



# The Impact of GRI-Compliant Sustainability Reporting on CO<sub>2</sub>e Emissions, an Analysis of Environmental and ESG Performances

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## ABSTRACT

This study investigates the relationship between sustainability reporting practices aligned with the Global Reporting Initiative (GRI) standards and CO<sub>2</sub>e emissions reduction across six companies operating over two industrial sectors. Grounded in two primary hypotheses, the research aims to assess whether there is a discernible trend toward GRI-compliant reporting and whether these reporting practices are associated with CO<sub>2</sub>e emissions reductions as part of effective sustainability communication. Utilizing a longitudinal analysis of ESG scores, CO<sub>2</sub>e emission levels, and annual changes from 2019 to 2022, the study examines the dynamics of sustainability reporting within the context of environmental performance. Preliminary observations indicate that firms from the oil and extractive industries have made strides in enhancing their ESG scores, which may suggest a potential link between structured sustainability reporting and improved environmental outcomes. However, the analysis also reveals variability among companies, with some exhibiting inconsistent emission trends despite stable ESG scores. This variability raises questions about the strength and universality of the relationship between GRI-aligned reporting and emissions reductions. The study posits that industry-wide incentives and regulatory frameworks may be essential for fostering more consistent adherence to GRI standards across different sectors. Future research directions are suggested to explore deeper mechanisms and variations across industries to gain a comprehensive understanding of the broader impacts of GRI standards on environmental outcomes.

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## 1. Introduction

Sustainability reporting has become a pivotal focus for managers as organizations are increasingly evaluated not only on financial performance but also on their social and environmental impacts. This study investigates the compliance of companies across various sectors with the Global Reporting Initiative (GRI) framework, specifically focusing on the extractive industries and pharmaceuticals. A detailed analysis was conducted on firms that have published at least one sustainability report, utilizing a scoring system developed from an extensive literature review to assess adherence to Environmental, Social, and Governance (ESG) criteria.

This research aims to contribute to the understanding of sustainability practices in the corporate sector globally and highlights the critical role of GRI compliance in promoting responsible business conduct. The implications of continued support for sustainability initiatives are essential for advancing the transition to a green economy while addressing global challenges such as climate change (Doering, 2023).

Corporate social responsibility (CSR) initiatives play a crucial role in communicating sustainability information (Fatima et al., 2023). These initiatives aim to enhance corporate reputation and increase stakeholder interest in the impact that economic entities have on society and the environment. Consequently, stakeholders are increasingly demanding that companies adopt socially and environmentally responsible behaviors. CSR encourages organizations globally to pay greater attention to sustainability reporting practices (Avotra et al., 2023).

The Global Reporting Initiative (GRI) has continued to demonstrate its commitment to environmental protection and conservation through the development of comprehensive and specific performance indicators. A significant step in the evolution of sustainability reporting standards was marked by the collaboration between GRI and the European Financial Reporting Advisory Group (EFRAG), initiated in 2021 (EFRAG-GRI, 2021). Looking ahead, there is an increasing need for strengthening and harmonizing the standards published

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by various organizations regarding corporate responsibility. Policymakers face the challenge of identifying effective ways to hold economic entities accountable for their corporate reporting without compromising the benefits derived from voluntarily adopting CSR principles (Chi et al., 2020).

This study investigates the compliance of companies with GRI standards, particularly focusing on those within the extractive industries and pharmaceuticals. The analysis includes companies listed on the Bucharest Stock Exchange (BVB), providing insights into their sustainability practices. A detailed examination was conducted on firms that have published at least one sustainability report, utilizing a scoring system developed from an extensive literature review to assess adherence to Environmental, Social, and Governance (ESG) criteria.

The findings reveal an upward trend in the publication of sustainability reports aligned with GRI standards among these entities, characterized by an increasing level of detail in their disclosures. Additionally, there is a notable reduction in greenhouse gas emissions, measured in CO<sub>2</sub> equivalent (CO<sub>2</sub>e), indicating a commitment to sustainable practices. These results highlight the critical importance of transparent reporting in fostering corporate accountability and enhancing stakeholder trust.

This research enriches the understanding of sustainability practices within various sectors and emphasizes the role of GRI compliance as a vital component in promoting responsible business conduct across different contexts.

The structure of this paper is organized as follows: Section 2 reviews relevant literature; Section 3 outlines the methodologies and research design used and, as well, the development of the hypotheses; Section 4 presents the empirical results obtained from our analysis; Section 5 details the conclusions obtained from our analysis and Section 6 the limitations of the study and the further directions that can be pursued.

## 2. Literature review

Sustainability reports provide a comprehensive view of an organization's social and environmental activities, serving as a vital complement to traditional financial statements (Velte, 2022). These reports encompass all dimensions of Environmental, Social, and Governance (ESG) performance, with their reliability, objectivity, and credibility bolstered by ISO certifications and the GRI reporting framework (Sugianto et al., 2022). Consequently, sustainability reports focus on performance management within the organization and the strengthening of relationships with stakeholders (Khuong et al., 2021).

Adams and Frost (2008) explored how environmental and social reporting practices integrate into management by interviewing personnel from British and Australian companies. Their study did not aim to evaluate whether sustainability performance itself improved due to reporting practices; instead, it focused on examining how this type of information was utilized in managerial decision-making and performance management. They identified a need for further research to establish a more direct link between reported metrics and their influence on actual company performance outcomes.

Drawing from earlier literature, Skouloudis et al. (2009), following Morhardt's (2002) framework, categorized four primary motives for corporate sustainability reporting: reducing operational costs, improving stakeholder relations, enhancing environmental visibility, and gaining competitive advantage. These motivations carry an implicit assumption that reporting should contribute to environmental or sustainability improvements, as it would be challenging for companies to achieve these benefits without meaningful gains in performance.

Chen et al. (2014) conducted a study examining the relationship between Environmental Management Practices (EMP) and financial performance in manufacturing firms from Sweden, China, and India. Their analysis, which used GRI reporting as a measure of EMP, found no positive correlation between these practices and financial outcomes, with a negative association observed between environmental standards for suppliers and sales growth. However, this study did not investigate how EMP might relate to improvements in environmental or social metrics, leaving questions about the extent to which these practices impact broader sustainability performance.

Proponents of sustainability reporting, like Bosetti (2023), argue that sustainability disclosures offer companies a strategic edge by facilitating investor evaluations of future competitiveness. Effective sustainability management is suggested as a way for investors to differentiate companies poised to maintain market strength from those at risk of future challenges. The GRI's Sustainability Reporting Guidelines are frequently cited as the leading global standard, enabling companies to document their impact on stakeholders and the environment comprehensively. According to these proponents, sustainability reporting can contribute to shareholder value by addressing gaps in traditional financial reporting that often overlook crucial non-financial factors.

Together, these studies reveal an assumption that GRI reporting can enhance sustainability performance, yet no study definitively shows that GRI-compliant reporting directly leads to improved environmental or social outcomes. Instead, evidence suggests that companies already invested in sustainability practices are more likely to report at advanced levels, raising questions about whether GRI standards independently encourage better sustainability or merely reflect existing commitments.

This article aims to contribute to a deeper understanding of sustainability reporting practices from the perspective of compliance with the GRI framework and demonstrates the degree of alignment of sustainability reports from Romanian companies indexed on BVB with international standards. It aims to highlight the potential for Romanian companies listed on the Bucharest Stock Exchange (BVB) that publish sustainability information to achieve enhanced performance by adhering to and aligning with the principles of the GRI conceptual framework.

Cross-sectional studies reveal that robust carbon governance frameworks—characterized by stringent carbon regulations, heightened awareness of carbon issues, and a solid legal infrastructure—significantly enhance firms' capabilities in carbon mitigation (Christensen et al., 2017; Sun, 2016). In this regard, the implementation of Global Reporting Initiative (GRI) standards functions as a valuable alternative to these carbon governance mechanisms.

This research contributes to the current academic discourse in certain ways, by it expanding the understanding of the tangible effects of Environmental, Social, and Governance (ESG) reporting on carbon reduction efforts by underscoring the specific influence of GRI standards.

Previous investigations that have largely concentrated on the broader implications of ESG reporting, often emphasize different aspects of ESG performance such as pollution management, employee well-being, or corporate philanthropy (Christensen et al., 2021). This study is pioneering in its focus on the direct impacts of GRI standards on carbon reduction.

Also, we delve into the pathways through which GRI standards affect carbon mitigation outcomes and further empirical findings have been investigated in order to see if provision of support for signaling purposes has been achieved, indicating if the adoption of ESG standards serves as a signal of a firm's proactive strategies and policies and demonstrate a sincere commitment to reducing carbon emissions and fostering stakeholder engagement.

Our investigations also strive to contribute to international research by shedding light on how national institutional contexts interact with the adoption of GRI standards to influence corporate carbon mitigation efforts. As climate change presents a global challenge that requires coordinated action, understanding how different countries' institutional environments either substitute or complement GRI standards in promoting carbon mitigation is essential for policymakers considering whether to mandate ESG reporting standards.

The interplay between sustainability reporting and environmental performance remains complex and multifaceted. While existing literature suggests various motivations and outcomes related to GRI compliance, our study aims to contribute further to this discourse by providing empirical evidence from Romanian companies, thereby enriching the understanding of how structured sustainability communication can influence corporate behavior and environmental impact.

### **3. Research Methodology and Design**

The objective of this study is to analyze the extent to which companies across various sectors are oriented towards publishing sustainability reports as a tool for improving CO<sub>2</sub> equivalent (CO<sub>2e</sub>) emissions performance. To achieve this goal, the research employs a scoring system to evaluate the compliance of sustainability reports with the Global Reporting Initiative (GRI) standards.

The primary aim of the study is to evaluate the extent to which organizations are inclined to publish sustainability reports as a means of improving their CO<sub>2e</sub> emissions performance. As the global focus on climate change intensifies, the role of sustainability reporting becomes increasingly critical in guiding corporate practices and stakeholder engagement. To achieve this objective, we have formulated the following research hypotheses:

H1: Organizations exhibit an increasing trend in publishing sustainability reports aligned with GRI standards.

H2: The firms analyzed demonstrate reduced CO<sub>2e</sub> emissions as a direct result of implementing effective sustainability communication practices.

Hypothesis H1 posits that there is a growing recognition among organizations of the importance of sustainability reporting, particularly in alignment with GRI standards. This trend reflects a broader commitment to transparency and accountability in environmental practices, as companies seek to enhance their reputations and meet stakeholder expectations. By adopting GRI standards, organizations not only improve their reporting quality but also signal their dedication to sustainable development.

Hypothesis H2 focuses on the expected outcomes of enhanced sustainability reporting on CO<sub>2e</sub> emissions performance. It suggests that organizations that effectively communicate their sustainability efforts through GRI-aligned reports are likely to experience reductions in their CO<sub>2e</sub> emissions. This relationship highlights the potential for sustainability reporting to drive meaningful environmental improvements, as companies implement strategies aimed at mitigating their carbon footprints.

Together, these hypotheses underscore the significance of GRI standards as a framework for fostering responsible business practices and promoting environmental stewardship. By investigating these

relationships, this study aims to provide valuable insights into how sustainability reporting can contribute to both corporate accountability and tangible reductions in carbon emissions. Understanding these dynamics is essential for guiding future research and informing policy decisions aimed at addressing climate change challenges.

The reference period analyzed encompasses the years 2020, 2021, and 2022. Following this analysis, a total of 21 sustainability reports were identified, all of which were included in the evaluation.

To ensure a comprehensive understanding of the key components within an entity's value structure, companies have increasingly turned to the voluntary publication of sustainability information. Such disclosures enable the identification and assessment of primary indicators that drive the overall performance of the organization.

The sustainability reports from the analyzed companies were sourced from both the Bucharest Stock Exchange (BVB) website and the companies' own websites. This dual sourcing approach ensures that stakeholders have access to reliable and relevant information regarding the companies' sustainability practices and performance metrics. By focusing on these reports, stakeholders can better evaluate how effectively organizations are managing their environmental impacts and fulfilling their social responsibilities. The insights gained from this analysis are crucial for understanding how sustainability initiatives contribute to long-term corporate success and stakeholder engagement.

To evaluate the conformity of sustainability-related communications with established ESG reporting framework GRI, we adjusted and adapted the methodology utilized in Skouloudisi's (2009) study. A scoring model was developed, ranging from 0 to 3, applied to GRI indicators. These GRI indicators were tailored to fit the specific reporting conditions of local companies, with certain categories deemed irrelevant in the local context being excluded.

The content and format of the information presented in sustainability reporting must be relevant and meaningful. The responsibility for selecting the information to be included in these reports lies with company management, which has an obligation to consider the informational needs of all stakeholders. This approach ensures increased transparency and effective communication with stakeholders.

This approach ensures that the evaluation process is relevant and aligned with the unique challenges faced by organizations in their sustainability reporting efforts. By focusing on GRI standards, companies can effectively communicate their sustainability initiatives and performance metrics, thereby enhancing transparency and accountability.

The adaptation of the scoring model allows for a nuanced assessment of how well companies are aligning their practices with GRI standards. This is particularly important as stakeholders increasingly demand reliable information regarding corporate sustainability efforts. The results of this evaluation can provide valuable insights into best practices and areas for improvement, ultimately contributing to better environmental performance and stakeholder engagement.

Furthermore, this methodology not only facilitates compliance assessment but also encourages organizations to reflect on their sustainability strategies and their impact on CO<sub>2</sub>e emissions. By identifying key indicators that drive performance, companies can implement more effective measures to reduce their carbon footprint and enhance their overall sustainability profile.

The scoring system was designed to accurately reflect the level of compliance of companies with GRI standards. Specifically:

A score of 3 is awarded to companies that provide comprehensive and systematic coverage of the analyzed elements, demonstrating full compliance with GRI requirements.

A score of 2 is assigned to companies that partially meet GRI requirements, for instance, by providing information but lacking the necessary details for complete understanding.

A score of 1 is given when a GRI element is presented only in generic terms, without substantial information (e.g., merely mentioning the GRI indicator without concrete data).

A score of 0 is assigned when a GRI element is not mentioned at all, and no related data are provided in accordance with the GRI standards.

Within the analysis of the three fundamental categories of sustainability, a methodology was developed to quantify compliance with Global Reporting Initiative (GRI) standards. This approach is encapsulated in a distinct mathematical formula applicable to all pillars, allowing for the percentage calculation of sustainability disclosure indices:

$$Score_{Company} = \frac{\sum_{j=1}^m (ElementScore_{GRI_j})}{\sum_{i=1}^n \max((ElementScore_{GRI})_i)} * 100$$

where:

$Score_{Company}$  is the Total Score of the analyzed economic entity obtained for one of the three categories, expressed as a percentage;

$n$  is the maximum number of elements that can be disclosed;

$max(ElementScore_{GRI})$  is the Maximum Score that can be awarded to the economic entity;

$m$  is the total number of elements disclosed for the same category;

$ElementScore_{GRI}$  is the Score awarded to the economic entity for the overall sustainability, according to the scoring methodology mentioned above.

This mathematical formula serves as a quantitative evaluation tool, providing an objective perspective on the level of transparency and compliance with GRI requirements in sustainability reporting. By employing this methodology, a systematic and comparative analysis of organizations' performance in sustainability reporting is facilitated. This not only enhances accountability but also encourages continuous improvement in sustainability practices across various sectors.

Table 1 presents the GRI elements considered in this study, organized across three fundamental dimensions: governance, natural environment, and social aspects. These categories are essential for evaluating the sustainability performance of organizations and ensuring comprehensive reporting.

**Table 1. GRI Elements considered for this Study**

| Governance                        | Natural Environment              | Social                                  |                                    |
|-----------------------------------|----------------------------------|-----------------------------------------|------------------------------------|
| GRI 102 General Disclosure        | GRI 301 Materials                | GRI 401 Employment                      | GRI 410 Security Practices         |
| GRI 103 Management Approach       | GRI 302 Energy                   | GRI 402 Labor/Management Relations      |                                    |
| GRI 201 Economic Performance      | GRI 304 Biodiversity             | GRI 403 Occupational Health and Safety  | GRI 412 Human Rights               |
| GRI 202 Marketing                 | GRI 305 Emissions                | GRI 404 Training and Education          | GRI 415 Public Policies            |
| GRI 203 Indirect Economic Impact  | GRI 306 Waste                    | GRI 405 Diversity and Equal Opportunity | GRI 416 Customer Health and Safety |
| GRI 204 Procurement Practices     |                                  |                                         |                                    |
| GRI 205 Anti-Corruption           | GRI 307 Environmental Compliance | GRI 406 Non-Discrimination              | GRI 417 Marketing and Labeling     |
| GRI 206 Anti-Competitive Behavior |                                  |                                         | GRI 418 Customer Privacy           |

In the process of adapting GRI indicators to the specific context of local companies, a critical analysis was conducted to eliminate certain categories that were deemed inapplicable or irrelevant within the local business environment. The removed indicators include: GRI 408 (Child Labor), GRI 409 (Forced or Compulsory Labor), GRI 419 (Socioeconomic Compliance), GRI 308 (Supplier Environmental Assessment), GRI 407 (Freedom of Association and Collective Bargaining), GRI 414 (Supplier Social Assessment), GRI 411 (Rights of Indigenous Peoples), and GRI 413 (Local Communities).

This tailored methodology allows for a more precise and contextually relevant evaluation of sustainability reporting practices within the local market. By considering the specific legislative, economic, and social dynamics at play, we have refined our focus to include only those indicators that are applicable and meaningful in the regional context. This selective approach ensures a comprehensive understanding of how organizations align with international reporting standards.

Moreover, this framework not only streamlines the analysis of sustainability performance but also empowers organizations to articulate their environmental and social contributions more effectively. By leveraging these carefully chosen indicators, companies can uncover opportunities for enhancement and respond proactively to stakeholder expectations. This ultimately fosters greater transparency and accountability in their reporting efforts, strengthening their commitment to sustainable business practices.

The analysis of Romanian companies was conducted on an initial sample of all the entities from the pharmaceutical and extractive industry, which are indexed and listed on the Bucharest Stock Exchange (BVB), taking into account the information available on their respective websites. The selection process was based on the following rigorous criteria: Companies must be publicly listed, Companies must be registered in Romania and part of the European region, Companies must publish sustainability information, Financial and sustainability information of the companies must be publicly accessible. These criteria gave a sample of 6 entities, that can be seen in Table 2.

**Table 2. Analyzed Companies**

| Name                               | Industry        | Reporting years relevant to ESG |
|------------------------------------|-----------------|---------------------------------|
| Rompetrol Well Services S.A. (PTR) | Extractive      | 2020, 2021, 2022                |
| S.N.G.N. Romgaz S.A. (SNG)         | Extractive      | 2020, 2021, 2022                |
| OMV Petrom S.A. (SNP)              | Extractive      | 2020, 2021, 2022                |
| Antibiotice S.A. (ATB)             | Pharmaceuticals | 2020, 2021, 2022                |
| Biofarm SA (BIO)                   | Pharmaceuticals | 2020, 2021, 2022                |
| Zentiva SA (SCD)                   | Pharmaceuticals | 2020, 2021, 2022                |

To determine the degree of adoption and compliance with GRI requirements, we analyzed the sustainability reports of the selected companies, published on both the official BVB database website and the companies' own websites, over a three-year period: 2020, 2021, and 2022. The compliance of the sustainability reports from the analyzed companies was measured across the three ESG dimensions (corporate governance, social, and environmental) using scores ranging from 0 to 3.

This structured approach allows for a comprehensive evaluation of how well these organizations align their practices with international sustainability reporting standards, thereby enhancing transparency and accountability in their operations. By focusing on these criteria, we aim to provide valuable insights into the effectiveness of sustainability reporting among Romanian firms listed on BVB.

The analysis of CO<sub>2</sub>e values derived from sustainability reports focused on changes year-to-date (YTD) starting from the year 2020 with a specific comparison to 2019 where applicable. The values for Romanian companies focus on the sustainability reports published from 2020 onward. It is important to note that this comparison could not be made for Rompetrol and Biofarma for the comparison between the years 2020 and 2019, as these companies did not provide CO<sub>2</sub>e data for the year 2019, as it can be seen in Table 3.

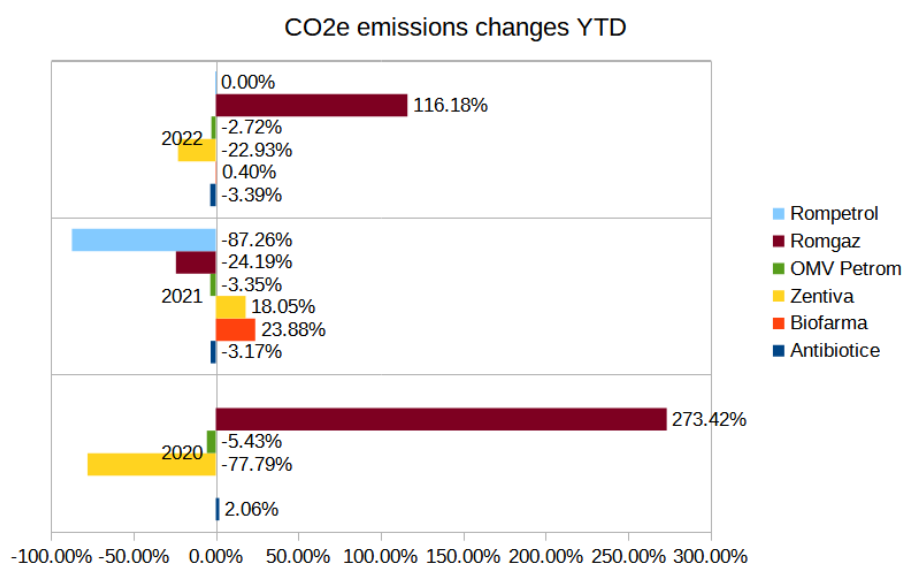
**Table 3. Results of CO<sub>2</sub>e emissions and GRI Standard compliances according with the publicly sustainability reports**

| Name        | Year | CO <sub>2</sub> e (tonnes) | CO <sub>2</sub> e YTD changes | ESG Compliance Score (%) | ESG YTD changes |
|-------------|------|----------------------------|-------------------------------|--------------------------|-----------------|
| Antibiotice | 2019 | 15917.5                    |                               |                          |                 |
|             | 2020 | 16246.1                    | -2.06%                        | 70.37                    |                 |
|             | 2021 | 15730.5                    | 3.17%                         | 70.37                    | 0.00%           |
|             | 2022 | 15196.5                    | 3.39%                         | 81.48                    | 15.79%          |
| Biofarma    | 2019 |                            |                               |                          |                 |
|             | 2020 | 201                        |                               | 13.58                    |                 |
|             | 2021 | 249                        | -23.88%                       | 13.58                    | 0.00%           |
|             | 2022 | 250                        | -0.40%                        | 13.58                    | 0.00%           |
| Zentiva     | 2019 | 22650                      |                               |                          |                 |
|             | 2020 | 5031                       | 77.79%                        | 17.4                     |                 |
|             | 2021 | 5939                       | -18.05%                       | 17.4                     | 0.00%           |
|             | 2022 | 4577                       | 22.93%                        | 17.4                     | 0.00%           |
| OMV Petrom  | 2019 | 4.42                       |                               |                          |                 |
|             | 2020 | 4.18                       | 5.43%                         | 70.37                    |                 |
|             | 2021 | 4.04                       | 3.35%                         | 74.07                    | 5.26%           |
|             | 2022 | 3.93                       | 2.72%                         | 96.3                     | 30.01%          |
| Romgaz      | 2019 | 143768.57                  |                               |                          |                 |
|             | 2020 | 536867.351                 | -273.42%                      | 81.48                    |                 |
|             | 2021 | 406980.78                  | 24.19%                        | 81.48                    | 0.00%           |
|             | 2022 | 879793.02                  | -116.18%                      | 81.48                    | 0.00%           |
| Rompetrol   | 2019 |                            |                               |                          |                 |
|             | 2020 | 984100                     |                               | 88.89                    |                 |
|             | 2021 | 125419.34                  | 87.26%                        | 96.3                     | 8.34%           |
|             | 2022 | 125413.16                  | 0.00%                         | 96.3                     | 0.00%           |

*Source: Non-financial and Sustainability Reports of each analyzed company 2019-2022*

#### 4. Results

The dataset provided offers a detailed examination of the CO<sub>2</sub>e emissions and ESG (Environmental, Social, and Governance) scores for six companies from 2019 to 2022, with particular focus on their alignment with GRI (Global Reporting Initiative) standards. This analysis explores emission trends, sustainability efforts, and ESG compliance over time, examining fluctuations and identifying patterns across the selected companies.



**Figure 1. Year-to-Date Changes in CO<sub>2</sub>e emissions for analyzed companies**

*Source: Non-financial and Sustainability Reports of each analyzed company 2019-2022*

In Figure 1, which illustrates the changes in CO<sub>2</sub>e emissions across the years, it is evident that the companies exhibit diverse patterns in managing their greenhouse gas emissions. Antibiotice, for instance, shows a slight increase in emissions from 2019 to 2020, rising from 15,917.5 tons to 16,246.1 tons, before reducing consistently in the following years, reaching 15,196.5 tons by 2022. This trend reflects Antibiotice's efforts to stabilize emissions, although the changes were relatively modest, indicating some volatility in achieving consistent reductions. The year-to-date (YTD) percentage changes confirm this pattern, showing minor increases in 2020 (2.06%) followed by gradual decreases in 2021 (-3.17%) and 2022 (-3.39%).

In contrast, Biofarma's emissions data, available from 2020, presents a more stable but significantly lower volume of CO<sub>2</sub>e emissions compared to Antibiotice. The initial figure of 201 tons in 2020 increased to 249 tons in 2021, followed by a marginal increase to 250 tons in 2022. This relatively stable emission level reflects Biofarma's consistency in managing its carbon output, although the 2021 data shows a substantial percentage increase (23.88%) before leveling off in 2022 (-0.40%).

Zentiva, on the other hand, experienced a sharp reduction in CO<sub>2</sub>e emissions, as depicted in Figure 1, with a notable decline from 22,650 tons in 2019 to 5,031 tons in 2020, which represents a 77.79% decrease. However, this initial reduction was not sustained, as emissions rose again to 5,939 tons in 2021 before declining to 4,577 tons in 2022. This fluctuation suggests that Zentiva implemented aggressive emission reduction measures initially, though the partial rebound in subsequent years indicates potential challenges in maintaining these reductions consistently.

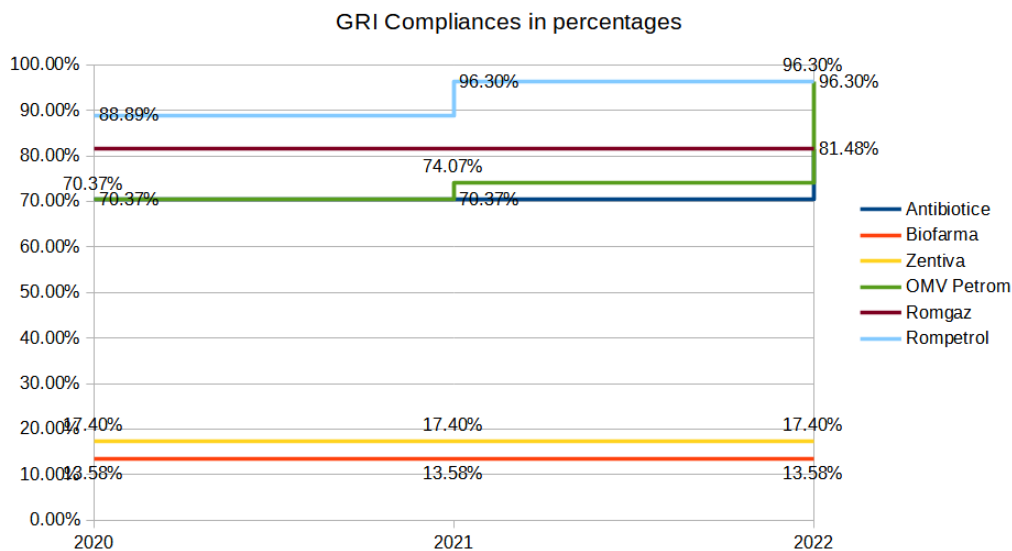
OMV Petrom displayed a relatively stable pattern in emissions across the period, starting at 4.42 tons in 2019 and achieving a gradual decrease to 3.93 tons by 2022. The modest year-on-year changes (5.43% in 2020, 3.35% in 2021, and 2.72% in 2022) suggest a steady approach to emissions management, with a clear downward trajectory.

The analysis of Romgaz reveals significant volatility in emission levels, as evidenced by the sharp increase in emissions from 143,768.57 tons in 2019 to 536,867.351 tons in 2020, an increase of 273.42%. Although emissions were reduced to 406,980.78 tons in 2021, they rose dramatically again in 2022, reaching 879,793.02 tons, corresponding to a year-over-year change of 116.18%. This high level of variability indicates inconsistent emission management practices and raises questions about operational changes or fluctuations in production scale.

Rompetro's emissions data, available from 2020, reveal a significant reduction from an initial level of 984,100 tons to 125,419.34 tons in 2021, a substantial improvement reflected in an 87.26% decrease. The company managed to maintain this lower emission level in 2022, with a minor change to 125,413.16 tons. Rompetrol's performance suggests successful implementation of emission control measures that were sustained over multiple years.

The ESG scores, shown in Figure 2, provide insight into the companies' compliance with GRI standards. Antibiotice displayed a steady ESG score from 2020 to 2021 at 70.37%, followed by a significant improvement

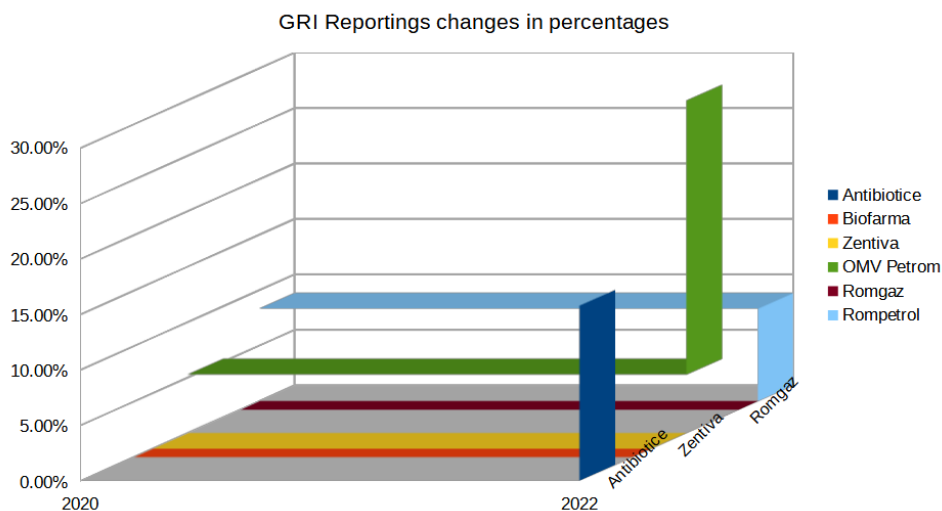
to 81.48% in 2022, representing a 15.79% increase. This improvement in ESG compliance could be indicative of enhanced sustainability practices, which align with Antibiotice's broader emission reduction efforts. Biofarma, however, shows a consistently low ESG score of 13.58% from 2020 to 2022, with no significant changes, implying a potential lack of progress in adopting or expanding its ESG initiatives. Zentiva, similar to Biofarma, maintained a low and static ESG score of 17.4 throughout the period. The lack of improvement in Zentiva's ESG score, despite the substantial initial reduction in emissions, suggests that while the company may have focused on emissions reduction, broader ESG factors have not been equally prioritized.



**Figure 2. GRI-compliant Score (%) for analyzed companies calculated in accordance with the methodology used**

In contrast, OMV Petrom displayed a gradual increase in ESG score from 70.37% in 2020 to 96.3% in 2022, marking a 30.01% improvement. This upward trend, as illustrated in Figure 3, aligns with OMV Petrom's consistent emissions control efforts, reflecting a broader commitment to sustainability and alignment with GRI standards. Similarly, Romgaz maintained a constant ESG score of 81.48% from 2020 to 2022, despite the significant volatility in its emissions, indicating that while the company may have some ESG frameworks in place, its approach to emissions management appears inconsistent.

Rompetrol also shows a favorable trend in ESG compliance, with a score increase from 88.89% in 2020 to 96.3% in 2021, followed by stability in 2022. The improvement in 2021 reflects Rompetrol's substantial reduction in emissions and suggests an alignment between emission control and ESG performance, in line with sustainability objectives.



**Figure 3. Changes of GRI compliance scores for the analyzed companies**

The variations in emissions and ESG scores across these companies highlight different approaches and commitments to sustainability. Companies like OMV Petrom and Rompetrol, which have shown both emission reductions and improvements in ESG scores, appear more aligned with global sustainability goals, while others, such as Biofarma and Zentiva, demonstrate limited progress in ESG compliance despite some changes in

emissions. The data overall suggest that further integration of ESG principles could benefit these companies, particularly those with low or unchanging ESG scores. Enhanced ESG practices, combined with consistent emission management, could better position these companies to meet international standards and address the growing expectations for corporate responsibility.

## 5. Conclusions

The findings of this study offer insightful conclusions regarding the two primary hypotheses posed. The first hypothesis (H1), which posited that organizations would demonstrate an increasing trend in publishing sustainability reports aligned with GRI standards, is partially supported by the observed data. The second hypothesis (H2), which proposed that firms would show a reduction in CO<sub>2</sub> emissions as a direct consequence of implementing effective sustainability communication practices, reveals a more complex relationship that varies significantly between firms. The conclusions, grounded in the evidence presented, explore these hypotheses in detail.

Our first hypothesis suggested that organizations would exhibit a progressive increase in publishing sustainability reports that adhere to GRI (Global Reporting Initiative) standards, reflecting a broader commitment to transparency, accountability, and alignment with global sustainability practices. However, the data across the six companies reveal a mixed pattern with respect to improvements in ESG scores—an indirect measure of GRI compliance—and suggest varying levels of commitment to these standards.

Antibiotice, OMV Petrom, and Rompetrol demonstrated significant improvements in ESG scores over the analysis period, indicating that these firms have likely enhanced their reporting practices or adopted additional sustainability initiatives in line with GRI standards. Notably, OMV Petrom's ESG score increased by 30.01% from 2020 to 2022, while Rompetrol also showed a notable improvement, with a score increase of 8.34% from 2020 to 2021. These upward trends in ESG scores suggest a growing focus on reporting and operational transparency for these companies, which may be interpreted as aligning with GRI's guidelines for effective sustainability communication and reporting.

Conversely, companies such as Biofarma and Zentiva displayed little to no change in their ESG scores over the same period, indicating a potential stagnation in their reporting practices or a limited commitment to expanding their sustainability disclosures. The static ESG scores of these firms, coupled with inconsistent emission management efforts, indicate that while some companies have embraced GRI-aligned reporting as a strategic priority, others may either lack the resources or the motivation to enhance their sustainability practices.

Overall, these findings lend partial support to H1, as only some firms demonstrated an upward trajectory in GRI-compliant reporting, as inferred from the changes in ESG scores. This suggests that while there is a broader trend toward increasing sustainability reporting among larger firms, the commitment to GRI standards remains uneven across industries and is potentially influenced by organizational resources, market pressures, or regulatory environments. The mixed results underscore the need for stronger industry-wide or regulatory mandates to encourage more universal adherence to GRI standards and sustainability disclosures.

The second hypothesis posited that the firms analyzed would demonstrate a reduction in CO<sub>2</sub>e emissions as a direct result of implementing effective sustainability communication practices, under the assumption that a structured approach to ESG reporting would drive improvements in environmental performance. The findings provide a nuanced view of this relationship, revealing substantial variability across the companies.

Rompetrol provides a compelling case supporting H2, showing an 87.26% reduction in CO<sub>2</sub>e emissions between 2020 and 2021, paired with a steady improvement in ESG score during the same period. This substantial decline in emissions suggests that Rompetrol's increased transparency and sustainability efforts may indeed have contributed to operational changes resulting in lower carbon output. Similarly, OMV Petrom also demonstrated both a gradual decrease in emissions and a significant increase in ESG score from 2020 to 2022, supporting the hypothesis that improved sustainability communication and practices contribute to effective emission management.

However, the findings for other companies challenge the direct applicability of H2 across all cases. Romgaz, for instance, exhibited extreme volatility in emissions, with increases of up to 273.42% in 2020 and 116.18% in 2022, despite a constant ESG score of 81.48% throughout the period. This inconsistency suggests that while Romgaz may maintain some form of sustainability communication practice, the impact on actual emission levels remains limited or sporadic. Similarly, Biofarma's low and unchanging ESG score is paired with only slight reductions in CO<sub>2</sub>e emissions, indicating that in the absence of effective sustainability practices, emissions management alone may not result in substantial or consistent reductions.

Antibiotice, while showing a modest reduction in emissions from 2019 to 2022, displayed fluctuating year-over-year changes, which complicates a straightforward interpretation of the impact of sustainability practices on emissions. The firm's increase in ESG score in 2022 might reflect an enhanced commitment to GRI-aligned practices, yet the emission reductions observed are modest relative to other firms, suggesting that while sustainability practices may contribute to emission reductions, the relationship is not linear or uniformly strong across all cases.

These mixed findings suggest that while effective sustainability communication practices, as evidenced by GRI-aligned ESG reporting, may contribute to CO<sub>2</sub>e emissions reductions for some companies, this relationship is not universally consistent. The observed results indicate that reductions in emissions may depend not only on the presence of sustainability practices but also on their integration into core operational strategies, the scale of the company's operations, and potentially the industry sector.

## 6. Limitations and Further Directions

While this study provides valuable insights into the relationship between GRI-compliant sustainability reporting and CO<sub>2</sub>e emissions reduction, several limitations should be acknowledged, and avenues for further research should be proposed.

This analysis includes six firms from diverse industrial sectors, which may limit the generalizability of the findings. The mixed results observed between firms highlight the need for a larger and more sector-specific sample to allow for a more robust analysis of industry-specific factors that may influence the relationship between GRI-compliant reporting and emissions reduction. Future studies should consider expanding the sample to include a broader range of companies within specific sectors to capture potential variations in how industry-specific practices and regulatory pressures shape sustainability efforts. Further research could benefit from a more granular assessment of GRI compliance, evaluating individual indicators and metrics outlined in GRI reports to better understand the direct impact of these reporting practices on environmental outcomes.

The study's reliance on CO<sub>2</sub>e emissions data highlights the scope of its environmental performance assessment. CO<sub>2</sub>e emissions represent a very important dimension of a company's environmental impact. A more comprehensive approach can include additional environmental indicators, such as water usage, waste management, and energy efficiency, and could provide a more comprehensive picture of how sustainability reporting influences a company's environmental footprint.

This study does not establish causality between sustainability reporting and CO<sub>2</sub>e emissions reduction; instead, it identifies correlations. While firms with enhanced ESG scores tend to show improved environmental performance, it is challenging to isolate the effect of GRI-compliant reporting from other factors, such as economic performance, regulatory pressures, and corporate strategies that may also influence emissions. Future studies could adopt experimental or quasi-experimental designs to assess probable causal relationships, such as analyzing emission trends before and after implementing specific GRI-compliant practices or comparing firms with different levels of GRI adoption.

Finally, this study's time frame covers the period from 2019 to 2022. The evolving nature of sustainability practices and reporting standards may mean that firms are at different stages of implementing GRI guidelines, which can affect the outcomes. Longitudinal studies extending over more years could provide a deeper understanding of long-term trends and the potential lag effect between adopting sustainability practices and achieving measurable environmental improvements.

Overall, while this study provides powerful insights into the relationship between GRI-compliant reporting and CO<sub>2</sub>e emissions, further research can pursue a more comprehensive, causal, and sector-specific examination to better understand the effectiveness of sustainability reporting in driving genuine environmental change.

This comprehensive analysis of the collected data suggests that the sustainability reporting practices of the Romanian companies in the sample are shaped by both national and international legislative frameworks, indicating an increased awareness of the importance of sustainability reporting and a gradual alignment with global standards.

The findings highlight a clear trend among these companies toward greater compliance with ESG standards and international best practices, as they work to improve their sustainability efforts and align with global norms. This trend reflects a broader shift toward responsible corporate behavior in response to growing demands for transparency and accountability.

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