become an integral part of enterprise environmental safety. Environmental safety is understood in this article as the obligation to identify environmental risks (risk-based approach), to assess double materiality, and to report the company's impact on the environment. Therefore, the greater the compliance of the disclosed information by the analysed entities, the higher the level of environmental security observed in those entities. Thus, this study aims to examine the compliance of companies' reports - relating solely to the environmental dimension of ESG reporting - with the new ESRS standards, which may reflect the level of environmental safety within companies. The paper further discusses the development of non-financial reporting, which has been shaped by significant regulatory reforms, including the implementation of the Corporate Sustainability Reporting Directive (CSRD) and the European Sustainability Reporting Standards (ESRS).

2. REGULATORY CONTEXT AND SUSTAINABILITY REPORTING TOOLS

Regulations and international initiatives play a crucial role in sustainability reporting, providing the frameworks and direction for the development of responsible business practices (Cicchello et al., 2023). The reporting obligation originates from the Directive 2014/95/EU of the European Parliament and of the Council of 22 October 2014, which required companies to report non-financial information (the so-called NFRD – Non-Financial Reporting Directive) (Breijer & Orij, 2022).

At the global level, the strategic framework for ESG activities is defined by the United Nations' Sustainable Development Goals (SDGs), which encompass a wide range of challenges, including poverty reduction, gender equality, and climate protection. The implementation of these goals is rooted in the 2030 Agenda (Delgado-Ceballos et al., 2023). In addition to the initiatives mentioned above, environmental security is also influenced by other regulations such as the Sustainable Finance Disclosure Regulation (SFDR), the Corporate Sustainability Due Diligence Directive (CSDDD), as well as standards developed by international organizations such as the Global Reporting Initiative (GRI) or the IFRS Sustainability Standards (Cremasco, & Boni, 2024, Bais, et al., 2024). Among the most important legal acts shaping the modern approach to ESG is Directive (EU) 2022/2464 of the European Parliament and of the Council on corporate sustainability reporting (Corporate Sustainability Reporting Directive - CSRD), which significantly expands the scope of companies' reporting obligations in the area of sustainable

development. The CSRD introduces mandatory non-financial reporting based on uniform ESRS standards, increasing the transparency of corporate activities with respect to their impact on the environment, society, and governance (Odobáša & Marošević, 2023). In the context of the CSRD, environmental safety is understood not only as the absence of harm but also as an organization's ability to mitigate environmental risks and its impact on human health, ecosystems, and the climate (Fornasari & Traversi, 2024).

In parallel, the EU Taxonomy constitutes a classification system for economic activities in terms of their alignment with the Sustainable Development Goals, defining criteria that enable the assessment of whether a given activity contributes to the European Union's environmental priorities (Lucarelli et al., 2020). Table 1 presents a summary of the most important sustainability reporting standards and their links to the new ESRS standards.

Table 1

Sustainability reporting standards and their connection to the CSRD

Standard / Framework	Type	Thematic scope	For whom?	Mandatory	Link to CSRD / ESRS
GRI (Global Reporting Initiative)	Global, voluntary standard	ESG – environment, society, governance	All organizations, all sectors	Partially	Yes – aligned with ESRS under CSRD
IRF (Integrated Reporting Framework)	Integrated reporting framework	Combining ESG and finance; value creation	Mainly large companies	Voluntary	Partially integrated with ESRS
SASB (Sustainability Accounting Standards Board)	Sector-specific ESG standards	ESG topics differentiated by industry	Investors, U.S. market & capital markets	Voluntary	Indirectly supported by ESRS
TCFD (Task Force on Climate-related Financial Disclosures)	Climate disclosure recommendations	Climate risks and opportunities	Large companies, the financial sector	Mandatory in some countries	Included in ESRS E1 (climate)
CDP (Carbon Disclosure Project)	Scoring disclosure system	Climate, water, forests, emissions	Companies, investors	Voluntary	Sometimes indirectly required
SDGs (UN Sustainable Development Goals)	UN goals (non-standard)	17 sustainable development goals	Every organization	No	Complementary (strategic role)
IFRS Sustainability Standards (ISSB – S1/S2)	Technical standards	General ESG (S1); climate (S2)	Publicly listed companies, investors	Mandatory in some countries	Complementary to ESRS
ESRS (European Sustainability Reporting Standards)	European standards (CSRD)	ESG: E (climate, resources), S, G	Mandatory for large companies in the EU	Yes	Primary source of CSRD compliance

UNGC (United Nations Global Compact)	Principles and values (not a standard)	Human rights, labor, environment	Companies participating in the initiative	No	Often referenced in report
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Source: own elaboration

To conclude, ESRS standards are currently the main and mandatory ESG reporting in the EU under the CSRD, forming the basis for both regulatory compliance and disclosure. Other initiatives (GRI, SASB, TCFD, ISSB, IRF, CDP, SDGs, UNGC) are largely voluntary and serve a complementary or supportive role to ESRS, often focusing on specific areas such as climate or integrated reporting.

3. ESRS STANDARDS

The CSRD directive introduces new criteria through the ESRS environmental standards, increasing the rigor and transparency of environmental reporting (Operato et al., 2025). According to the extension of the CSRD with the new ESRS environmental standards, companies will be required to report data across five new thematic standards, designated as E1 to E5. The E1-E5 standards outline key environmental areas for ESG reporting. E1 addresses climate-related measures, E2 focuses on pollution, while E3 emphasizes water and marine resource management. E4 highlights biodiversity and ecosystem protection. Finally, E5 targets resource efficiency and the transition to a circular economy, promoting sustainable material use, waste reduction, and product durability (EFRAG, 2023) (tab 2).

Table 2.

Environmental disclosure requirements according ESRS standards

Code	Name of the standard	Example key topics
ESRS E1	Climate Change	
E1-1		Transition plan for climate change mitigation
E1-2		Policies related to climate change mitigation and adaptation
E1-3		Actions and resources in relation to climate change policies
E1-4		Targets related to climate change mitigation and adaptation
E1-5		Energy consumption and mix
E1-6		Gross Scope 1, 2, and 3 GHG emissions
E1-7		GHG removals and GHG mitigation projects financed through carbon credits
E1-8		Internal carbon pricing
E1-9		Anticipated financial effects from material physical and transition risks and potential climate related opportunities
ESRS E2	Pollution	
E2-1		Policies regarding pollutants
E2-2		Actions and resources for pollutant reduction
E2-3		Targets for pollution control
E2-4		Emissions to air, water, and soil
E2-5		Hazardous substances and impact on health and environment
E2-6		Anticipated financial effects from material related risks and opportunities
ESRS E3	Water and Marine Resources	

		Policies related to water and marine resources
E3-1		Water and marine resources policies
E3-2		Actions and resources for water management
E3-3		Targets related to water and marine resources
E3-4		Water consumption and quality of discharges
E3-5		Financial impacts related to water risks
ESRS E4	Biodiversity and Ecosystems	
E4-1		Transition plan and consideration of biodiversity and ecosystems in strategy and business model
E4-2		Policies supporting biodiversity and ecosystem preservation
E4-3		Actions and resources related to biodiversity and ecosystems
E4-4		Targets for biodiversity conservation
E4-5		Impact metrics related to biodiversity and ecosystem change.
E4-6		Anticipated financial effects from material biodiversity and ecosystem-related risks and opportunities
ESRS E5	Resource Use and Circular Economy	
E5-1		Policies related to resource use and circular economy
E5-2		Actions and resources related to resource use and circular economy
E5-3		Targets related to resource use and circular economy
E5-4		Resource inflows
E5-5		Resource outflows

Source: (EFRAG, 2023), ESRS E1 Delegated act 2023 5303 annex 1. [Online] Available at: https://www.efrag.org/Assets/Download?assetUrl=%2Fsites%2Fwebpublishing%2FSiteAssets%2FESRS%2520E1%2520Delegated-act-2023-5303-annex-1_en.pdf

Compared to the previous CSRD standards, the new version of ESRS simplifies the thematic scope of individual standards. The most significant changes in the revised ESRS concern Climate Change (E1), Pollution (E2) and Biodiversity (E4), where detailed and duplicative disclosure requirements were substantially reduced and shifted towards a materiality - and principle-based approach. In contrast, Resource Use and Circular Economy (E5) introduces relatively new and strategically oriented disclosures, while Water and Marine Resources (E3) has been substantially reoriented towards risk-based and location-specific reporting. The environmental standards included in the ESRS should be considered collectively, as they are closely interconnected and actions or impacts in one area influence the others. These are thematic standards, which means that companies are required to disclose information if they deem it material. However, E1 is the only thematic standard that, if considered non-material, requires companies to disclose the reasons for this assessment (Leal Filho et al., 2025). In accordance with the ESRS standards, companies will be required to report data in the following conceptual categories: environmental risk management, monitoring of emissions and pollution, environmental safety management systems, and responses to environmental incidents. Additionally, in the areas of environmental safety and environmental management, several key international standards influence the outcomes achieved in sustainable development, and therefore, will be directly or indirectly linked to data disclosures in reports. For reporting environmental (E) data, the key standards include not only the ISO 14001 family of environmental management standards, such as ISO 14001 and EMAS, but also standards related to energy management (ISO 50001), greenhouse gas emissions (ISO 14064), water footprint monitoring and management (ISO 14046),

environmental performance evaluation (ISO 14031), and occupational health and safety (ISO 45001).

4. MATERIALS AND METHODS

For the qualitative analysis, the most recent sustainability reports of the six largest companies listed on the WIG20 stock exchange and covered by the CSRD directive were included as follows: PKN Orlen, LPP, KGHM, CD Projekt, Allegro, and PZU. The surveyed organizations represent six different sectors. The sample selection was purposive. The selection of companies' reports for evaluation was based on the following criteria: year of publication (2025), availability, alignment of ESG reports with the CSRD requirements. The analyzed reports related to the 2024 financial year and were published in 2025 in accordance with the earlier CSRD requirements introduced in Poland. In the area of environmental data (the E – environmental part of ESG disclosure), the analysis examined whether companies disclosed information on environmental risks in their reports in accordance with the new ESRS criteria (E1–E5), consistent with the updated CSRD guidelines, including: climate change adaptation (ESRS E1), pollution (ESRS E2), water and marine resource management (ESRS E3), biodiversity and ecosystem protection (ESRS E4), and efficient resource use and the circular economy (ESRS E5).

To analyze the ESG reports in relation to the ESRS standards (E1–E5), VOSviewer was used to map and visualize term networks (so-called co-occurrence networks) in a cluster view. VOSviewer utilizes bibliometric mapping algorithms to identify semantic relationships between terms and group them into thematic clusters. However, sustainability reports do not follow a standard bibliographic format. Therefore, the report files were first converted into '.txt' format using online software, and only the sections related to the environmental dimension of ESG reporting were extracted. VOSviewer automatically analyzes the frequency with which words or phrases co-occur in a text, effectively extracting keywords. The following program settings were used to create the maps: input data type – *create a map based on text data*; data source – *read data from VOSviewer files*; counting method – *full counting*; threshold – 5; maximum number of terms – 40. As a result, it becomes possible to capture the structure of report content, highlight the most frequently discussed issues, and identify areas that are strongly or weakly represented in the analysed documents. VOSviewer, therefore, constitutes an effective method for supporting the qualitative assessment of the alignment of ESG reports with CSRD requirements, revealing hidden relationships and patterns in environmental terminology (E1 - E5). In the next section the analysis also included the implementation of ISO standards by the examined entities, where these relate to specific ESG reporting areas, enhance environmental safety, and address "double materiality" according to the new CSRD guidelines.

5. RESULTS

The first part of the results presents visualizations in the form of maps generated using VOSviewer software to illustrate the relationships between the most important concepts (keywords) appearing in the analyzed sustainability reports (environmental dimension) and the ESRS standards for each company included in the study. Map 1, showing word co-occurrence for PKN Orlen's sustainability report, accurately reflects the new ESRS reporting requirements under the CSRD directive. The map illustrates a broad range of ESG topics required by the ESRS: environmental issues (e.g., "emission," "production,"

"oil," "electricity," "biodiversity," "water"), social aspects (e.g., "local community," "engagement," "safety," "health," "person"), as well as governance and strategic themes ("scope," "opportunity," "support"). Large clusters of technical and environmental terms (green cluster – "production," "oil," "electricity," "emission," "use," "ghg emission," "biogas") demonstrate a strong emphasis on detailed presentation of production processes, greenhouse gas emissions, and raw materials across the value chain - consistent with ESRS E1, E2, and E4 (climate, water, biodiversity). The map for LPP reveals "risk" as the central node, closely linked to "biodiversity", "pollution", "own operation", and "supply chain", emphasizing strategic ESG risk management across the entire value chain. The green emissions cluster ("emission", "scope", "greenhouse gas emission", "electricity") indicates detailed carbon footprint reporting by Scope 1-3, aligned with ESRS E1. The blue cluster "store-waste-clothing" reflects sector-specific focus, connecting retail sales, textile waste, and consumers, fitting ESRS E5.

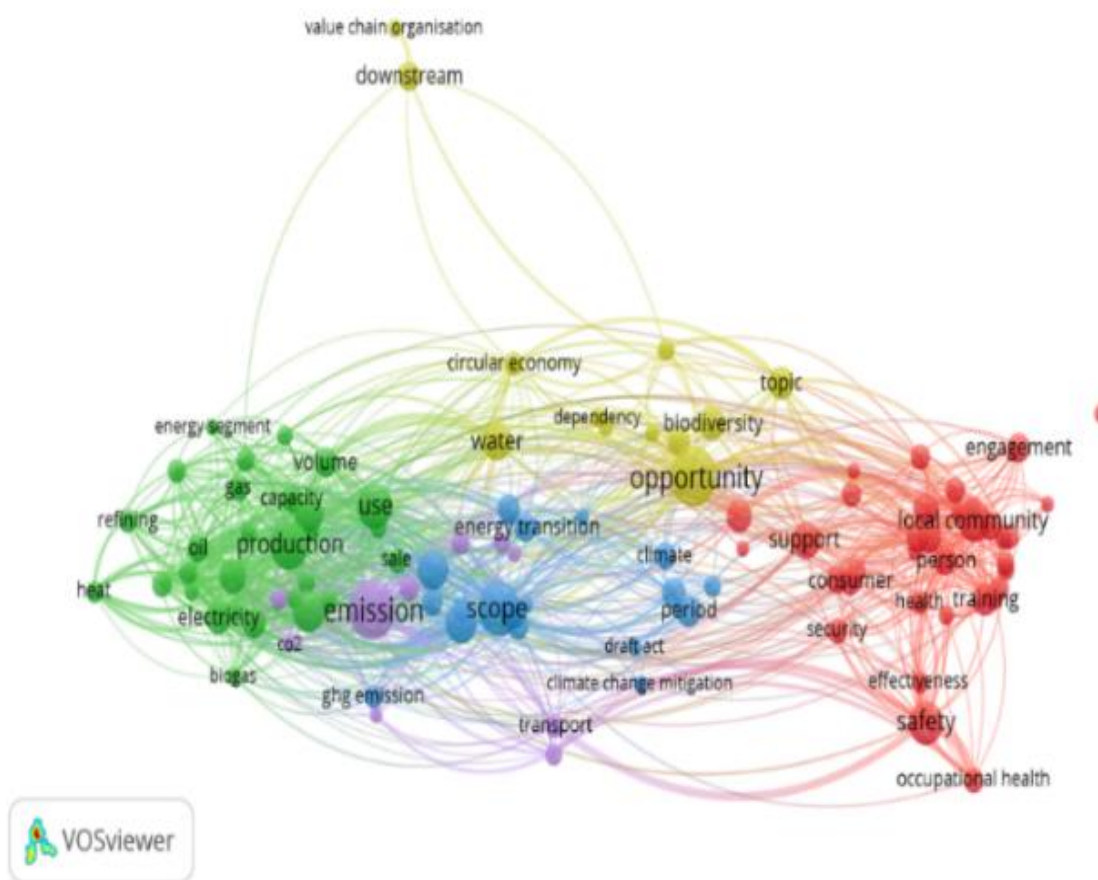
For KGHM, the central concepts on the map are "emission," "scope," and "greenhouse gas emission" (purple cluster), clearly emphasizing emission reporting, Scope 1, 2, and 3 categories, and detailed carbon footprint analysis - aligned with ESRS E1 (climate change) and E2 (pollution) Strong relationships between water, emissions, and mining topics illustrate an integrated approach to the environmental impacts of industrial operations (Map 3).

The central concepts for Allegro Group, such as "emission," "scope," "carbon footprint," "waste," "packaging," "eco design," "circularity," and "adaptation," point to a broad approach to emission management and product and waste life-cycle considerations. These themes align with ESRS E1 (climate) and E5 (circular economy and resource use). The network structure and highly integrated clusters indicate that Allegro's ESG report addresses all key aspects of modern ESRS-aligned reporting, encompassing emissions and carbon footprint, supply chain, strategy, materiality, and data transparency (Map 4). In the case of PZU, the most prominent cluster (red) includes the terms "investment," "banking," and "insurance," which are strongly interconnected. This link highlights the company's core business areas: investments, banking, and insurance. Strong links between these terms highlight the internal interdependencies within the capital group and the complexity of the financial offering. The absence of strong connections to environmental keywords typical of industrial sectors underscores the distinct ESG reporting focus in the financial sector: a stronger emphasis on risk management, responsible investment (Sustainable Finance), and monitoring impacts on the financial and social environment (Map 5).

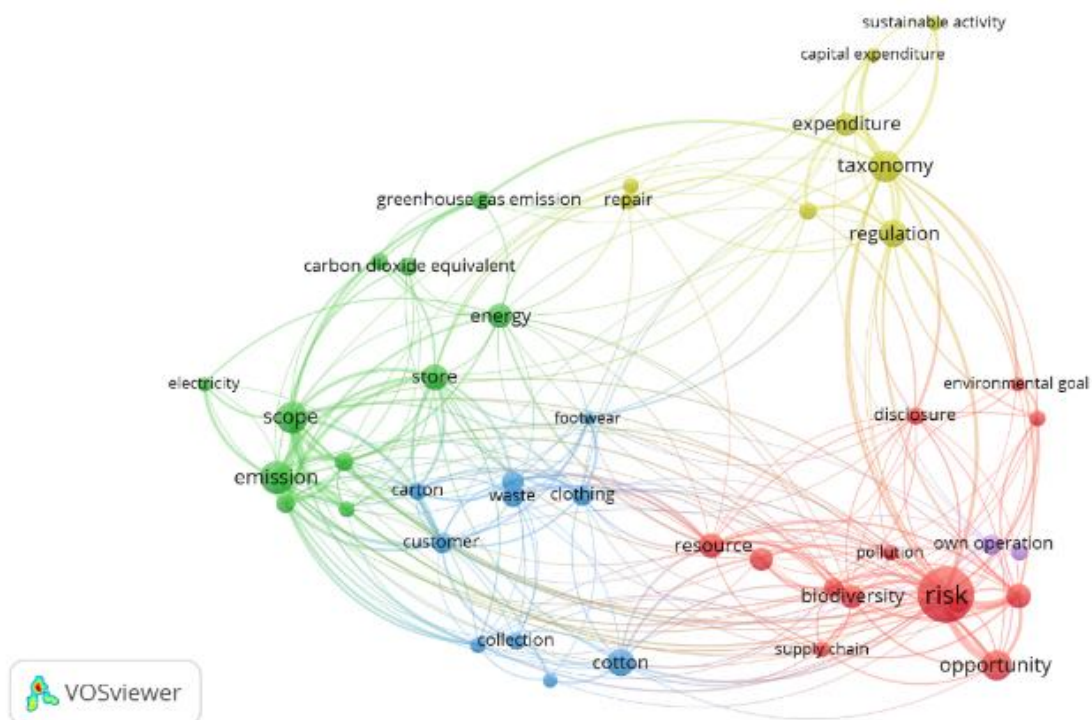
The analysis of the maps indicates that only PKN Orlen, in its 2024 report, refers to three different thematic areas - E1, E2, and E3. For this company, the thematic relationship map appears to be the most developed.

The co-occurrence word maps from VOSviewer show that key ESG topics cluster around environmental issues, aligned with ESRS standards. Each company's map highlights priorities relevant to its sector; for example, PKN Orlen focuses on emissions and production, LPP on risk and supply chain responsibility, and PZU on financial sector risks and investments. Overall, the maps reveal integrated and sector-tailored ESG report themes reflecting each company's strategic focus under EU sustainability reporting requirements.

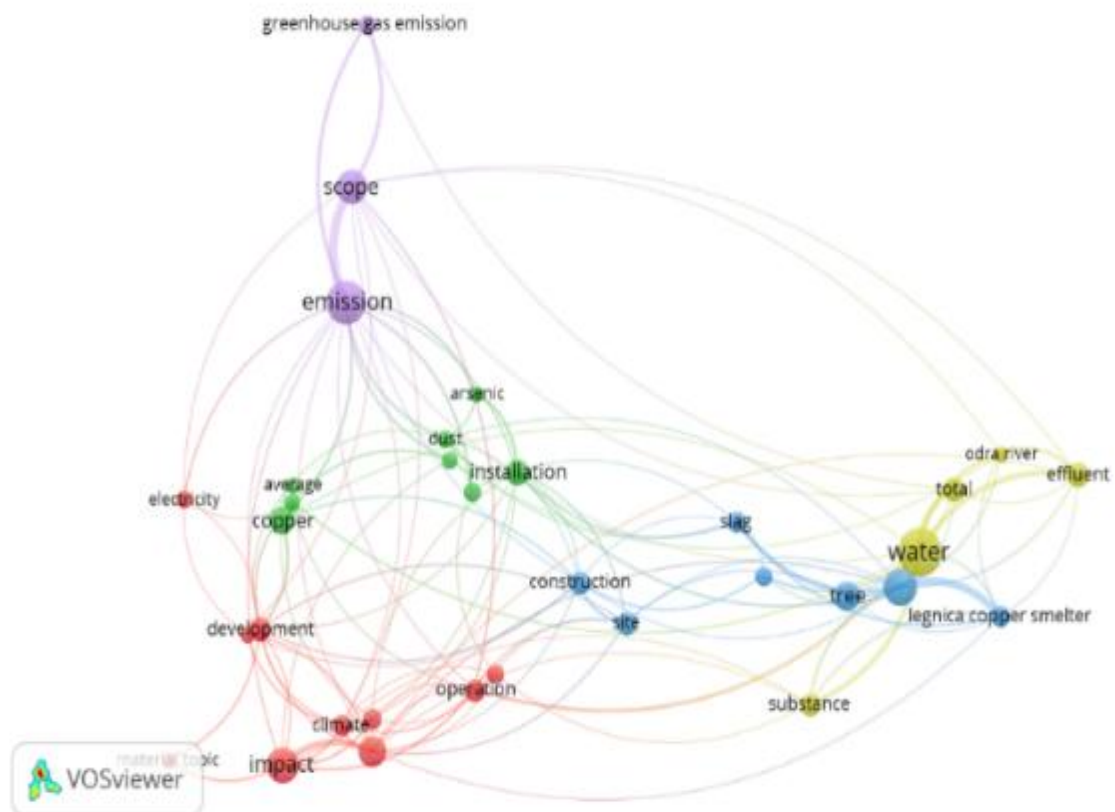
Map 1. PKN Orlen



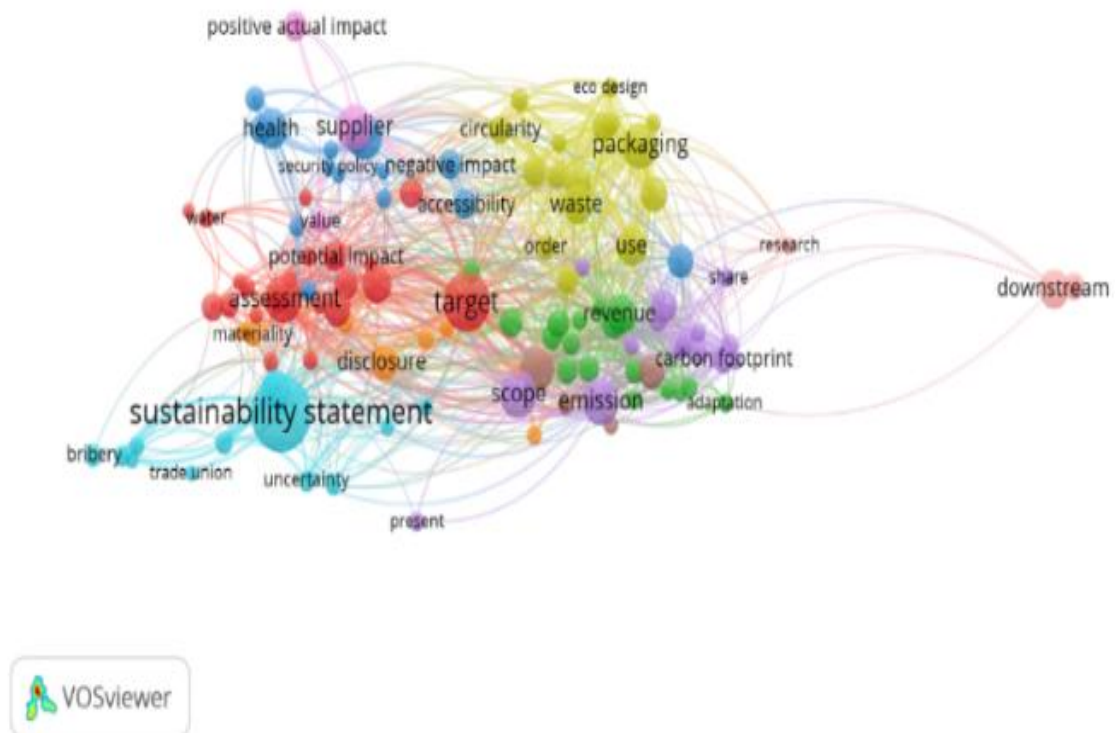
Map 2. LPP SA



Map 3. KGHM



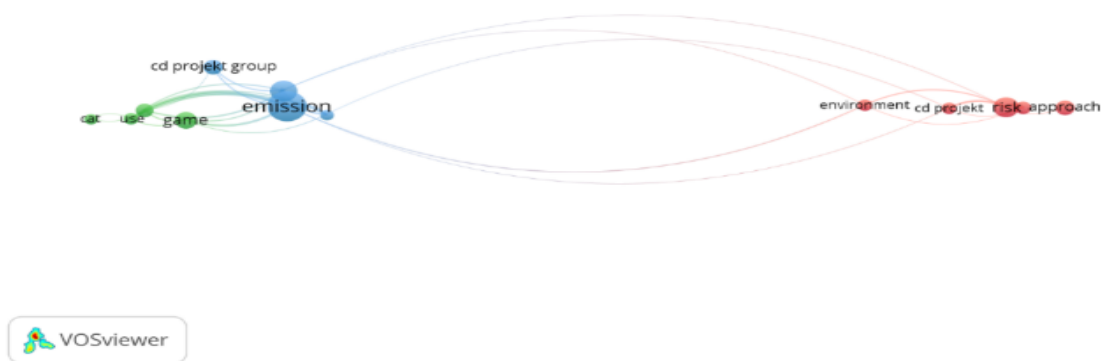
Map 4. Allegro



Map 5. PZU



Map 6. CD project



To conclude, environmental safety is a key aspect of ESG reporting, as it is closely linked to risk management and compliance with ESRS requirements, as evident in the co-occurrence maps. However, references to the new ESRS standard areas relate most strongly to ESRS E1 - Climate Change (e.g., emissions, energy, and adaptation plans) and ESRS E5 – Resource Use and Circular Economy (e.g., raw material consumption and circular economy). Companies most readily report on climate and resource management, while devoting the least attention to biodiversity, ecosystems, and the management of water and pollution—an imbalance visible both in the content of the reports and in the word co-occurrence maps.

The second part of the analysis aimed to prepare a summary showing which of the analyzed companies have implemented standards such as ISO 14001, ISO 45001, ISO 50001, ISO 14064, ISO 14046, and ISO 14031 and which represent how company's management of their environmental risks focusing also on the assessment of double materiality (compliance with ESRS), as well as the identification and management of environmental and climate-related risks, and the implementation of ISO standards related to environmental management, occupational safety, and energy efficiency (Table 3).

Table 3.

Environmental safety standards in the surveyed organizations

Company	Environmental Risks	ISO 14001	ISO 45001	ISO 50001	ISO 14064	ISO 14046	ISO 14031
PKN Orlen	Yes - climate and environmental risks	Yes	Yes	Yes	Yes	No	Yes
LPP	Yes – environmental and social risks	Yes	Yes	No	No	No	No
KGHM	Yes – environmental risks, occupational health and safety	Yes	Yes	Yes	Yes	Yes	Yes
Allegro	Yes – environment and energy risks	Yes	Yes	Yes	Yes	No	No
PZU	Yes – safety and energy risks	Yes	Yes	Yes	Yes	No	Yes
CD Projekt	Yes – environment and employee health risks	Yes	Yes	No	Yes	No	Yes

Source: own elaboration based on companies' sustainability reports.

The analysis shows that all ISO standards were adopted by KGHM. With regard to the implementation of standards related to occupational health and safety (OHS) and environmental management (ISO 14001 and ISO 45001, respectively), all of the surveyed enterprises are certified. ISO standards related to energy efficiency and specific environmental aspects (ISO 50001, ISO 14064, ISO 14046, ISO 14031) are primarily implemented in companies such as KGHM, PKN Orlen, and PZU, and to a lesser extent in LPP and Allegro. In summary, KGHM and PKN Orlen demonstrate the highest level of environmental safety in ISO standards.

6. DISSCUSION

In recent years, we have observed a significant increase in the importance of environmental, social, and corporate governance (ESG) issues in enterprises (Almnadheh et al., 2025). Environmental safety is a critical component of ESG reporting, encompassing the management of environmental risks, compliance with international standards, and transparent disclosure under evolving regulatory frameworks such as ESRS standards. So far, researchers argue that ESG scores still do not adequately consider issues related to climate change or global warming (Rekker et al., 2021) and exhibit considerable bias regarding social issues (Christensen et al., 2022).

The analysis in this paper reveals varying levels of maturity in embedding environmental safety within ESG frameworks and in the emphasis placed on environmental risk management in sustainability disclosures. This is consistent with emerging research indicating that, despite increasing regulatory requirements, many enterprises remain unprepared. Based on a literature review, Khamisu & Paluri (2024) conclude that the application of mandatory ESG regulations (e.g., ESRS) and reporting frameworks influences the scope and depth of disclosures, and that organisations with stronger governance structures and higher corporate maturity are more likely to produce extensive ESG reports.

KPMG (2024), in its ESG Assurance Maturity Index, indicated that among a group of 314 surveyed companies in the European Union, only a portion both report on and obtain assurance for sustainability disclosures in accordance with the requirements of the CSRD

for financial years beginning on or after 1 January 2024 (the “first wave”). The report revealed significant disparities: only some companies achieved the status of “maturity leaders,” while a large group remains in the “beginner” or “advanced” phase (but not yet fully mature). The analysed companies achieved an average score of 48.87 out of 100 on the maturity index. Additionally, the highest scores were recorded by enterprises in the energy and natural resources sector. These results align with the findings of this analysis for KGHM and PKN Orlen, as both companies exploit natural resources and have a significant environmental impact. Our results are also supported by Broniewicz et al. (2024), who found that among Polish companies - particularly banks - environmental data are disclosed in their reports to a lesser extent than required by the ESRS, with the most significant gaps observed in areas such as biodiversity (ESRS E4) and resources (ESRS E5).

7. CONCLUSION

This paper discusses that environmental safety is not merely a checklist item but a strategic pillar that drives governance and operational policies within ESG reporting. It highlights the interplay between qualitative materiality analyses and quantitative disclosure requirements, demonstrating that comprehensive environmental safety management contributes significantly to the overall sustainability performance and risk mitigation strategies of corporations. Maintaining and enhancing environmental safety thus remains integral to meeting stakeholder expectations and regulatory demands, particularly under the CSRD framework and ESRS standards (KPMG, 2024; Deloitte, 2024).

As regulatory requirements continue to increase, there is a risk that some companies will adopt a symbolic approach - that is, they will report only superficially in accordance with the ESRS, without undertaking real operational transformation. The process of homogenization in ESG reporting (e.g., convergence toward low environmental engagement) was described by Xia et al. (2023), who conducted textual analysis of ESG reports and found that companies from different industries are increasingly imitating one another, which may lead to superficial disclosure of environmental topics. This article may serve as a basis for an in-depth comparative analysis of sustainability initiatives in Polish enterprises and for assessing their preparedness for future reporting obligations arising from the ESRS and CSRD.

Future research may include an investigation of sustainability disclosures in accordance with the new ESRS standards by various companies, including those from the first wave (Public Interest Entities), as well as large enterprises not previously covered by the NFRD (non-NFRD), and small and medium-sized listed companies that will report for the year 2028 (Wave 3).

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