Acta Montanistica Slovaca
ISSN 1335-1788
actamont.tuke.sk

The Impact of Formal and Legal Conditions on Environmental Disclosures in the ESG Framework by Capital Groups in the Hard Coal Mining Sector: Evidence from Poland

Aleksandra SULIK-GÓRECKA[1]* *and Marzena STROJEK-FILUS*[2]

Authors' affiliations and addresses:
[1] University of Economics in Katowice, Faculty of Finance, Department of Accounting, 1 Maja Poland 50, 40-287 Katowice
e-mail: aleksandra.sulik-gorecka@uekat.pl

[2] University of Economics in Katowice, Faculty of Finance, Department of Accounting, 1 Maja Poland 50, 40-287 Katowice, Poland
e-mail: marzena.strojek-filus@uekat.pl

***Correspondence:**
Aleksandra Sulik-Górecka, University of Economics in Katowice, Faculty of Finance, Department of Accounting, 1 Maja Poland 50, 40-287 Katowice, Poland
e-mail: aleksandra.sulik-gorecka@uekat.pl

Funding information:
The research was financed by a grant obtained from the project "UEKAT Scientific, Research and Educational Excellence Programme" co-financed by the Minister of Science under the "Regional Excellence Initiative" Programme.

How to cite this article:
Sulik-Górecka, A., Strojek-Filus, M. (2025). The Impact of Formal and Legal Conditions on Environmental Disclosures in the ESG Framework by Capital Groups in the Hard Coal Mining Sector: Evidence from Poland. *Acta Montanistica Slovaca,* Volume 30 (1), 259-271

DOI:
https://doi.org/10.46544/AMS.v30i1.19

Abstract
The extraction of hard coal has significant adverse effects on the natural environment, which mining entities disclose in their non-financial reports in compliance with increasingly stringent legal regulations. Regular stakeholder communication, encompassing comprehensive information on a company's economic, social, and environmental activities, enhances corporate transparency, facilitates the assessment of strategic implementation, and supports the identification of future risks. The objective of this article is to assess the impact of formal and legal conditions on ESG reporting within the environmental disclosure domain by the largest capital groups in Poland's hard coal mining sector over the period 2017–2024, with a particular focus on the role of taxonomy reports. The study employs an in-depth qualitative comparative analysis of data contained in the Management Board's activity reports and the consolidated financial statements of the three largest capital groups in the hard coal mining sector: the Jastrzębska Spółka Węglowa (JSW) Group, the Lubelski Węgiel Bogdanka S.A. (LWB) Group, and the Polska Grupa Górnicza S.A. (PGG). The comparative findings of these three capital groups – two of which are publicly listed on the Warsaw Stock Exchange (GPW) and one that remains privately held and subject to the Polish Accounting Act – revealed significant differences in the scope of environmental disclosures within the ESG framework. The primary reason for these differences lies in the varying ESG reporting regulations applicable to publicly traded groups. The study's results indicate that due to the classification of their operations as non-sustainable under the EU Taxonomy, the ESG indicators reported by the publicly listed companies are notably low, as coal extraction and sales are not considered sustainable activities. However, a detailed analysis of the companies' activity reports highlights substantial engagement in pro-environmental initiatives, reflected in expenditures, costs, and investments related to environmental protection. The study's findings contribute to a deeper understanding of the specific characteristics of the hard coal mining sector in the context of ESG reporting, offering insights into the implications of regulatory frameworks on corporate disclosure practices.

Keywords
EU taxonomy, sustainable development, coal mining, non-financial reporting, financial report

Introduction

Coal mines remain the cornerstone of Poland's energy security, despite a decline in production in recent years. As of December 2024, there are 19 active hard coal mines and four lignite mines operating in Poland (Instrat, 2025). Hard coal extraction in Poland accounts for approximately 96% of the total coal production in the European Union, primarily due to the closure of coal mines in other EU countries (Siciński, 2024).

Despite its monopolistic position within the European Union, Poland's mining sector faces numerous challenges, including underinvestment, low productivity, competition from non-EU coal imports, technological difficulties, and the strong influence of labor unions compared to other stakeholders (Antonowicz et al., 2023; Ulewicz et al., 2022). The operation of coal mining activities in Poland is subject to significant uncertainty, driven by the need to align the sector with EU regulations and Poland's energy transition strategy. This strategy is outlined in the Polish Energy Policy 2040 (2021) and the Social Agreement signed on May 28, 2021, which mandates a reduction in coal usage in the national economy. These regulatory requirements have a direct impact on the restructuring processes and business models of mining enterprises.

Coal mining is an industry characterized by high capital intensity. In light of the necessity to secure financial resources, the role of equity capital and shareholder engagement cannot be overlooked. Research conducted by Ernst & Young in 2024 identifies capital availability as the most significant risk for the mining and metallurgical sectors. Furthermore, three out of the ten most critical risks concern environmental issues, specifically environmental stewardship, resource management, and climate change (EY, 2024).

The extraction of hard coal has significant negative environmental impacts, resulting in long-term and often irreversible changes to ecosystems. The environmental consequences of coal mining, such as damage to both surface and underground infrastructure, have been highlighted by Biały et al. (2020). Mocek (2022), in turn, emphasizes the impact of excessive industrial noise on the working environment of hard coal mines. It is currently postulated that mining processes should be automated and carried out with reduced energy and water consumption, as well as the progressive use of clean energy from renewable sources. (Ulewicz et al., 2021; Kluczek 2022; Senova et al., 2024). Consequently, the mining sector plays a crucial role in achieving sustainable development goals and requires urgent and comprehensive measures. However, research findings indicate a low level of implementation of environmental objectives in the mining sector in Central and Eastern European countries (Jonek-Kowalska, 2022). Mining enterprises must systematically identify and assess the environmental impact of their operations, as stakeholders increasingly demand the integration of sustainable development policies in the coal mining sector (Jonek-Kowalska et al., 2022). Financial reports of mining enterprises serve as a key communication tool with shareholders and investors and must adhere to specific quality requirements, a topic extensively discussed in the literature (Luther, 1996; Abdo, 2016; Cortese et al., 2009).

According to the research of Jorge-Vazquez et al. (2024), European Union countries are adjusting to the changes in the energy transition at varying rates and to different extents. However, according to legitimacy theory, organizations strive to maintain or gain societal approval and the acceptance of other stakeholders in order to operate in a manner deemed "legitimate" – that is, in accordance with the norms, values, and expectations of a given community (Clarkson et al., 2008; Deegan 2019). An expression of this is their alignment with legal regulations regarding non-financial reporting. The obligation of non-financial reporting, stemming from the implementation of Directive 2014/95/EU of the European Parliament and the Council (NFRD, 2014), was incorporated into the Polish Accounting Act in 2017. Entities employing more than 500 people and meeting at least one of two financial thresholds (PLN 85,000,000 in total assets at the end of the financial year or PLN 170,000,000 in net revenue from sales of goods and products) are required to include in their Management Report a statement containing at least the following: a concise description of the entity's business model; key non-financial performance indicators related to the entity's activities; a description of the policies implemented regarding social, labor, environmental, human rights, and anti-corruption matters; a description of significant risks related to these issues; and an outline of due diligence procedures. Furthermore, as a result of the Corporate Sustainability Reporting Directive (CSRD, 2022) and the EU Taxonomy (2020), companies are obligated to apply the criteria derived from the EU Taxonomy and disclose them in non-financial reports and product-related environmental information.

Despite the increasing legal requirements regarding sustainability reporting, including environmental disclosure obligations arising from the Corporate Sustainability Reporting Directive (CSRD, 2022), the EU Taxonomy Regulation, and the Sustainability Reporting Standards Regulation, the authors have identified a research gap related to the formal and legal conditions of environmental information reporting by entities in the Polish hard coal mining sector. The primary research problem concerns the impact of formal and legal factors, including the public listing status of corporate groups, on the type and scope of reported information, particularly in the context of taxonomy application.

This study aims to assess the impact of formal and legal conditions on the ESG reporting of the largest corporate groups in the Polish hard coal mining sector, with a focus on environmental disclosures between 2017 and 2023, paying particular attention to the role of taxonomy reports.

The authors formulated three research questions:

RQ1: How did the financial situation of mining entities evolve between 2017 and 2023?

RQ2: What is the significance of taxonomy reports in presenting the actual achievements and activities of entities in the Polish hard coal mining sector?

RQ3: To what extent does the listing or non-listing of a corporate group on the public market influence the manner, scope, and content of environmental disclosures in Poland's mining sector?

The empirical research employed a case study approach, focusing on the largest corporate groups in the Polish hard coal mining sector. The study was based on an in-depth comparative analysis of secondary data from both financial and non-financial reports prepared by the examined corporate groups. Elements of text analysis were applied to the information contained in non-financial reports, while financial data were utilized to calculate selected indicators within the framework of financial analysis.

The study's findings expand and deepen the understanding of the determinants of ESG reporting in the Polish hard coal mining sector. They also highlight the significant complexity of environmental reporting in this industry, particularly in relation to taxonomy reports. According to the authors' assessment, taxonomy reports not only fail to enhance user access to information but may even distort the representation of companies' actual environmental activities. Consequently, they do not meet expectations regarding the fulfillment of sustainable development objectives.

Literature Review

International studies on public attitudes toward active hard coal mines highlight the complexity of the issue, significant cross-country differences, and varying approaches to reducing coal-based energy consumption in favor of environmentally friendly renewable energy sources (Frantál et al., 2025). The economic and social conditions of coal phase-out have been analyzed in various countries, including those in Central and Eastern Europe (for instance, Mayer, 2022; Żuk, 2023; Frantál et al., 2022).

Research conducted by Maruszewska et al. (2023) examines the challenges of energy transition and coal consumption reduction in Central and Eastern European countries. The study also incorporates psychological factors influencing young people's attitudes toward these issues in Poland, Romania, Slovakia, and the Czech Republic. The findings suggest that these countries are lagging behind in adopting European Commission strategies and meeting their renewable energy targets. The situation in Poland is particularly complex.

The financial condition of the Polish coal mining industry has been a subject of academic research for many years. Studies have addressed issues and challenges in the Polish mining sector, including the need for restructuring, declining average coal prices, and poor financial and economic performance (Lisowski, 2015). Other research has examined the effects of coal mining and energy sector integration in Poland (Bukowski et al., 2016), as well as the sector's overall financial health, profitability, liquidity, and value creation between 2007 and 2019 (Sobczyk et al., 2020).

Particularly interesting findings emerge from analyses of the 2020–2023 period, when mining companies faced challenges related to the COVID-19 pandemic and the outbreak of war in Ukraine. The financial situation of the mining sector was significantly affected by the collapse in energy demand in 2020 and the resulting decline in industrial coal consumption. The sharp rise in global coal prices in 2021–2022 led to a temporary boom for coal producers, as high coal fuel prices drove industry growth and enabled unprecedented profit margins. However, following the outbreak of war in Ukraine, fears of supply disruptions due to sanctions on Russian coal led to large-scale coal procurement in Europe. As a result, from autumn 2022 onward, thermal coal prices began to decline steadily. The risks of financial distress and potential bankruptcy in the mining sector have been analyzed in this context (Siciński, 2024).

Amid the challenges and volatility of the global mining industry, researchers have examined the scope and role of financial reports in presenting the economic situation of mining entities. Studies on sustainability reporting in the mining sector emphasize the importance of integrated sustainability reporting, particularly in understanding the evolution and development of reporting methodologies across all dimensions of corporate social responsibility (Lauwo et al., 2016; Gray et al., 2019; Samkin et al., 2024; Centorrino et al., 2025). Stakeholders, especially regulatory authorities, are increasingly interested in monitoring the quantitative impacts of mining activities. This has led mining companies to intensify efforts to mitigate the negative environmental effects of their operations (Fikru et al., 2024). ESG ratings play a crucial role in assessing the sustainability performance of mining companies and are particularly valuable for investors. Research by Fikru et al. (2024) has identified several factors that influence ESG rating assessments. ESG ratings have been extensively studied (for instance, Tsang et al., 2024; Fikru et al., 2024; Fredericsen, 2018; Dougherty, 2017).

Scholars have also explored the need to expand traditional financial performance measurement and assessment frameworks in the mining industry to incorporate sustainability-related data. ESG reporting is essential for evaluating the economic and social dimensions of mining operations, particularly in fostering trust among stakeholders (Pavloudakis et al., 2024). It broadens the concept of non-financial corporate performance by

prioritizing environmentally responsible mining practices. A study of Greek mining companies demonstrated the environmental impact of their operations, particularly in terms of CO_2 emissions, alongside their financial performance. ESG and taxonomy reports play a critical role in presenting information on risk, uncertainty, and the life cycle of mining companies (Maybee, Lilford, & Hitch, 2023). Studies have also been conducted to analyze the significance and value of environmental costs incurred in divisions of the parent company operating in different geographical locations (Teplicka and Hurna, 2023).

According to Zharfpeykan's (2021) research, in line with legitimacy theory, an increasing number of companies voluntarily publish costly sustainability reports, which may expose them to risks and focus on controversial environmental and social issues. Companies strategically seek to enhance their legitimacy, either by leaning towards "representative" reporting of both positive and negative information, particularly in areas of highest impact within their industry, or by engaging in "greenwashing", which downplays negative information and high-impact areas while emphasizing positive but less relevant information.

The environmental reporting of mining entities prior to the mandatory reporting requirements under the Accounting Act coming into force was examined by Bogacz and Mizga (2021), who assessed the degree of compliance with the GRI Guidelines and found that most of the analyzed entities fulfilled their obligations to approximately 50%.

Similarly, Pactwa (2022), after analyzing Achieving United Nations Sustainable Development Goals by the Polish Mining Sector, identified significant variations in reporting practices while also noting efforts to improve corporate image through environmental reports. Further studies have analyzed compliance with IFRS 6: Exploration for and Evaluation (E&E) of Mineral Resources, as well as challenges arising from the flexibility in accounting methods for E&E costs (Stadler and Nobes, 2022; Abdo, 2016; Cortese et al., 2022).

Based on the analysis of prior research, the following research hypotheses were proposed:

H1: Taxonomy reports limit users' access to information on the actual activities of mining sector entities regarding the reduction of their negative environmental impact.

H2: Taxonomy reports, in practice, diminish the relevance of the concept of non-financial performance for mining sector entities.

H3: The comparability of environmental information reported within the Polish mining sector is hindered due to the ownership and legal diversity of capital groups.

Materials and Methods

The largest coal mines in Poland include those operated by the Jastrzębska Spółka Węglowa (JSW) Group (KWK Knurów-Szczygłowice, KWK Borynia-Zofiówka, KWK Pniówek, KWK Budryk), the Polish Mining Group (Polska Grupa Górnicza, PGG) (KWK ROW, KWK Piast-Ziemowit, KWK Staszic-Wujek, KWK Ruda), and Lubelski Węgiel Bogdanka S.A. (Charkowska et al., 2024). To verify the research hypotheses, case studies were conducted on all three of these capital groups. Jiang et al. (2023) highlight challenges in analyzing the text of non-financial reports, which stem from issues related to the comparability of ESG data and the need to develop a more effective taxonomy.

This study employs an in-depth comparative analysis of secondary data contained in management board reports and consolidated financial statements. Based on these reports, selected financial figures were compiled and assessed in the context of national data. Key financial indicators were also calculated to evaluate the financial situation of the examined entities. The applied text analysis enabled a comparison of actions undertaken to mitigate environmental impact, investments related to qualifying activities, and expenditures on environmental projects. Additionally, summarized data were compiled on selected environmental disclosures in physical units, as well as expenditures on waste management, land reclamation, and the costs of mitigating mining-related damages.

The study period spans 2017–2023, as the obligation to include non-financial information statements in management board reports was introduced in 2017. Due to the significant variation in the scope of disclosures, for comparability purposes, the study focused on those disclosures consistently presented by all examined entities.

To evaluate the scope and structure of disclosures, management board reports for the years 2017–2023 were analyzed for all three entities: the Jastrzębska Spółka Węglowa (JSW) Group, the Polish Mining Group (PGG), and the Lubelski Węgiel Bogdanka S.A. (LWB) Group. For publicly traded entities, namely JSW and PGG, additional analysis was conducted on taxonomic disclosures from the time this reporting obligation was introduced (2021–2023). Consolidated financial reports and management reports of JSW and LWB were obtained from the websites of these entities. PGG, not being listed on the stock exchange, does not publish reports on its website; therefore, they were sourced from the government financial reporting database EKRS.

To assess the financial situation, a review of the consolidated financial reports of the three examined entities for the period from 2017 to 2023 was conducted. The analysis considered key financial metrics, including total revenue, net financial result, profitability indicators (ROA, ROE, ROS), the current liquidity ratio (CC), the total debt ratio (DR), and the price-to-book value ratio (P/BV).

Results

Figure 1 presents data on coal sales by the analyzed entities, based on Management Board Reports for the Years 2017-2023, in the context of overall coal sales in Poland from 2017 to 2023.

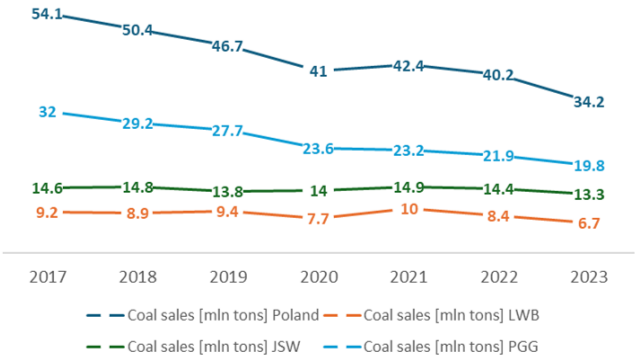

Fig. 1. Comparison of coal sales in Poland from 2017 to 2023

The chart indicates a declining trend in coal sales in Poland. In 2023, coal sales amounted to 63% of the sales recorded in 2017. A significant decrease in sales can be observed in LWB and PGG, while JSW experienced a comparatively smaller decline, with its 2023 coal sales reaching 91% of the 2017 level.

Table 1 presents a synthesized summary of financial data for the analyzed entities. The financial situation of the analyzed entities based on selected criteria.

Tab. 1. The financial situation of the analyzed entities based on selected criteria

Year	Revenue [mln PLN]	Net income [mln PLN]	ROE [%]	ROA [%]	ROS [%]	CR [%]	DR [%]	P/BV [%]
JSW								
2017	8,877.2	2,543.3	38.4	21.04	28.65	156.62	45.24	170.72
2018	9,809.5	1,760.8	20.8	12.79	17.95	95.49	38.64	93.51
2019	8,671.8	649.6	7.3	4.35	7.49	96.20	40.70	28.36
2020	6,989.4	-1,537.4	-21.0	-10.23	-22.00	94.75	51.32	41.64
2021	10,629.1	952.6	11.5	5.97	8.96	100.40	48.01	49.34
2022	20,198.5	7,593.8	47.6	28.16	37.60	101.53	40.89	42.85
2023	15,338.5	997.1	5.9	3.59	6.50	81.27	38.94	29.08
LWB								
2017	1,780.3	667.9	23.0	16.06	37.52	98.01	30.23	78.54
2018	1,756.7	53.8	1.8	1.37	3.06	105.09	25.00	59.15
2019	2,157.9	308.7	9.6	7.26	14.31	198.49	24.08	36.72
2020	1,822.1	95.2	2.2	1.67	4.00	169.63	24.58	19.79
2021	2,371.3	288.3	8.0	6.13	12.16	198.95	23.57	30.29
2022	2,451.7	175.6	4.7	3.64	7.16	208.88	23.06	45.80
2023	3,939.3	687.1	16.0	11.93	17.44	227.32	25.31	26.89
PGG								
2017	8,238.1	91.7	2.6	0.79	1.05	53.13	69.18	
2018	9,374.6	494.9	11.8	4.02	5.26	75.00	66.03	
2019	9,019.1	-424.8	-11.5	-3.43	-4.74	55.10	70.18	
2020	7,481.9	-3,251.0	-727.4	-33.27	-43.52	27.20	95.43	NA
2021	8,093.5	-3,818.5	114.9	-51.10	-47.23	22.07	144.47	
2022	12,363.0	2,533.6	-1,138.7	26.31	20.49	38.66	102.31	
2023	16,121.1	2,357.4	154.6	20.15	14.62	68.16	86.96	

Regarding question RQ1, the table indicates that despite operating within the same sector, the financial performance of the examined entities varied significantly. It should be noted that the revenues of JSW, a publicly listed company, and PGG, which has been fully owned by the State Treasury since 2022, remained at a comparable level. However, their net financial results differed substantially. For instance, in 2023, PGG recorded more than twice the net profit of JSW, despite similar revenue levels. At the same time, PGG reported significant financial losses in 2020 and 2021.

Unfortunately, both JSW and the significantly smaller entity, LWB, experienced a decline in the P/BV ratio during the analyzed period (calculated as the closing price * number of issued shares/equity).

To assess the structure and scope of environmental reporting by the publicly listed entity LWB, the management board reports for the years 2017–2023 were thoroughly analyzed. As early as 2017, LWB outlined its commitment to conducting business operations in accordance with its corporate social responsibility (CSR) strategy, which encompasses ensuring the highest level of workplace safety, environmental efficiency, protecting local biodiversity, and effective stakeholder relationship management based on the principles of sustainable development.

In compliance with the requirements of the Accounting Act, the group identified and described various risks, including those related to land reclamation and mining damages, the tightening of environmental standards and regulations, and the obligation to obtain environmental permits. The group has implemented an Integrated Quality and Environmental Management System and obtained certifications for ISO 14001, 9001, and 18001 standards.

Since 2022, LWB has been calculating its carbon footprint at both the organizational level and for three specific products: thermal coal, coal fines, and mining waste. In 2023, the carbon footprint methodology underwent an external audit. That same year, the LWB adopted a new development strategy for 2023–2030, with a long-term perspective extending to 2040, outlining objectives related to the circular economy, improvements in energy efficiency, and the reduction of greenhouse gas emissions.

The company reported environmental protection expenditures amounting to PLN 29.661 million, including investments in the construction and expansion of underground water pumping stations. Various initiatives were implemented, including circular economy (CE) projects aimed at maximizing the utilization of waste rock as a byproduct of coal production. Additionally, automation, intelligent process control, and production monitoring initiatives were undertaken to enhance cost optimization and improve safety.

The scope of environmental reporting can be assessed as average. While the group strives to present its environmental goals and achievements comprehensively, the disclosures primarily focus on the information required by regulations. Table 2 provides a summary of selected environmental disclosures of LWB.

Tab. 2. Summary of LWB's environmental disclosures according to selected criteria.

Specification	2017	2018	2019	2020	2021	2022	2023
CO2 emissions	48557	ND	ND	ND	ND	ND	ND
Electricity consumption [m³]	326,444.20	340823	328,211	305,492	327,320	316,831	327,383
Water consumption [thousands of m³]	7,538	10,770	11,623	11,990	11,442	11,875	13,964
Extractive waste production [thousands of tons]	5963.7	6646.2	6,299.90	5,091.40	4,790.50	4,794.30	5,433.10
Waste recovery [%]	47.1	46.5	48.6	45.3	53.8	48.5	40.9
Waste management expenditures [mln PLN]	33373.9	36729	38,739.70	33,502.30	38,350.00	42,543.60	41,274.40
Costs of environmental protection, reclamation, and monitoring [thousands PLN]	2028.3	3985.7	6 473, 6	2,048.10	1,366.40	2,439.10	2,274.90
Environmental use fees [thousands PLN]	525.8	451.5	507.4	545	640.7	599.3	545

It should be noted that since 2018, there has been no disclosure regarding CO_2 emissions, along with a significant increase in water consumption and a reduction in the level of mining waste. At the same time, expenditures on waste management and fees for environmental usage have been rising.

An analysis of the environmental disclosures of the largest entity, PGG, indicates that the group undertakes measures aimed at reducing its negative environmental impact. These efforts are implemented within the framework of the certified Integrated Management System (IMS), which complies with the requirements of ISO 9001:2015 (Quality Management Systems) and ISO 14001:2015 (Environmental Management Systems). To limit air pollution resulting from the combustion of solid fuels, the group discontinued the sale of slurry assortments and flotation concentrates to the municipal and residential sectors in August 2017.

Additionally, the group installed a 410 kW photovoltaic system on the roofs of the mines, which generated 410.071 MWh of electricity for internal use in 2022. In December 2021, two cogeneration units (2 × 2 MWe) powered by methane drainage gas from one of the mines were commissioned. In 2022, these units produced 24,369.262 MWh of electricity and 29,222 GJ of thermal energy, which was used by PGG S.A. and partially sold. The economic utilization of methane resulted in financial benefits amounting to PLN 119.7 million and prevented the emission of over 57 million m³ of methane into the atmosphere, corresponding to a reduction of 1.14 million tons of CO_2. This initiative significantly mitigated environmental impact, given that methane has a greenhouse effect 28 times greater than CO_2.

The level of compliance with environmental reporting requirements under the Accounting Act should be assessed as minimal. The reports primarily contain only the essential environmental information presented in a condensed manner, with little observable expansion in their scope over time. Table 3 presents a compilation of PGG's environmental disclosures according to selected criteria.

Tab. 3 Summary of PGG's environmental disclosures according to selected criteria.

Specification	2017	2018	2019	2020	2021	2022	2023
Gas emissions [tons]	384	390	441	439	434.00	401.30	329.2
Electricity consumption [GWh]	1607	1639.9	1,599.30	1,554.70	1534.3	1522.8	1,461.60
Water consumption [thousands of m³]	3,812	3,753	3,831	3,560	3,267	3,424	4,111
Extractive waste production [thousands of Mg]	8,420.0	7,864.0	7 977	7,605.0	6,644.0	6,026.9	6,435.7
Waste recovery [%]	98	98	98	98	majority	majority	majority
Environmental use fees [mln PLN]	41.9	44.9	43	46.6	45.8	40.8	50.7
Costs of mining damage removal [mln PLN]	118.9	133.5	154.7	128.8	136.2	152	182
Penalty costs for exceeding permissible environmental standards [thousands PLN]	0	0	38.9	0	19.8	116.2	56

Since 2019, the group has been reducing greenhouse gas emissions and allocating increasing amounts of funds for the remediation of mining damages. Notably, the group exhibits a high rate of utilization of mining waste, which it either repurposes or sells for various applications, including aggregate production, reclamation of land and areas degraded by mining activities, construction of various structures and hydrotechnical facilities, railway and road embankments, road and highway foundations, and cement production.

A detailed analysis of the management reports of the JSW Group was also conducted. Compared to the two previously examined case studies, JSW's reports stand out due to their comprehensiveness and the extensive scope of disclosures. In 2017, the group announced the adoption of the JSW Group Sustainable Development Strategy for 2017-2020, which aimed to enhance the synergy between business objectives and sustainable development goals while implementing the concept of responsible management in practice. That same year, JSW initiated the implementation of comprehensive solutions for advanced carbon footprint estimation at both the organizational level and within key production processes.

The report informed stakeholders that in 2017, the European Commission confirmed the classification of coking coal as a critical raw material on the list of 27 materials deemed to have a higher risk of supply shortages and greater economic impact than other raw materials. In its 2020 report, the group further elaborated that coking coal and coke continue to play a crucial role in steel production, which is essential for constructing low- and zero-emission infrastructure. Policymakers often focus on end solutions such as wind farms and photovoltaic installations, overlooking the significance of raw materials required for their production. As a result, coking coal is sometimes mistakenly equated with thermal coal. For instance, the production of a single wind turbine requires approximately 140 tons of steel, which, in turn, necessitates the use of 0.56 tons of coking coal and 0.4 tons of coke.

The 2017 report also indicated that the parent company and several subsidiaries had implemented an environmental management system based on the ISO 14001:2015 standard.

In 2022, the JSW Management Board approved the JSW Group's Environmental Strategy for 2030, with a long-term outlook extending to 2050. The company committed to reducing its carbon footprint by 30% by 2030 (Scope 1 and Scope 2 emissions) and set a goal to achieve climate neutrality by 2050. Table 4 presents a compilation of JSW's environmental disclosures according to selected criteria.

Tab. 4. Summary of JSW's environmental disclosures according to selected criteria

Specification	2017	2018	2019	2020	2021	2022	2023
Gas emissions [tons]	306.7	292.3	presented in a separate table				
Electricity consumption [GWh]	1,390	1,437.58	ND	ND	1,519.97	1,479.37	825.65
Water consumption [mln m³]	ND	19.95	20.14	20.21	21.06	20.56	18.92
Extractive waste production [mln Mg]	11.1	10.8	12.1	11.6	12.4	13.1	13
Waste recovery [%]	99	99	93	92	92	90	86
Environmental use fees [mln PLN]	3.7	4.3	3.5	3.6	4.4	4.2	4.8
Costs of mining damage removal [mln PLN]	58.5	75.8	101.1	99.7	102.2	107.5	123
Env. protection investments [mln PLN]	3.5	29.7	76.6	126.1	170.1	123.5	113.8

A positive aspect, as observed in the previously analyzed cases, is the high percentage of mining waste utilization for filling and sealing caving walls to mitigate fire and methane hazards, reduce methane emissions and land subsidence, improve ventilation conditions, and fill decommissioned and sealed redundant mining excavations.

In addition to the disclosures aligned with the reporting criteria also applied by PGG and LWB, the group reports fuel consumption, reclamation expenditures, and saline water management. However, no information was found regarding the total area of degraded land undergoing reclamation efforts. JSW comprehensively presents the structure of environmental and climate responsibility within the organization.

It is noteworthy that the group has consistently reported annual expenditures on environmental and climate-related investments, providing detailed descriptions of these initiatives. For example, in 2022, JSW, as the leader of the ICE-CMM scientific research consortium, secured €11 million for the Methane Emission Reduction (REM) project, with a total budget of €22 million. The project aims to utilize methane from post-extraction deposits for electricity generation, leading to a reduction of 19 million m³ of methane emissions per year and the production of 60,000 MWh of energy. In 2022, JSW managed 90.9 million m³ of methane, preventing the emission of 1.83 million tons of CO_2e. The group's carbon footprint decreased by 7.8% compared to 2018 (Scope 1 by 7.9% and Scope 2 by 7.5%).

According to the reports, the entire group has been implementing projects aimed at improving energy efficiency, including reactive power compensation, modernization of lighting systems, heating networks, pumping stations, and heat exchangers, as well as thermal modernization of buildings and the installation of heat pumps. Other projects focus on modernizing the existing methane drainage network, analyzing and researching air emission parameters from European hard coal mines, and forecasting CH_4 emissions in the context of the coal mining sector's transition.

In 2023, JSW signed a Sustainability-Linked Loan agreement with a consortium of financial institutions for PLN 1.65 billion. The funds are allocated to investments and corporate purposes (PLN 730 million), environmental projects (PLN 490 million), and working capital financing (PLN 430 million). Additionally, in 2023, JSW secured approximately PLN 120 million for methane emission reduction projects supporting the implementation of its Environmental Strategy.

For the first time in 2022, JSW reported climate-related issues and received a "C" rating in the CDP (Carbon Disclosure Project), outperforming its competitors in the mining industry. It ranked 4th among 152 listed companies in the Climate Awareness Ranking. Reporting environmental data through CDP ensures full transparency of data and actions related to water management and climate change, as outlined in the Environmental Strategy. This process, subject to review and evaluation, helps prevent accusations of greenwashing.

The company has comprehensively reported greenhouse gas emissions, providing extensive data on its environmental impact (Table 5).

Tab. 5. Greenhouse gas emissions – JSW carbon footprint

Year	Direct and Indirect GHG Emissions		Direct emissions Scope 1			Indirect emissions Scope 2		Total Emissions (Scope 1+2) market based	
	Market based [mln Mg CO_2e]	Location based [mln Mg CO_2e]	[mln Mg CO_2]	[mln Mg CH_4]	[mln Mg HFCs]	Market based	Location based	Emissions per Unit of Product [mln Mg CO_2e / mln Mg]	Emissions per mln PLN of Revenue [mln Mg CO_2e / mln PLN]
2017	8.1	8.14	1.06	6.03	0.01	1	1.04	0.456	0.000912
2018	8.2	8.22	1.1	6.05	0.02	1.02	1.05	0.445	0.000836
2019	7.87	7.88	1.05	5.83	0.01	1.16	1.18	0.490	0.000907
2020	7.15	7.17	1.13	5.32	0.02	0.68	0.7	0.405	0.001024
2021	7.92	7.94	1.29	5.86	0.01	0.98	0.99	0.510	0.001024
2022	7.57	7.58	1.12	5.78	0.01	0.96	0.97	0.466	0.000745
2023	8.01	8.06	1.21	5.86	0.01	0.93	0.97	0.477	0.000752

Against the backdrop of the efforts undertaken by the largest Polish entities in the mining sector to minimize their negative environmental impact and the substantial investments allocated to environmental projects, the synthetic summary of the key taxonomy disclosures presented by JSW and LWB (Table 3) appears particularly noteworthy. As publicly listed companies, JSW and LWB commenced taxonomy reporting for the year 2021 (Table 6).

Tab. 6. The EU Taxonomy Disclosures of JSW and LWB

Type of data	data	JSW			LWB		
		2021	2022	2023	2021	2022	2023
Turnover enviromentally sustainable and taxonomy-aligned	k PLN	34,400	0	600	32,881	0	0
	%	0%	0%	0%	1%	0%	0%
Turnover enviromentally sustainable and not taxonomy-aligned	k PLN	ND	262,600	244,500	ND	43,487	58,044
	%	ND	1%	2%	ND	2%	1%
Turnover not enviromentally sustainable	k PLN	13,516,000	19,935,900	15,093,400	2,338,082	2,408,228	3,881,243
	%	100%	99%	98%	99%	98%	99%
Capex enviromentally sustainable and taxonomy-aligned	k PLN	34,500	18,600	47,100	21,257	250	11,450
	%	3%	1%	1%	5%	0%	1%
Capex enviromentally sustainable and not taxonomy-aligned	k PLN	ND	167,700	268,000	ND	10,941	26,021
	%	ND	6%	6%	ND	2%	3%
Capexnot enviromentally sustainable	k PLN	1,323,200	2,454,700	4,163,700	461,448	605,323	761,224
	%	98%	93%	93%	96%	98%	95%
Opex enviromentally sustainable and taxonomy-aligned	k PLN	27,800	6,700	8,200	0	0	0
	%	7%	1%	1%	0%	0%	0%
Opex enviromentally sustainable and not taxonomy-aligned	k PLN	ND	59,700	128,300	0	2,820	5,408
	%	ND	7%	13%	0%	2%	3%
Opex not enviromentally sustainable	k PLN	380,200	168,900	883,200	138,852	157,024	192,497
	%	93%	92%	87%	100%	98%	97%

The analysis of the presented data indicates that both publicly listed entities, which are thus required to conduct taxonomy reporting, exhibit very low turnover, CAPEX, and OPEX indicators in terms of eligibility for classification under the Taxonomy Regulation and environmental sustainability. This outcome arises from the straightforward fact that mining activities, including coal extraction and sales, are not included in the annexes of Commission Delegated Regulation (EU) 2021/2139 as inherently unsustainable activities.

As previously highlighted in the context of JSW's disclosures, coking coal remains a critical raw material for steel production and plays a key role in the transition to a low-emission economy.

Consequently, JSW's key financial performance indicators for 2022 and 2023 are primarily related to the sale of organic chemicals produced within the Group, freight transport, railway infrastructure, and selective waste collection and transportation, which are currently eligible under Annex I of Delegated Regulation 2021/2139.

The reported revenue from eligible activities primarily concerns the sale of benzene produced by JSW KOKS, as well as municipal and industrial wastewater treatment, road and rail freight transport, maintenance and modernization of railway infrastructure, and water treatment and potable water distribution.

The reported capital expenditures related to environmentally sustainable activities involve the expansion of cogeneration systems using methane captured from mines, a technology aimed at significantly reducing greenhouse gas emissions. Additionally, investments are made in zero-emission suspended monorails for transporting equipment that supports production processes, and photovoltaic panels are installed.

The reported capital expenditures related to eligible activities mainly pertain to the construction of a power unit for high-efficiency cogeneration of heat and electricity using fossil gas fuels (coke oven gas), construction and modernization of heat or cooling distribution networks in production plants, installation of heat pumps in one of the subsidiaries, modernization of water intake, treatment, and distribution systems, and wastewater treatment systems, expansion/modernization of railway infrastructure, procurement of vehicles for freight transport, as well as projects aimed at increasing energy efficiency in buildings managed by the Group.

The reported operating expenditures related to environmentally sustainable activities include the maintenance of cogeneration systems fueled by methane captured from mines.

The reported operating expenditures related to eligible activities primarily concern the maintenance and repair of heat and power cogeneration systems based on fossil gas fuels (coke oven gas), maintenance and repair of heat and cooling distribution networks in production plants, renovation of buildings managed by the Group, maintenance and repair of railway infrastructure and rolling stock, as well as maintenance of potable water intake systems and wastewater treatment systems.

Similarly, in the case of LWB, the taxonomy also includes additional activities related to revenue generation, such as the provision of heating and hot water through a subsidiary, work related to water and sewage connections, coal transport via railway, and the renovation of existing buildings.

The capital expenditures from eligible activities included investments in modernizing heating networks, expanding and modernizing hot water transmission networks within the Group, and investments related to railway operations.

In terms of operating expenditures eligible under the taxonomy, the main costs involved the installation, maintenance, and repair of equipment aimed at improving energy efficiency, such as replacing and installing window and door joinery, as well as railway freight transport services for coal transportation.

The findings of this study indicate that due to the classification framework within the taxonomy, the reported indicators of capital groups listed on the Warsaw Stock Exchange (GPW) are very low, as mining operations involving coal extraction and sales are not classified as sustainable activities.

At the same time, a detailed and in-depth analysis of the activity reports has revealed significant environmental initiatives undertaken by these entities, reflected in investments, expenditures, and environmental projects. In the case of JSW, even during periods of negative financial results, environmental investments and expenditures aimed at mitigating the negative impact on the natural environment increased compared to previous years, suggesting a strong commitment in this area.

In light of these results, a critical question arises regarding the relevance of taxonomy indicators, which fail to reflect the actual sustainability efforts of these companies accurately. Consequently, the authors have positively verified Hypothesis H1.

Due to the inability to fully present the environmental activities and their outcomes in taxonomy reports, users of these reports cannot adequately identify or assess the non-financial performance of companies in the mining sector. As a result, this type of performance is devalued, which contradicts the concept of non-financial performance in the extractive industry. This confirms Hypothesis H2, which posits that taxonomy reporting in practice limits the significance of non-financial performance for companies in the mining industry.

A comparison of three capital groups – two listed on GPW and one non-publicly traded entity subject to accounting regulations – revealed differences in the scope of ESG-related environmental information disclosed. These discrepancies stem from varying legal regulations governing ESG reporting for publicly traded groups and the third group, which is state-owned.

The entities differed not only in their reported financial results but also in the manner and scope of their environmental disclosures. For instance, LWB did not prepare taxonomy reports and adopted different disclosure formats, omitting key environmental investment and expenditure data.

In this context, the authors positively verified Hypothesis H3, which states that comparability of environmental information reported by the mining industry in Poland is hindered by differences in ownership structure and legal frameworks governing capital groups.

Discussion and Conclusions

Sustainability reports serve as a communication tool for stakeholders, and by incorporating both financial and non-financial data, they should facilitate accountability for both the positive and negative impacts of business operations. Furthermore, they contribute to corporate value creation.

Our research findings support the perspective of Fikru et al. (2024), formulated based on their own research and literature review (for instance, Fredericsen, T., 2018; Tsang et al., 2024), which suggests that entities in the hard coal mining sector, commonly perceived as "polluters," are particularly active in undertaking measures to mitigate their environmental impact. These efforts are not solely aimed at demonstrating financial and organizational commitments through investments and environmental expenditures to reduce negative impacts, but also at providing quantitative data to illustrate the effectiveness of these actions. The entities examined in our study exhibited significant activity, extensively and meticulously documented in management reports, aligning with other studies. Reported activities included, among others, the construction of a power unit for high-efficiency cogeneration of heat and electricity using fossil gas fuels, the construction and modernization of heat distribution networks, the installation of heat pumps, and the modernization of water intake, treatment, and distribution systems.

It is important to emphasize that the entities analyzed in our research represent the largest firms in the Polish coal mining sector. Company size is frequently cited in the literature as the most significant factor influencing ESG ratings (for instance, Fikru et al., 2024; Fredericsen, 2018; Dougherty, 2017).

A comparative analysis of data contained in the taxonomy reports of the JSW and PGG capital groups revealed that the legislative framework underpinning the taxonomy does not sufficiently ensure the presentation of actual efforts undertaken by these entities to mitigate their environmental impact. The classification of activities for inclusion in taxonomy reports has, in effect, restricted access to critical information regarding the environmental impact of mining companies. The examined entities reported only supplementary or even incidental activities qualifying as sustainable. Pavloudakis et al. (2024) emphasized in their studies the significance of non-financial performance in the mining sector and the role of ESG reporting in presenting such data. Their research underscored the importance of identifying and disclosing non-financial results based on ESG reports, with detailed comparative analyses for each company under study. The reports highlighted key information on progress toward achieving the goals of the "Green Deal."

Greece serves as an example of a country that has effectively addressed the environmental challenges of the mining sector in the context of sustainable development goals. However, the authors of the referenced study did not address the taxonomy framework.

Our research findings indicate difficulties in comparing environmental data between publicly traded entities subject to the ESG Directive and taxonomy reporting and a state-owned enterprise governed by accounting regulations but not publicly listed. In line with the findings of Maybee et al. (2023), incorporating environmental

information into the broader financial assessment enables a more accurate evaluation of risk, uncertainty, and the life cycle of companies in this sector.

Regular communication with stakeholders, encompassing comprehensive information on economic, social, and environmental activities, enhances corporate transparency, facilitates the assessment of strategic implementation, and helps identify future risks. The entities studied by us, although to varying degrees, operate in accordance with legitimacy theory, presenting both positive and negative environmental disclosures, which is consistent with previous research (Zharfpeykan, 2021). The results of our study are also consistent with the research by Pactwa (2021), which similarly highlighted significant variability in environmental reporting, emphasized the challenges faced by mining entities in this area, and their efforts to address these challenges.. Responsible environmental reporting and increased corporate transparency in the mining sector should foster trust among key stakeholders, enhance reputation, and attract consumers.

Scientific studies in the extractive sector emphasize the evolution toward sustainability reporting, which integrates all dimensions of corporate social responsibility. However, in practice, the taxonomy framework does not yield the desired effect. The findings obtained in this study provided answers to both research questions. Regarding question RQ2, our findings indicate that taxonomy reports do not accurately reflect the actual environmental initiatives undertaken by mining companies or their effectiveness. The results also highlight significant challenges in data comparability between publicly listed entities and those subject to different financial reporting regulations, addressing research question RQ3. The study allowed for the positive verification of the proposed hypotheses, thereby achieving the research objective.

The study expands and deepens knowledge on the specific characteristics of the hard coal mining sector in the context of ESG reporting. It highlights the effects of legal and regulatory frameworks on the scope, method of reporting, and types of information presented, potentially informing the development of new ESG regulatory solutions. These findings are also valuable for ESG report users, as they illustrate the complexity of correctly interpreting the reported data.

Limitations: The study was limited to three capital groups, representing the largest entities in Poland's hard coal mining sector, which restricted the applicability of statistical research methods. Another limitation was the focus on Polish entities within the Central and Eastern European region. This approach is justified by the significant scale of the issue in Poland, in contrast to its decline in neighboring countries.

The authors intend to continue researching ESG reporting conditions in the coal mining sector by incorporating comparisons with other major coal-producing countries, such as China, India, Australia, and the United States, now facing new challenges related to reporting their activities in the field of sustainable development. The research on Polish entities will also be worth continuing due to the new challenges arising from January 1, 2025, following the amendment to the Accounting Act, which introduces Chapter 6c on sustainability reporting, adapted to the European Sustainability Reporting Standards (ESRS).

References

Abdo, H. (2016). Accounting for extractive industries: Has IFRS 6 harmonised accounting practices by extractive industries? *Australian Accounting Review*, 26(4), 346–359. https://doi.org/10.1111/auar.12106

Abdo, H., Owusu, F.B. and Mangena, M. (2024). Accounting practices and regulations for extractive industries: a framework for harmonization. *Journal of Financial Reporting and Accounting*, 22(1), 147-180. https://doi.org/10.1108/JFRA-07-2023-0425

Accounting Act (2017) The Accounting Act of 29 September1994, (Journal of Laws 2017, item 2342, Journal of Laws 2023 item 120, with amendments), https://isap.sejm.gov.pl/isap.nsf/DocDetails.xsp?id=WDU20240001863,

Biały, W., Grebski, W., Galecki, G. and Kaniak, W. (2020). Environmental impact of the mechanical coal processing plant. *Acta Montanistica Slovaca*, 25, 139-149. https://doi.org/10.46544/AMS.v25i2.1.

Bogacz, P. and Migza, M. (2016). Environmental management reporting in Polish mining companies in the context of World CSR trends, E3S Web Conferences, 10, 00058, https://doi.org/10.1051/e3sconf/20161000058.

Bukowski, M., , Siedlecka, U. and Śniegocki, A., (2016) Zapaść czy fuzja z energetyką uratuje polskie górnictwo?, Wise Europa Fundacja, Warszawski Instytut Studiów Ekonomicznych i Europejskich, https://wise-europa.eu/wp-content/uploads/2024/06/Made-in-Europe_Made-in-Europe.-Polityka-przemyslowa-wobec-wyzwan-XXI-wieku_WiseEuropa.pdf

Centorrino, G., Naciti, V. and Rupo, D. (2025). Extending the boundaries of financial reporting in the extractive industries: Insights from bibliometric analysis. *Corporate Social Responsibility and Environmental Management,* 32(1), 563–579. https://doi.org/10.1002/csr.2967

Charkowska, Z., Przedlacki, W., Borowczyk, Z. and Swoczyna B. (2024). Baza danych kopalni węgla kamiennego i brunatnego w Polsce. Instrat, https://energy.instrat.pl/gornictwo/baza-kopalni/

Clarkson, P. M., Li, Y., Richardson, G. D. and Vasvari, F. P. (2008). Revisiting the relation between environmental performance and environmental disclosure: An empirical analysis. *Accounting, Organizations and Society*, 33(4), 303–327. https://doi.org/10.1016/j.aos.2007.05.003.

Cortese, C. L., Irvine, H. J. and Kaidonis, M. A. (2009). Extractive industries accounting and economic consequences: Past, present and future. *Accounting Forum*, 33(1), 27–37. http://dx.doi.org/10.1016/j.accfor.2008.07.005

Cortese, C.L., Moerman, L., and Chang, M. (2022). Is the extractive industries standard still fit for purpose? *Accounting & Finance*, 62 (2), 2807–2838, DOI: 10.1111/acfi.12893

CSRD (2022), Directive (EU) 2022/2464 of the European Parliament and of the Council of 14 December 2022 amending Regulation (EU) No 537/2014, Directive 2004/109/EC, Directive 2006/43/EC and Directive 2013/34/EU, as regards corporate sustainability reporting, https://eur-lex.europa.eu/legal-content/PL/TXT/?uri=CELEX%3A32022L2464

Deegan, C. (2019). Legitimacy theory: Despite its enduring popularity and contribution, time is right or a necessary makeover. Accounting, *Auditing & Accountability Journal*, 32(8), 2307–2329. https://doi.org/10.1108/AAAJ-08-2018-3638.

Dougherty, M. L. (2017). Entanglements of Firm Size and Country of Origin with Mining Company Reputational Risk in Guatemala. ISA eSymposium, 7(1). 1-15. Available at SSRN: https://ssrn.com/abstract=2928246.

Energy Policy of Poland until 2040 (2021). Ministry of Climate and Enviroment, https://www.gov.pl/web/climate/energy-policy-of-poland-until-2040-epp2040.

EU Taxonomy (2020), Regulation [EU] 2020/852 of the European Parliament and of the Council of 18 June 2020 on the Establishment of a Framework to Facilitate Sustainable Investment, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32020R0852

EY (2024). Top 10 risks and opportunities for mining and metals companies in 2025, EY Survey, https://www.ey.com/en_gl/insights/energy-resources/risks-opportunities

Fikru, M., Brodmann, J., Eng, L.L. and Grant, J.(2024). ESG Ratings in the Mining Industry: Factors and Implications, *The Extractive Industries and Society*, 20, 101521, https://doi.org/10.1016/j.exis.2024.101521.

Frantál, B., Chodkowska-Miszczuk, J.M., Alexandrescu, F., Stölzel, F., Klusáček, P., Konečný, O. , Süsser ,D., Lewandowska, A. and Zieliński, D. (2025), With coal forever? Conflicted attitudes of residents in coal mining areas in the Czech Republic, Germany and Poland to coal phase-out, *Resources Policy*, 101(C), doi: 10.1016/j.resourpol.2025.105476.

Fredericsen, T. (2018), Corporate social responsibility risk and development in the mining industry, Resources Policy, 59; 495-505

Gray, S. J., Hellman, N. and Ivanova, M. N. (2019). Extractive industries reporting: A review of accounting challenges and the research literature. *Abacus,* 55(1), 42–91. https://doi.org/10.1111/abac.12147

Jiang, L., Yu G. and Dai Y. (2023). Environmental, Social, and Governance Taxonomy Simplification: A Hybrid Text Mining Approach. *Journal of Emerging Technologies in Accounting*. 20(1): 305–325. https://doi.org/10.2308/JETA-2022-041.

Jonek-Kowalska, I. (2022) Multi-criteria evaluation of the effectiveness of energy policy in Central and Eastern European countries in a long-term perspective, Energy Strategy Reviews, 44, 100973, https://doi.org/10.1016/j.esr.2022.100973

Jonek-Kowalska, I., Wolniak, R., Marinina, O. A. and Ponomarenkoi, T.V. (2022). Stakeholders, Sustainable Development Policies and the Coal Mining Industry. Perspectives from Europe and the Commonwealth of Independent States, Routledge, London, https://doi.org/10.4324/9781003091110

Jorge-Vazquez, J., Kaczmarek, J., Knop, L.,. Kolegowicz, K., Alonso S. N. and Szymla, W. (2024). Energy transition in Poland and Spain against changes in the EU energy and climate policy, *Journal of Cleaner Production*, 468, 143018. https://doi.org/10.1016/j.jclepro.2024.143018

Kluczek, A. (2019). Multi-criteria decision analysis for simplified evaluation of clean energy technologies. *Production Engineering Archives*, 23(23), 3–11. https://doi.org/10.30657/pea.2019.23.01.

Lauwo, S. G., Otusanya, O. J. and Bakre, O. (2016). Corporate social responsibility reporting in the mining sector of Tanzania: (Lack of) Government regulatory controls and NGO activism. *Accounting, Auditing &Accountability Journal*, 29(6), 1038–1074. doi: 10.1108/AAAJ-06-2013-1380

Lisowski A., (2015), Recovery plan of hard coal mining industry and better use of coal in the Polish economy in future, Polemics-discussion., Przegląd Górniczy, 4(1109)

Luther, R. (1996). The development of accounting regulation in the extractive industries. *The International Journal of Accounting*, 31(1), 67–93. https://doi.org/10.1016/S0020-7063(96)90014-X

Maruszewska, E.W., Kołodziej, S. and Boitan, I. (2023). Intention to Pay Higher Taxes Dedicated to Reduction of Coal Energy – A Case of Young Central Eastern Europeans. *Acta Montanistica Slovaca*, 28(3), 579-591. doi: https://doi.org/10.46544/AMS.v28i3.05

Maybee, B., Lilford, E. and Hitch, M. (2023). Environmental, Social and Governance (ESG) risk, uncertainty, and the mining life cycle. *The Extractive Industries and Society*, 14(14) 101244. http://dx.doi.org/10.1016/j.exis.2023.101244.

Mayer, A. (2022). More than just jobs: understanding what drives support for a declining coal industry, *The Extractive Industries and Society*, 9(2), 101038. http://dx.doi.org/10.1016/j.exis.2021.101038.

Mocek P. (2022). Research on the Environmental Impact of Industrial Noise Emitted By Mine and Mining Plants, *Management Systems in Production Engineering,* 30(20), 146-155. https://doi.org/10.2478/mspe-2022-0018.

NFRD (2014), Directive 2014/95/EU of the European Parliament and of the Council of 22 October 2014 amending Directive 2013/34/EU as regards disclosure of non-financial and diversity information by certain large undertakings and groups, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32014L0095&qid=1740840716391

Pactwa, K. (2021), Achieving United Nations sustainable development goals by the mining sector – a Polish example, *Gospodarka Surowcami Mineralnymi – Mineral Resources Management*, 37(1), 57-80 https://doi.org/10.24425/gsm.2021.136289.

Pavloudakis, F., Kirtikidis, S., Roumpos, Ch. and Agioutantis, Z. (2024), ESG reporting in the mining sector: case studies from greek industry leaders. Conference: Sustainable Development in The Minerals Industry (SDIMI)At: Turin, Italy, 9-11 July 2024

Samkin, G.. Mihret, D. G. and Lemma, T. (2024). Accounting in and by the extractive industries: development of a conceptual framework and avenues for future research, *Meditari Accountancy Research*, 32 (1), 1 – 41. doi: 10.1108/MEDAR-11-2023-22

Senova, A., Kuffa, F., Grososova, L. and Alkhalaf, I. (2024). Assessment of the environmental and economic impacts of mining and elimination of negative impacts of mining activities. *Acta Montanistica Slovaca*, 29(4), 873-884. https://doi.org/10.46544/AMS.v29i4.07.

Siciński, J. (2024), Ocena zagrożenia finansowego i perspektyw naprawczych polskiego sektora górnictwa węgla kamiennego w dobie dynamicznych zmian geopolitycznych 2020–2023, *Ekonomista*, 4, 483-502 doi: 10.52335/ekon/188775

Sidney, J. Gray, S. J., Hellman, N. and Ivanova M. N. (2019), Extractive Industries Reporting: A Review of Accounting Challenges and the Research, *Abacus*, 55(1), 42-91. doi: 10.1111/abac.12147

Sobczyk, E. J., Kaczmarek, J., Fijorek, K. and Kopacz, M. (2020), Efficiency and financial standing of coal mining enterprises in Poland in terms of restructuring course and effects. *Gospodarka surowcami mineralnymi – mineral resources management*, 3(2), 127-152. doi: 10.24425/gsm.2020.132565

Stadler, Ch. And Nobes, Ch., (2024), Varied international practice in accounting for extractive activities, *Accounting and Business Research*, 1-34. https://doi.org/10.1080/00014788.2024.2381503

Teplicka K.a and Hurna S. (2023), Comparison of Environmental Costs in Divisions with Different Geographical Action and their Significance in Environmental Management, *Management Systems in Production Engineering,* 31(3). 248-253, https://doi.org/10.2478/mspe-2023-0027.

Tsang, A., Wang, K.T., Wu, Y., and Lee, J. (2024), Nonfinacial corporate social responsibility reporting and firm value: international evidence on the role of financial analysts, *European Accounting Review*, 33(2); 399-434. doi: 10.1080/09638180.2022.2094435

Ulewicz, R., Krstić, B. and Ingaldi, M. (2022). Mining Industry 4.0 - Opportunities and Barriers. *Acta Montanistica Slovaca*, 27 (2), 291-305. doi: https://doi.org/10.46544/AMS.v27i2.02.

Ulewicz, R., Siwiec, D., Pacana, A., Tutak, M., and Brodny, J. (2021). Multicriteria method for the selection of renewable energy sources in the polish industrial sector. *Energies*, 14(9). https://doi.org/10.3390/en14092386.

Yerdavletova, F., Zhadigerova, O., Shakbutov,a A., Zhumabayeva, M. and Kyzdarbekova A. (2024). Financial assessment of the costs of exploration and evaluation of natural resources: Addressing environmental inequalities through sustainable mineral exploration and evaluation practices, *Rivista di Studi sulla Sostenibilita*, 14(2). 71 – 86. doi: 10.3280/RISS2024-002005

Zharfpeykan, R. (2021). Representative account or greenwashing? Voluntary sustainability reports in Australia's mining/metals and financial services industries. *Business Strategy and the Environment*, 30(4), 2209–2223. doi: 10.1002/bse.2744.