

KATARZYNA
JOACHIMIAK-LECHMAN
MATEUSZ MIKUTOWSKI

**CE in corporate
sustainability reporting –
general insights based on
Polish companies listed
on the Warsaw Stock
Exchange**

1. Introduction

The circular economy (CE) represents a new management paradigm that demonstrates sustainable development ideas. The concept of CE emerged more than 50 years ago, and since then, there have been many publications on the subject. In 1977, the report *The Potential for Substituting Manpower for Energy* was created, which presented the CE and its impact on the environment. The report was published as a book where CE is described, indicating the need to ensure product recycling, reuse, and remanufacturing (Iwaszczuk et al., 2022, after Stahel and Reday-Mulvey, 1981). The definition as well as the principles and assumptions of CE are included in various policies and regulations, where it is stated that “CE means an economic system whereby the value of products, materials and other resources in the economy is maintained for as long as possible, enhancing their efficient use in production and consumption, thereby reducing the environmental impact of their

Katarzyna Joachimiak-Lechman,
Institute of Management, Poznan
University of Economics and Business,
Poland,
ORCID: 0000-0003-2917-9131.

Mateusz Mikutowski,
Institute of Finance, Poznań University
of Economics and Business, Poland,
ORCID: 0000-0002-5248-265X.

use, minimising waste and the release of hazardous substances at all stages of their life cycle, including through the application of the waste hierarchy (OJ L 198/26, 2020, p. 184)". The above definition indicates that, the main objective of implementing the CE principles is to create a resource-efficient society. This aim is related to the concept of "cradle to cradle," which refers to the process of designing and manufacturing a product (Zarębska, 2019). Many parameters may be used to improve the product: durability, reliability, ease of repair and maintenance, ease of upgrading, reusability, remanufacturing, refurbishment, quality of recycling, and energy and resource efficiency (European Commission, 2022).

According to Eurostat, in Poland in 2018-2020, a decrease in the circular material use rate from 9.8% to 7.5% was observed (The 2023 National Report, 2023). The special report *Circular Economy – Slow Transition by Member States Despite EU Action* included a note that under cohesion policy, the European Commission should consider the scope for providing more incentives for developing projects targeting circular product design (European Court of Auditors, 2023). In this context, research on the CE in enterprises in the Podkarpackie Voivodeship is worth presenting. One of the conclusions is that the level of awareness of the CE among enterprises of the Podkarpackie Voivodeship is unsatisfactory. There was also a slight emphasis on financial support for enterprises from the EU structural and investment funds on implementing activities convergent with the CE. The identified barriers also include a lack of knowledge (competence gaps) about the potential effects of implementing CE solutions (Bernatowicz et al., 2021). Another study, which sheds light on companies' attitudes to the concept of CE, was carried out in 2023 and focused on the activities of selected industries in the field of product life cycle. It was found that the companies surveyed take the most significant number of measures to increase the durability/reliability of the products they offer, explaining that in this way, they build their prestige and the trust of their customers. For the same reason, respondents showed relatively little interest in using secondary raw materials (Joachimiak-Lechman, 2024). This conclusion gives cause for concern; after all, circular solutions are one of the main elements of the transition to CE.

Undoubtedly, the Corporate Sustainability Reporting Directive (CSRD) and the implementation of delegated acts - European Sustainability Reporting Standards (ESRS), will increase the popularity of the CE at the business level. The ESRS core standards include two cross-cutting standards and ten thematic standards, one of which focuses specifically on resource use and the

CE (ESRS E5). ESG reporting is a concept that is becoming more important in Poland. It will soon be a “game changer” for many business entities. This article contributes to the ongoing discussion on how businesses approach ESG, focusing on measuring one of the critical environmental areas. To date, few publications have presented the context of Polish organisations against the background of ESG. The mining industry, among others, is described through the prism of ESG challenges. The paper by Sukiennik et al. (2020) presented the provisions of the European Green Deal that make changes in the area of the corporate culture of entities operating in the mining industry an imperative necessity. The paper by Zieliński and Adamska (2022) assessed the ESG reporting activities carried out by the Opole Power Plant. ESG has a particular impact on financial market participants. The paper by Pyka and Nacoń (2024) assesses the changes in ESG risk management in the Polish banking sector. The questionnaire survey showed that banks publish the results of their ESG analyses regularly and list the main threats and factors that affect their exposure to ESG risk (Pyka & Nacoń, 2024).

2. Methodology and research limitations

The primary objective of this study is to assess the CE indicators that are covered in the ESG reports of Polish companies listed on the Warsaw Stock Exchange. As of 2023, only the most prominent companies, employing more than 500 employees and meeting one of two financial criteria—either 85 million PLN in total assets at the end of the financial year or 170 million PLN in net sales revenues for the financial year (OJ L 330/1, 2020, 2014)—were required to report ESG. Therefore, the focus was on the most prominent companies on the Warsaw Stock Exchange. Due to the specific type of activity from the CE perspective, financial companies, telecommunications services, and game development were excluded from the analysis. The study concentrated on the remaining ten companies whose type of activity was more dependent on and susceptible to circularity (Allegro SA, Budimex SA, Dino Polska SA, JSW SA, KGHM SA, Grupa Kęty SA, LPP SA, PEPCO SA, PGE SA, PKN Orlen SA.). Of course, the selected group cannot be considered representative of the entire population of enterprises; however, it can be assumed that the most significant public companies should serve as a benchmark for this reporting for others. Thus, the level they represent may indicate the effectiveness of such actions for a large part of the market, especially considering that most enterprises in Poland at this point are not required to publish non-financial reports, let alone report on their level of circularity.

The methodology adopted by the authors consisted of several stages. Firstly, the assumptions of the CE model were presented with a focus on CE indicators and knowledge about sustainability reporting was systematised. Next, a qualitative analysis of best practices and recommended solutions applied by other institutions was conducted. Given that the circularity of enterprises is still in its early development phase, there are no specific proposals or procedures, only directions for potential actions that possess a general form. In the next stage, an analysis of enterprises' quality of circularity reporting was undertaken. Initially, using the tool Worldclouds.com, the most frequently occurring words in ESG reports of the companies under study were analysed. The goals, policies and programmes of the surveyed companies with regard to CE and the indicators they identify in this area were then analysed. As noted, the main focus of this article is on CE indicators. However, in order to evaluate them, it is necessary to refer to the companies' strategies in this area. Therefore, corporate sustainability strategies in terms of CE were analysed first. This was followed by a focus on the CE indicators presented. In the final stage of the study, proprietary indicators have been proposed that could be used for enterprise circularity reporting, responding to the needs of the stakeholders. The particular steps of the study are shown in the figure 1.

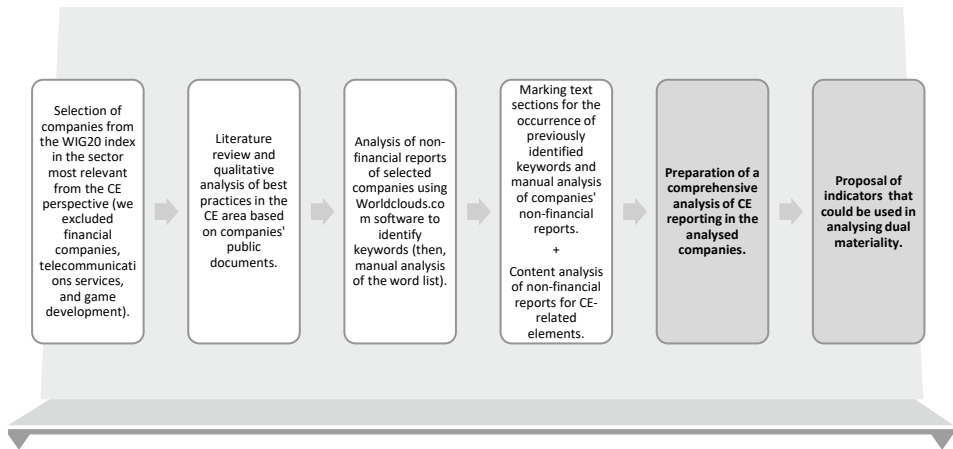


Figure 1. Stages of the study

Source: own elaboration

As highlighted, the primary source of research was the non-financial reports of the selected companies obtained directly from websites. However, due to the varied publication methods, other documents, such as financial or management activity reports, were also analysed, as not all enterprises had separate ESG reporting documents. The methodology is subject to limitations related to variability in reporting standards, terminology, and the voluntary nature of CE reporting in many jurisdictions. Some companies may not report on all aspects of their practices, leading to potential gaps in the data. Additionally, differences in sector-specific reporting practices and company size could introduce inconsistencies.

3. CE models and indicators – selected aspects

The conceptual basis of CE is presented in the form of business models, which should be integrated into company strategies. The opportunities, but also the challenges, that the CE is causing companies to transform their business models, expecting to achieve tangible economic benefits. Implementing CE in a company requires profound changes in key business areas: production, logistics, energy efficiency management, strategic and operational management, and design and placement of products and services (Iwaszczuk et al., 2022). The cooperation between consumers and producers, among producers and entrepreneurs, researchers and the public sector is needed.

Implementing CE ideas into companies' operations involves changing how they think about products and processes. The business model, developed by the Ellen MacArthur Foundation, includes: (1) product and process design, (2) sell and buy-back, (3) life cycle supporting, (4) lifetime extension, (5) product as a service, (6) sharing, (7) recovery, (8) refurbish, (9) recycling, and (10) circular supplies (Carra & Magdani, 2016). Companies like IKEA and H&M Group exemplify the comprehensive adoption of circular business models, including many innovative practices. Specific activities are presented below to illustrate how CE is integrated into the business strategies of these companies (table 1).

Table 1. Selected sustainability practices of IKEA and H&M Group companies

Variables/ Companies	IKEA	H&M Group
Circular Business Models	It uses sections like „As-Is“ to sell reconditioned or returned goods, promoting reuse and reducing waste. It also offers a spare parts service.	Employs models including resell, rental, repair, and collect, aiming to prolong garment life cycles and enhance resource efficiency.
Business Model Innovation	Adoption of AI technologies like „Winnow“ for managing food waste and „Too Good to Go“ app to distribute surplus food	Innovations such as collaborative financing tools for supply chain decarbonisation, and partnerships in renewable energy and regenerative agriculture.
Sustainability Strategies	„People & Planet Positive“ strategy emphasises circular and climate-positive efforts, sustainable living	Focus on creating a circular ecosystem, investing in sustainable materials and technologies

Source: Koulizou and Georgousis, 2024, p.25

The effects of implementing CE models should be monitored. One of the projects supporting companies in measuring circularity is the 17 Goals Campaign. It is a nationwide cross-sectoral initiative for the implementation of the Sustainable Development Goals (SDGs) in Poland. As part of this initiative, a set of SDGs indicators for business has been created, called the Impact Barometer. The tool enables companies to make simple calculations of key indicators. In order to measure circularity, indicators related to SDG 12 have been defined (The 17 Goals Campaign, 2023):

- Material efficiency,
- Energy efficiency,
- Percentage of energy from renewable source,
- Greenhouse gas emissions,
- Water efficiency,
- Percentage of recycled or reused waste,
- Percentage of raw materials and materials from sustainable sources.

The literature provides many more micro-level indicators that can be used to estimate the level of circularity (e.g. Kristensen & Mosgaard, 2020; Vinante et al., 2021; De Pascale et al., 2021; Matos et al., 2023). Kristensen and Mosgaard (2020) reviewed 30 CE indicators at the micro level, where the majority of indicators focused on three areas:

- recycling,
- end-of-life management,
- remanufacturing.

One of the recycling related indicator is the Material Circularity Indicator (MCI). MCI considers the recycled content in a product along with waste (linear flow) and utility of a product (expressed through lifetime) (Kristensen & Mosgaard, 2020 after Ellen MacArthur Foundation and Granta Design, 2015). Among the indicators for EOL management, the End-of-life Index (EOLI) can be distinguished. It is based on the total cost of each EOL process and consists of EOL indices for modules, sub-assemblies and components of a product (Kristensen & Mosgaard, 2020 after Lee et al., 2014). The regeneration is another CE category for which there are numerous indicators. One of them is the Combination Matrix (CM). It combines circularity and longevity of a product, and considers the contribution made by product remanufacturing along with recycling (Kristensen & Mosgaard, 2020 after Figge et al., 2018).

Vinante et al. (2021) gathered insights from 130 papers belonging to the academic and practical literature reviewing existing CE indicators and structuring them according to the circular value chain framework. More than 300 firm-level metrics have been identified and classified into 23 categories. The highest number of metrics was distinguished in the eco-design category, among them (Vinante et al., 2021):

- percentage of recycled materials/components in products,
- extent to which company is active in designing products that are recyclable and reusable,
- extent to which products are designed for reduced consumption of material/energy,
- extent to which products are designed for waste minimization,
- longevity (lifetime in months considering sum of use, reuse and recycle),
- extent to which “green packaging” initiatives are carried out.

Based on existing literature on categorization and assessment of micro-level indicators, further authors explored a large number of indicators, describing their characteristics. De Pascale et al. (2021) starting by 137 articles published from 2000 to 2019, surveyed 61 indicators measuring the circular economy. The indicators were grouped on the basis of the 3R Core CE principles. Indicators referring to the LCA method are worth noting. One of these is Recyclability Benefit Rate (RBR). It shows the relationship between the environmental benefits of product recovery and the external effects associated with the disposal of the product (De Pascale et al., 2021 after Huysman et al., 2015).

Another example is Eco-cost Value Ratio that combines LCA and LCC. It presents marginal prevention costs of environmental pollution added to the costs for prevention of material and energy depletion divided by the market value of the products and services delivered (De Pascale et al., 2021 after Scheepens et al., 2016).

Matos et al. (2023) analysed CE indicators derived from the literature review, highlighting significant correlations between them. It was stated that only a few micro-indicators are entirely within the sphere of influence of the company. Some categories of indicators are affected by the market and legislation. The market significantly affects indicators in almost all categories of CE. Legislation has an impact on indicators in the Recycling, Waste Management, Life Extension and Reuse categories. Categories which are entirely dependent on the company are Disassembly and Multidimensional Indicators (Matos et al., 2023). Multidimensional indicators are difficult to categorize. They consider multiple CE categories and strategies of CE. Multidimensional indicators use a life-cycle perspective or even broader CE perspective (Kristensen & Mosgaard, 2020). One of them is the CE Indicator Prototype (CEIP) that measures and evaluates product life cycle performance (Cayzer et al., 2017). Another example could be the Circular Design Guidelines (CDG). They present design guidelines to be considered for a better circular design product (Bovea & Pèrez-Belis, 2018).

The multitude of indicators does not make it easy for companies to understand the CE. Moreover, they are not standardised enough to allow companies to compare values against each other or refer to a specific benchmark. For these reasons, ESRS have been developed, among others. Knowledge of sustainability reporting is systematised in a separate section. Below, only the CE indicators included in the ESRS are recalled. According to ESRS E5: Resource use and Circular Economy, the information to be disclosed should, in particular, relate to (European Commission, 2023):

- the increase of circular product design (including, for instance, design for durability, dismantling, reparability, recyclability, etc.).
- the increase of circular material use rate,
- the minimization of primary raw materials,
- sustainable sourcing and use (in line with the cascading principle) of renewable resources,
- the waste management, including preparation for proper treatment,
- other matters related to resource use or CE.

4. Sustainability reporting – an overview

For a long time, corporate reporting has gone beyond the framework of typical financial indicators, taking the form of sustainable reporting. The guidelines developed by the Global Reporting Initiative (GRI) were essential in this context. The GRI issued guidelines at the end of 2016 to promote the first global sustainability reporting standards, which have been in force since July 2018, and their application is voluntary (Szadziewska et al., 2021). In recent years, further initiatives have been to prepare sustainability reporting standards. Below (figure 2) are presented the standards and norms most commonly used by Polish companies.

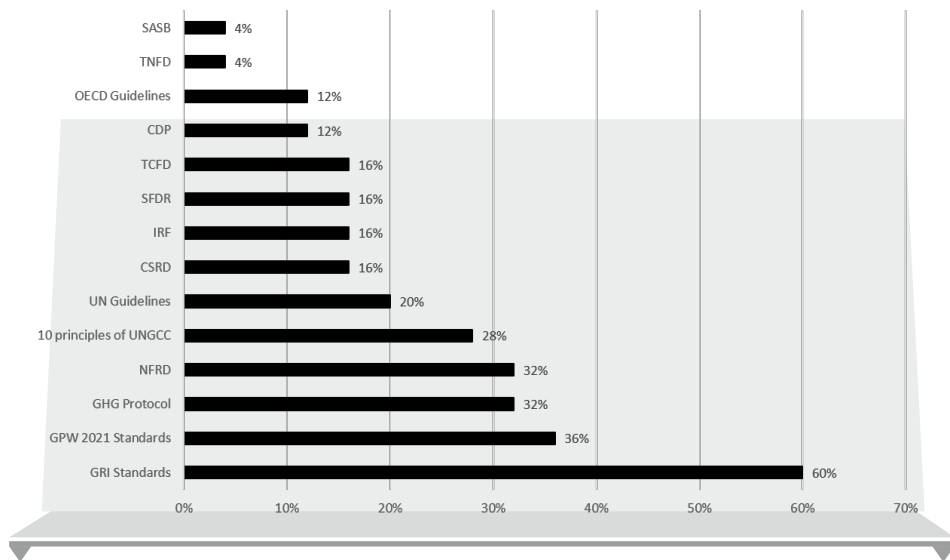


Figure 2. Non-financial reporting standards and norms applied by companies in Poland

Source: Implementation of the Sustainable Development Goals in Poland, 2023, p.55

It is worth noting that the NFRD (Non-Financial Reporting Directive) was the first legal act requiring certain companies in the EU to report on sustainability issues, and it applied to significant public interest entities. The NFRD was replaced by the Corporate Sustainability Reporting Directive 2022/2464, which

came into effect in early 2023. Polish law will soon implement this directive. The bill amending the Accounting Act, the Act on Statutory Auditors, Audit Firms and Public Oversight, was published in April 2024.

The CSRD expands the scope of the NFRD and introduces more detailed and ambitious reporting requirements for the companies covered, including an audit obligation. Estimates suggest that the CSRD regulations will soon apply to approximately 4-5 thousand companies in Poland (Fundacja Climate& Strategy, 2023). It is worth noting that more and more business entities will be required to take ESG action due to EU legal regulations and their location in a particular supply chain. The Polish Chamber of Commerce estimates that in 2023-2024, 37 thousand companies will receive their contractors' inquiries about sustainable development issues. In 2025-2026, this applies to another 99 thousand entities (Osiecki, 2023).

The implementing tools for the CSRD are the ESRS. The European Financial Reporting Advisory Group (EFRAG) was crucial in their preparation. The ESRS was adopted in 2023, and it clearly stated that the definitions, concepts, and disclosures within the scope of the ESRS and GRI are so strongly related that the problem of double reporting has been eliminated. The core ESRS standards include two cross-cutting standards (ESRS 1 and ESRS 2) and ten thematic standards corresponding to the following areas: environmental (ESRS E1 - ESRS E5), social (ESRS S1 - ESRS S4), and governance (ESRS G1).

According to ESRS, double materiality analysis is the first step in sustainability reporting. This is necessary for the entity to identify material impacts, risks, and opportunities that will be disclosed. Companies use this process to compile a list of ESRS that receive the 'irrelevant' statement. However, irrespective of the outcome of its materiality assessment, the undertaking shall always disclose the information required by ESRS 2 *General Disclosures*. A company must disclose information in the following areas: governance, strategy, impact, risk, and opportunity management, as well as metrics and targets (European Commission, 2023). According to the definition, ESG strategy integrates environmental, social, and governance factors into a company's operations and investment decisions (de Souza Barbosa et al., 2023). The ESG strategy therefore addresses the key assumptions of sustainability reporting, including dialogue with stakeholders, double materiality analysis, a value-chain approach, and risk management.

The presentation of a multitude of data poses a potential problem for economic entities, mainly as many are scattered information resources. KPMG International surveyed between April – June 2023 senior executives

and board members with ESG reporting and assurance knowledge at 750 companies across industries and global regions, with a mean revenue of US \$15.6 billion. It was found that most companies are still at the beginning of their “ESG assurance journey” and are not ready to have all of their ESG data independently assured. According to the study, there are six top challenges in preparing for ESG assurance: high initial costs/inefficient budget, lack of internal skills and experience, lack of clarity/evolving regulations, inadequate supplier ESG performance, insufficient IT/digital solutions, lack of precise metrics/measurement tools (KPMG International, 2023). The above results conclude that companies – especially those for which ESG reporting is a new legal obligation – need multifaceted support. One of the forms is the exchange of experience, not only in data collection but, above all, taking into account activities in sustainable development, the implementation of which is the starting point in adapting to new market conditions. The Responsible Business Forum is one of the platforms for sharing good practices in Poland. Below are selected examples of activities that serve the transformation of enterprises, with a focus on the CE.

5. Examples of good practice in the area of CE – qualitative analysis

In the next step of the study, a review of organisations’ good practices in the CE field has been carried out. The activities in the area of CE were taken from companies’ public documents. A search engine managed by the Corporate Responsibility Forum, which is available at <https://odpowiedzialnybiznes.pl/dobre-praktyki>, was used for this purpose. After entering the keyword “Circular Economy” in the search field of the responsible business forum without indicating other criteria such as “industry” or “source of good practice”, a list of 74 practices was obtained. The activities came from various resources of environmental communication.

The list of companies consisted mainly of large players with a strong market position. The sorted examples were analysed in terms of the pillars of the CE: Reduce, Reuse, Repair, Recycle. The research was conducted using content analysis, which aims to reduce the content of the entire text to its most essential meanings: the most frequent CE activities.

Strong players in the retail market present the most significant number of initiatives. A general slogan, “giving a second life to products,” describes the activities carried out. While some of these activities align with eco-design requirements, such as repair and provision of spare parts, the majority are

voluntary initiatives that reflect a growing awareness of responsible production and consumption. The following activities were most often identified in this area:

- organizing a permanent or periodic selective collection of used private label products (and not only) in order to transfer them to professional recycling points,
- “second-hand” sales - an offer to buy back used private label products in order to renew and resell them,
- offer of repair of private label products after the warranty period and regeneration,
- provision of spare parts,
- charity campaigns collect used products and donate them to those in need.

Upon examining manufacturing companies, various activities ranging from simple to complex were observed. Capital-intensive activities rarely occurred, as did activities demonstrating cooperation between a manufacturing company and a market participant in the so-called end-of-life stage. Only one of the analysed companies successively invests in technological lines, enabling the recovery of its production waste by returning it to the system. Two entities actively cooperate with recycling plants - one example is the implementation by the company of production waste pre-treatment methods to facilitate its further recycling, and the other is the selective collection of office supplies and transfer to the recycling plant, which then returns the secondary raw material to the company. Three of the analysed production companies declared plans to expand their offer by introducing a recycling service, assuming the collection of specific waste from the market or with the proviso that the collection of used products applies only to business partners. Significantly more entities indicated that they use recycled raw materials in production. Many of the identified programs are also related to packaging: putting products in recycled/recyclable packaging, a pallet recovery program, introducing returnable packaging, and adjusting the packaging to the size of the products. It is also interesting to use the waste of appropriate quality in an alternative production system, not necessarily as part of diversifying one’s activities, but more often to sell to other business entities. Few entities (only 2) declared the comprehensive design of their products for dismantling and recycling. One of the analysed entrepreneurs implements a business model based on producing products from

100% waste. Additionally, only one of the analysed manufacturing companies provides a service where customers can rent their products through an appropriate platform, thereby implementing the sharing concept. The idea of CE gives an impulse to manufacturing companies, but it is not an issue foreign to other sectors. The activity in this area of representatives of the intangible services market is worth noting, where CE seemingly seems to be a topic of lower importance, yet some initiatives have been identified. Examples include:

- alterations of outdoor advertisements into gifts for customers: shopping bags, backpacks, laptop cases,
- a platform for the sale of furniture (desks, chairs, cabinets) from liquidation, relocation or modernization,
- organization of service points enabling the repair of shoes, small-size equipment, etc.

6. Analysis of the CE elements in ESG reports of selected companies

As mentioned, the study covered companies listed on the Warsaw Stock Exchange from the WIG 20 index, whose activities relate to trade, industrial activity, or extraction of raw materials. Initially, the ESR reports of companies included the study were analysed using the tool Worldcloud.com. Based on this analysis, words that may be related to the CE were selected. Using this information, along with a review of the literature and expert knowledge, a list of keywords was prepared to be searched in the documents. The context of these keywords was then manually verified to check whether the reports contained any goals or indicators related to circularity. A set of predefined keywords relevant to CE principles was used to search the reports. Keywords included terms such as e.g. "Circular Economy," "resource efficiency," "waste reduction," "recycling," "reuse," "product life cycle," and "sustainability" (for the article, the indicated words have been translated into English; however, the analysis was conducted in Polish). Below (figure 3) is a word cloud illustrating the terms related to circularity and their frequency of occurrence in the analysed documents (the larger the word, the more frequently it appears).



Figure 3. Word cloud of the most popular terms related to the CE in the analyzed reports

Source: own elaboration and calculation using worldclouds.com software

To verify whether the reports mentioned issues related to circularity, automated text-mining software was used to scan documents for relevant keywords, which led to conclusions regarding the significance of circularity for the company. Then we manually marked the worlds, which potentially could be connected to CE. This was done to enable manual verification of the reports for the occurrence of this type of reporting. Consequently, the sections of documents discussing issues that could impact circularity (mainly environmental sections) were manually searched. Both authors conducted the analyses independently, resulting in more precise outcomes. The companies were then categorised based on the following criteria:

- Is there a standalone ESG report?
- Are CE issues discussed?
- Are there measurable goals for the CE?
- Are measurable CE indicators reported?

- Are there CE policies?
- Are there CE programs?

The study's main goal focused on CE indicators. The analysis sought also specific goals and actions companies took in the CE area. The tables below summarise the most important issues.

Table 2. Analysis of ESG reports in the context of CE goals, policies, and programs

Lp.	Industry	Is there a standalone ESG report?	Are CE issues discussed?	Are there measurable goals of a CE?	Is there standalone CE policy?	Is there any CE related program?
1	E-commerce	Yes	Yes	Yes	No	Yes
comment	The company integrates ESG reporting, including some CE-related elements, especially regarding supply chain management and offering sustainable solutions for clients and sellers. However, a full CE policy is not directly outlined in the publicly available reports.					
2	Construction	Yes	Yes	Yes	No	Yes
comment	The company actively reports on eco-friendly initiatives, including CE principles, especially in waste management and recycling materials in construction. Implementing CE practices is part of its sustainability strategy. It's working on reducing environmental impact, primarily by optimizing material use in projects, aligning with some CE concepts but without a dedicated CE policy.					
3	Retail	No	Yes	No	No	No
comment	Available report indicate company's focus on reducing carbon footprint and increasing energy efficiency, though a CE strategy is not fully developed in ESG reports. They report on minimizing resource use and environmental impacts but have not detailed a CE policy.					
4	Raw materials	No	Yes	No	No	Yes
comment	Company reports mention pro-environmental efforts, though a formal CE policy is not a main focus. The company primarily reports environmental actions related to water management and emissions reduction and it is part of their whole operation report. Their strategy includes certain activities aimed at water recycling however, in the authors' opinion, it is immeasurable and inadequate to the scale of company. CE initiatives are limited and more focused on compliance and impact mitigation rather than resource cycling or reuse.					
5	Raw materials	Yes	Yes	Yes	No	Yes
comment	Company reports numerous CE-related activities, particularly in raw materials recycling. The company incorporates CE principles into its mining and production activities. Its sustainability reporting mentions resource efficiency and waste management as parts of its broader sustainability policy, though it lacks a formal CE policy.					

6	Mechanical engineering	No	Yes	Yes	No	Yes
comment	Company demonstrates CE commitment, particularly in metal recycling, which is crucial to its operations. Recycling is a core part of its strategy. However, they haven't formally labelled this a CE policy.					
7	Retail	Yes	Yes	Yes	No	Yes
comment	Company is actively developing a CE strategy, especially in sustainable fashion. The company implements initiatives such as garment recycling and eco-design as part of its sustainability strategy. However, they haven't formally labelled this a CE policy.					
8	Retail	No	Yes	No	No	No
comment	CE-related information in company's reports is limited, though the company undertakes basic environmental efforts such as energy efficiency and waste reduction. Company addresses environmental issues within its sustainability goals but lacks a dedicated CE policy. Their focus is primarily on energy efficiency and emissions reduction without a circular economy framework.					
9	Power engineering	Yes	Yes	Yes	No	Yes
comment	Company includes some CE elements, primarily in the context of emission reduction and waste processing. CE policy is part of its long-term environmental strategy. The company even established a dedicated daughter company whose main task is to implement circular economy. There is no indication of a specific circular economy policy, but establishing a dedicated company can be considered quite a significant substitution.					
10	Raw materials	Yes	Yes	No	No	Yes
comment	Company implements numerous CE actions, particularly in raw material recycling and reducing the environmental impact of its products. They report on initiatives to reduce waste, reuse resources, and optimize material use, effectively implementing CE concepts even though a standalone CE policy is not specified.					

Source: own study based on reports taken from company websites: *JSW S.A.* (2023); *Grupa Kęty S.A.* (2023); *Grupa Budimex S.A.* (2023); *LPP S.A.* (2023); *PGE S.A.* (2023); *Grupa Allegro S.A.* (2023); *Dino S.A.* (2023); *KGHM S.A.* (2023); *PEPCO S.A.* (2023); *PKN Orlen S.A.* (2023)

In summary, some companies actively integrate CE principles into their strategies, as seen in their non-financial reports, while other companies report only selected aspects of the circular economy. Circularity policy as a separate, comprehensive document (as with many other ESG-related policies, e.g. corruption, diversity) does not exist within the analysed companies, which suggests that it is still an issue that is not a priority in ESG activities. However,

most companies have programs aimed at implementing CE strategies, which may lead to expansion of CE policy in the future.

Table 3. Analysis of ESG reports in the context of the occurrence of CE indicators

Lp.	Industry	Are measurable CE indicators reported?	Example of the CE indicator
1	E-commerce	Yes	Percentage of sustainable packaging
comment	Due to its activities, the company mainly indirectly implements the issues of recycling and environmental pollution. However, their ESG report indicates information that may be included in the CE categories. They provide information about recycled packaging materials and show changes in their use. However, it is not easy to assess the level of circularity comprehensively, as it is rather selective. Again, the company focuses on nominal measures such as CO2 emissions.		
2	Construction	Yes	Recycling rate of construction waste
comment	The company pays attention to issues related to the CE. Some of its activities and investment plans specify how a given action will impact the implementation of the CE. It also reports on the reuse rates of certain materials. The company has a particular purpose vehicle, „Circular Construction SA,” which conducts activities in the broadly understood recycling: collection, storage, and processing of waste for reuse.		
3	Retail	Yes	Recycling rate of waste paper
comment	The company has yet to publish a separate report on its ESG activities, but it mentions CE in its management report. However, it needs to define its goals related to circularity measurably and approach the issue briefly. The company publishes specific indicators regarding the CE, e.g. the level of waste paper recycling. However, they do not refer to, for example, waste paper consumption. The information is incomplete, and it is not easy to assess the level of circularity.		
4	Raw materials	Yes	Water consumption ratio per unit of revenue million m ³ /million PLN
comment	The company describes ESG issues in the management report on its operations without indicating the objectives. It publishes quite detailed indicators on the level of raw material and energy use. In the case of water consumption, it publishes very detailed data along with information about the water recovered during the production process. Interestingly, it also shows the ratio of water consumption to revenues generated by the company, similar to wastewater management. The recipient can, therefore, assess whether the reduction in water consumption is due to efficiency or, for example, a reduction in the scale of the company's operations.		

5	Raw materials	Yes	Scrap Recycling (copper-bearing materials of various percentage of metals)
comment	The company has described investments in the CE. It sets qualitative goals such as restoring mining machinery, such as the Mining Waste Disposal Facility (OUOW) „Iron Bridge.” It also publishes measurable targets and indicators but does not directly relate them to the scale of operations. They are also selective and difficult to relate to the company’s operations. The company indicates that increasing circularity can increase the profitability of the core business.		
6	Mechanical engineering	Yes	Share of aluminium scrap in products extruded from low-emission ingots
comment	The company points to the CE in its report. The CE also has a single primary goal for all ESG activities. It describes in detail the methodology of calculating the ratio, which is an exception in relation to the other analysed companies. The company provides a specific level of implementation of the current ratio as well as the target level of the ratio. However, there is a lack of touching on more areas in the context of the CE.		
7	Retail	Yes	The percentage of clothing made of more sustainable materials (i.e. organic, cellulosic fibres, or recycled).
comment	The company should be distinguished when referring to the issue of CE in a separate section of the ESG report. The disadvantage, however, is that it mainly describes quality issues and nominal values of certain areas (e.g., tons of recycled clothes). In another section, the company reports specific indicators that can be assigned to the CE but are selective and poorly defined. The example of the percentage of clothing made of more sustainable materials is controversial, as it is challenging to say why only one brand was chosen since the group has many brands and what the word „more sustainable” means. There are also no references to the company’s size or financial figures.		
8	Retail	No	-
comment	Despite indicating that ESG activities are critical to the company, the company does not publish a separate ESG report. Its activity report describes its ESG activities in a somewhat opaque way. The CE is indicated very perfunctorily, but some of the activities described in the report can be considered from the level of the CE. It has a lot of qualitative descriptions and plans for implementing specific solutions, but most often, they are immeasurable. Even when specific target levels, e.g., the use of recycled materials, are published, their current implementation levels are not directly presented. Moreover, the goals seem to be quite selective, referring only to selected areas of the company’s operations, not to the entire operation. There is also no reference to the size of the company.		

9	Power engineering	Yes	Percentage of renewable energy in the portfolio
comment	In its ESG report, the company devotes a separate section to the CE and repeatedly mentions this issue in its report. The company indicates one measurable main goal (% share of renewable energy in the portfolio) and its implementation. It also provides detailed qualitative information on how to achieve the indicated goals. Of course, the energy sector is a specific type of activity, and thanks to the renewable energy generation index in the portfolio, it is possible to assess the entire activity of the company in this area. However, other companies should also strive to create this type of measure so that it is possible to look at this area holistically. A relatively broad description of investments and activities that aim to achieve circularity should also be pointed out as an advantage.		
10	Raw materials	No	-
comment	The company reports mainly nominal measures, e.g. water consumption and RES energy production. However, it mainly reports nominal measures, which do not allow for a direct assessment of the level of circularity. Analysing the given measures in detail makes it possible to obtain certain conclusions, but they are not determined directly. The company touches on CE in its report but describes it mainly qualitatively, without specific, measurable goals and their reporting.		

Source: own study based on reports taken from company websites: *JSW S.A.* (2023); *Grupa Kęty S.A.* (2023); *Grupa Budimex S.A.* (2023); *LPP S.A.* (2023); *PGE S.A.* (2023); *Grupa Allegro S.A.* (2023); *Dino S.A.* (2023); *KGHM S.A.*, (2023); *PEPCO S.A.* (2023); *PKN Orlen S.A.* (2023).

In analysing the CE indicators of these companies, several patterns emerge. First, not all companies provide measurable indicators related to circular economy, making it difficult to assess their impact in this area. Additionally, there is often a lack of financial values in these, so interpreting the influence of CE initiatives on business performance can be challenging. The reported indicators are also selective, covering only certain aspects of CE activities, limiting an understanding of their overall effectiveness on company operations. While companies in certain sectors have improved in CE-related reporting (e.g., renewable energy in power engineering), the variability across sectors suggests the need for more standardized, comprehensive CE reporting to enhance transparency and comparability.

7. Discussion

Based on secondary data analysis, recommendations for enterprises in the field of CE reporting were formulated. Among other things, it is recommended:

- Use of indicators relating to the scale of the company's operations (*JSW S.A.*),

- A good definition of the method of building and calculating the ratio (the example of Kęty S.A.).
- A comprehensive approach to the subject of CE and including it in many areas of the company's operations (the example of Budimex S.A.),
- Reporting on CE issues in separate, dedicated sections that will allow stakeholders to assess the company's overall activity in this area (examples: LPP S.A.; Budimex S.A.; PGE S.A.),
- Creating a universal set of indicators to assess the level of circularity of the entire company, not just selected areas (the example of PGE S.A.),
- Creating a universal indicator/scoring allows companies to compare the level of circularity of different companies or at least within a given industry.

The above issues are critical in the context of problems frequently raised by regulators and audit firms (Grant Thornton, 07.11.2022; KGHM, 2023) or scientists (Smoleńska, 2023) on the integration of non-financial statements with traditional financial statements, as well as in the context of double materiality. The dual materiality assessment examines a company's environmental and social impact (impact materiality), as well as how ESG (environmental, social, and governance) factors affect its financial (financial materiality). The considerations presented in this article can bring the world of science and practitioners closer to finding solutions.

Determining and calculating the appropriate indicators is critical for reporting success. Companies offering accounting software are already indicating their willingness to implement special modules that allow the integration of ESG data with elements of standard financial statements. However, defining objective materiality criteria is necessary to assess them from the perspective of all company stakeholders. In addition, they must be reliable and calculable for businesses. Currently, it is difficult to find a standard for this type of indicator because, as the above analysis shows, they are often selective and do not refer to the financial condition of enterprises. Building an appropriate set of indicators requires in-depth analyses and recognition of the needs of entrepreneurs and other stakeholders, taking into account the specifics of the industry and the costs of implementing this type of reporting. Undoubtedly, it is possible to identify and propose groups and drafts of potential indicators that may be useful for assessing the financial significance of a CE. Therefore, the authors proposed groups of indicators that can be used to analyse double significance (table 4).

Table 4. Proposals for financial materiality indicators of CE

Group	Examples of indicators
<p>Material/energy cost reduction ratios/ Intermediates</p> <p>Justification: The company saves money because it does not have to buy recycled goods</p>	<ul style="list-style-type: none"> ● W1 = total costs saved by not having to purchase “goods” obtained from recovery in the production process / net revenues of the company ● W2 = actual profitability on sales/potential profitability on sales when it is necessary to purchase “goods” obtained from recycling ● W3 = actual earnings per share/earnings per share when purchasing “goods” obtained from recovery
<p>Indicators of reduction of tax costs and environmental fees and obtained reliefs.</p> <p>Justification: The company does not incur additional fees and penalties for failure to implement the environmental policy</p>	<ul style="list-style-type: none"> ● W4 = sum of costs of taxes and fees saved (or reliefs obtained) thanks to the CE policy / net revenues of the company ● W5 = actual net profit margin/potential net profit margin with the need to pay environmental taxes and fees (or no reliefs) ● W6 = actual earnings per share/earnings per share with taxes and fees (no tax reliefs)
<p>CE investment indicators</p>	<ul style="list-style-type: none"> ● W7 = Total own investment expenditure on CE policy / Total total investment expenditure ● W8 = Savings related to the CE policy/depreciation of own expenditure of CE investments in a given period ● W9 = IRR of CE investments in the given period ● W10 = IRR from CE investment projects
<p>Indicators of a complete CE policy</p>	<ul style="list-style-type: none"> ● W11 = total costs saved thanks to CE solutions / net revenues of the company ● W12 = actual profitability on sales/potential profitability on sales with no savings from the CE ● W13 = actual earnings per share / potential earnings per share with no savings from the CE

Source: own elaboration

8. Conclusion

Companies with robust CE analytics can present precise, quantifiable data on resource efficiency, waste management, and material recycling processes. CE metrics predict financial resilience, as companies that optimise resource use and reduce waste are better equipped to handle volatile market conditions and rising input costs. The research concludes that despite the growing trend

of striving to circulate the economy, analysed companies do not demonstrate impressive consistency and standardisation. The conclusions reached are as follows:

1. Some companies actively integrate CE principles into their strategies. A tendency can be noticed that companies with a greater impact on the environment (heavy industry, raw materials) focus more on this issue, which is a positive phenomenon. This may be due to the fact that they have greater opportunities to implement this type of solutions, and additionally, their effective implementation may result in greater savings, and the lack of their implementation has a more negative impact on them financially, image-wise and regulatory-wise. In contrast, other companies report only selected aspects of the circular economy proposing a single, selective indicator whose definition remains to be clarified.
2. Not all companies provide measurable indicators related to circular economy, making it impossible to accurately assess their impact in this area. There are no specific measures for the entire company activity; only single, selective areas are shown, which are difficult to relate to all operations. Only one analysed company (PGE S.A.) shows a measure from which the total level of circularity of the company can be deduced. It is impossible to compare the level of circularity of companies (even from similar industries) because there is no standardisation in this area. There is also a need for appropriate indicators of the CE for a given industry. Presumably, the non-specific nature of the indicators causes enterprises to have problems understanding the CE itself, the requirements set for them and how they are to monitor and report progress in implementing the CE.
3. There is little attention given to the financial aspect of circularity (double materiality). This article highlights gaps in the current form of ESG and CE reporting, such as the need for standards and comparability, which makes it difficult to assess the actual implementation of these solutions for stakeholders. The introduction of standardised reporting improves the transparency of CE efforts and strengthens decision-making processes for investors, auditors, etc., by providing more apparent, accurate data.

The paper proposes specific, practical indicators for CE reporting to address these shortcomings. These indicators aim to fill the gap by offering companies tools that are easier to track, interpret, and align with the principles of double materiality, considering both financial and environmental impacts. By advocating for these indicators, the article shows their potential to become standard metrics that can enhance the reliability of sustainability reporting across industries. We

also mention that the biggest challenge may be gathering the necessary data for such analyses; however, this is achievable with proper planning and preparation. Additionally, the development of AI technology can support these activities. AI tools could help automate the gathering of circularity data, making reporting more accessible and reducing the burden on companies.

Abstract:

The circular economy (CE) represents a new paradigm in management. The introduction of the Corporate Sustainability Reporting Directive (CSRD) and the accompanying delegated acts (European Sustainability Reporting Standards, ESRS) highlight that CE is also an integral part of legal requirements at the European Union level. The primary objective of this study is to assess the CE indicators that are covered in the ESG reports of Polish companies listed on the Warsaw Stock Exchange. In the present study, the sustainability strategies of selected companies were also reviewed in terms of CE objectives, policies and action programmes. The findings suggest that despite a growing trend towards circularity in the economy, analysed companies do not demonstrate impressive consistency and standardisation. The analysis concluded that some enterprises approach circularity comprehensively and thoughtfully, implementing actual actions and investment expenditures. In contrast, others merely mention CE by proposing a single, selective indicator whose definition is unclear. Within the framework of this article, groups of indicators were proposed that could serve in analysing dual materiality, one of which is the indicator for reducing material and energy costs.

Keywords: *CE, sustainable development reporting, CE goals, CE indicators, best practices.*

JEL

Classification: Q56.

Acknowledgment

Supported by funds granted by the Minister of Science of the Republic of Poland under the 'Regional Initiative for Excellence' Programme for the implementation of the project 'The Poznań University of Economics and Business for Economy 5.0: Regional Initiative - Global Effects (RIGE).

References

- Aydoğmuş, M., Gülay, G., & Ergun, K. (2022). Impact of ESG performance on firm value and profitability. *Borsa Istanbul Review*, No. 22, 119-127. DOI: 10.1016/j.bir.2022.11.006.
- Bernatowicz, W., Raftowicz, M., Ryng-Duczmal, W., Raczkowski, K., Szkudlarek, Ł., & Ziętek -Fidecka, A. (2021). *Gospodarka obiegu zamkniętego w przedsiębiorstwach województwa podkarpackiego*. <http://rsi.podkarpackie.pl/wp-content/uploads/2021/11/Gospodarka-Obiegu-Zamknietego-w-przedsiębiorstwach-województwa-podkarpackiego-raport-koncowy.pdf> (15.04.2024 - access date).
- Bovea, M.D., & Pérez-Belis, V. (2018). Identifying design guidelines to meet the circular economy principles: a case study on electric and electronic equipment. *Journal of Environmental Management*, Vol. 228, 483-494. <https://doi.org/10.1016/j.jenvman.2018.08.014>.
- Carra, G., & Magdani, N. (2016). *Circular business models for the built environment*. https://circulareconomy.europa.eu/platform/sites/default/files/knowledge_circular_business-models-for_the_environment.pdf (29.09.2024 - access date).
- Cayzer, S., Griffiths, P., & Beghetto, V., (2017). Design of indicators for measuring product performance in the circular economy. *International Journal of Sustainable engineering*, Vol. 10, No. 4-5, 289-298. <https://doi.org/10.1080/19397038.2017.1333543>.
- D'Amato, V., D'Ecclesia, R., & Levantesi, S. (2024). Firms' profitability and ESG score: A machine learning approach. *Applied Stochastic Models in Business and Industry 4.0*, No. 2, 243-261. DOI:10.1002/asmb.2758.
- De Pascale, A., Arbolino, R., Szopik-Depczyńska, K., Limosani, M., & Ioppolo, G. (2021). A systematic review for measuring circular economy: The 61 indicators. *Journal of Cleaner Production*, 281(3), 124942. <http://dx.doi.org/10.1016/j.jclepro.2020.124942>.
- de Souza Barbosa, A., da Silva, M. C. B. C., da Silva, L. B., Morioka, S. N., & de Souza, V. F. (2023). Integration of Environmental, Social, and Governance (ESG) criteria: their impacts on corporate sustainability performance. *Humanities and Social Sciences Communications*, 10(410). DOI: 10.1057/s41599-023-01919-0
- Dino S.A. (2023). Sprawozdanie Zarządu z działalności 2022. <https://grupadino.pl/raporty-gpw/raporty-okresowe/> (28.05.2024 - access date).
- 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. Official Journal of the European Union L 330/1.
- European Commission (2022). Proposal for a regulation of the European Parliament and of the Council establishing a framework for setting

ecodesign requirements for sustainable products and repealing Directive 2009/125/EC (COM /2022/142).

European Commission (2023). Commission Delegated Regulation (EU) 2023/2772 of 31 July 2023 supplementing Directive 2013/34/EU of the European Parliament and of the Council as regards sustainability reporting standards. Official Journal of the European Union.

European Court of Auditors (03.07.2023). Special report 17/2023: CE – Slow transition by member states despite EU action. Retrieved from <https://www.eca.europa.eu/en/publications/sr-2023-17>

Forum Odpowiedzialności Biznesu (n.d.). <https://odpowiedzialnybiznes.pl/dobre-praktyki> (28.05.2024 - access date).

Fundacja Climate& Strategy. (16.11.2023). Co Dyrektywa CSRD oznacza dla małych firm?. Retrieved from <https://firmove.pl/aktualnosci/dobre-praktyki/dyrektywa-csrd-co-oznacza-dla-malych-firm>

Grant Thornton. (07.11.2022). Podwójna istotność jako perspektywa w raportowaniu niefinansowym ESG. Retrieved from <https://grantthornton.pl/publikacja/podwojna-istotnosc-jako-perspektywa-w-raportowaniu-niefinansowym-esg/>

Grupa Allegro S.A. (2023). Raport ESG 2022. https://about.allegro.eu/system/files-encrypted/nasdaq_kms/assets/2023/04/04/9-10-25/PL_Raport%20ESG%202022.pdf (28.05.2024 - access date).

Grupa Budimex S.A. (2023). Raport Zrównoważonego Rozwoju. <https://esg.budimex.pl/> (28.05.2024 - access date).

Grupa Kęty S.A. (2023). <https://grupakety.com/zrownowazony-rozwoj/zarzadzanie/wskazniki-esg/> (28.05.2024 - access date).

Iwaszczuk, A., Sobal, M., Nowaczek, A., Kutyna-Bakalarska, M., Uberman, R., & Mazur, J. (2022). *Implementing the principles of CE in economic practice* (in Polish). Publishing House AGH: Kraków e-ISBN 978-83-67427-10-4.

Jo, H., Saha, T., Sharma, R., & Wright, S. (2010). *Socially responsible investing vs. vice investing*. Academic and Business Research Institute. <https://www.aabri.com/LV2010Manuscripts/LV10107.pdf> (20.05.2024 - access date).

Joachimiak-Lechman, K. (2024). Life cycle perspective in design and product development. *Engineering Management in Production and Services*, 16(3), 143-156. <https://doi.org/10.2478/emj-2024-0029>.

JSW S.A. (2023). ESG Report. <https://jsw.pl/raportroczny-2022#CSR> (28.05.2024 - access date).

Kampania17celow. Retrieved from <https://kampania17celow.pl/the-17-goals-campaign/> (4.11.2024 - access date).

KGHM S.A. 2023. Raport Zintegrowany 2022. <https://kghm.com/pl/inwestorzy/centrum-wynikow/raporty-zintegrowane> (28.05.2024 - access date).

- Koh, H. K., Burnasheva, R., & Suh, Y. G. (2022). Perceived ESG (environmental, social, governance) and consumers' responses: The mediating role of brand credibility, Brand Image, and perceived quality. *Sustainability*, 14(8), 4515. DOI:10.3390/su14084515.
- Koulizou, K., & Georgousis, I. (2024). *The state of circular business model adoption in Sweden: review and a company case study*. (Master's thesis). Retrieved from <https://urn.kb.se/resolve?urn=urn:nbn:se:hig:diva-44677>.
- KPMG International (2023). ESG Road to Readiness. <https://assets.kpmg.com/content/dam/kpmg/cn/pdf/en/2023/10/esg-maturity-report-2023.pdf> (20.05.2024 - access date).
- KPMG. (2023). Analiza podwójnej istotności. <https://kpmg.com/pl/pl/home/services/esg-environmental-social-and-governance/analiza-podwójnej-istotnosci.html> (25.05.2024 - access date).
- Kristensen H. S., & Mosgaard M. A. (2020). A review of micro-level indicators for a CE-moving away from the three dimensions of sustainability? *Journal of Cleaner Production*, Vol. 243, 118531. DOI:10.1016/j.jclepro.2019.118531.
- Lee, H.J., & Rhee, T.H. (2023). How does corporate ESG management affect consumers' brand choice? *Sustainability*, 15(8), 6795. DOI:10.3390/su15086795.
- Liberadzki, K., & Liberadzki, M. (2022). Aspekty regulacyjne finansowania zrównoważonej działalności banku. Zielone instrumenty kapitałowe. *Bezpieczny Bank*, 87(2), 25-46. DOI: 10.26354/bb.2.2.87.2022.
- Lobe, S., & Walkshäusl, C. (2016). Vice versus virtue investing around the world. *Review of Managerial Science*, No. 10, 303-344. DOI: 10.1007/s11846-014-0147-3.
- LPP S.A. (2023). Sprawozdanie zrównoważonego rozwoju za rok 2023. <https://www.lpp.com/zrownowazony-rozwoj> (28.05.2024 - access date).
- Matos, J., Martins, C., Simões, C. L., & Simoes, R. (2023). Comparative analysis of micro-level indicators for evaluating the progress towards a CE. *Sustainable Production and Consumption*, No. 39, 521-533. Doi:10.1016/j.spc.2023.06.002.
- Osiecki, A. (27.04.2023). Kontrahenci z zagranicy zapytują firmy o kwestie ESG. *Rzeczpospolita*. E-issue. Retrieved from <https://www.rp.pl/europejski-kongres-gospodarczy/art38402621-kontrahenci-z-zagranicy-zapytaja-firmy-o-kwestie-esg>.
- PEPCO S.A. (2023). Nasza odpowiedzialność. <https://pepco.pl/nasza-odpowiedzialnosc/> (28.05.2024 - access date).
- PGE S.A. (2023). Raport Zintegrowany 2022. <https://raportzintegrowany2022.gkpgc.pl/> (28.05.2024 - access date).
- PKN Orlen S.A. (2023). Raport Zintegrowany Grupy ORLEN 2022. <https://raportzintegrowany2022.orklen.pl/interaktywne-dane-esg/> (28.05.2024 - access date).

- Pyka, I., & Nacoń, A. (2024). Exposure to the ESG risk of the Polish banking sector. *Economics and Environment*, 1(88), DOI: 10.34659/eis.2024.88.1.701.
- Pyrka, M., Aukcji, Z. S. A., Jeszke, R., & Tobiasz, I. (2022). The costs and challenges for the Polish economy related to the achievement of the climate policy targets by 2050. In: R. Jeszke (Ed.), *Go, '50. Climate. Society. Economy*, No. 03 (pp. 33-45). Warsaw: Institute of Environmental Protection – National Research Institute (IOŚ-PIB) and National Centre for Emissions Management.
- 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, and amending regulation (EU) 2019/2088. Official Journal of the European Union L 198/13.
- Smoleńska, A.P. (2023). Sustainable banks? ESG factors in EU macroprudential regulations (in Polish). *Studia BAS*, 2(74), 67-88. DOI:10.31268/StudiaBAS.2023.12.
- Sukiennik, M., Kapusta, M., & Bąk, P. (2020). Transformation of corporate culture in the aspect of European Green Deal - Polish raw materials industry. *Journal of the Polish Mineral Engineering Society*, 2(2), 177-182 DOI: 10.29227/IM-2020-02-59.
- Szadziewska, A., Majchrzak, I., Remlein, M., & Szychta, A. (2021). *Management accounting and sustainable development* (in Polish). Publishing House IUS PUBLICUM: Katowice.
- The 2023 National Report (02.06.2023). Implementation of the Sustainable Development Goals in Poland. Retrieved from https://planipolis.iiep.unesco.org/sites/default/files/ressources/poland_vnr_2023_eng.pdf
- Vinante, C., Sacco, P., Orzes, G., & Borgianni, Y. (2021). CE metrics: Literature review and company-level classification framework. *Journal of Cleaner Production*, 288(3), 125090. doi:10.1016/j.jclepro.2020.125090.
- Zarębska, J. (2019). *Packaging waste management in the context of a closed loop economy - essence, tools, environmental communication* (in Polish). Publishing House Uniwersytet Zielonogórski: Zielona Góra.
- Zhang, T., Zhang, J., & Tu, S. (2024). An Empirical Study on Corporate ESG Behavior and Employee Satisfaction: A Moderating Mediation Model. *Behavioral Sciences*, 14(4), 274. DOI: 10.3390/bs14040274.
- Zieliński, M., & Adamska, M. (2022). ESG Assessment from the Perspective of the Management Board and Trade Unions on the Example of the Opole Power Plant. *Energies*, 15(21), 8066; DOI: 10.3390/en15218066.