European Research Studies Journal
Volume XXVIII, Issue 1, 2025

pp. 1033-1049

Opportunities for ESG Reporting in Railway Electric Power Supply Enterprises Based on Annual Reports

Submitted 12/02/25, 1st revision 27/02/25, 2nd revision 14/03/25, accepted 30/03/25

Ferensztajn-Galardos Ewa[1], Krajewska Renata[2], Wojciechowski Jerzy[3]

Abstract:

Purpose: *The aim of this paper is to analyse the implementation status of ESG reporting in railway electric power companies in Poland.*
Design/Methodology/Approach: *The study employed a qualitative approach based on content analysis and comparative analysis of reporting documents from four railway electric power supply enterpris in Poland.*
Findings: *The findings indicate a notable inconsistency in the level and structure of ESG reporting among the analysed companies operating in the railway electric power and transport sectors. Only one of the four companies, PKP CARGO S.A., has published a standalone ESG report for 2023. PGE Energetyka Kolejowa provided ESG-related content within the integrated report of the PGE Group, which limits the granularity of sector-specific insights. PKP PLK S.A. and PKP Intercity S.A. have not yet produced independent ESG disclosures.*
Practical Implications: *The findings of this study have significant practical relevance for railway electric power companies that will be required to comply with the CSRD directive as well as GRI and ESRS standards. The study can support ESG reporting teams in structuring their reports and identifying information gaps. Moreover, the conclusions drawn from the analysis provide a foundation for implementing procedures for monitoring and collecting non-financial data in the environmental, social, and governance areas.*
Originality/Value: *The study focuses on a narrowly defined yet strategically important sector—railway electric power supply—which has so far been only marginally represented in the ESG literature.*

Keywords: *Electric power economy, sustainable transport, non-financial reporting, sustainable development.*
JEL codes: *M14, L92, Q56, G34, L94.*
Paper type: *Research article.*

[1]*Dr., Casimir Pulaski Radom University, Department of Transportation, Electrical Engineering and Computer Science, Poland, ORCID ID: 0000-0003-4447-3806, e-mail: e.ferensztajn@urad.edu.pl;*
[2]*Dr., Casimir Pulaski Radom University, Department of Transportation, Electrical Engineering and Computer Science, Poland, e-mail: r.krajewska@urad.edu.pl;*
[3]*Assoc. Prof., DSc, Eng., Casimir Pulaski Radom University, Department of Transportation, Electrical Engineering and Computer Science, Poland, e-mail: j.wojciechowski@urad.edu.pl;*

1. Introduction

The newly introduced Environmental, Social, and Governance (ESG) regulations, closely aligned with the European Green Deal, have a significant influence on the socio-economic development of countries. On the one hand, corporate activities shape societies and their living environments; on the other, ESG frameworks impose obligations on companies to align their strategies with environmental and social standards. Businesses are now required to ensure compliance with ESG criteria, particularly in terms of environmental protection, social responsibility, and corporate governance.

ESG can be considered an evolution of the concept of Corporate Social Responsibility (CSR). Its rising prominence is largely due to a growing number of regulations concerning sustainable development—especially at the EU level—which frame ESG as a set of measurable requirements and parameters within an analytical approach to this broad domain. Climate change, regulatory development, and shifting consumer attitudes and purchasing behaviors have made sustainable strategies essential for business operations.

Moreover, ESG has increasingly become a source of competitive advantage, as consumers pay closer attention to sustainability-related issues. This evolving context necessitates both robust data collection and the implementation of solutions aligned with ESG criteria, and it highlights the significance of ESG's influence on corporate reporting systems.

Corporate reporting must now include disclosures on environmental, social, and governance activities, structured according to established principles. While ESG reporting is not a new concept in corporate practice, recent regulations considerably expand existing obligations, providing clearer guidance regarding the scope and format of such disclosures.

The non-financial reporting obligation is governed by Directive (EU) 2022/2464 of 10 November 2022—commonly referred to as the Corporate Sustainability Reporting Directive (CSRD). This directive introduces more detailed reporting requirements related to companies' impacts on the environment, human rights, and society at large. Entities falling under its scope are required to prepare ESG reports based on standardized criteria consistent with the EU's climate objectives, which the European Commission plans to adopt by June 2023.

Consequently, ESG has become an integral element across all areas of economic activity, though the scope of regulatory expansion still calls for continuous improvement. According to the Polish Ministry of Economic Development and Technology (2023), under the CSRD, over 3,500 Polish enterprises will be obligated to disclose sustainability-related information starting from January 1, 2027.

Given this context, the authors of the present study focused on the segment of large enterprises operating in Poland—specifically, those in the power generation and rail transport sectors, which are particularly suited for the development of high-speed rail (HSR). High-Speed Rail (HSR) (Rosler, 2024; High-Speed Rail…, 2025) represents a key component in the development of the national transport system, economic growth, and international integration. HSR is defined as railway infrastructure enabling scheduled services at speeds of at least 200 km/h, although speeds exceeding 300 km/h are increasingly common in global projects.

In Poland, plans envision a nationwide HSR system, with several priority routes. Chief among them is the so-called "Y" corridor, connecting Warsaw through Łódź to Wrocław and Poznań, designed to serve the Central Transport Hub (CTH). Additional HSR lines include the extension of the Central Railway Mainline (CMK) through Płock, Włocławek, and Grudziądz to the Tricity (Gdańsk–Gdynia–Sopot), as well as Line 9 from Warsaw East to Gdynia Main (323 km), and a 21 km section of Line 202.

The Central Transport Hub (CTH) (Rosler, 2024; *Progress Report…,* 2024) is one of the most important infrastructure projects in Poland. Located approximately 40 km west of Warsaw in the Baranów municipality, the CTH aims to enhance both domestic and international transportation. Its implementation is of fundamental importance to Poland's economic development and integration into the European transportation network. Designed as a multimodal hub, the CTH will integrate air, rail, and road transport. Its centerpiece will be a modern airport intended to become the principal air hub of Central and Eastern Europe.

The project also entails the construction of new railway lines to significantly reduce travel time between Poland's major cities, along with the expansion of road infrastructure to ensure efficient connectivity with the airport. As a result, the CTH is expected to improve national mobility, enhance transport accessibility, and support regional economic development. The new high-speed rail infrastructure will enable fast and comfortable travel between major urban centers, reducing reliance on car transport and thereby contributing to lower CO_2 emissions.

2. Literature Review

This section provides a literature review aimed at defining ESG non-financial reporting from various perspectives. In academic literature, ESG reporting is often referred to as non-financial reporting or CSR (Corporate Social Responsibility) reporting (Ferensztajn-Galardos *et al.,* 2024).

Although ESG is designed to address a range of critical environmental and social issues, there is no universally accepted definition of ESG factors or standardized metrics to assess their outcomes (Clément *et al.*, 2023). Two leading perspectives on the integration of ESG factors into business activities can be identified in the

literature. The first centers around Socially Responsible Investing (SRI), which considers ESG from the standpoint of financial market investment strategies (Aldowaish *et al.,* 2022). The second has evolved from the concept of sustainable development and examines ESG dimensions from the operational perspective of firms (Clément *et al.,* 2023).

In both scholarly discourse and business practice, ESG criteria are commonly understood as a set of non-financial performance indicators that reflect the extent to which a given enterprise or organization acts in a socially and environmentally responsible manner, adheres to ethical standards, and practices sound corporate governance. These indicators have emerged in response to market demand for evaluating organizations based on their non-financial outcomes, with the aim of identifying high-performing, socially responsible companies.

As noted above, ESG evaluations were initially developed for the financial markets; however, they quickly gained popularity among corporations themselves. ESG has proven to be a valuable tool for improving corporate reputation (Murè *et al.,* 2021; Karwowski *et al.,* 2021), reducing legislative pressure (Christensen *et al.,* 2019; Porter *et al.,* 2019), mitigating financial risk (Chollet *et al.,* 2018), and attracting capital (Cheng *et al.,* 2014).

Research on ESG reporting spans multiple directions and incorporates various analytical criteria. Key areas of focus include the quality of non-financial disclosures (Szadziewska, 2015), challenges in reporting standardization (Breijer *et al.,* 2022; Krištofik *et al.,* 2016), and the impact of ESG-related activities on corporate image (Axjonow *et al.,* 2018) or financial performance (Crous *et al.,* 2022; Lament *et al.,* 2022). These studies often concentrate on publicly listed companies, whereas enterprises operating in the transport or energy sectors remain underrepresented in this body of research.

Meeting ESG requirements poses a significant challenge for enterprises, yet it should be viewed as a noble endeavor that integrates environmental, humanistic, and social dimensions. Although numerous publications address aspects relevant to ESG, they often lack a unifying framework rooted in the ESG philosophy.

In the context of railway power supply enterprises—an area of focus in this study—many publications examine technical issues related to electricity management. It is important to emphasize that energy management constitutes a critical component of the environmental dimension of ESG. Efficient energy use contributes to the reduction of greenhouse gas emissions and resource consumption, aligning directly with environmental sustainability objectives.

Despite this, a substantial portion of the literature on electricity management in railway transport does not explicitly incorporate ESG considerations (Kawałkowski *et al.,* 2018; Wojciechowski *et al.,* 2018; Alfieri *et al.,* 2019; Barbosa, 2019). While

general ESG-focused literature does address the broader power sector (Li et al., 2024; Mao et al., 2022; Shixiu et al., 2022), there remains a notable gap concerning ESG applications specific to the railway energy sector.

3. Research Methodology

The objective of this study is to assess ESG reporting practices among the largest power supply enterprises operating within the railway transport sector in Poland, as well as to analyze the scope of ESG-related disclosures in their annual reports. The study employed the following research methods: a critical review of the literature, an analysis of legal acts and regulations, and a content analysis of non-financial reports issued by the selected enterprises.

The research was conducted in two stages:

- Evaluation of ESG reporting principles adopted by selected enterprises operating in the railway energy sector,
- Analysis of the scope of ESG disclosures presented in the annual reports of these selected companies.

For the purposes of the study, four major electricity-related enterprises operating in the railway sector were selected: PGE Energetyka Kolejowa, PKP Polskie Linie Kolejowe S.A. (PKP, PLK), PKP Intercity S.A., and PKP CARGO S.A. The selection was based on the following criteria: compliance with ESG reporting requirements, strategic involvement in the development of High-Speed Rail (HSR) and the Central Transport Hub (CTH), and representation of key areas of railway power systems, such as traction power supply networks, electric traction vehicles, the interface between traction and industrial power systems, and activities directly impacting ESG dimensions.

PGE Energetyka Kolejowa (operating under this name since 2023) (PGE…2023) is an infrastructure company, an electricity supplier, and a distribution system operator. It provides DC electricity at 3.3 kV for PKP PLK's traction network and is responsible for maintaining and upgrading the electrical infrastructure of the railway traction system.

The company operates over 500 traction substations and nearly 400 sectional cabins. It also supplies non-traction electricity (LPN) to facilities such as signaling centers, railway stations, and other railway automation infrastructure, as well as individual consumers. PGE Energetyka Kolejowa was established in 2023, following the reorganization of PKP Energetyka (originally founded in 2001), through the separation of the Railway Power Division from Polish State Railways (PKP).

The company holds licenses for electricity trading, electricity distribution, and fuel trading (including a gas trading tariff since July 1, 2014), as well as a license as a

railway carrier. Additionally, it manufactures traction poles and network accessories and provides electrical services and transport operations. The organizational structure consists of regional branches and smaller operational units called sections.

These are responsible for maintaining the power equipment, traction substations, and traction networks. Specific sections include:

- Power Sections, responsible for non-traction energy infrastructure (e.g., transmission lines, transformer stations, lighting systems, and building electrical installations),
- Electrotraction Sections, focused on maintaining the railway traction network,
- Electric Power Supply Sections, handling both traction and non-traction power infrastructure, electrical measurements (including LV and HV cables), transformers, dielectric equipment, and electric tools,
- Repair and Measurement Sections, specialized in electrical diagnostics and emergency power services,
- Production and Repair Sections, involved in manufacturing traction poles and network accessories.

PKP Polskie Linie Kolejowe S.A. (PKP PLK) (PKP PLK…2023) manages the national railway infrastructure in Poland, comprising 18,634 km of rail lines. It is responsible for coordinating and managing the movement of approximately 5,000 passenger and freight trains operated by 123 licensed railway carriers.

Established in 2001 from the former PKP Infrastructure Directorate, PKP PLK plays a critical role in national transport planning. On August 17, 2022, a framework agreement was signed to form the PKP Group holding, excluding PKP PLK. On August 8, 2022, PKP PLK submitted a request to the Office of Competition and Consumer Protection (UOKiK) to acquire 100% of PKP Telkol Sp. z o.o. from PKP S.A.

PKP CARGO S.A. commenced operations in October 2001 (PKP CARGO…2023). As part of the PKP CARGO Group, it is a leading freight operator offering comprehensive rail logistics services across Poland and the EU. The company holds freight transport certifications in ten EU countries, including Lithuania (with restrictions), Slovakia, Slovenia, Austria, the Czech Republic, Germany, the Netherlands, Italy (with restrictions), Hungary, and Poland.

The second-largest freight entity in the group is PKP CARGO International a.s., primarily active on the Czech market. Both Poland and the Czech Republic are pivotal hubs in the European and global supply chains.

PKP Intercity S.A. (PKP INTERCITY…2023) is the largest Polish passenger rail

operator, providing connections between major urban centers and popular tourist destinations, linking smaller towns with metropolitan areas, and facilitating international travel across Europe. The company is heavily investing in rolling stock to increase capacity and enhance passenger comfort.

These investments are part of PKP Intercity's strategic plan to prepare for the liberalization of the passenger rail market in the current decade. PKP Intercity aims to offer a high and consistent standard of travel and promote rail as the preferred mode of public transportation. As the most environmentally sustainable form of mass transit, railway development aligns with the goals of the European Green Deal. PKP Intercity aspires to become the first Polish passenger rail operator with climate-neutral operations.

PKP Intercity was established on September 1, 2001, through the separation of its operations from Polish State Railways S.A. Initially focused on unsubsidized intercity services, the company later expanded into the economy segment with the launch of "Tanie Linie Kolejowe" (now known as "Twoje Linie Kolejowe" – TLK).

In 2008, it acquired the interprovincial express segment from PKP Przewozy Regionalne. In 2014, the company introduced the InterCity (IC) and Express InterCity Premium (EIP) brands. Today, PKP Intercity operates both domestic and international passenger services in the premium travel market.

The first stage of the research involved evaluating the 2023 annual reports of selected railway power supply enterprises. The evaluation focused on the principles and formats of ESG reporting adopted by the companies, with specific attention to the structure of ESG-related disclosures—whether they were integrated reports, separate non-financial sections within financial reports, or standalone ESG, sustainability, or CSR reports.

The structure of the analyzed enterprises, according to the characteristics defining their operations, is presented in Table 1. Based on the data in Table 1, the examined companies are categorized as entities that fall within the scope of mandatory ESG reporting requirements.

Table 1. *Characteristics of enterprises operating in the railway power supply sector (as of December 31, 2023)*

Specification	**PGE Energetyka Kolejowa**	**PKP PLK S.A.**	**PKP CARGO S.A. (Group)**	**PKP Intercity S.A.**
Number of Employees	4 943*	37 292	19 933	9 225
Net Sales Profit (Turnover) [million PLN]	866	-4 485.1	336.3	214
Net Revenue from Sales	4.728	8 110,5	5 491,9	4 998.6

[million PLN]				
Net Financial Profit [million PLN]	b.d.	-937.1	82.1	90.7
Total Assets [million PLN]	7 150	124 000	8 320	8 439.0

Note: ** According to data from the ESG Report (2023) of PGE Energetyka Kolejowa for the year 2022, the company employed 4,843 individuals at the end of that year. In 2023, the company planned to increase its workforce by approximately 100 employees, suggesting that the total number of staff may have risen to around 4,943. However, it should be noted that precise data for 2023 are not yet available, and the reported figure is therefore an estimate based on the authors' own calculation.*

Source: *Authors' calculation based on (PGE…2023; PKP PLK…2023; PKP CARGO…2023; PKP INTERCITY…2023).*

In the second stage of the study, the scope of ESG information disclosed in the annual reports of the analyzed enterprises was assessed. The evaluation focused on the range of ESG-related content presented in standalone ESG reports (sustainability reports, corporate social responsibility – CSR reports), individual or consolidated non-financial statements included as part of the financial report, as well as in integrated reports.

Four types of annual reports were selected for purposive sampling and included in the analysis. The selection aimed to ensure diversity in the formats used for ESG information disclosure. The characteristics of the annual reports, based on selected features of enterprises operating in the transport and energy sectors, are presented in Table 2.

Table 2. *Characteristics of annual reports of enterprises operating in the transport and energy sectors included in the evaluation in the second stage of the study.*

Specification	**PGE Energetyka Kolejowa**	**PKP PLK S.A.**	**PKP CARGO S.A. (Group**	**PKP Intercity S.A.**
	Number of Reports			
Annual Reports	No	Yes	Yes	Yes
Sustainability/ESG Reports	Yes*	No**	Yes	Yes
Integrated Report(s)	Yes*	Yes	Yes	No
Financial Statements	Yes*	Yes	Yes	Yes

Note: ** Consolidated report for the PGE S.A. Capital Group.*

******** *Information regarding Corporate Social Responsibility (CSR) is provided in the Annual Report*

Source: *Authors' calculations based on (PGE…2023; PKP PLK…2023; PKP CARGO…2023; PKP INTERCITY…2023).*

Based on the data presented in Table 2, it can be concluded that the highest number

of reports reflecting both financial performance and sustainability-related issues are published by PKP CARGO S.A. Group and PKP Intercity S.A. However, it should be noted that the latter does not report in an integrated manner.

It is also worth emphasizing that PGE Energetyka Kolejowa does publish reports; however, the disclosures are incorporated within the consolidated reporting of the PGE S.A. Group, which significantly limits the availability of detailed and entity-specific information. This may be attributed to the change of ownership in 2023 and the lack of alignment with the new reporting standards of the PGE S.A. Group.

PKP PLK publishes only annual activity reports and financial statements. Nevertheless, information related to Corporate Social Responsibility (CSR) is included in the Annual Report and may serve as a foundation for ESG reporting.

It should be highlighted that the structure of the analyzed annual reports, according to selected classification criteria, is consistent with the general structure of the transport and energy sectors. This suggests that the research sample can be considered representative, and the findings may be generalized to the broader population of enterprises operating in the railway power supply sector.

4. Research Results and Discussion

The ESG concept is defined as the management of environmental, social, and corporate governance issues within an enterprise. The primary aim of ESG is to ensure that non-financial factors are taken into account in the assessment of a company and are treated at least equally to financial indicators. The concept of ESG was first introduced in 2004 in the UN Global Compact report. Its inclusion in this document was supported by 20 of the world's largest financial institutions, including Deutsche Bank and Goldman Sachs.

The preparation of non-financial ESG reports should be based on international reporting standards, such as ESRS (European Sustainability Reporting Standards), GRI (Global Reporting Initiative), or SASB (Sustainability Accounting Standards Board).

The European Sustainability Reporting Standards (ESRS) provide a comprehensive set of guidelines that precisely define how companies should report on their ESG-related activities. Under ESRS, enterprises are required to collect detailed data documenting their impact on the environment, society, and corporate governance. Each ESRS standard focuses on a specific area of activity (Table 3).

These standards encompass various indicators that are crucial for sustainable management practices. The key ESRS standards forming the basis for detailed and transparent non-financial ESG reporting in the railway transport and electric power supply sectors are presented in Table 3.

Table 3. *ESRS Standards and their indicators relevant to the railway transport and electric power supply sectors*

Standard	Area	Description and Sectoral Relevance
ESRS E1	Climate Change	Focuses on climate change mitigation and adaptation, including GHG emissions, energy usage, and climate targets. Highly relevant for emissions-intensive industries like railway operations and energy production.
ESRS E2	Pollution	Covers emissions to air, water, and soil, including actions to prevent and reduce pollution. Important for railway infrastructure maintenance and energy generation.
ESRS E3	Water and Marine Resources	Addresses water use, discharge, and marine ecosystem impacts. Relevant for energy plants and facilities requiring significant water resources.
ESRS E4	Biodiversity and Ecosystems	Focuses on the protection of biodiversity and ecosystems affected by large-scale infrastructure projects in both transport and energy sectors.
ESRS E5	Resource Use and Circular Economy	Concerns material use, circularity, waste management, and efficiency strategies. Applies to both sectors due to large-scale resource consumption.
ESRS S1	Own Workforce	Targets employment conditions, diversity, equal opportunity, and health & safety—critical in both sectors with large technical workforces.
ESRS S2	Workers in the Value Chain	Addresses labor practices in the supply chain. Relevant for subcontractors in railway construction and energy distribution networks.
ESRS S3	Affected Communities	Relates to the impact of corporate activities on local communities. Important for public sector projects such as railway hubs or energy grids.
ESRS S4	Consumers and End-users	Covers consumer rights, safety, and data protection. Increasingly relevant with digital ticketing systems and smart grid technologies.
ESRS G1	Business Conduct	Focuses on corporate ethics, anti-corruption, lobbying, and legal compliance—applicable across all enterprise operations.

Source: *Authors' calculations based on: (Europejskie Standardy….2024).*

The Global Reporting Initiative (GRI**)** is one of the most recognized and widely used sustainability reporting frameworks in the world. GRI provides organizations with comprehensive guidelines for reporting their impact on the environment, society, and the economy.

The GRI Standards are flexible and adaptable to organizations of all sizes, enabling their use by both large corporations and smaller enterprises.

The GRI Standards relevant to the railway transport and electric power supply sectors are presented in Table 4.

Table 4. *GRI Standards relevant to the railway transport and electric power supply sectors*

Standard	Area	Description and Sectoral Relevance
GRI 1	Foundations 2021	Defines the principles and requirements for reporting in accordance with GRI. Forms the basis for ESG disclosures in both railway and energy sectors.
GRI 2	General Disclosures 2021	Includes organizational profile, governance, ethics, and stakeholder engagement—essential for transparency in public transport and energy utilities.
GRI 3	Material Topics 2021	Helps identify sustainability issues most relevant to railway infrastructure, energy systems, and stakeholder expectations.
GRI 302	Energy	Highly relevant to the power sector; addresses energy efficiency, consumption, and renewable energy—key issues for both railway traction systems and energy providers.
GRI 303	Water and Effluents	Important for energy production and infrastructure maintenance (e.g., cooling, cleaning), less critical but still applicable in railway operations.
GRI 305	Emissions	Crucial for both sectors in reporting greenhouse gas emissions from train operations and electricity production.
GRI 306	Waste	Relevant for waste management in railway maintenance depots and power infrastructure projects.
GRI 307	Environmental Compliance	Compliance with environmental regulations is key for infrastructure projects in both sectors.
GRI 401	Employment	Pertinent to large-scale employers like national railway operators and power utilities; includes job stability and labor conditions.
GRI 403	Occupational Health and Safety	Critical in both sectors due to technical and field-related hazards (e.g., electrification, maintenance work, rail operations).
GRI 404	Training and Education	Addresses continuous skill development in highly technical industries such as railway engineering and energy distribution.
GRI 405	Diversity and Equal Opportunity	Applicable to both sectors, especially for public and state-owned entities committed to social equity.
GRI 406	Non-discrimination	Ensures ethical practices across hiring and operations in both sectors.
GRI 418	Customer Privacy	Increasingly important in digitalized passenger rail services and smart energy metering systems.
GRI 419	Socioeconomic Compliance	Covers legal and economic compliance, relevant in regulated industries like transport and energy.

Source: *Authors' calculations based on: (Wytyczne do…2024).*

An ESG (Environmental, Social, Governance) report is a document that presents information on a company's activities in the context of its environmental and social impact, as well as the quality of its corporate governance. A well-prepared ESG report should be transparent, reliable, and provide detailed data that enables an

objective assessment of the company's performance across these three pillars.

In the railway transport sector and railway electric power supply industry, ESG reporting is of particular importance due to the significant impact of these sectors on the environment, public safety, and the development of national critical infrastructure.

The most essential components of a non-financial ESG report should include:

- Introduction and business context – a description of the company, its activities, the industry and markets in which it operates, and its strategy for sustainability and ESG. For companies in the railway and traction energy sectors, it is crucial to indicate their role in maintaining and powering railway infrastructure, providing services to carriers, and investing in modern, low-emission technologies.

- Governance and responsibility structure – a description of ESG management processes, including decision-making and accountability structures, as well as information on ESG-related policies, procedures, and initiatives tailored to the specific context of the transport and energy sectors.

- Environmental dimension – information on the company's environmental impact, including greenhouse gas emissions (e.g., from traction networks and auxiliary vehicles), energy and water consumption, waste management, and biodiversity protection. Key data should include energy efficiency metrics, investments in renewable energy sources, and efforts to reduce transmission losses in the energy infrastructure.

- Social dimension – information on employment practices, such as gender equality, diversity, and inclusion. In the railway sector, particular attention should be paid to the culture of occupational safety, accident prevention, and risk mitigation related to infrastructure operation. The report should also include community engagement activities, including cooperation with local governments and educational initiatives.

- Corporate governance – a description of management structures and processes, board composition, ethical policies, and anti-corruption measures. Especially relevant are actions related to the oversight of critical infrastructure, compliance with sector-specific regulations, and adherence to safety standards.

In addition, the ESG report should include:

- Presentation of key performance indicators (KPIs) for each ESG pillar;

- List of ESG-related risks and challenges, along with an action plan to improve performance;

- External verification and compliance, including information on audits and certifications (e.g., ISO 14001 for environmental management), which validate the accuracy and credibility of the data and activities described;

- Summary and conclusions, highlighting key achievements and future development plans in the ESG context, progress analysis toward targets, and identification of future challenges.

An ESG report should be published at least once a year to ensure data transparency and timeliness. The document must be easily accessible to all stakeholders. Companies subject to non-financial reporting obligations should develop a strategy that enables measurable monitoring of their ESG goals. Transparency and regular reporting build trust and strengthen organizational credibility.

In the digital era, companies—especially those in infrastructure-related sectors—face growing pressure to effectively communicate their ESG efforts. Reporting includes data on environmental impact, social engagement, and governance practices. Transparency facilitates performance evaluation and helps identify areas for improvement. This approach enhances corporate value, operational stability, and public image.

Modern technologies support ESG objectives through data monitoring and analysis. Tools such as AI, blockchain, and Big Data assist in risk management and sustainable development planning. Automation and digitalization of processes reduce emissions and energy consumption, making companies in the railway power and transport sectors more socially responsible and environmentally sustainable.

Table 5. *Content analysis of reports in companies operating within the analyzed sector*

Category	**PGE Energetyka Kolejowa***	**PKP PLK S.A.**	**PKP CARGO S.A.****	**PKP Intercity S.A.**
Introduction and Business Context	Yes	Yes	Yes	Yes
Governance and Responsibility Structure	Yes	No	Yes	No
Environmental Dimension	Yes	No	Yes	Yes
Social Dimension	Yes	Yes	Yes	No
Corporate Governance	Yes	No	Yes	No

Note: ** Refers to the entire PGE S.A. Group*
*** Refers to the entire PKP CARGO S.A. Group*
Source: *Authors' calculations based on (PGE…2023; PKP PLK…2023; PKP CARGO…2023; PKP INTERCITY…2023).*

Following the analysis of reports from selected companies in the railway electric power supply sector, it should be noted that information related to long-term and sustainable development—which forms the foundation of ESG reporting—is not consistently addressed across all key areas.

Non-financial reporting requires the disclosure of data concerning three main ESG pillars: environment, social responsibility, and corporate governance. According to applicable EU directives, companies are required to report on the impact of their operations on the environment, society, and the economy.

PGE Energetyka Kolejowa, as part of the PGE Group, did not publish a separate ESG report for 2023. Instead, information about its ESG-related activities is included in the Integrated Report of the PGE Group for 2023. This report covers, among other things, investment expenditures in the railway power segment, which amounted to PLN 1,053 million.

PKP PLK S.A. publishes annual reports that contain both financial and operational information. The 2023 report is available on the company's website. However, based on publicly accessible data, it is unclear whether the company publishes a separate non-financial report focusing exclusively on ESG matters.

The PKP CARGO Group released its first Sustainability Report for 2023, covering the activities of all its subsidiaries. The report focuses on issues related to corporate governance, environmental impact, and social responsibility. Additionally, for the first time, the report includes disclosures aligned with the EU Taxonomy for Sustainable Activities, indicating the extent to which the group’s operations are compliant with EU sustainable development regulations.

According to information available on the company’s website, PKP Intercity S.A. will be required to publish its first ESG report in 2026, covering the year 2025. Currently, the company is focused on implementing its 2030 development strategy, one of the core objectives of which is to achieve climate neutrality.

Among the analyzed companies, only PKP CARGO S.A. has published a separate non-financial ESG report for 2023. PGE Energetyka Kolejowa includes ESG-related information within the integrated PGE Group report. In contrast, PKP PLK S.A. and PKP Intercity S.A. have not yet published separate ESG reports for 2023.

5. Conclusions, Proposals, Recommendations

ESG (Environmental, Social, Governance) is a comprehensive framework for evaluating corporate activities based on their environmental and social impact, as well as the quality of corporate governance. ESG reporting is gaining importance due to both growing stakeholder expectations and regulatory requirements—particularly the Corporate Sustainability Reporting Directive (CSRD) introduced

by the European Union.

An analysis of companies operating in the railway power supply and transport sectors revealed that the degree of ESG reporting implementation varies. Among the four analyzed entities, only PKP CARGO S.A. published a standalone ESG report for 2023. PGE Energetyka Kolejowa included relevant information in the integrated report of the PGE Group, while PKP PLK S.A. and PKP Intercity S.A. have yet to release separate ESG reports. Furthermore, only some of these companies fully address all three ESG pillars in their disclosures.

In light of existing and upcoming regulations, infrastructure-related companies will need to adapt their internal structures and strategic approaches to comply with sustainability reporting obligations. Modern technologies such as artificial intelligence (AI), blockchain, and Big Data support ESG efforts through monitoring, data analysis, and long-term planning.

ESG reporting has become increasingly important due to growing consumer expectations that companies take responsibility for environmental and social outcomes. Customers are looking for concrete actions such as reducing emissions, managing resources responsibly, and investing in renewable energy. Companies that pursue these goals build trust and loyalty, while enhancing their public image.

Another major driver of ESG reporting is the Corporate Sustainability Reporting Directive (CSRD) introduced by the European Union, which aims to standardize sustainability reporting across member states. CSRD requires companies to disclose their ESG activities transparently, prompting many organizations to adapt their strategies. CSRD represents a critical regulatory milestone, and its implications will be addressed in further sections of this report.

References:

Aldowaish, A., Kokuryo, J., Almazyad, O., Goi, H.C. 2022. Environmental, Social, and Governance Integration into the Business Model: Literature Review and Research Agenda. Sustainability, 14(5), Article 5. https://doi.org/10.3390/ su14052959.

Alfieri, L., Battistelli, L., Pagano, M. 2019. Impact on railway infrastructure of wayside energy storage systems for regenerative braking management: a case study on a real Italian railway infrastructure. IET Electrical Systems in Transportation, 9(3), 140-149. https://doi.org/10.1049/iet-est.2019.0005.

PKP PLK S.A. Annual Report 2023. Available at: https://www.plk-sa.pl/files/public/raport_roczny /Raport_roczny_2023_EN.pdf.

Axjonow, A., Ernstberger, J., Pott, Ch. 2018. The Impact of Corporate Social Responsibility Disclosure on Corporate Reputation: A Non-professional Stakeholder Perspective. Journal of Business Ethics, 151. https://doi.org/10.1007/s10551-016-3225-4.

Barbosa, F.C. 2019. Fuel cell rail technology review: a tool for an autonomous rail electrifying strategy. Proceedings of the 2019 Joint Rail Conference. Snowbird, Utah, April 9-12, V001T07A001. ASME. https://doi.org/10.1115/jrc2019-1223.

Breijer, R., Orij, R.P. 2022. The Comparability of Non-financial Information: An Exploration of the Impact of the Non-financial Reporting Directive (NFRD, 2014/95/EU). Accounting in Europe, 3(23). https://dx.doi.org/10.2139/ssrn.3874896.

Cheng, B., Iannou, I., Serafeim, G. 2014. Corporate Social Responsibility and Access to Finance. Strategic Management Journal, 35(1), 1-23.

Chollet, P., Sandwidi, B.W. 2018. CSR engagement and financial risk: A virtuous circle? International evidence. Global Finance Journal, 38, 65-81. https://doi. org/10.1016/j.gfj.2018.03.004.

Christensen, D.M., Serafeim, G., Sikochi, A. 2022. Why is Corporate Virtue in the Eye of The Beholder? The Case of ESG Ratings. The Accounting Review, 97(1), 147-175. https://doi.org/10.2308/TAR-2019-0506.

Clément, A., Robinot, É., Trespeuch, L. 2023. The use of ESG scores in aca demic literature: A systematic literature review. Journal of Enterprising Com munities: People and Places in the Global Economy, ahead-of-print. https://doi. org/10.1108/JEC-10-2022-0147.

Crous, C., Battisti, E., Leonidou, E. 2022. Non-financial Reporting and Company Financial Performance: A Systematic Literature Review and Integrated Framework. EuroMed Journal of Business, 17(4). https://doi.org/10.1108/EMJB-12-2020–0134.

Directive (EU) 2022/2464 of the European Parliament and of the Council of 14 December 2022 amending Regulation (EU) No 537/2014. Available at: https://eur-lex.europa.eu/eli/dir/2022/2464/oj.

Europejskie Standardy Sprawozdawczości Zrównoważonego Rozwoju. 2024. Available at: https://www.gov.pl/web/finanse/europejskie-standardy-sprawozdawczosci-zrownowazonego-rozwoju.

Ferensztajn-Galardos, E., Krajewska, R. 2024. Społeczna odpowiedzialność biznesu na przykładzie branży TSL, Logistyka w Ratownictwie 2024, (red.) A. Chudzikiewicz & A. Krzyszkowski, Instytut naukowo-Wydawniczy SPATIUM, Radom. pp. 39-58. ISBN: 978-83-68026-24-5, eISBN 978-83-68026-25-2.

Karwowski, M., Raulinajtys-Grzybek, M. 2021. The application of corporate social responsibility (CSR) actions for mitigation of environmental, social, cor porate governance (ESG) and reputational risk in integrated reports. Corporate Social Responsibility and Environmental Management, 28(4), Article 4. https:// doi.org/10.1002/csr.2137.

Kawałkowski, K., Młyńczak, J., Olczykowski, Z., Wojciechowski, J. 2018. A Case Analysis of Electrical Energy Recovery in Public Transport. In: Sierpiński, G. (eds) Advanced Solutions of Transport Systems for Growing Mobility. TSTP 2017. Advances in Intelligent Systems and Computing, vol 631. Springer, Cham. https://doi.org/10.1007/978-3-319-62316-0_11.

Kolej Dużych Prędkości wprowadzi Polskę do europejskiej kolejowej ekstraklasy, Rzeczpospolita, Gremi Media SA, 17.01.2025. Available at: https://www.rp.pl/transport/art41690091-kolej-duzych-predkosci-wprowadzi-polske-do-europejskiej-kolejowej-ekstraklasy.

Krištofik, P., Lament, M., Musa, H. 2016. The Reporting of Non-financial Information and the Rationale for Its Standardization. E&M Economics and Management, 2(XIX). https://doi.org/10.15240/ tul/001/2016-2-011.

Lament, M., Bukowski, S. 2022. Non-fnancial Reporting as a Determinant of Financial Efficiency of Insurance Companies. The Polish Statistician, 67(7). https://doi.org/10.5604/ 01.3001.0015.9299.

Li, Q., Zou, G., Zeng, W., et al. 2024. ESG guidance and artificial intelligence support for power systems analytics in the energy industry. Sci Rep, 14, 11347. https://doi.org/10.1038/s41598-024-61491-8.

Mao, J., Jafari, M., Botterud, A. 2021. Planning low-carbon distributed power systems: Evaluating the role of energy storage. Energy 238, 121668. https://doi.org/10.1016/j.energy.2021.121668.

Ministerstwo Rozwoju i Technologii. 2023. Realizacja celów zrównoważonego roz woju w Polsce. Raport 2023 w ramach programu monitoringu realizacji Agendy 2030. Available at: https://www.gov.pl/web/rozwoj-technologia/monitoring--realizacji-agendy-2030.

Murè, P., Spallone, M., Mango, F., Marzioni, S., Bittucci, L. 2021. ESG and reputation: The case of sanctioned Italian banks. Corporate Social Responsibility and Environmental Management, 28(1), 265-277. https://doi.org/10.1002/csr.2047.

PGE - Integrated Report. 2023. Available at: https://raportzintegrowany2023. gkpge.pl/en/.

Porter, M.E., Kramer, M., Serafeim, G. 2019. Where ESG fails. Institutional Investor. Pozyskano z: https://www.institutionalinvestor.com/article/2bswdin 8nvg922puxdzwg/opinion/where-esg-fails.

Raport: Podsumowanie postępów w realizacji Programu CPK 2017-2023 Warszawa. 2024. Available at: https://www.cpk.pl/wp-content/uploads/Podsumowanie-postepow-w-realizacji-Programu-CPK-2017-2023.pdf.

Rosler, J. 2024. CPK: Linia "Y" powstanie do 2035 r. Takie będą polskie koleje dużych prędkości. Rynek Kolejowy. Available at: https://www.rynek-kolejowy.pl/wiadomosci/cpk-ygrek-powstanie-do-2035-roku-119786.html.

Shixiu Bai, Jinxia Zhang. 2022. Management and information disclosure of electric power environmental and social governance issues in the age of artificial intelligence. Computers and Electrical Engineering, Volume 104, Part A, 108390. ISSN: 0045-7906. https://doi.org/10.1016/j.compeleceng. 2022.108390.

PKP CARGO S.A. oraz Grupa Kapitałowa PKP CARGO - sprawozdanie Zarządu z działalności za rok 2023. Available at: https://www.pkpcargo.com/raporty_okresowe/raport-roczny-2023.

PKP INTERCITY S.A. - sprawozdanie Zarządu z działalności spółki za 2023 rok.

Szadziewska, A. 2015. Przejrzystość i porównywalność informacji niefinansowych w sprawozdawczości spółek w świetle zmian regulacji unijnych. Prace Naukowe Uniwersytetu Ekonomicznego We Wrocławiu, 396, 141-149.

Wojciechowski. J., Lorek. K., Nowakowski. W. 2018. An influence of a complex modernization of the DC traction power supply on the parameters of an electric power system. MATEC Web of Conferences 180 0200. DOI: 10.1051/matecconf/201818002001

Wytyczne do raportowania ESG – przewodnik dla spółek. 2024. GPW. Available at: https://www.gpw.pl/pub/ GPW/ESG/Wytyczne_do_raportowania_ESG.pdf.