

Brandenburg University of Technology Cottbus

Chair of Environmental Planning

Environmental and Resource Management (MSc.)

Study Project



**Sustainability Reporting in the European Union: A Systematic Review of
Regulatory Developments and Their Influence on Corporate Sustainability
Strategies**

Esmail Salehi, 5008307

Shabnam Rezazadeh Pilehdarboni, 5004258

Amir Reza Borzoueinia, 5003600

Date of Submission:
07.05.2025

Prof. Dr. Michael Schmidt
Supervisor: M.Sc. Chandragupt Natvarlal Atara

Declaration of Authorship

We hereby declare that we have independently completed this study project titled:

Sustainability Reporting in the European Union: A Systematic Review of Regulatory Developments and Their Influence on Corporate Sustainability Strategies

The work presented in this document is our own and has not been submitted in the same or similar form to any other institution for academic credit. Authors confirm that all sources and materials used have been properly cited and acknowledged. Furthermore, we used AI-powered tools solely to assist with grammar checking and to enhance the academic quality of the writing. The primary content and structure were originally written by the authors.

We understand the rules of good scientific practice and confirm that we have complied with them.

Place, Date .04.06.2025

Esmail Salehi

Handwritten signature of Esmail Salehi in blue ink, featuring a stylized 'E' and the name 'Goni' written above it.

Amir Reza Borzoueinia

Handwritten signature of Amir Reza Borzoueinia in blue ink, featuring a stylized 'A' and 'B'.

Shabnam Rezazadeh Pilehdarmoni

Handwritten signature of Shabnam Rezazadeh Pilehdarmoni in blue ink, featuring a stylized 'S' and 'R'.

Acknowledgments

We would like to express our sincere gratitude to **Prof. Dr. Michael Schmidt** for his continuous support, valuable insights, and encouragement throughout the course of this study project. His expertise and guidance were essential to shaping the direction and depth of our work.

We are also deeply thankful to our supervisor, **M.Sc. Chandragupt Natvarlal Atara**, for his dedicated support, constructive feedback, and ongoing assistance during the research and writing process. His mentorship played a key role in the successful completion of this project.

Place, Date .04.06.2025

Esmail Salehi



Amir Reza Borzoueinia



Shabnam Rezazadeh Pilehdarmoni



Table of Contents

LIST OF ABBREVIATIONS: I

ABSTRACT II

1 INTRODUCTION..... 1

1.1 Background and Context; A Brief overview 1

1.2 Research Significance 1

1.3 Research Questions 5

2 METHODOLOGY 7

2.1 Research Design 7

2.2 Data Sources and Search Strategy 8

2.3 Inclusion and Exclusion Criteria 9

2.4 Screening and Selection Process 10

2.5 Data Analysis 12

3 HISTORICAL EVOLUTION OF EU SUSTAINABILITY REPORTING REGULATIONS (2014–2025)..... 12

3.1 The Non-Financial Reporting Directive (NFRD) (2014–2018) 14

3.2 Transition to CSRD (2019–2022): Addressing NFRD’s Limitations 16

3.3 Corporate Sustainability Reporting Directive (CSRD) (2023–2024)..... 16

4 CURRENT STATUS QUO OF EU SUSTAINABILITY REPORTING REGULATIONS (2025) 18

4.1 CSRD Implementation Timeline and Scope Expansion..... 18

4.2 European Sustainability Reporting Standards (ESRS) Framework 20

4.3 The Omnibus Package: Simplification Measures 22

5 CORPORATE STRATEGY ADAPTATIONS TO EVOLVING REGULATIONS 24

5.1 Governance Changes: Embedding Sustainability at the Core 24

5.2 Operational Overhauls: Aligning with ESRS Requirements 26

5.3 Supply Chain Management Strategies..... 26

5.4 Innovation as a Strategic Response 27

5.5 Risk Management Architecture Transformation..... 28

5.6 Workforce and Organizational Culture Adjustments 30

6 SECTORAL IMPACTS: VARIED RESPONSES ACROSS INDUSTRIES 32

6.1 High-Impact Sectors: Energy, Manufacturing, and Automotive 32

6.2 Financial Sector Adaptations..... 33

6.3 SMEs: Indirect Impacts Through Value Chains..... 34

6.4 The Tech Sector: Digital Footprints and ESG Transparency..... 35

6.5 Agriculture and Food Industry: Sustainable Supply Chains and Biodiversity Reporting 35

6.6 construction industry 35

7 CHALLENGES AND OPPORTUNITIES IN COMPLIANCE 36

7.1 Challenges in Achieving Compliance with Evolving Regulations 37

7.2 Strategic Opportunities Arising from Compliance 42

8 FUTURE OUTLOOK 46

8.1 EU Sustainability Reporting Post-2025 46

8.2 The Role of Technology in Enhancing Sustainability Reporting..... 48

9 CONCLUSION 52

10 REFERENCES 53

List of Abbreviations:

AI – Artificial Intelligence

CapEx – Capital Expenditure

CSDDD – Corporate Sustainability Due Diligence Directive

CSR – Corporate Social Responsibility

CSRD – Corporate Sustainability Reporting Directive

EC – European Commission

EFRAG – European Financial Reporting Advisory Group

EP – European Parliament

ERM – Enterprise Risk Management

ESG – Environmental, Social, and Governance

ESRS – European Sustainability Reporting Standards

EU – European Union

EVS – Environmental and Sustainability Standards

GAR – Green Asset Ratio

GHG – Greenhouse Gas

GHGP – Greenhouse Gas Protocol

GRI – Global Reporting Initiative

IME – Institute of Environmental Sciences and Environmental Technology

ISSB – International Sustainability Standards Board

NFRD – Non-Financial Reporting Directive

NLP – Natural Language Processing

OpEx – Operational Expenditure

SAP – Systems, Applications, and Products in Data Processing

SDGs – Sustainable Development Goals

SEPR – Sustainability and Environmental Performance Reporting

SFDR – Sustainable Finance Disclosure Regulation

SMEs – Small and Medium-sized Enterprises

TCFD – Task Force on Climate-related Financial Disclosures

XHTML – Extensible Hypertext Markup Language

Abstract

This study project presents a systematic literature review that explores how the Corporate Sustainability Reporting Directive (CSRD) influences the design and implementation of Enterprise Risk Management (ERM) systems in EU-based corporations.

In response to the growing regulatory emphasis on environmental, social, and governance (ESG) transparency, the CSRD is reshaping corporate behavior by embedding sustainability considerations into formal risk management practices.

Using peer-reviewed academic sources and official publications post-2015, the study identifies how CSRD requirements contribute to a shift in risk taxonomies, strengthen internal control frameworks, and align ERM with stakeholder-oriented and long-term corporate sustainability strategies.

The analysis underscores the role of stakeholder theory and double materiality in driving this transformation, revealing how companies are now required to consider both the financial impact of sustainability risks and their broader social and environmental consequences.

To ground these findings in practice, case examples from TotalEnergies, Siemens, and Volkswagen are examined, illustrating how leading corporations are adapting their ERM frameworks to meet CSRD expectations and enhance strategic resilience.

These companies demonstrate differing levels of maturity in integrating sustainability risks into ERM, providing insights into the variability of implementation strategies across sectors.

The findings suggest that the CSRD acts as a regulatory catalyst, advancing the convergence between sustainability reporting and enterprise risk governance.

This review contributes to academic and managerial debates by clarifying the evolving role of non-financial disclosure regulations in shaping corporate risk cultures, while also identifying key gaps for future empirical research.

Keywords: Sustainability Reporting, Non-financial Reporting, Corporate sustainability Reporting, European Union

1 Introduction

1.1 Background and Context; A Brief overview

Sustainability reporting is crucial for delivering stakeholders with dependable and comparable information., especially as sustainability issues increasingly have become a central concern for investors, creditors, legislators, customers, and other key groups. By enabling transparency, sustainability reporting supports the direction of private capital towards funding the green and social transition, while also helping to draw more investments aimed at achieving sustainable economic objectives (Ruohonen & Kullas, 2024). Sustainability reporting has emerged as a crucial instrument for integrating company plans with global goals related to environmental, social, and governance (ESG) issues (Opferkuch et al., 2023). sustainability reporting is meant to deliver stakeholders dependable and clear information, so they can understand how a company creates value ,including its non-financial goals and how well it achieves them (Opferkuch et al., 2023).

By sharing environmental and social data, companies improve their ability to evaluate, track, and handle non-financial performance. This helps them recognize sustainability-related risks and build stronger trust with stakeholders (Posadas et al., 2023). Beyond transparency, sustainability reporting serves as a vehicle for aligning internal business strategies, corporate planning processes, and management control systems with sustainability principles. This strategic alignment empowers organizations to shape externally communicable, sustainability-oriented business models (Raucci & Tarquinio, 2020).

Over time, the evolving understanding of organizational behavior in the context of sustainability, has led to the institutionalization of both voluntary and mandatory disclosure frameworks, now formally recognized under European regulations as sustainability reporting. These mechanisms are designed to serve stakeholders across sectors and enable their use in various decision-making contexts (Fontaine et al., 2024). Sharing non-financial information allows companies to handle business risks more efficiently, which can ultimately contribute to improved financial performance (Primec & Belak, 2022). The importance of sustainability reporting is also reflected in its ability to integrate and balance quantitative and qualitative dimensions of both financial and non-financial data, forming a central component of corporate annual and sustainability disclosures (Paun et al., 2020).

As mentioned before, sustainability reporting also strengthens collaboration between communities by the ESG framework (Yébenes, 2024). Its role in advancing both corporate and global sustainability objectives is increasingly evident, given that stakeholders use disclosed information to determine how well a company aligns with ESG criteria. The

availability of ESG data enhances transparency, offering a clearer understanding of how companies and investors contribute to the transition toward a carbon-neutral economy (Yébenes, 2024).

In recent years, a growing global awareness, driven by citizens and policymakers alike, has emphasized the critical importance of reexamining the structural dynamics underpinning the global economy (Principale & Pizzi, 2023). Unlike the past, the private sector now plays a key role in embedding ESG considerations into its core operational strategies. This shift has been accompanied by a rising stakeholder interest in ESG matters, which has intensified corporate focus on sustainability reporting as a means to demonstrate accountability and long-term responsibility (Nampoothiri et al., 2024).

Organizations now are key players in the implementation of sustainable business practices, that not only create value for investors but also serve the wider interests of society. Their contributions are central to mitigating climate change and fostering the transition toward a greener economy (Perevoznic & Dragomir, 2024). Accordingly, Stakeholders are increasingly encouraged to integrate non-financial information into their decision-making processes, prompting companies to revise business models and align them with ambitious policy objectives set by legislators (Pizzi et al., 2023). Consequently, sustainability has emerged as a central concern not only for corporations but also for researchers and society at large. Prioritizing environmental and social dimensions in corporate strategy and decision making signifies a broader commitment to socially responsible behavior (Krasodomska et al., 2023).

Financial institutions, as primary channels of fundings, are pivotal in supporting the shift toward a sustainable and circular economy. The EU Commission reinforced this in its 2018 action plan, Financing Sustainable Growth, which highlighted the necessity of redirecting private resources towards more sustainable initiatives (Siri & Zhu, 2019).

This makes the circular economy—which aims to minimize waste and prolong the life of resources—a strategic model that is in line with long-term environmental objectives. A shift toward such an economy is essential not only for mitigating climate risks but also for promoting innovation, resource efficiency, and economic resilience (Biondi et al., 2020, Janik et al., 2020). To support this transition, transparent and reliable corporate disclosures play a critical role. They contribute to the dissemination of long-term strategic objectives, support circular economy models, engage key stakeholders, and sustain public confidence. Non-financial reporting thus represents the initial regulatory step toward embedding socially responsible governance across European business landscapes (Primec & Belak, 2022). As awareness of responsible and ethical business conduct continues to rise, there has been a corresponding increase in the demand for both voluntary and mandatory sustainability disclosures, a trend evidenced by the global expansion of sustainability reporting frameworks and instruments (Ottenstein et al., 2022).

Sustainability has become a key factor in long-term economic performance, especially when it comes to coordinating corporate operations with the Sustainable Development Goals (SDGs) of the UN (Velte, 2023). Over the past two decades, the European Union has systematically built one of the world's most comprehensive regulatory frameworks for sustainability. This began with the launch of the EU Sustainable Development Strategy in 2001, which was subsequently revised in 2006 and 2009 to intensify efforts across all ESG dimensions (Paccès, 2021).

The introduction of the Europe 2020 Strategy, along with the 2016 Commission Communication, represented a major step forward in the EU's strategic direction by explicitly incorporating the United Nations Sustainable Development Goals into its policy framework (Paccès, 2021). Together, these initiatives have established the EU as a global front-runner in climate governance, with ambitious targets and substantial investments aimed at reshaping the European economy through the European Green Deal (Principale & Pizzi, 2023).

A comprehensive growth plan, the European Green Deal was introduced in 2019 with the goal of making Europe the first continent to achieve carbon neutrality by 2050. It tackles important industries including energy, building, transportation, and agriculture, encouraging a fair and inclusive shift to a resource-efficient, circular, and sustainable economy (Pozzoli et al., 2023). Along with legally mandated climate goals, the Green Deal also contains intermediate targets like a 55% reduction in greenhouse gas emissions by 2030 and financial tools like the Just Transition Mechanism and the European Green Deal Investment Plan to help the areas most impacted by the transition. The creation of strong sustainability reporting systems that convert the Green Deal's lofty objectives into concrete business responsibilities has been a crucial part of this shift (Pozzoli et al., 2023, Biondi et al., 2020)

Adoption of Directive 2014/95/EU, the Non-Financial Reporting Directive (NFRD), which was the EU's first law requiring big public-interest corporations to report ESG-related information, was a major turning point in this legislative history (Paun et al., 2020). As the foundation for harmonized sustainability reporting across Europe, the NFRD introduced the principle of mandatory non-financial disclosure, though its flexibility in implementation revealed several shortcomings, such as limited comparability and lack of coverage for SMEs (Stefanescu, 2022).

The European Commission introduced the Corporate Sustainability Reporting Directive (CSRD) in response to these issues; it was published in December 2022 and went into force in early 2023. The CSRD dramatically expands reporting obligations, introduces obligatory third-party assurance, and enforces The CSRD significantly broadens reporting requirements, mandates independent third-party assurance, and requires the use of the European Sustainability Reporting Standards (ESRS), thereby improving the reliability and consistency of sustainability-related data throughout the EU (Ruohonen & Kullas, 2024 ; Opferkuch et al., 2023). Complementing these directives, the EU introduced a set of financial and due diligence regulations aimed at structuring capital flows and corporate accountability. In July 2020, the EU implemented the first uniform categorization system for sustainable economic activities, known as the EU Taxonomy Regulation (Tettamanzi et al., 2024 ; Fontaine et al., 2024). It complements instruments like the EU Green Bond Standard and is closely related to the EU Action Plan on Financing Sustainable Growth (Hoepner & Schneider, 2023). Furthermore, the EU's position as a worldwide leader in ESG finance is strengthened by the Sustainable Finance Disclosure Regulation (SFDR), which mandates that financial institutions include sustainability concerns into their investment choices (Yébenes, 2024). Meanwhile, the Corporate Sustainability Due Diligence Directive (CSDDD) pushes beyond financial transparency, imposing mandatory human rights and environmental risk assessments across global value chains. It requires companies

to adopt enforceable codes of conduct and obtain contractual assurances from partners, under the supervision of national authorities (Tettamanzi et al., 2024 ; Vandenbroucke, 2024). Nearly 80 percent of European multinationals have now implemented such due diligence protocols, marking a paradigm shift from voluntary corporate sustainability reporting (CSR) toward enforceable corporate accountability (Mieszkowska, 2024; Dempere et al., 2024). Despite persistent challenges including fragmented reporting frameworks, data inconsistency, and the risk of greenwashing the European Commission has continued refining its policy tools. Reforms such as the Omnibus Package aim to reduce administrative burdens, especially for SMEs, while reinforcing the EU's leadership in sustainable governance (Fiandrino et al., 2022; Pantazi, 2024).

This framework's fundamental idea is materiality, which describes how relevant information is for stakeholders' decision-making, especially when it comes to a company's financial success. By combining two dimensions—financial materiality, which addresses how sustainability issues affect the firm, and impact materiality, which concentrates on how the company's activities influence society and the environment—the more sophisticated concept of double materiality advances this. This dual perspective is now embedded in both the NFRD and the CSRD (Miettinen, 2024; Dragomir et al., 2024). It redefines how companies must interpret and disclose sustainability risks, balancing their financial impacts with broader societal and environmental consequences (Mezzanotte, 2023; Pozzoli et al., 2023). Through the implementation of this concept via detailed ESRS requirements and digital reporting tools, the EU has established a solid foundation for a transparent, accountable, and future-oriented corporate environment. In this broader context, the EU's regulatory architecture has evolved from principle-based disclosure toward a binding, enforceable, and metrics-driven regime. In addition to bringing business conduct into line with social norms, this change creates a governance framework where sustainability reporting is both a legal need and a competitive advantage (Godt, 2023; Klimczak et al., 2023 ; Elamer & Boulhaga, 2024).

1.2 Research Significance

The increasingly dynamic and evolving nature of sustainability reporting legislation presents a significant challenge to researchers and practitioners alike (Hummel & Jobst, 2024). As regulatory instruments such as CSRD continue to develop, uncertainties have emerged regarding their interpretation and implementation (Posadas et al., 2023). In particular, many companies remain unclear about how to operationalize new requirements in practice, due in part to the absence of comprehensive guidance from EU institutions at the national enforcement level (Fiechter et al., 2022).

A key concern is the lack of harmonized and clearly defined reporting standards, which contributes to inconsistencies, minimalist disclosure practices, and limited comparability between corporate sustainability reports (Villiers, 2022). Moreover, questions remain regarding the substantive impact of governance mechanisms such as sustainability-focused supervisory boards on corporate social responsibility (CSR) strategies. It is yet to be determined

whether such boards function as symbolic structures or are genuinely motivated by long-term commitments to sustainable transformation (Velte, 2023). Although certain small, and medium-sized businesses (SMEs) are excluded from these criteria, the CSRD is applicable to all corporations listed on EU-regulated markets. Which introduces new and complex compliance obligations (Dimes & Molinari, 2024). These include third-party verification, digital formatting requirements, and extensive qualitative and quantitative ESG disclosures. Startups and SMEs are particularly vulnerable to the administrative and financial burdens introduced by these obligations, which may pose barriers to market entry and inhibit innovation (Dempere et al., 2024).

Standardized frameworks for sustainability reporting, such the Global Reporting Initiative (GRI), provide a place to start, although they are sometimes disproportionately designed for big businesses. As such, they may fail to account for the unique stakeholder dynamics, operational constraints, and reporting motivations of SMEs. This emphasizes how urgently a more adaptable and proportionate reporting structure that takes into account the unique traits and capabilities of smaller businesses is needed (Nowak et al., 2024). Although various frameworks, such as GRI exist to support sustainability reporting in businesses, they are predominantly used by large corporations, as their implementation often demands resources and expertise that many SMEs lack. Moreover, the GRI framework may not fully reflect the unique characteristics and needs of smaller firms including their stakeholders, impacts, and motivations which underscores the necessity for a more holistic and tailored reporting approach for SMEs (Nowak et al., 2024).

It is now relevant to examine the state of EU sustainability reporting frameworks and evaluate their strategic implications for business practices in light of the changing regulatory environment. These fundamental questions are addressed in the section that follows.

1.3 Research Questions

What is the current status quo of EU sustainability reporting regulations?

The present EU framework for sustainability reporting represents a clear shift away from earlier voluntary practices toward a more comprehensive and mandatory regulatory system. Since 2018, by requiring major public-interest organizations in the EU with more than 500 workers to reveal crucial environmental and social statistics, NFRD has established a fundamental benchmark for accountability and openness in business sustainability initiatives (Dinh et al., 2023). Building upon the foundation laid by the NFRD, the CSRD establishes a more detailed and far-reaching reporting framework. Fully replacing the NFRD, the CSRD broadens the scope of reporting requirements to include all businesses listed on markets subject to EU regulation, as well as large entities that exceed defined thresholds in terms of net turnover, total assets, or number of employees. These requirements also apply to insurance companies and credit institutions (Dimes & Molinari, 2024).

In addition to mandating third-party assurance for disclosed information, the directive introduces digital formatting standards, requiring XHTML-tagged financial and management reports to facilitate machine-readability and comparability across the EU (Mezzanotte, 2023). Complementing the CSRD, two other key regulatory instruments shape the current status quo: the EU Taxonomy and the SFDR. In effect since March 2021, financial market players and advisors are subject to required transparency rules set by the SFDR, which oblige them to reveal the sustainability-related aspects of their investment products (Partiti, 2024). Meanwhile, a defined classification system for identifying economically sustainable practices is provided by the EU Taxonomy, thereby providing investors with a consistent basis for decision-making (Dinh et al., 2023). Despite the increasingly mandatory nature of these frameworks, no single EU Member State prescribes a uniform reporting standard for compliance. This regulatory flexibility has introduced uncertainty among reporting firms, many of which must navigate a landscape of overlapping international frameworks while seeking alignment with the CSRD and ESRS (Dumay et al., 2019). While this flexibility enables firms to adapt the requirements to their specific operations, it also creates challenges in interpretation, especially for companies with little reporting experience or those moving from voluntary to mandatory disclosure. (Breijer et al., 2024).

These tools collectively serve as the foundation for the EU's existing sustainability reporting system, an architecture designed to enhance transparency, facilitate responsible investment, and strengthen the integration of sustainability considerations across corporate and financial systems (García-Sánchez et al., 2023). *(Note: The legislative trajectory and historical evolution of these regulations are addressed in detail in the preceding section and are not repeated here.)*

How do these regulations influence corporate sustainable strategies?

The introduction and implementation of EU sustainability regulations have had far-reaching implications for corporate strategy, particularly in how companies position themselves competitively, manage risks, and structure internal governance. The reporting obligations under the EU Taxonomy have led companies to reassess their core business activities by measuring them against three main performance indicators: turnover, capital expenditure (CapEx), and operational expenditure (OpEx) associated with environmentally sustainable operations (Hummel & Bauernhofer, 2024).

The CSRD also demands a swift and thorough transformation of organizational structures and corporate culture. In order to comply, businesses are required to adopt risk-oriented management tools that integrate sustainability across all functions and processes within the organization. This shift demands not only technical adaptation but also deep organizational change, as sustainability is embedded into enterprise-wide decision-making systems (Cavallaro et al., 2024). Nevertheless, the effectiveness of these regulatory frameworks may be compromised by certain structural weaknesses. Despite the consistent rollout of reporting directives, the absence of sufficiently robust enforcement mechanisms and sanctions may undermine their intended impact (Cavallaro et al., 2024). At the same time, companies must navigate rising

operational costs and capital expenditures as they redesign business models to align with regulatory obligations, stakeholder expectations, and the European Green Deal's more general objectives (Burca et al., 2024). In practical terms, firms are now required to obtain contractual assurances from business partners and enforce codes of conduct that are aligned with evolving EU standards. This increased demand for accountability across the value chain has led many companies to restructure not only their immediate operations but also their long-term strategic outlook (Vandenbroucke, 2024). The Taxonomy Regulation has also catalyzed internal dialogue within firms, fostering competition around sustainability performance and encouraging alignment with regulatory benchmarks (Chrzan & Pott, 2024).

One of the key characteristics of the new regulatory landscape introduced by the CSRD is the formal integration of the double materiality principle. According to this concept, businesses must assess and report on the wider social and environmental effects of their activities in addition to the financial effects of sustainability-related concerns on their operations (Biondi et al., 2020). Its implementation represents a fundamental shift in governance, demanding that businesses integrate sustainability factors into core strategic and reporting frameworks. However, critical perspectives suggest that not all firms may embrace these changes in good faith. There is a growing concern that some companies may engage in what has been termed “creative compliance”, a practice in which regulatory requirements are technically fulfilled while circumventing their underlying intent. This strategy may limit the transformative potential of sustainability regulations by focusing on formalistic box-ticking rather than substantive corporate change (Biondi et al., 2020).

2 Methodology

2.1 Research Design

In order to investigate the changing regulatory environment around EU sustainability reporting and its effects on business strategy, this research employs a systematic literature review (SLR) methodology. The approach ensures an open, repeatable, and objective review process by adhering to the recognized SLR and Meta-Analyses (PRISMA) 2020 criteria. The following main question serves as the basis for the investigation:

"What is the current status quo of sustainability reporting regulations in European union and how it influences the corporate sustainable strategies?"

The main research question is then broken down to the following sub-questions:

- What is the current status quo of EU sustainability reporting regulations?
- How do these regulations influence corporate sustainable strategies??

Since 2015 saw the approval of significant international frameworks like the UN SDGs and the Paris Agreement, EU sustainability policies have been impacted. This time frame documents the development of important EU laws, such as NFRD and its successor, CSRD.

2.2 Data Sources and Search Strategy

To identify relevant literature, we searched two academic databases—Web of Science and Google Scholar—and complemented these with manual searches of official websites, including those of the European Commission, Siemens, and TotalEnergies, to access grey literature such as policy frameworks and corporate sustainability reports. We applied three main search strings in Web of Science, combining keywords related to sustainability reporting frameworks, European policy instruments, and corporate outcomes. Boolean operators and topic field tags (TS=) were used to structure the queries, such as:

(TS=("sustainability reporting" OR "non-financial reporting" OR "Integrated Reporting" OR "EU Taxonomy" OR "circular economy action plan" OR "sustainability policies") AND TS=("European Union" OR "European regulations" OR "EU") AND TS=("corporate" OR "corporate performance"))

(TS=("CSRD" OR "NFRD" OR "ESRS" OR "CSDDD" OR "EU ETS" OR "SFDR" OR "ESG" OR "RED") AND TS=("European Union" OR "European Regulations" OR "EU") AND TS=("corporate sustainability" OR "corporate strategies" OR "corporate performance"))

(TS=("sustainability directives" OR "sustainability frameworks" OR "sustainability reports") AND TS=("European Union" OR "European Regulations" OR "EU") AND TS=("corporate sustainability" OR "corporate strategies" OR "corporate performance"))

2.3 Inclusion and Exclusion Criteria

A set of precise inclusion and exclusion criteria was created in order to guarantee the quality, academic rigor, and usefulness of this systematic literature review. These standards provided a framework for choosing sources that significantly advanced the study's goals, which included comprehending how EU sustainability reporting laws have changed over time and how they affect business sustainability plans. In order to capture a thorough yet targeted picture of the regulatory environment and its business consequences, the selection process sought to achieve a balance between breadth and depth.

Geographic scope served as the initial inclusion criteria. We only took into account research that specifically addressed the regulatory environment of the European Union. In order to preserve consistency and comparability across the chosen literature, regional distinctiveness was crucial, especially because the EU has been instrumental in establishing sustainability and ESG reporting criteria. This strategy also reflects the systematic review's major focus on EU legislative and regulatory frameworks, including the CSRD and NFRD.

Secondly, thematic relevance was a critical filter. Selected studies had to address topics directly related to sustainability reporting, ESG disclosure, or non-financial reporting. These areas are central to the thesis and represent key domains through which regulatory frameworks influence corporate behavior. Particular attention was paid to studies that connect reporting requirements with organizational responses, such as changes in corporate strategy, improvements in performance metrics, or enhanced compliance practices. This ensures that the analysis remains aligned with the research question and allows for a deeper exploration of the regulatory impact on business decision-making.

In terms of source quality, only peer-reviewed journal articles and official reports were included. Peer-reviewed publications guarantee a certain standard of academic reliability and methodological soundness. However, considering the evolving nature of EU regulation, some grey literature—specifically official reports and documents from recognized institutions such as the European Commission—was also included, provided it met standards of credibility and relevance.

Exclusion criteria were also carefully defined to eliminate studies that could potentially dilute the analytical focus or compromise the credibility of the review. First, non-English language publications were excluded due to language constraints and to ensure consistency in interpretation. Second, studies published before 2015 were omitted. This cutoff was chosen to focus on the most recent developments in sustainability reporting, especially in light of significant legislative changes in the past decade.

Moreover, papers that fell outside the EU context, even if related to sustainability reporting, were excluded to maintain regional specificity. Non-peer-reviewed materials, including blogs, opinion pieces, or unofficial reports, were also excluded unless they originated from verified and authoritative sources. Additionally, studies that, based on title and abstract screening, appeared to be irrelevant to the research topic were removed from consideration. Finally, studies that have never been cited were excluded due to concerns about their academic credibility and influence within the scholarly community. All things considered, these inclusion and exclusion criteria were created to guarantee that the chosen literature offers a strong and pertinent basis for the analysis that follows. They aid in making sure the review is methodologically sound and in line with the goals of comprehending how business sustainability strategy and legislation interact in the EU.

2.4 Screening and Selection Process

The initial search yielded 428 records. After removing non-English records (10), duplicates (52), and non-peer-reviewed materials (27), 339 records remained for screening. After the first review, 156 were excluded due to irrelevance or being outside the EU context. The remaining 156 full-text reports sought for retrieval, of which 8 could not be accessed, and 148 were assessed for eligibility. Of these, 48 were excluded, either due to credibility issues (10) or failing to meet the final inclusion criteria (38). Ultimately, 94 articles were included from database searches, with 33 additional sources from manual and grey literature searches, resulting in a final review sample of 127 documents. Figure 1 shows the screening and selection procedure using a PRISMA flow diagram.

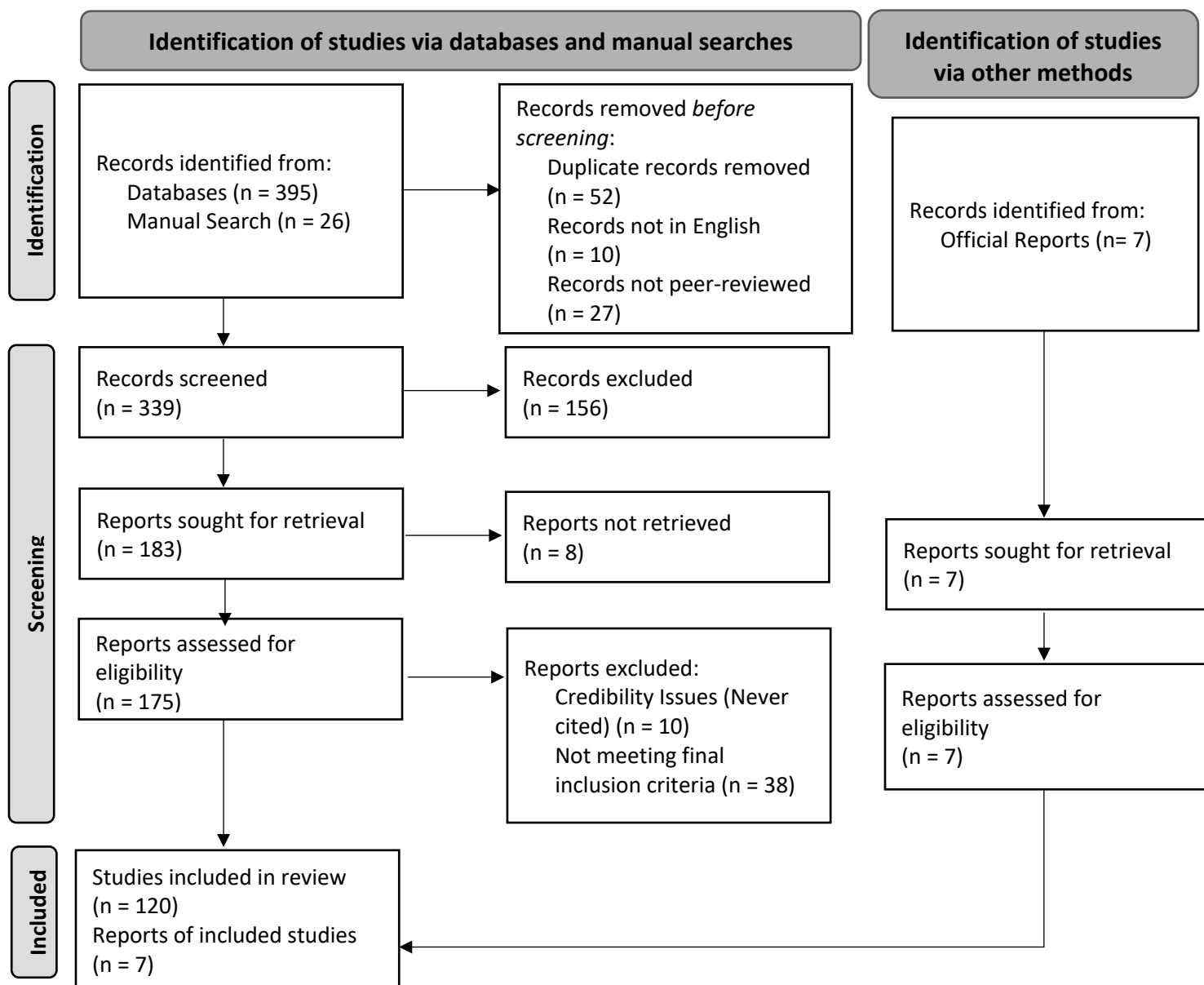


Figure 1: PRISMA 2020 Flow Diagram illustrating the screening and selection process

2.5 Data Analysis

A key focus of the study is the differentiated impact of these regulations on large firms versus SMEs. Initially, the NFRD targeted only large public-interest entities, effectively excluding SMEs despite their vital economic role within the EU (Fiandrino et al., 2022). The CSRD addresses this gap by extending mandatory reporting obligations to incorporate listed SMEs and a broader range of large private companies. These new requirements are proportionately tailored to firm size and available resources, recognizing the structural and financial constraints that SMEs often face (European Commission, 2024).

Included literature was analyzed using qualitative content analysis. Key themes were recognized, focusing on how EU sustainability directives (e.g., CSRD, NFRD, EU Taxonomy) guide corporate sustainability strategy, reporting procedures, and performance metrics. Particular attention was given to differences in corporate response across sectors and over time.

3 Historical Evolution of EU Sustainability Reporting Regulations (2014–2025)

Over the past decade, EU sustainability reporting regulations have evolved significantly, moving from scattered and voluntary practices toward a unified and legally binding framework (Hummel & Jobst, 2024). A chronological overview of key regulatory milestones from 2014 to 2025 is presented in Table 1, highlighting the EU's evolving approach to sustainability reporting. This chapter outlines the general trajectory from 2014 to 2025, marking the EU's progressive consolidation of non-financial reporting into a binding system that integrates corporate sustainability into strategic, financial, and governance structures.

The shift started with the adoption of the NFRD, known as Directive 2014/95/EU, which marked the EU's first significant step toward establishing mandatory ESG disclosures for large public-interest companies employing more than 500 people (Breijer et al., 2024). Although it created a foundation for non-financial reporting, its flexible implementation across Member States resulted in inconsistent practices and limited comparability (Fiandrino et al., 2022). A more detailed analysis of the NFRD is provided in Section 3.1.

In response to stakeholder feedback and growing demands for transparency, the European Commission launched a formal review process and consultation between 2019 and 2021. This led to the

proposal and eventual adoption of the CSRD in December 2022. The CSRD significantly expanded the number of companies subject to reporting requirements and introduced structural reforms such as double materiality, mandatory assurance, and machine-readable XHTML formatting (Dragomir et al., 2024 ;Mezzanotte, 2023; European Commission, 2024). The transition to the CSRD is addressed in detail in Section 3.2, while the implementation framework and innovations of the CSRD are explored in Section 3.3.

In order to reinforce the importance of ESG factors in corporate plans and investment choices, the European Union concurrently developed a number of new initiatives, such as the EU Taxonomy, SFDR, and the Corporate Sustainability Due Diligence Directive (CSDDD). When taken as a whole, these programs demonstrate how the EU is in the forefront of incorporating sustainability into corporate governance worldwide (Dempere et al., 2024; Hoepner & Schneider, 2023; Huq et al., 2024; Villiers, 2022).

By 2025, the regulatory environment continues to evolve with the introduction of reform proposals such as the Omnibus Package, reflecting the European Commission’s intent to balance transparency and regulatory ambition with the need for administrative proportionality, particularly for smaller firms. These ongoing refinements highlight the EU’s pragmatic approach to sustainable governance, one that recognizes the diverse capabilities of reporting entities while maintaining alignment with its long-term environmental and social objectives (Klimczak et al., 2023; Martínez-Torres, 2024; Miettinen, 2024; Villiers, 2022). *(Note: The Omnibus Package and its phased implementation, scope adjustments, and simplified standards are discussed in detail in the following chapter.)*

Table 1: Evolution of EU Sustainability Reporting Framework, European Commission

Year	Key Developments	Outcomes
2014	Adoption of Directive 2014/95/EU (NFRD)	Introduced mandatory non- financial reporting for large public-interest entities
2015	Stakeholder consultations, preparation of non-binding guidelines	Laid the groundwork for consistent implementation; alignment with global sustainability goals
2016	Transposition of NFRD into national laws	Legal foundation for sustainability reporting established across all Member States
2017	Publication of Non-binding Guidelines	Practical tool for companies to prepare relevant, comparable non-financial reports
2018	First NFRD-based reports published; Sustainable Finance Action Plan launched	Highlighted reporting inconsistencies and initiated deeper policy integration of sustainability disclosure
2019	European Commission launches formal review of NFRD	Identified weakness in comparability, reliability, and scope; began planning a revision of the directive
2020	Public consultation on NFRD revision; Taxonomy adopted	Identified major flaws in the NFRD; created momentum for a complete necessary change
2021	Proposal of the CSRD published	Introduced expanded scope, mandatory reporting standards, digitalization, and assurance requirements
2022	CSRD formally adopted as EU law (Directive 2022/2464)	Created a new mandatory sustainability reporting regime with phased implementation and assurance
2023	First set of ESRS adopted; SME and sectoral standards under development	Provided companies with detailed, binding reporting standards; began technical support for implementation
2024	Phased implementation of CSRD begins for companies already subject to NFRD	Companies start preparing reports under new ESRS; first experiences with mandatory digital reporting and assurance emerge
2025	Extension of CSRD reporting to large companies not previously covered under NFRD	Broader application of ESRS; external assurance and digital tagging become mainstream; more sector- specific standards adopted

Source: adopted by authors from European Commission

3.1 The Non-Financial Reporting Directive (NFRD) (2014–2018)

Adopted in October 2014 as an amendment to the EU Accounting Directive (Directive 2013/34/EU), the NFRD, officially designated as Directive 2014/95/EU, represented the EU’s initial legislative move to incorporate ESG aspects into corporate reporting structures (Ferrer et al., 2020). By requiring big businesses to report on non-financial risks and consequences, the order sought to increase corporate responsibility and transparency (Matuszak & Rózanska, 2021). It was conceived as part of the

EU's post-financial crisis response, supporting responsible business conduct in alignment with broader societal values (Cavallaro et al., 2024).

According to the European Commission, the NFRD was designed to make businesses responsible for their environmental and social effects while supporting the objectives of the European Green Deal. Another key objective was to enhance corporate transparency concerning climate-related and social risks (Aluchna et al., 2022; Fiechter et al., 2022). The directive specifically targeted public interest entities (PIEs) with more than 500 employees, which encompassed listed firms, banks, and insurance companies. Organizations also needed to fulfill other requirements in order to be eligible, such as having a net turnover of at least €40 million or a balance sheet total surpassing €20 million (Heichl & Hirsch, 2023; Martínez-Torres, 2024). Approximately 6,000 companies across the EU fell within its scope. While SMEs were excluded from mandatory reporting obligations, voluntary uptake was encouraged (Raith, 2023). The EU emphasized that the NFRD should apply to firms with significant societal and environmental impacts, particularly those with high visibility and systemic importance in financial markets (Cuomo et al., 2024; García-Benau et al., 2022).

The mandate required businesses to report on topics such as corporate board diversity, human rights, social and labor concerns, environmental policies, and anti-corruption measures (Pantazi, 2024). The NFRD was principles-based, offering companies discretion in reporting format and depth, so long as they addressed relevant material issues. The twofold materiality idea, which encourages businesses to report on the financial repercussions of ESG risks as well as their wider societal and environmental effects, was also an early regulatory reference point (Raith, 2023). However, due to the lack of clear definitions, this principle was inconsistently applied across countries (Pantazi, 2024).

The directive's flexibility, particularly its "comply or explain" model and absence of mandatory auditing, led to inconsistencies and limited comparability between firms (Velte, 2024). Despite these weaknesses, the NFRD established the necessary foundation for the EU's sustainability reporting architecture. It made ESG disclosure a legal requirement and emphasized the importance of consistent reporting practices, thereby setting the foundation for the CSRD and the creation of unified reporting standards under the ESRS (Ottenstein et al., 2022).

3.2 Transition to CSRD (2019–2022): Addressing NFRD’s Limitations

Following the NFRD's installation, numerous stakeholders including regulators, investors, and reporting entities voiced criticism about the directive’s lack of clarity, standardization, and enforcement. Chief among the concerns were the absence of harmonized standards, limited comparability across disclosures, and the non-binding nature of reporting guidelines (Pantazi, 2024).

In 2020, the European Commission launched a public consultation to address these issues. Over 80% of participants expressed support for mandatory sustainability reporting standards, emphasizing the importance of trustworthy and comparable information to prevent greenwashing and reduce regulatory inconsistencies (Pantazi, 2024; Primec & Belak, 2022). A key issue was the freedom granted to companies under the NFRD to use any preferred framework such as GRI, SASB, or IIRC or none at all, which resulted in highly inconsistent reporting practices (Heichl & Hirsch, 2023). Moreover, the absence of third-party assurance further reduced the reliability and perceived legitimacy of reported data (Ruohonen & Kullas, 2024).

As a reaction to these issues, the European Commission introduced the CSRD on April 21, 2021. This initiative formed a key component of the broader European Green Deal and the Sustainable Finance Action Plan, both of which seek to direct financial resources toward sustainable development goals (Klimczak et al., 2023). The CSRD was explicitly designed to correct the shortcomings of the NFRD by introducing mandatory EU-wide reporting standards, expanding company coverage, and requiring that all reported sustainability data be digitally tagged and independently audited (Primec & Belak, 2022).

Importantly, the CSRD also reframed the terminology and conceptual scope of disclosure from “non-financial reporting” to “sustainability reporting.” This transition signals a recognition of the financial significance of ESG matters and the necessity for integrated and future-oriented reporting that spans short-, medium-, and long-term perspectives (Pantazi, 2024; Primec & Belak, 2022).

3.3 Corporate Sustainability Reporting Directive (CSRD) (2023–2024)

The CSRD is a significant advancement in the EU's sustainability reporting structure, having been introduced in 2022 and going into effect in 2023. It replaces the NFRD and greatly expands the reporting obligations to include a greater number of businesses, including big businesses and publicly traded organizations across the EU (Ruohonen & Kullas, 2024). This broader scope demonstrates a deliberate

policy initiative aimed at increasing transparency across the entire value chain, with a particular focus on high-impact industries like energy, finance, and manufacturing (Becchetti et al., 2024).

The mandatory application of the ESRS is a crucial part of the CSRD. The European Financial Reporting Advisory Group (EFRAG) created these guidelines, which provide thorough reporting requirements in the domains of governance, social responsibility, and the environment. They differ from the NFRD's voluntary frameworks in that they are legally binding (Primec & Belak, 2022). As of 2024, ESRS encompasses climate impacts, circular economy metrics, working conditions, human rights protections, ethical governance, and anti-corruption practices (Primec & Belak, 2022).

Another key element of the CSRD is the requirement for limited assurance of sustainability information by independent auditors, with a pathway toward more exact reasonable assurance over time. This reform aims to mitigate the prevalence of greenwashing and enhance the credibility of reported data (Klimczak et al., 2023; Pantazi, 2024). Additionally, all disclosures must be digitally tagged in XHTML format, enabling machine-readability and aligning sustainability disclosures with existing financial reporting practices (Lombardi et al., 2022). As demonstrated throughout the preceding chapters, the transformation of sustainability reporting within the European Union reflects a significant regulatory and strategic shift, from fragmented, voluntary disclosure frameworks to a unified, mandatory system centered on transparency, standardization, and accountability (Breijer et al., 2024).

This overview has focused primarily on developments up to the year 2024, laying the groundwork for understanding the initial rollout of the CSRD and related directives. Building on this foundation, the following chapters shift focus to the year 2025 and beyond, presenting empirical case studies and applied analyses that illustrate how these regulations, particularly the CSRD, ESRS, and the Omnibus Package are being interpreted and operationalized across sectors and firm sizes. These studies give a thorough picture of the state of EU sustainability reporting now and its prospects for the future by offering useful insight into company changes, governance tactics, and reporting difficulties.

4 Current Status Quo of EU Sustainability Reporting Regulations (2025)

Over the preceding ten years, the European regulatory scene for sustainability reporting has changed dramatically. In January 2023, the Corporate Sustainability Reporting Directive (CSRD) was enacted to replace the Non-Financial Reporting Directive (NFRD), expanding the reporting universe from 11,700 to nearly 50,000 firms (Stojanović-Blab & Blab, 2024). This expansion reflects the EU's determination to embed ESG considerations into mainstream financial analysis and corporate strategy. It aimed to improve transparency, comparability, and accountability in corporate disclosures, a response to growing concerns among investors and society about climate change and social responsibility (European Commission, 2025a; Krasodomska et al., 2024). This comprehensive approach is designed to encourage long-term value creation that aligns corporate objectives with broader societal goals, necessitating that firms adopt more rigorous and standardized reporting practices (European Commission, 2025a).

At the same time, the EU Green Deal, launched in 2019, set ambitious targets to achieve climate neutrality by 2050 (Danila et al., 2022). This target further reinforces the need for comprehensive sustainability disclosures that integrate both financial and non-financial performance metrics. However, in the midst of economic pressures and market uncertainties, the regulatory framework was adjusted in February 2025 with the introduction of the Omnibus Package (European Commission, 2025a). This package seeks to minimise the compliance workload on companies while preserving the integrity of sustainability disclosures (Primec & Belak, 2022). The Omnibus Package attempts to balance regulatory stringency with economic pragmatism, aiming to foster more efficient and effective compliance practices that support the EU's overall sustainability goals (European Commission, 2025a).

4.1 CSRD Implementation Timeline and Scope Expansion

The CSRD is implemented in carefully planned phases designed to support a gradual transition and ensure uniform disclosure practices across Europe (Martinčević & Dorić, 2024). As the directive unfolds in FY2025, its phased approach from FY2024 to FY2028 serves not only as a timeline but also as a catalyst for companies like Siemens to rethink their sustainability commitments from the ground up (Becchetti et al., 2024). The implementation phases are structured to broaden the scope of sustainability reporting gradually, allowing companies to adapt their data collection and reporting processes while accommodating entities of varying sizes and operational scales (Hummel & Bauernhofer, 2024). The CSRD's implementation is strategically structured across four distinct waves, each targeting different

categories of companies based on size, listing status, and geographical location. This phased approach aims to ensure a gradual and manageable transition to the new reporting requirements, allowing companies time to adapt their systems and processes (Farbstein et al., 2024). The specific criteria and deadlines for the individual waves are explained in the following sections.

Wave 1: Beginning in FY2024, this stage targets large public-interest companies with more than 500 employees already subject to NFRD standards. These firms must submit their first reports under CSRD guidelines by FY2025, setting benchmarks for sustainability reporting across Europe (European Commission, 2025a; Krasodomska et al., 2024).

Wave 2: Extending to large companies meeting two out of three criteria (>250 employees, €40M turnover, €20M assets), this phase requires compliance beginning FY2025 for reports due in FY2026 (European Commission, 2025a; Krasodomska et al., 2024).

Wave 3: Covering listed SMEs starting FY2026 with reports due by FY2027, this phase addresses smaller entities while maintaining robust sustainability standards across diverse organizational structures (European Commission, 2025b; Hummel & Bauernhofer, 2024).

Wave 4: Targeting non-EU entities operating within Europe with substantial turnover (€150M net or €40M branch), this final phase begins in FY2028 for reports due by FY2029 (Becchetti et al., 2024; European Commission, 2025a).

This phased approach not only allows companies time to upgrade internal data systems and reporting processes but also fosters comparability of ESG information across diverse industries (Odobasa & Marosevic, 2023). The gradual ramp-up is particularly critical for firms that historically had limited experience in non-financial reporting, enabling them to adjust their internal controls and management practices (Doni et al., 2025).

The following sections and table 2 will detail the specific criteria and timelines associated with each wave.

Table 2: CSRD Implementation Phases

Wave	Start Year	Report Due	Scope	Approx. Number of Firms
1	FY2024	2025	Large public-interest entities	11,700
2	FY2025	2026	Other large firms	30,000
3	FY2026	2027	Listed SMEs, non-EU firms	8,000
4	FY2028	2029	Significant non-EU entities	500

Sources: Adopted by authors from (European Commission, 2025c; Stojanović-Blab & Blab, 2024)

By March 2025, early-adopter firms such as TotalEnergies have begun finalizing their initial CSRD reports, marking a significant advancement in corporate transparency and data integration (TotalEnergies, 2025). However, challenges persist and companies still face issues related to data collection, the integration of non-financial information into existing financial systems, and resource constraints that are especially pronounced for SMEs (Martinčević & Dorić, 2024; Primec & Belak, 2022). These challenges underscore the complexity of transitioning from legacy reporting systems to a comprehensive, standardized framework. Further research indicates that organizational readiness, internal capacity, and the availability of reliable data are key determinants of successful CSRD implementation (Doni et al., 2025).

4.2 European Sustainability Reporting Standards (ESRS) Framework

At the core of the CSRD are the European Sustainability Reporting Standards (ESRS), which were developed by the European Financial Reporting Advisory Group (EFRAG) and adopted in July 2023 (European Financial Reporting Advisory Group, 2024). The ESRS framework comprises 12 sector-agnostic standards, including cross-cutting (ESRS 1–2) and topical (ESRS E1–G1) requirements, designed to enforce double materiality assessments and align with global reporting initiatives (Dragomir et al., 2024). These standards aim to provide a consistent and comparable basis for sustainability reporting across industries, promoting market transparency and fostering investor confidence. ESRS serves as a framework through which firms, such as TotalEnergies, can strategically communicate their commitment to environmental stewardship, potentially enhancing their attractiveness to global investors. This perspective aligns with

emerging research on the performative aspects of sustainability reporting and its influence on capital markets (Baumuller & Sopp, 2022; Martinčević & Dorić, 2024).

One of the most transformative features of the ESRS framework is its double materiality principle (Mezzanotte, 2023). This concept requires companies to assess their sustainability performance through two lenses: impact materiality, which assesses how a company’s activities affect society and the environment, and financial materiality, which analysis how sustainability risks and opportunities impact the company’s financial performance (Dragomir et al., 2024). By incorporating this dual perspective, ESRS ensures that sustainability reporting is both comprehensive and actionable, enabling stakeholders to gain a holistic understanding of corporate performance while aligning disclosures with global frameworks like ISSB and GRI (Baumuller & Sopp, 2022; Fontaine et al., 2024).

As ESRS reporting takes effect in 2025, businesses face significant opportunities to enhance their market positioning through compliance. The framework facilitates improved comparability across firms by standardizing key performance indicators and metrics, such as Scope 3 emissions tracking, labor practices, and governance structures (European Commission, 2025b). This consistency is particularly valuable for investors who increasingly view sustainability performance as a proxy for long-term corporate resilience. Moreover, compliance with ESRS opens access to the EU’s €15 trillion market, positioning companies at the forefront of global sustainability trends while fostering trust among environmentally conscious consumers and stakeholders (European Commission, 2025a; Fontaine et al., 2024).

While sector-specific standards are slated for introduction in June 2026 under the Omnibus Package, the current set of ESRS provides a strong foundation for comprehensive ESG reporting (Bataleblu et al., 2024). By aligning with global frameworks such as the Task Force on Climate-related Financial Disclosures (TCFD), ESRS enhances cross-border comparability while reducing compliance burdens for multinational entities operating in multiple jurisdictions (European Commission, 2025a). This alignment ensures that European companies remain competitive in a global marketplace increasingly driven by sustainability considerations. While sector-specific standards are slated for introduction in June 2026 under the Omnibus Package, the current set of ESRS mention in table 3.

Table 3: Key ESRS Standards and Their Focus Areas

Standard	Focus Area	Key Metrics
ESRS E1	Climate Change	GHG emissions, climate-related risks
ESRS E2	Pollution	Pollutant management, waste metrics
ESRS E3	Water and Marine Resources	Water usage, impacts on marine systems
ESRS E4	Biodiversity and Ecosystems	Land use, conservation efforts
ESRS S1	Own Workforce	Labor practices, human rights
ESRS S2	Workers in Value Chain	Supply chain labor practices
ESRS S3	Affected Communities	Local community impacts
ESRS S4	Consumers and End-Users	Consumer protection measures
ESRS G1	Business Conduct	Ethical behavior, anti-corruption
ESRS G2	Governance	Board oversight, stakeholder engagement

Sources: Adopted by authors from (Baumuller & Sopp, 2022; Dragomir et al., 2024)

4.3 The Omnibus Package: Simplification Measures

In February 2025, the European Commission unveiled the Omnibus Package, a landmark initiative aimed at minimizing the compliance effort for companies while evaluating the integrity of sustainability disclosures (European Commission, 2025a; Primec & Belak, 2022). The Omnibus Package, proposed in February 2025, introduces a complex dynamic to the CSRD implementation. While it may offer short-term regulatory relief for SMEs such as EcoWeave by easing immediate compliance burdens, the potential long-term implications for achieving ambitious sustainability targets across the European Union remain a subject of ongoing scholarly debate (European Commission, 2025b; Hummel & Bauernhofer, 2024). This raises critical questions about the equilibrium required between fostering economic growth and maintaining environmental integrity within the evolving regulatory landscape.

This package represents a strategic recalibration of the Corporate Sustainability Reporting Directive (CSRD) in response to mounting concerns over the administrative complexity of sustainability

reporting requirements. A key measure within the Omnibus Package is the increase in the employee threshold for mandatory reporting to over 1,000 employees, coupled with additional financial criteria such as an annual turnover of more than 50 million euros or a balance sheet total of more than 25 million euros. (European Commission, 2025b). This adjustment reduces the number of firms required to produce full-scale sustainability reports from approximately 50,000 to 10,000, concentrating compliance efforts on larger organizations with greater resources and environmental impacts. By narrowing the scope, smaller entities are afforded the opportunity to focus on their core operations while larger corporations remain accountable for their significant societal and environmental footprints (European Commission, 2025b).

Another pivotal feature of the Omnibus Package is the introduction of ESRS Lite, a simplified reporting framework tailored for small and medium-sized enterprises (SMEs) (European Commission, 2025b). ESRS Lite aims to strike a balance between regulatory compliance and administrative feasibility by reducing mandatory data points and streamlining disclosure requirements. This framework alleviates disproportionate financial and operational burdens on SMEs while ensuring they can still contribute meaningfully to sustainability goals. Additionally, reporting deadlines for Waves 2 and 3 companies have been postponed by two years—extending compliance deadlines to FY2027 and FY2028 (European Commission, 2025b). This delay provides companies with additional time to upgrade their internal systems and adapt to evolving regulatory demands (European Commission, 2025a). These measures reflect a pragmatic approach by policymakers to address criticisms that EU red tape hinders competitiveness while preserving alignment with the broader objectives of the Green Deal (European Commission, 2021).

Although these simplifications have been welcomed by many business leaders as a necessary step toward reducing administrative burdens, they have sparked concerns among environmental advocates who fear that easing requirements could dilute the regulatory framework's effectiveness in achieving long-term sustainability goals (Dicuonzo et al., 2022). For large corporations like TotalEnergies, this recalibration shifts strategic focus from peripheral value chain issues toward core operational impacts (Doni et al., 2025). This divergence in perspectives underscores an ongoing debate about finding an optimal balance between regulatory efficiency and environmental stewardship, a central theme in the evolving landscape of EU sustainability reporting (Ottenstein et al., 2022). As illustrated in Table 4, This adjustment reduces the number of firms required to produce full-scale sustainability reports from approximately 50,000 to 10,000.

Table 4: Key Changes Under the Omnibus Package

Measure	Impact	Effective Date
Employee threshold > 1,000	Reduces reporting scope from 50,000 firms to 10,000	FY2025
Introduction of ESRS Lite	Simplifies compliance requirements for SMEs	FY2025
Postponement of Waves 2 & 3	Extends reporting deadlines to FY2027 and FY2028	February 2025

Sources: Adopted by authors from (European Commission, 2025b)

5 Corporate Strategy Adaptations to Evolving Regulations

The European Union's Corporate Sustainability Reporting Directive (CSRD) has catalyzed a paradigm shift in corporate strategy (Petrova, 2024). As companies face increasingly stringent sustainability reporting requirements, they are compelled to rethink their governance structures, operational processes, supply chain strategies, and innovation frameworks (Velte, 2024). This chapter explores these adaptations in detail, emphasizing how firms are balancing compliance with the CSRD while leveraging opportunities for competitive advantage. The analysis integrates theoretical frameworks such as legitimacy theory and resource dependence theory to contextualize these changes within broader academic debates.

5.1 Governance Changes: Embedding Sustainability at the Core

Corporate governance has undergone a profound transformation in response to the CSRD's emphasis on transparency and accountability (Stojanović-Blab & Blab, 2024). (Tonello, 2025) found that 61% of companies have an ESG steering committee at C-suite level, while 63% have such a committee one or two levels below. Board-level oversight is also important. Many companies have established a board committee to oversee the review of sustainability information. In response to the requirements set forth by the CSRD, Siemens' establishment of a Sustainability Committee in 2023 went beyond mere

compliance. It represented a strategic shift, effectively integrating Environmental, Social, and Governance (ESG) considerations into the core decision-making processes of the company's boardroom (Dimes & Molinari, 2024). These committees oversee sustainability initiatives, ensuring alignment with the ESRS and integrating ESG metrics into strategic decision-making processes (Velte, 2024).

Case Study: Siemens

Siemens demonstrates the evolving integration of sustainability governance within corporate strategy, particularly through the centralization of ESG leadership roles (Siemens AG, 2024). The appointment of a Chief People and Sustainability Officer in 2020 marked a strategic shift toward embedding sustainability objectives across operational and decision-making frameworks (Siemens AG, 2024). This governance restructuring has facilitated the alignment of ESG targets with core business performance, prioritizing initiatives such as decarbonization, supply chain emissions reduction, and workforce engagement. The company's DEGREE1 framework, encompassing decarbonization, ethics, governance, resource efficiency, equity, and employability, exemplifies this systemic approach, with measurable progress in emissions reduction and diversity metrics (Siemens AG, 2024).

The company's 2024 Sustainability Report reflects these advancements and aligns with double materiality principles outlined by European regulations. While not explicitly labeled as CSRD-compliant, this report sets a benchmark for integrating ESG metrics into corporate governance (Siemens AG, 2024).

Siemens continues to institutionalize sustainability within its corporate hierarchy through leadership roles like Wiese's and strategic frameworks like DEGREE. These efforts demonstrate the company's commitment to aligning with evolving regulatory standards while setting industry benchmarks for sustainable (Siemens AG, 2024). Legitimacy theory provides a compelling framework for understanding these changes. It posits that firms adopt transparent governance practices to secure societal approval and mitigate reputational risks. Siemens' proactive approach demonstrates how aligning governance structures with ESRS requirements can strengthen its legitimacy among stakeholders (Mio et al., 2020; Velte, 2024).

¹ The DEGREE framework is Siemens' comprehensive sustainability strategy, structured around six core pillars designed to integrate ESG principles into its operations and value chain. Introduced in 2021, the framework emphasizes measurable, long-term targets to align with global sustainability imperatives.

5.2 Operational Overhauls: Aligning with ESRS Requirements

Operational systems have been restructured to meet the granular disclosure requirements of the ESRS. By FY2025, many large companies integrated ESG data into their enterprise risk management (ERM) systems, enabling them to link environmental metrics directly to business risks same as carbon pricing and obligations penalties (Krasodomska et al., 2024). These systems represent a critical step in aligning operational processes with sustainability goals, ensuring compliance with EU Taxonomy regulations and mitigating financial risks associated with climate change (Martínez-Torres, 2024).

Sectoral Case Study: TotalEnergies

TotalEnergies illustrates how operational overhauls can drive strategic alignment with sustainability goals. Historically an oil and gas giant, the company has accelerated its transition toward renewable energy in response to CSRD requirements. By FY2025, TotalEnergies aims to achieve 35 GW of gross renewable capacity, supported by investments exceeding \$4 billion annually in low-carbon energy (TotalEnergies, 2025). This includes significant expansions in solar and wind projects, aligning operations with the EU Taxonomy's criteria for sustainable activities.

The company's dual-pillar strategy, combining profitable growth in oil and gas with accelerated investments in electricity, has positioned TotalEnergies as a leader in energy transition. Notably, its lifecycle carbon intensity target for energy products sold has been updated to a 17% reduction by FY2025, compared to 2015 levels (TotalEnergies, 2025). These achievements underscore how regulatory pressures like ESRS requirements can catalyze operational innovation across industries (Janik et al., 2020).

Despite these advancements, operational overhauls present significant challenges. A recent industrial report revealed that a vast number of companies struggle to collect accurate data for CSRD compliance, particularly for Scope 3 emissions. These challenges highlight the importance of digital transformation tools such as cloud-based analytics platforms and blockchain technologies in ensuring data accuracy and consistency across business units (Martinčević & Dorić, 2024).

5.3 Supply Chain Management Strategies

The CSRD's emphasis on value chain transparency has compelled companies to overhaul their supply chain strategies. As shown in Table 5, with Scope 3 emissions accounting for 75-85% of total

greenhouse gas emissions across most sectors, firms are implementing rigorous due diligence protocols to ensure compliance. These protocols extend beyond environmental metrics to include social and human rights considerations (Rísquez Ramos & Ruiz-Gálvez, 2024).

Case Study: Volkswagen

Volkswagen’s Sustainability Program exemplifies this shift toward supply chain accountability. In FY2024, the company audited over 40,000 suppliers, focusing on labor practices and environmental compliance in alignment with the Corporate Sustainability Due Diligence Directive (CSDDD) (Dempere et al., 2024). This comprehensive approach not only ensures regulatory compliance but also enhances operational resilience by identifying vulnerabilities along the value chain. Resource dependence theory explains these adaptations by highlighting how firms mitigate supply chain risks through proactive due diligence. By aligning supplier audits with CSDDD mandates, companies can secure critical inputs while enhancing their overall sustainability performance (Dempere et al., 2024; European Commission, 2025b).

Table 5: Emissions Breakdown by Scope

Scope	% of Emissions	Focus Area
Scope 1	10%	Direct operations
Scope 2	10%	Energy consumption
Scope 3	80%	Supplier practices

Source: (Rísquez Ramos & Ruiz-Gálvez, 2024)

5.4 Innovation as a Strategic Response

Innovation has emerged as a cornerstone of corporate adaptation to sustainability regulations. Companies are investing heavily in green technologies and circular economy initiatives to not only comply with the CSRD but also secure long-term competitive advantages (Becchetti et al., 2024).

Between 2023 and 2025, Siemens has advanced significant investments in innovation, particularly in digitalization, automation, and sustainability-focused infrastructure. In July 2023, Siemens announced a €2 billion global investment strategy, including approximately €1 billion in Germany, to expand development and manufacturing capacities, establish a new Technology Campus in Erlangen, and drive forward the industrial metaverse and net-zero operations (Siemens AG, 2024). These initiatives are underpinned by a comprehensive sustainability and energy concept, with the new campus designed to be a net-zero location that meets the highest sustainability criteria. Siemens' portfolio and sustainability reporting demonstrate strong alignment with the EU Taxonomy, with Siemens Mobility achieving 86% alignment for FY2024 and the company as a whole reporting high eligibility and alignment rates across revenue, CapEx, and OpEx. These investments reinforce Siemens' position as a leader in sustainable innovation and support the EU's climate and circular economy objectives (Siemens AG, 2024).

5.5 Risk Management Architecture Transformation

Risk management in sustainability reporting has become a critical area of focus for businesses, stakeholders, and regulatory bodies within the European Union (EU). The integration of risk management practices into sustainability reporting is essential for addressing social, environmental, and ethical risks, which can significantly impact corporate performance and stakeholder trust. This section explores the current state of sustainability reporting tools, risk assessment methodologies, and the implications of risk disclosure in the EU context (Fitriana & Wardhani, 2020).

State of the Art in Sustainability Reporting and Risk Assessment

Sustainability reporting has evolved to include comprehensive risk management practices, addressing non-financial risks such as climate change, data fraud, and social issues. The development of ESG standards and metrics has provided companies with frameworks to measure, manage, and mitigate these risks (Antoncic, 2019). Despite advancements, the reliability and authenticity of sustainability reporting remain under scrutiny due to issues with non-financial information recording, management discretion, and limited assurance (Bischof, 2022).

Methodologies in Risk Disclosure

The research methodology for studying sustainability risk disclosure involves creating relational semantic maps and developing structural equation models using partial least squares (PLS-SEM). This approach helps to understand the factors that influence the exposure of risks in corporate sustainability reporting. The exploratory study on Italian public and private organizations applying the G4 sustainability reporting guidelines highlights the importance of risk identification and mitigation strategies (Truant et al., 2017).

Typologies of Risks in Sustainability Reporting

Sustainability reports often illustrate various types of risks, including ethical, social, and environmental risks. These reports also forecast social and environmental impacts, providing stakeholders with insights into potential future challenges. The integration of risk management tools into sustainability reporting is crucial for addressing these risks effectively (Truant et al., 2017).

Impact of Risk Disclosure on Stakeholders

The disclosure of risks in sustainability reporting serves as an independent decision-making tool for banks, investors, rating agencies, and other stakeholders interested in corporate performance and risk avoidance mechanisms. The disclosure of risk management practices enhances transparency and helps stakeholders make informed decisions regarding investments and corporate strategies (Siri & Zhu, 2019).

Case Studies and Empirical Evidence

Empirical studies have shown that enterprise risk management (ERM) and sustainability reporting quality positively affect firms' performance, particularly in terms of return on assets (ROA) (Antoncic, 2019). Companies that manage both internal and external risks, including social and environmental risks, tend to perform better financially. Additionally, stakeholder engagement in sustainability reporting is found to be a process of managing reputational risk, with companies using rhetorical strategies to address social issues and increase market share (Dragomir et al., 2024).

Challenges and Future Directions

Despite the progress in sustainability reporting and risk management, several challenges remain. The need for uniform and global sustainability reporting standards is evident, as stakeholders demand more transparent and reliable information (Gebhardt et al., 2024). Future research should focus on developing improved methodologies for risk assessment and sustainability practices, ensuring that risks are managed resourcefully to avoid unsustainability practices (Dragomir et al., 2024). Risk management in EU sustainability reporting is a dynamic and evolving field that requires continuous improvement and adaptation. The integration of risk management practices into sustainability reporting enhances transparency, stakeholder trust, and corporate performance (Andersson & Arvidsson, 2023). As the regulatory landscape evolves, companies must adopt comprehensive risk management frameworks to address social, environmental, and ethical risks effectively. Further research and development of standardized reporting practices will be crucial for advancing sustainability and risk management in the EU context (Siri & Zhu, 2019).

5.6 Workforce and Organizational Culture Adjustments

The transition to sustainability reporting under frameworks like the CSRD and ESRS has necessitated profound changes in workforce strategies and organizational culture. Companies are increasingly recognizing that compliance requires not only technological upgrades but also a transformation in how employees engage with sustainability goals (Wijethilake et al., 2023). This section explores how organizations are adapting through training programs, cross-functional collaboration, and cultural shifts, supported by empirical evidence and academic insights.

Building Competencies Through Training Programs

Employee training is pivotal for equipping the workforce with the skills required to manage ESG data effectively, interpret regulatory requirements, and contribute to broader sustainability strategies. Siemens, for example, has invested heavily in cultivating an active learning culture across its workforce, emphasizing digitalization, leadership, and sustainability. The company's employees accrued an average of 23 hours of digital learning annually in 2023, with plans to increase this to 25 hours per year by FY2025 (Siemens AG, 2024). These efforts ensure that employees are well-prepared to handle the complexities of ESG reporting while fostering a culture of continuous learning.

Academic research highlights the importance of training initiatives tailored to sustainability reporting frameworks like CSRD. (Wijethilake et al., 2023) argue that sustainability reporting can overcome resistance to organizational change by fostering transparency and improving internal communication. Furthermore, (Wijethilake et al., 2023) found that companies investing in sustainability education reported higher levels of employee engagement and smoother transitions during regulatory implementation phases. These findings underscore the critical role of training programs in driving workforce readiness for sustainability reporting.

Cross-Functional Teams for ESG Integration

To address the complexity of sustainability reporting, companies are forming cross-functional teams dedicated to ESG initiatives. Such teams integrate individuals from diverse departments (HR, finance, operations, and procurement) each contributing unique expertise toward achieving sustainability goals. Siemens exemplifies this approach by embedding cross-functional collaboration into its organizational fabric. These teams work together to collect ESG data, create materiality matrices, and implement double materiality assessments required under CSRD guidelines (BASF SE, 2025).

Cross-functional collaboration is particularly critical for integrating ESG metrics into enterprise risk management (ERM) systems (Truant et al., 2017). By leveraging diverse expertise across departments, companies ensure that sustainability goals align with broader corporate strategies. Cross-functional teams not only enhance reporting accuracy but also foster innovation by encouraging knowledge-sharing across functional boundaries. This collaborative model is essential for breaking down silos within organizations and ensuring seamless compliance with regulatory requirements (Mezzanotte, 2023).

Cultural Shifts Toward Sustainability Awareness

Organizational culture plays an integral role in embedding sustainability into corporate DNA. Studies have shown that cultural change is among the most significant factors influencing the success of sustainability initiatives (Vodonick, 2018). Siemens has adopted a people-centered approach to this transformation by investing \$482 million in employee education programs that emphasize inclusivity and future-ready skills (SIEMENS REPORT). The company's commitment to diversity is reflected in its achievement of surpassing its 2025 target for women in top management roles (32.6% as of FY2024) underscoring the importance of equity in driving cultural change (Siemens AG, 2024).

Additionally, (Caputo et al., 2021) argue that transparency fostered through sustainability reporting can lead to more open organizational climates where employees feel empowered to contribute to ESG goals. Siemens Foundation's "Everyone Charging Forward" initiative further demonstrates how workforce development can align with broader decarbonization goals while advancing diversity in clean energy industries (Siemens AG, 2024). These efforts highlight how cultural shifts toward inclusivity and accountability can drive both compliance and innovation (Vodonick, 2018).

6 Sectoral Impacts: Varied Responses Across Industries

The Corporate Sustainability Reporting Directive (CSRD) and European Sustainability Reporting Standards (ESRS) have introduced transformative changes across industries, compelling companies to adapt their strategies to meet stringent sustainability reporting requirements (Wijethilake et al., 2023). However, the impact of these regulations varies significantly across sectors, depending on their environmental footprint, operational complexity, and stakeholder expectations (De Micco et al., 2021). This chapter examines sector-specific responses to the CSRD, focusing on high-impact industries such as energy, manufacturing, and automotive; the financial sector; small and medium-sized enterprises (SMEs); the technology sector; and the agriculture and food industry. By analyzing academic insights and case studies, this chapter highlights how different industries navigate these challenges while leveraging opportunities for sustainability-driven innovation.

6.1 High-Impact Sectors: Energy, Manufacturing, and Automotive

High-impact sectors such as energy, manufacturing, and automotive are under intense regulatory scrutiny due to their significant contributions to greenhouse gas emissions. These industries are compelled to adopt aggressive decarbonization strategies to align with ESRS requirements and broader EU climate goals (Rísquez Ramos & Ruiz-Gálvez, 2024).

The energy sector exemplifies this transformation. Companies like TotalEnergies are realigning their portfolios by targeting a 30% renewable energy mix by FY2025. This shift is driven by ESRS E1 requirements for climate-related disclosures, which mandate detailed reporting on Scope 1–3 emissions and renewable energy investments (Becchetti et al., 2024). TotalEnergies' strategic shift reflects not only the influence of regulatory pressures but also a response to the evolving market dynamics, characterized by an increasing consumer demand for sustainable energy solutions (TotalEnergies, 2025).

Manufacturing firms are leveraging circular economy practices to reduce emissions and optimize resource use (Paz & Ruiz Gálvez, 2020). Siemens has implemented innovative waste reduction strategies that have contributed to a 15% reduction in emissions over the past five years. These practices align with ESRS E5 requirements for resource use and circular economy disclosures, demonstrating how manufacturing companies can integrate sustainability into their operational frameworks (Siemens AG, 2024).

The automotive industry is currently going through a period of profound change, driven by EU taxonomy regulations and ESRS mandates. Companies like Volkswagen are transitioning toward electric vehicles (EVs) and other low-emission technologies, achieving emission reductions of up to 25% compared to traditional internal combustion engines. This transition underscores the role of regulatory frameworks in accelerating innovation within high-impact sectors (Gebhardt et al., 2024).

6.2 Financial Sector Adaptations

The financial sector has emerged as a leader in integrating ESG factors into its core investment strategies. Regulatory measures such as the Sustainable Finance Disclosure Regulation (SFDR) and CSRD have compelled financial institutions to align their portfolios with sustainability goals. ING Bank exemplifies this adaptation by increasing its allocation of Taxonomy-aligned assets from 30% in FY2023 to 40% in FY2025 (Posadas et al., 2023).

The financial sector's focus on ESG integration is driven by both regulatory imperatives and strategic risk management considerations. Limited assurance processes under CSRD enhance the credibility of ESG disclosures, boosting investor confidence while ensuring transparency in an increasingly competitive market. Institutional theory explains this convergence in practices as essential for achieving legitimacy among stakeholders (Gebhardt et al., 2024).

Case studies highlight how financial institutions leverage sustainability reporting for strategic differentiation. ING Bank's alignment with SFDR and CSRD requirements has positioned it as a front-runner in sustainable finance. By prioritizing green bonds and renewable investments, the bank has reduced portfolio risks while enhancing market credibility (Posadas et al., 2023).

6.3 SMEs: Indirect Impacts Through Value Chains

Small and medium-sized enterprises (SMEs) are largely exempt from direct CSRD reporting due to provisions under the Omnibus Package. However, they face considerable indirect pressures from larger corporate partners demanding detailed Scope 3 emissions data. The introduction of ESRS Lite has facilitated voluntary sustainability reporting among SMEs, with adoption rates increasing from 10% in FY2023 to 40% in FY2025 (Krasodomska et al., 2024).

Voluntary reporting is critical for SMEs seeking market access and competitiveness as major companies increasingly require detailed sustainability information from their supply chains (Paz & Ruiz Gálvez, 2020). EcoWeave, a mid-sized textile firm in the Netherlands, exemplifies this trend by implementing ESRS Lite protocols to secure contracts with major retailers. By voluntarily reporting its Scope 3 emissions, EcoWeave has enhanced its market credibility while minimizing supply chain risks (Fontaine et al., 2024).

SMEs form the backbone of the European economy, representing a vast majority of businesses (European Financial Reporting Advisory Group, 2024). The expansion of sustainability reporting requirements under the CSRD inevitably raises questions about their inclusion and the principle of proportionality (Bischof, 2022). While SMEs collectively contribute significantly to environmental and social impacts, they often possess limited resources and expertise to navigate complex reporting framework (European Financial Reporting Advisory Group, 2024).

The response of SMEs (Cariola et al., 2020) to sustainability reporting is therefore likely to be contingent on the nature of these tailored standards and the extent to which they align with their specific governance, organizational structures, and resource availability. Some SMEs, particularly those within high-impact sectors or those integrated into the value chains of larger companies, may face indirect pressures to enhance their sustainability reporting. For instance, a small manufacturing firm supplying a large multinational corporation might be required to provide sustainability data to enable the larger entity to fulfill its own reporting obligations (Cariola et al., 2020). Leveraging digital technologies could also play a crucial role in facilitating sustainability reporting for SMEs, potentially making the process more efficient and less burdensome (Cariola et al., 2020).

6.4 The Tech Sector: Digital Footprints and ESG Transparency

The technology sector plays an increasingly pivotal role in driving ESG transparency through digital transformation tools such as big data analytics, cloud computing, and blockchain technologies. These innovations streamline data collection processes while enabling real-time monitoring of sustainability performance across industries (Jilková & Kotesovcová, 2023).

Tech companies are also developing digital platforms that facilitate cross-industry transparency by integrating ESG metrics into dashboards accessible to regulators and investors alike. This approach not only enhances accountability but also sets new standards for transparency that benefit stakeholders across sectors (Gebhardt et al., 2024).

6.5 Agriculture and Food Industry: Sustainable Supply Chains and Biodiversity Reporting

The agriculture and food industry faces unique challenges due to its direct impact on natural resources and biodiversity. Companies in this sector are increasingly required to report on practices such as regenerative agriculture, optimized water management, and biodiversity conservation under ESRS guidelines (Dragomir et al., 2024).

The integration of biodiversity indicators into ESG information not only helps companies to fulfil legal requirements, but also appeals to environmentally conscious consumers and investors. Case studies highlight how firms like Nestlé have adopted sustainable sourcing practices that align with ESRS E4 requirements for biodiversity reporting while enhancing brand reputation among stakeholders (Posadas et al., 2023).

6.6 construction industry

The construction industry, for example, is increasingly scrutinized for its environmental footprint, from material sourcing and energy consumption in buildings to waste management (Wijethilake et al., 2023). Sustainability reporting in this sector necessitates a focus on green building practices, the use of sustainable materials, and the management of construction waste. Similarly, the textile and garment industry face intense scrutiny regarding labor conditions in its global supply chains and the environmental impacts of fast fashion (Dinh et al., 2023). Sustainability reporting in this sector often involves detailed

disclosures on supply chain due diligence, fair labor practices, and efforts to reduce textile waste and pollution (Wijethilake et al., 2023).

Even within a specific sector, responses can vary based on company size, ownership structure, and stakeholder engagement. Larger, publicly listed companies generally face greater pressure from investors and regulatory bodies to produce comprehensive sustainability reports compared to smaller, privately held entities (before the CSRD's expanded scope) (Camilleri, 2015). Companies with strong stakeholder engagement are also more likely to prioritize and enhance their sustainability reporting to address the concerns and expectations of their diverse stakeholders, including employees, customers, communities, and NGOs (Du Toit, 2024).

7 Challenges and Opportunities in Compliance

Growing awareness that corporate performance should be assessed not just by financial outcomes but also by taking into account the social and environmental effects of business activities is what is driving the expansion of corporate sustainability reporting in the EU (Baumuller & Sopp, 2022; Cavallaro et al., 2024; De Micco et al., 2021). The European Green Deal and the EU Taxonomy for Sustainable Activities, which seek to allocate financial flows toward sustainable projects to solve pressing global issues including social inequality, climate change, and biodiversity loss, are based on this concept (Horn, 2024). Businesses face both major obstacles and exciting opportunities as a result of the shift to more thorough and uniform sustainability reporting under EU regulations, especially through directives like the NFRD and its successor, the CSRD (Baumuller & Sopp, 2022; Cavallaro et al., 2024).

The core purpose of these regulatory developments is to ensure sheerness and accountability with regard to ESG factors, ultimately developing a sustainable and responsible economy (Cavallaro et al., 2024). This shift necessitates substantial adjustments in how companies collect data, manage reporting processes, and carefully incorporate environmental concerns into their main business processes (Baumuller & Sopp, 2022; Cavallaro et al., 2024). The mainstreaming of sustainability reporting as an essential practice is highlighted by the growing demand from regulatory agencies and legislators for businesses to participate in sustainability programs and transparent reporting (De Micco et al., 2021; Vander Bauwhede & Van Cauwenberge, 2022). While sustainability reporting is becoming a generally accepted practice, it is also acknowledged as a complex process to manage, carrying substantial challenges, especially in handling and conveying non-financial data effectively (De Micco et al., 2021).

Addressing these challenges effectively, however, can transform them into significant business opportunities (De Micco et al., 2021). Understanding how companies navigate these hurdles and the mechanisms they employ, to achieve the goal, is essential for raising sustainability reporting's overall caliber and effect (De Micco et al., 2021).

7.1 Challenges in Achieving Compliance with Evolving Regulations

Complying with the expanding scope and increasing complexity of EU sustainability reporting regulations presents numerous challenges for businesses. These challenges span data quality, the availability of expertise, cost implications, and the complexities of new concepts like double materiality (De Micco et al., 2021; Petrova, 2024).

Data Quality

Making sure the sustainability data being disclosed is reliable and of high quality is a critical concern (Petrova, 2024). The credibility of sustainability reporting is often questioned due to concerns about its relevance and effectiveness in truly supporting sustainable development (Petrova, 2024). A persistent issue is the heterogeneous nature of the information reported, often assessed against varying standards, which undermines comparability and overall utility (Calabrese et al., 2020). High-quality sustainability reporting demands accuracy, reliability, comparability, and totality of information across ESG dimensions (Breijer & Orij, 2022; Fiandrino et al., 2022). In order to give undertakings clarity and legal certainty, the EU Commission plans to swiftly enact the updated delegated act for the ESRS (European Commission, 2025a). The revision will focus on removing less critical data points, emphasizing quantitative data, clarifying materiality application, improving consistency with other EU legislation, simplifying the standards' structure, and enhancing interoperability with global standards (European Commission, 2025a).

Tracking Scope 3 Emissions

One significant aspect of data quality challenges revolves around the complexities of tracking Scope 3 emissions (Emborg et al., 2023). In the past, businesses have focused mostly on monitoring and cutting emissions from their own operations (Scope 1) and emissions from energy (electricity) they have purchased (Scope 2) (Emborg et al., 2023). However, the urgency of mitigating greenhouse gas (GHG)

emissions has intensified the focus on Scope 3 emissions, which occur within a corporation's supply chain (Emborg et al., 2023). While taking responsibility for these indirect emissions has been encouraged for over a decade, it has not yet translated into substantial reductions in supply chain emissions (Emborg et al., 2023).

A major impediment to reporting Scope 3 emissions is the difficulty in obtaining accurate and reliable data (Fritsch et al., 2024; Vieira et al., 2024). Companies often lack comprehensive visibility into their whole value chain, making it challenging to get the required data from various suppliers, customers, and other stakeholders (Fritsch et al., 2024; Vieira et al., 2024). This is predominantly accurate for companies with intricate global supply chains, where data collection can be hampered by limited communication with suppliers and a lack of standardized reporting practices (Fritsch et al., 2024; Vieira et al., 2024).

This is specifically addressed by the Greenhouse Gas Protocol (GHGP3) standard, which mandates that businesses monitor their Scope 3 emissions—basically, performing a value chain emissions audit (Patchell, 2018). This calls for gathering data from outside sources that are not directly under the reporting company's control. This is a difficult and resource-intensive task, and the sheer volume and diversity of external sources involved make it difficult to get accurate data (Gopalakrishnan, 2022; Patchell, 2018).

Companies have significant obstacles in regulating their Scope 3 emissions that go beyond data collection. If the emissions are not precisely measured or even estimated in the first place, reporting and apportioning blame for them will have no effect (Gopalakrishnan, 2022). Additionally, the "scope" of Scope 3 emissions—that is, the extent to which businesses should penetrate their supply chains in order to measure and control emissions—is not well understood (Gopalakrishnan, 2022). Regulations with an overly limited scope, like requiring reporting from just direct suppliers, may unintentionally boost subcontracting, which would simply push emission-intensive processes farther down the supply chain (Gopalakrishnan, 2022; Paccès, 2021). This emphasizes how urgently standards bodies and regulators must provide precise and uniform frameworks for quantifying and characterizing the extent of supply chain emissions (Gopalakrishnan, 2022). Furthermore, although rules such as SFDR address the disclosure of greenhouse gas emissions, thorough accounting of Scope 3 emissions continues to be a significant challenge (Bataleblu et al., 2024; Paccès, 2021).

The complexity is amplified by the need to collect data from a multitude of sources across the value chain, many of which may have varying levels of maturity in their own sustainability reporting practices (De Micco et al., 2021). The likelihood of attaining consistency in reporting is further limited by the variety of data points associated with each sustainability pillar (Bataleblu et al., 2024). The CSRD's

mandatory reporting of Scope 3 emissions imposes new compliance challenges for companies. Non-compliance with these reporting obligations can lead to legal and financial consequences, along with potential harm to a company's reputation. To avoid these risks, businesses must allocate resources to develop systems and processes that ensure adherence to the CSRD and related regulations (Martínez-Torres, 2024; Pantazi, 2024).

Limited data availability from SMEs

The limited availability of data from SMEs is another major obstacle. (Nowak et al., 2024). Until recently, sustainability reporting mandates, such as the NFRD, were primarily imposed on large public-interested enterprises, typically those with over 500 employees (Fiandrino et al., 2022; Kristofík et al., 2016; Nowak et al., 2024). This meant that SMEs, despite their significant role in the European economy, were largely excluded from these mandatory reporting requirements (Fiandrino et al., 2022). Consequently, data on their sustainability impacts and practices has been less readily available and standardized (Cuomo et al., 2024; Matuszak & Różanska, 2021).

While the CSRD aims to extend disclosure requirements to listed SMEs, the challenge of obtaining data from these entities remains significant (Cuomo et al., 2024; Petrova, 2024). Majority of SMEs lack the dedicated staff, expertise, and funds necessary to implement the sophisticated data collection and reporting systems demanded by the new directive (Nowak et al., 2024). Even established sustainability reporting procedures such as the GRI, which require substantial resources and capabilities, are primarily adopted by large corporations and may not adequately consider the specific individualities and necessities of SMEs, including their stakeholders, implications, and incentives for sustainability reporting (Klimczak et al., 2023; Nowak et al., 2024). This stresses the necessity of a comprehensive and customized strategy for SMEs' sustainability reporting (Nowak et al., 2024).

Acknowledging the difficulties SMEs experience, the Omnibus proposal seeks to decrease the number of projects that must be reported by excluding listed SMEs and major projects with up to 1000 workers. The Commission plans to provide a proposal on voluntary reporting based on the VSME standard created by EFRAG, which serves as the basis for a proportional norm for voluntary applications for businesses exempt from obligatory reporting (European Commission, 2025a).

Additionally, by restricting information demands from bigger enterprises to the level of the voluntary norm, the value-chain cap would be tightened and expanded to safeguard all undertakings with up to 1000 employees. The Commission plans to start capacity-building programs, like a multi-country project under the 2025 Technical Support Instrument, to help SMEs even more. These programs will help

Member States help businesses, especially SMEs, comply with CSRD and EU Taxonomy reporting obligations (European Commission, 2025a).

To exchange information about the execution of sustainability reporting standards and how digital technologies may make reporting easier for SMEs, EFRAG has now started a SME forum. These measures collectively demonstrate a focus on easing the reporting burden, particularly for smaller businesses, while still encouraging progress towards sustainability goals (European Commission, 2025a).

Complexity and Lack of expertise

Beyond data-related challenges, a lack of expertise and understanding of the new regulations poses a significant hurdle (Calabrese et al., 2020; Pantazi, 2024; Petrova, 2024). The CSRD and ESRS require extensive disclosures on sustainability impacts, risks, and strategies, creating a multifaceted reporting environment (Bataleblu et al., 2024). The interconnectedness of various regulations, including the EU Taxonomy Regulation and SFDR, adds layers of complexity, making it challenging for businesses to keep track of compliance requirements (Hummel & Jobst, 2024). The new sustainability reporting standards, like ESRS, are acknowledged to be extremely complex, requiring high technical expertise not only from the reporting companies but also from those who will be using the reported information (Bergmann & Posch, 2018; Pantazi, 2024).

Terms like "double materiality," introduced by the NFRD and reinforced by the CSRD and ESRS, represent a novel approach to determining what information belong in sustainability reports, distinct from the traditional financial materiality principle (Mezzanotte, 2023). Impact materialism, which focuses on how the business affects society and the environment, and financial materiality, which examines how sustainability concerns impact the business's financial performance, are examples of double materiality. While financial materiality is a relatively well-understood concept, the notion of impact materiality is new and untested within a framework of mandatory rules (Dragomir et al., 2024; Mezzanotte, 2023).

Implementing the impact materiality assessment is not a straightforward process and introduces new sources of legal risk for reporting companies (Mezzanotte, 2023). This process requires engaging affected stakeholders to identify relevant impacts, which itself can raise legal questions. Moreover, problems with the quality and accessibility of impact-related data might jeopardize disclosure accuracy, raising the possibility of false claims or omissions (Dragomir et al., 2024; Mezzanotte, 2023). The criteria for determining materiality can also vary considering the kind of materiality and the stage of assessment, creating uncertainty about the legal interpretation of impact materiality. The expectation that companies

will not only identify and report on negative impacts but also develop plans to mitigate or remedy them adds another layer of complexity and potential legal exposure (Mezzanotte, 2023).

Cost Implications

Finally, cost implications represent a significant challenge, particularly for startups and SMEs operating in sensitive industries (Dempere et al., 2024). The new compliance obligations imposed by directives like the CSRD can directly and indirectly affect these smaller businesses through possible obstacles to market entry, administrative constraints, and increased expenses for compliance (Dempere et al., 2024). Due to pressure from investors and creditors as well as the Green Deal's goals, businesses may have to pay more for capital and operating expenses as they restructure their operations to become more sustainable (Burca et al., 2024).

The initial implementation of CSR disclosure mandates, like the NFRD, has already incurred significant resource allocation and additional costs for firms reporting for the first time, including investments in capabilities and systems for GHG emissions accounting and meeting diverse stakeholder expectations (Nampoothiri et al., 2024). The relatively higher cost of compliance for smaller firms compared to their larger peers can pose a significant threat to their dynamism and competitiveness within the EU (Bergmann & Posch, 2018; Cavallaro et al., 2024). Large corporations often benefit from economies of scale and may have existing resources and capabilities for reporting, while SMEs frequently need to make substantial new investments in systems, processes, and expertise to meet the regulatory requirements (Bergmann & Posch, 2018).

Greenwashing

One major issue with regards to sustainability reporting is greenwashing, especially when considering the legal environment in the EU (Buttigieg & Pulis, 2024; Zhao, 2023). The practice of exaggerating or misrepresenting the sustainability credentials of investment goods or business operations to make them seem more socially or ecologically conscious than they actually are is known as "greenwashing" (Buttigieg & Pulis, 2024; Kishan & Azhar, 2024; Xu et al., 2023; Zhao, 2023).

Some companies exploit the market's preference for sustainability reporting to overstate and misrepresent their sustainability strengths in management or business by engaging in 'greenwashing' practices, aiming to attract investors and persuade them and other stakeholders of their social and environmental value, capabilities, or contributions (Buttigieg & Pulis, 2024; Xu et al., 2023). Customers

may be sold goods that do not fit their sustainability goals as a result of this deception, endangering investor protection and market integrity and eroding consumer confidence in financial institutions and markets overall (Buttigieg & Pulis, 2024). Complexity of the regulations creates opportunities for companies to selectively present data, omit crucial details, use ambiguous language, and make unsupported claims (Buttigieg & Pulis, 2024).

7.2 Strategic Opportunities Arising from Compliance

Despite the considerable challenges, compliance with the evolving EU sustainability reporting regulations also unlocks significant strategic opportunities for businesses. These opportunities include better reputation and risk management and stakeholder trust, better access to sustainable finance, and the stimulation of innovation in sustainable practices and technologies (Baumuller & Sopp, 2022; Cavallaro et al., 2024; Dempere et al., 2024).

Enhancing Stakeholder Trust

Additionally, a company's reputation and stakeholder trust may be greatly improved by comprehensive sustainability reporting (Dempere et al., 2024; Moya, 2024; Pantazi, 2024). The rising interest of investors, consumers, and stakeholders in general in ESG issues has intensified the focus on corporate sustainability performance and transparency (Vander Bauwhede & Van Cauwenberge, 2022). Regulatory bodies are increasingly mandating sustainability reporting, which in turn increases the need for companies engaged in sustainable practices to credibly signal their commitment and differentiate themselves (Partiti, 2024; Vander Bauwhede & Van Cauwenberge, 2022).

Transparent reporting on ESG impacts fosters confidence among investors, consumers, and other stakeholders, contributing to a more positive perception of the company (Villiers, 2022). Sustainability reporting is viewed as a mechanism to ensure clarity and honest conduct by corporations, providing useful information for investors, creditors, and other users to make informed decisions and hold management accountable (Nampoothiri et al., 2024). Transparency is essential for healthy financial markets and for fostering stakeholder confidence in the information presented, as seen by the global trend toward required disclosure of non-financial performance complementing the financial information (Nampoothiri et al., 2024).

Companies that effectively report on their Scope 3 emissions and demonstrate progress in decreasing their environmental implications are particularly prone to enhance their reputation and build

stakeholder trust. Conversely, failure to meet reporting requirements or perceived inadequacy in emission reduction strategies can lead to reputational risks and stakeholder backlash (Moya, 2024; Pantazi, 2024).

A decrease in transparency can harm stakeholders' perceptions of a company's accountability and integrity as well as impair their capacity to make informed evaluations (Martínez-Torres, 2024). Because stakeholders want comprehensive and transparent reports that accurately depict the environmental and social risks and problems that businesses confront, subjectivity in reporting can also undermine confidence (Martínez-Torres, 2024). Adhering to robust sustainability reporting regulations presents an opportunity to enhance stakeholder trust by providing the clarity and completeness they expect (Partiti, 2024). Enhancing reporting procedures helps companies not only satisfy stakeholders but also contribute to the SDGs, enhancing stakeholder confidence and reputation and setting them up for long-term value generation (Lombardi et al., 2022; Petrova, 2024).

Access To Sustainable Finance

Another key strategic opportunity is improved access to sustainable finance. Financial product sustainability disclosures are essential for maintaining transparency and allocating funds to desired sustainable economic ventures (Dempere et al., 2024; Partiti, 2024). To enable stakeholders and investors to assess a business's capacity to generate long-term value and possible exposure to sustainability risks, EU legislation are designed to incentivize businesses to better include sustainability concerns into their investment processes (Moneva et al., 2023; Partiti, 2024). Reporting enables stakeholders to make well-informed evaluations by supplying information on sustainability and long-term value creation concerns, which may increase a company's appeal to sustainability-focused investors (Partiti, 2024). Implementing a sustainable finance strategy is increasingly key for companies and financial institutions to meet climate objectives demanded in various regions (Moneva et al., 2023).

A common EU-wide label and standards for socially and environmentally responsible investments make it easier for companies meeting these criteria to attract sustainable finance (Moneva et al., 2023). Corporate sustainability reporting is central to the EU Sustainable Finance policy, which aims to promote both the management of sustainability risks and the allocation of capital to sustainable investments (Habermann, 2021).

Businesses are being pushed by investors more and more to include ESG considerations in their investing choices (Chrzan & Pott, 2024). EU laws such as CSRD and EU Taxonomy are intended to provide investors the knowledge they need to make "green" investments and to create a consensus on what

makes an investment green (Chrzan & Pott, 2024; Hummel & Bauernhofer, 2024). Companies' internal conversations on integrating sustainability into their plans have been sparked by the EU Taxonomy Regulation, creating a competitive atmosphere that promotes improvements in sustainability policies (Chrzan & Pott, 2024).

Businesses may access the expanding pool of funds allocated to sustainable endeavors by giving investors clear and consistent information about green investments (Hummel & Bauernhofer, 2024). The EU Taxonomy links sustainability reporting with key financial metrics like capital expenditure (CapEx) and operating expenditure (OpEx), ensuring a focus on investment in sustainable technologies and ESG-related improvements (Hummel & Bauernhofer, 2024). This presents a strategic opportunity to connect sustainability performance with core financial metrics, enhancing long-term financial viability and investor appeal (Hummel & Bauernhofer, 2024).

As lenders and investors increasingly take ESG considerations into account when making choices, businesses that excel at sustainability reporting can obtain a competitive edge (Horn, 2024; Hummel & Bauernhofer, 2024). The EU Taxonomy and European Green Deal are designed to direct financial flows toward sustainable developments, which means that businesses who follow the Taxonomy will have easier access to this funding (Horn, 2024; Tettamanzi et al., 2024).

EU regulations help investors assess the environmental impact of potential investments and incorporate sustainability into their investment policies. This allows businesses to create policies that reduce negative externalities and to report on their progress in a thorough and comparable way (Tettamanzi et al., 2024). In addition to providing openness and protection against greenwashing, mandated corporate taxonomy disclosure seeks to encourage investment in ecologically sustainable ventures and give the financial industry the information they need to reallocate funds to sustainable ventures (Ostojic et al., 2024).

Metrics like revenue alignment with the EU Taxonomy indicate a company's current sustainability performance, while CapEx alignment reflects its future direction (Ostojic et al., 2024). Companies actively seek advice to develop and incorporate balanced ESG strategies into their policies (Danila et al., 2022). Investors may evaluate institutions and better allocate capital to those with higher green financing performance using the green asset ratio (GAR), which implies that businesses with a high GAR would have easier access to sustainable financing (Danila et al., 2022).

The CSRD supports the green transition and highlights the vital role of investors and sustainable finance by requiring the inclusion of sustainability reports in consolidated annual accounts. This

establishes a direct link between financial and non-financial reporting, highlighting their relevance to the market and the economy (Martínez-Torres, 2024).

The Omnibus plan creates a "opt-in" system for major projects that don't surpass a specific size barrier and don't assert complete compliance with the EU Taxonomy to offer financial incentives and more freedom (European Commission, 2025a). These businesses would be free to reveal a subset of KPIs linked to taxonomy without having to worry about complete compliance. The goal of this "opt-in" strategy is to completely remove the expense of adhering to Taxonomy reporting requirements for businesses who do not assert that their operations are ecologically sustainable as defined by the Taxonomy Regulation (European Commission, 2025a). Additionally, such businesses would be permitted to report on activities that only partially satisfy the technical screening requirements of the Taxonomy, promoting a slow environmental transformation (European Commission, 2025a).

Improving Risk Management

Companies must report on ESG risks as part of sustainability reporting, especially as required by the NFRD and the impending CSRD (Breijer & Orij, 2022; Raith, 2023). This procedure pushes companies to recognize, evaluate, and control a wider variety of risks, such as those associated with the climate, society and workers, human rights, and corruption and bribery (Breijer & Orij, 2022; Dembowska, 2021; Mio et al., 2020). Adherence to the guideline can greatly enhance a business's capacity for risk management (Dempere et al., 2024).

Businesses may create more effective mitigation plans by developing a deeper understanding of their environmental and social risks via the methodical collection and analysis of sustainability data. Businesses may avoid possible operational interruptions, fines from the government, and harm to their brand by taking a proactive approach to risk management (Martínez-Torres, 2024; Pantazi, 2024).

Catalyst for Innovation

Lastly, the directive's focus on sustainability can serve as a potent stimulant for the development of innovative sustainable technologies and practices (Dempere et al., 2024). The narrative of European sustainability regulations begins with a challenge, pushing companies beyond conventional practices and towards uncharted territories of innovation (Becchetti et al., 2024). These regulations, such as Directive 2014/95/EU, initially aimed to provide stakeholders with more complex and comparable information (Matuszak & Rózanska, 2021). However, they are faced with the need to comply and transparently

disclose their impact, businesses are compelled to rethink their production and decision-making processes. This push not only rewards more sustainable and innovative businesses but also incentivizes others to adopt more responsible approaches (Siri & Zhu, 2019).

Innovation in sustainable practices and technology can be stimulated by the directives' emphasis on sustainability (Dempere et al., 2024). To transform the added costs of activities like recycling into a competitive advantage, manufacturers are driven to innovate in efficiency, flexibility, and scalability (Bataleblu et al., 2024). Businesses are encouraged to create and implement cutting-edge solutions that increase their social effect and lessen their environmental impact as they work to satisfy the stricter reporting standards and show better sustainability performance. As a result, new goods, services, and business models may be developed that give firms a competitive advantage in the marketplace while simultaneously promoting a more sustainable economy (Dempere et al., 2024).

8 Future Outlook

8.1 EU Sustainability Reporting Post-2025

Going forward, the trend in EU sustainability reporting is toward stricter regulations meant to raise businesses' knowledge of their negative externalities and encourage ethical business practices over the long run (Cavallaro et al., 2024). The main objective is to acknowledge the inherent financial value of sustainability reporting, recognizing the importance of ESG issues to overall business success, in addition to standardizing reporting procedures and guaranteeing the delivery of clear, transparent, trustworthy, and verifiable information (Cavallaro et al., 2024).

The preceding NFRD was greatly expanded by the CSRD, which affects a far greater number of businesses and calls for more thorough reporting (Becchetti et al., 2024). All major corporations (those with more than 250 workers) and all companies listed on regulated markets—including listed SMEs but excluding listed micro-enterprises—are now subject to the same sustainability reporting requirements (Becchetti et al., 2024). In order to improve openness, the CSRD also forces businesses to disclose information digitally, imposes more thorough reporting requirements in line with ESRS, and demands the verification of submitted sustainability information (Becchetti et al., 2024). The anticipated rise in the number of businesses obliged to include non-financial disclosures in their sustainability reports—from around 11,700 under the NFRD to over 49,000 under the CSRD—is indicative of this development (Moya, 2024; Ostojic et al., 2024).

On January 1, 2024, the CSRD went into force, with a staggered implementation schedule (Martínez-Torres, 2024; Moya, 2024; Stojanović-Blab & Blab, 2024). In 2025, large public firms that were already subject to the NFRD had to submit their financial year 2024 reports. For the fiscal year 2025, large businesses that were not previously subject to the NFRD will have to submit reports in 2026. For the fiscal year 2026, listed SMEs will start to report in 2027, with the possibility to be voluntarily excluded until 2028 (Martínez-Torres, 2024; Moya, 2024). Nevertheless, there have been observed discrepancies and possible exemptions in the ESRS that appear to go against the more general objectives of the CSRD. For example, the ESRS permits businesses with fewer than 750 employees to omit specific environmental data in the first years of reporting, including comprehensive Scope 3 emissions information, which the CSRD stresses as crucial (Martínez-Torres, 2024; Stojanović-Blab & Blab, 2024).

The "Omnibus Package" represents a recent development aimed at balancing the ambition of sustainability goals with concerns about the competitiveness of businesses. This package includes proposals for phased implementation timelines, simplified reporting standards, financial incentives, and measures to support SMEs (European Commission, 2025a).

Future regulatory reforms are also expected to place a greater emphasis on biodiversity reporting (Stojanović-Blab & Blab, 2024). One of the six main environmental goals outlined in the European Commission's legislation is the preservation and restoration of ecosystems and biodiversity (Camilleri, 2015). This indicates that biodiversity is already recognized as a crucial aspect of EU sustainability regulations, and future reforms are likely to strengthen the requirements and frameworks related to reporting on this area, potentially focusing on biodiversity loss as a material risk for businesses (Stojanović-Blab & Blab, 2024).

A particular standard called ESRS E4 is part of the ESRS and covers all disclosure obligations pertaining to ecosystems and biodiversity (Stojanović-Blab & Blab, 2024; Velte, 2024). While this standard exists, there has been debate about potential exemptions for smaller companies in the initial reporting periods (Martínez-Torres, 2024). Although there are some subtleties, the general trend is for biodiversity concerns to be more integrated into sustainability reporting; transition plans under the CSRD are already expected to make reference to the new Post-2020 Global Biodiversity Framework and the EU Biodiversity Strategy for 2030 (Velte, 2024).

8.2 The Role of Technology in Enhancing Sustainability Reporting

Technology must be included into sustainability reporting to increase efficiency, accuracy, and transparency. By automating the recording and processing of accounting activities, artificial intelligence (AI) systems, for example, greatly improve the quality of financial reports and provide more relevant data for logical investment decisions. AI's ability to automatically report and correct errors in data entry further sustains the quality of financial reports, increasing their reliability and credibility (Gshayish & Faik, 2023).

Technology, particularly Artificial Intelligence (AI) and blockchain, is playing an increasingly significant role in transforming sustainability reporting, offering solutions to enhance efficiency, accuracy, and transparency (Correia & Água, 2024; Seretakakis & Mezzanotte, 2023). SDG reporting is significantly influenced by digitalization, especially in emerging economies. Higher use of digital technology is typically associated with better sustainability reporting, as well as excellent performance in terms of ecosystem vitality, environmental health, and economic advancement (Ștefănescu, 2024).

AI-Powered ESG

By using machine learning, natural language processing, and predictive analytics to automate data collection and analysis, AI-powered data analysis offers a potent tool for enhancing ESG reporting (Correia & Água, 2024). By combining data from several sources, these technologies can produce a more accurate and comprehensive picture of ESG performance (Correia & Água, 2024). AI also makes it possible to interpret data in real time, which changes ESG reporting from a retrospective process to a proactive one that can forecast future patterns and results (Correia & Água, 2024; Rane et al., 2024).

Companies are already using AI technology to more accurately measure and report ESG parameters, which enables them to minimize carbon emissions, optimize resource use, and assess environmental consequences (Rane et al., 2024). Sustainability reporting has grown more robust and insightful thanks to the application of machine learning algorithms and Natural Language Processing (NLP) in ESG data analytics, allowing company plans to better match with global sustainability goals (Rane et al., 2024). It has been demonstrated that business financial performance and ESG ratings positively correlate. Long-term financial returns are often greater for companies with strong ESG ratings, especially during volatile market times like the COVID-19 epidemic. This positive correlation is attributed to enhanced risk management capabilities and financial resilience in firms with robust ESG practices (Juthi et al., 2024). AI may offer insightful information on how various business practices affect the environment and

recommend more sustainable options by evaluating enormous volumes of data from several sources (Rane et al., 2024).

AI-based systems can also automate the detection of fraudulent activities, monitor regulatory changes, and ensure compliance with legal standards (Rane et al., 2024). The collecting and analysis of ESG data heavily relies on AI and machine learning technology. More precise and timely risk assessment and decision-making are made possible by these technologies, which are essential for long-term business success and investment plans (Juthi et al., 2024).

Emerging tech-based ESG reporting solutions provide extensive feature sets that let businesses efficiently monitor and report on their ESG performance (Markova-Karpuzova et al., 2024). These systems improve productivity, accuracy, and transparency by automating data collecting, analysis, and reporting procedures via the use of AI, machine learning, and big data analytics (Markova-Karpuzova et al., 2024). Key features of these AI-driven platforms include automated data collection and aggregation, sophisticated data analysis and visualization, customizable reporting templates, and tools for stakeholder engagement (Markova-Karpuzova et al., 2024). Organizations may automate intricate accounting procedures, lower human error, and produce more trustworthy financial reports by using AI-powered systems to analyze immense quantities of financial information, find trends, and deliver predictive insights with previously unheard-of speed and accuracy (Budiarto et al., 2024).

Blockchain Technology

Additionally, blockchain technology has a lot of promise to improve supply chain transparency in sustainability reporting (Correia & Águas, 2024; Seretakakis & Mezzanotte, 2023). As a decentralized and immutable ledger, blockchain can enhance trust and transparency while reducing fraud (Seretakakis & Mezzanotte, 2023). Its ability to automatically update the ledger and make changes observable to users makes tampering extremely difficult, improving the permanence and immutability of transaction records. Blockchain is also resilient against cyberattacks and failures of individual nodes (Seretakakis & Mezzanotte, 2023).

Blockchain and other emerging technologies can improve ESG data management by establishing more transparent and safe systems. The immutable ledger of blockchain ensures data integrity and adds another degree of security and reliability (Correia & Águas, 2024). Blockchain technology and AI-driven risk management solutions can improve company governance by guaranteeing supply chain and financial reporting compliance and transparency (Seretakakis & Mezzanotte, 2023). Moreover, blockchain can

significantly improve sustainability reporting, aiding firms in implementing the requirements introduced by the CSRD (Seretakakis & Mezzanotte, 2023).

Current corporate systems for tracking transactions and aggregating data often struggle with global and multi-layered supply chains, and existing verification and auditing systems rely on human intervention, making them susceptible to fraud and waste (Seretakakis & Mezzanotte, 2023). By guaranteeing fair labor standards and ethical material procurement, blockchain technology improves social responsibility by bringing transparency and traceability to supply chains. Through the reduction of carbon emissions and reliance on fossil fuels, this technology helps to mitigate climate change and promote environmental sustainability. Furthermore, blockchain technology improves productivity and simplifies processes, which lowers expenses and boosts profitability while leaving a smaller environmental impact (Kiyani, 2023).

Blockchain's features, such as creating a distributed and continually updated record, can make sustainability data automatically and widely available (Seretakakis & Mezzanotte, 2023). The tamper-resistant nature of blockchain databases makes fraud and data manipulation extremely difficult, confirming the sustainability features of products in order to help create more sustainable supply chains (Seretakakis & Mezzanotte, 2023).

Challenges and Recommendations

Although using AI in ESG reporting has many advantages, there are drawbacks, restrictions, and hazards as well (Markova-Karpuzova et al., 2024; Rane et al., 2024). Since businesses frequently live off a variety of internal and external sources with differing degrees of accuracy and completeness, ensuring the quality and dependability of the data used for reporting is a top priority (Markova-Karpuzova et al., 2024).

To solve these problems, strong data validation procedures, data cleaning methods, and continuous monitoring are crucial (Markova-Karpuzova et al., 2024). It can be difficult and time-consuming to integrate tech-based ESG reporting platforms with current systems and procedures; compatibility problems and staff resistance to change may also arise (Markova-Karpuzova et al., 2024). Careful preparation, stakeholder involvement, training expenditures, and organizational change management are necessary for a smooth integration (Markova-Karpuzova et al., 2024). Another major problem is keeping up with changing standards and regulations, which calls for constant observation, revisions to reporting formats, and adherence to industry best practices (Markova-Karpuzova et al., 2024). These platforms' gathering, storing, and processing of private information raises questions about data

security and privacy, necessitating strong data protection measures to reduce the possibility of breaches and illegal access (Markova-Karpuzova et al., 2024).

The reliability of ESG reports may be weakened by the possibility of algorithm bias and interpretation problems brought on by the usage of AI algorithms and machine learning techniques (Markova-Karpuzova et al., 2024). Careful assessment of algorithm validity, sensitivity analyses, and transparent disclosures about limitations are crucial (Markova-Karpuzova et al., 2024). A loss in human supervision and judgment, which is required to take into account subtle or context-specific aspects, might result from an over-reliance on technology and automation. A balance between automation and human expertise is essential (Markova-Karpuzova et al., 2024). Additional significant obstacles to the broad use of AI in ESG reporting include problems with data integration and quality, the significant computational resources and knowledge needed, privacy and ethical issues like data misuse and the "black box" problem (the lack of transparency of AI's decision-making process), the high cost of AI technology, the requirement for scalable and dependable systems, and the complexity introduced by the changing regulatory environment (Correia & Água, 2024).

In order to overcome these obstacles, businesses should make investments in strong data governance frameworks, implement transparent AI procedures, scale AI systems gradually, and keep up with regulatory changes. This will allow them to optimize the advantages of AI in supporting sustainable business practices and increasing corporate accountability and transparency (Correia & Água, 2024). Collaboration among stakeholders is necessary to accomplish complete sustainability goals since it is vital to include suppliers, customers, and regulatory agencies (Blessing Ameh, 2024). It is recommended that digital technologies and artificial intelligence be strategically used as key facilitators of sustainable supply chain management, giving businesses the flexibility to adjust to shifting customer demands and environmental restrictions (Blessing Ameh, 2024).

9 Conclusion

The changing link between European Union enterprise risk management (ERM) techniques and sustainability reporting laws, particularly the CSRD, has been methodically examined in this literature review. Through a comprehensive literature review of post-2015 scholarly articles and official reports, the study uncovered how CSRD acts as a compliance framework as well as a strategic driver, influencing corporate behavior, risk culture, and governance mechanisms.

The integration of stakeholder theory and the principle of double materiality emerged as foundational conceptual lenses, enabling a deeper understanding of how sustainability risks are reclassified and internalized within ERM systems. Moreover, the analysis demonstrated how CSRD contributes to the formalization of sustainability-related risks, the refinement of internal control structures, and the alignment of ERM processes with long-term corporate sustainability strategies.

Case studies from TotalEnergies, Siemens, and Volkswagen provided real-world illustrations of how large corporations interpret and operationalize CSRD guidelines, highlighting both the opportunities and challenges inherent in implementation. These examples revealed sectoral differences in readiness and capacity to embed sustainability in risk governance, suggesting that uniform regulatory pressure yields differentiated organizational responses.

From a managerial perspective, this research emphasizes the growing importance of integrating ESG considerations not only into reporting processes but into core strategic and risk management decisions. From a policy perspective, the study indicates that the CSRD may serve as a model for future non-financial regulation, pushing firms toward holistic risk-awareness and more transparent accountability mechanisms.

Nevertheless, the research also revealed a number of unresolved questions, particularly concerning how SMEs and less-resourced firms will adapt to CSRD requirements, and how internal ERM transformations will be monitored and assessed over time. Future studies could benefit from comparative, empirical research across industries and regions, as well as long-term case studies that trace how sustainability and risk converge under dynamic regulatory environments. In conclusion, this thesis demonstrates that the CSRD is not only redefining how companies report, but also how they think, plan, and act in relation to sustainability and risk—laying the groundwork for a more resilient and accountable corporate landscape in Europe.

10 References

- Aluchna, M., Roszkowska-Menkes, M., & Kaminski, B. (2022). From talk to action: The effects of the non-financial reporting directive on ESG performance. *MEDITARI ACCOUNTANCY RESEARCH*, 31(7), 1–25. <https://doi.org/10.1108/MEDAR-12-2021-1530>
- Andersson, F., & Arvidsson, S. (2023). Understanding, mapping and reporting of climate-related risks among listed firms in Sweden. *CLIMATE POLICY*, 23(8), 945–958. <https://doi.org/10.1080/14693062.2022.2116383>
- Antonicic, M. (2019). Why sustainability? Because risk evolves and risk management should too. *Journal of Risk Management in Financial Institutions*, 12(3), 206. <https://doi.org/10.69554/NGCI9028>
- BASF SE. (2025). *BASF Report 2024: Combined Management's Report and Consolidated Financial Statements*. BASF SE. <https://ppl-ai-file-upload.s3.amazonaws.com/web/direct-files/attachments/23288063/5e54e07a-209e-4fa0-8706-2c0f565e490a/entire-full-report-basf-ar24.pdf>
- Bataleblu, A., Rauch, E., Cochran, D., & Matt, D. (2024). Impact of European Sustainability Reporting Standards Guidelines on the Design of Sustainable Factories and Manufacturing Systems. In M. Grabowska, M. Hinz, & A. Hamrol (Eds.), *Free University of Bozen-Bolzano* (WOS:001267311600014; pp. 237–253). https://doi.org/10.1007/978-3-031-56474-1_18
- Baumuller, J., & Sopp, K. (2022). Double materiality and the shift from non-financial to European sustainability reporting: Review, outlook and implications. *JOURNAL OF APPLIED ACCOUNTING RESEARCH*, 23(1), 8–28. <https://doi.org/10.1108/JAAR-04-2021-0114>
- Becchetti, L., Mancini, S., & Solferino, N. (2024). Sustainability reporting and corporate environmentally sustainable investment. *APPLIED ECONOMICS*. <https://doi.org/10.1080/00036846.2024.2405198>
- Bergmann, A., & Posch, P. (2018). Mandatory Sustainability Reporting in Germany: Does Size Matter? *SUSTAINABILITY*, 10(11). <https://doi.org/10.3390/su10113904>

- Biondi, L., Dumay, J., & Monciardini, D. (2020). Using the International Integrated Reporting Framework to comply with EU Directive 2014/95/EU: can we afford another reporting facade? *MEDITARI ACCOUNTANCY RESEARCH*, 28(5), 889–914. <https://doi.org/10.1108/MEDAR-01-2020-0695>
- Bischof, J., Dutzi, A., & Gros, M. (2022). Sustainability reporting and risk governance. *Journal of Business Economics*, 92(3), 349–353. <https://doi.org/10.1007/s11573-022-01096-7>
- Blessing Ameh. (2024). Digital tools and AI: Using technology to monitor carbon emissions and waste at each stage of the supply chain, enabling real-time adjustments for sustainability improvements. *International Journal of Science and Research Archive*, 13(1), 2741–2757. <https://doi.org/10.30574/ijstra.2024.13.1.1995>
- Breijer, R., Erkens, M., Orij, R., & Vergoossen, R. (2024). Mandatory versus voluntary non-financial reporting: Reporting practices and economic consequences. *ACCOUNTING FORUM*. <https://doi.org/10.1080/01559982.2024.2326334>
- Breijer, R., & Orij, R. (2022). The Comparability of Non-Financial Information: An Exploration of the Impact of the Non-Financial Reporting Directive (NFRD, 2014/95/EU). *ACCOUNTING IN EUROPE*, 19(2), 332–361. <https://doi.org/10.1080/17449480.2022.2065645>
- Dumitru, V. F., Chersan, I. C., Gorgan, C., Bucharest University of Economic Studies, Romania. (2023). Early Disclosure of the Double Materiality Concept in a European Oil and Gas Company. *New Trends in Sustainable Business and Consumption*, 425–432. <https://doi.org/10.24818/BASIQ/2023/09/006>
- Budiarto, A., Iskandar, A. A., & Suryathi, W. (2024). Digital Transformation in Financial Reporting: How AI and Blockchain Are Shaping Transparency and Efficiency in Corporate Accounting. *International Journal of Social and Human*, 1(3), 199–207. <https://doi.org/10.59613/ky8h2e26>

- Burca, V., Bogdan, O., Bunget, O., & Dumitrescu, A. (2024). Corporate Financial Performance vs. Corporate Sustainability Performance, between Earnings Management and Process Improvement. *SUSTAINABILITY*, 16(17). <https://doi.org/10.3390/su16177744>
- Buttigieg, C. P., & Pulis, S. (2024). Strategic initiatives to address greenwashing. *ERA Forum*, 25(3), 327–337. <https://doi.org/10.1007/s12027-024-00815-7>
- Calabrese, A., Costa, R., Levialdi, N., Menichini, T., & Montalvan, R. (2020). Does More Mean Better? Exploring the Relationship between Report Completeness and Environmental Sustainability. *SUSTAINABILITY*, 12(24). <https://doi.org/10.3390/su122410635>
- Camilleri, M. (2015). Environmental, social and governance disclosures in Europe. *SUSTAINABILITY ACCOUNTING MANAGEMENT AND POLICY JOURNAL*, 6(2), 224–242. <https://doi.org/10.1108/SAMPJ-10-2014-0065>
- Caputo, F., Pizzi, S., Ligorio, L., & Leopizzi, R. (2021). Enhancing environmental information transparency through corporate social responsibility reporting regulation. *BUSINESS STRATEGY AND THE ENVIRONMENT*, 30(8), 3470–3484. <https://doi.org/10.1002/bse.2814>
- Cariola, A., Fasano, F., La Rocca, M., & Skatova, E. (2020). Environmental sustainability policies and the value of debt in EU SMEs: Empirical evidence from the energy sector. *JOURNAL OF CLEANER PRODUCTION*, 275. <https://doi.org/10.1016/j.jclepro.2020.123133>
- Cavallaro, E., Sessa, M., & Malandrino, O. (2024). Sustainable Finance Disclosure Regulations as a Tool for Change of City Environment. In O. Gervasi, B. Murgante, C. Garau, D. Taniar, A. Rocha, & M. Lago (Eds.), *University of Salerno* (WOS:001294386000010; Vol. 14824, pp. 153–169). https://doi.org/10.1007/978-3-031-65332-2_10
- Chrzan, S., & Pott, C. (2024). Limiting environmental reporting flexibility: Investor judgment based on the EU taxonomy. *REVIEW OF QUANTITATIVE FINANCE AND ACCOUNTING*, 63(4), 1511–1548. <https://doi.org/10.1007/s11156-024-01297-x>

- Correia, A., & Água, P. B. (2024). Harnessing artificial intelligence for enhanced environmental, social, and governance reporting: A new paradigm in corporate transparency. *Corporate Governance: Research and Advanced Practices*, 92–98. <https://doi.org/10.22495/cgrapp15>
- Cuomo, F., Gaia, S., Girardone, C., & Piserà, S. (2024). The effects of the EU non-financial reporting directive on corporate social responsibility. *EUROPEAN JOURNAL OF FINANCE*, 30(7), 726–752. <https://doi.org/10.1080/1351847X.2022.2113812>
- Danila, A., Horga, M., Oprisan, O., & Stamule, T. (2022). GOOD PRACTICES ON ESG REPORTING IN THE CONTEXT OF THE EUROPEAN GREEN DEAL. *AMFITEATRU ECONOMIC*, 24(61), 847–860. <https://doi.org/10.24818/EA/2022/61/847>
- De Micco, P., Rinaldi, L., Vitale, G., Cupertino, S., & Maraghini, M. (2021). The challenges of sustainability reporting and their management: The case of Estra. *MEDITARI ACCOUNTANCY RESEARCH*, 29(3), 430–448. <https://doi.org/10.1108/MEDAR-09-2019-0555>
- Dembowska, K. (2021). NON-FINANCIAL REPORTING REGARDING NATURAL ENVIRONMENT IN PUBLIC COMPANIES IN THE ENERGY, FUEL AND GAS SECTOR IN 2019. *EKONOMIA I SRODOWISKO-ECONOMICS AND ENVIRONMENT*, 3(78), 122–134. <https://doi.org/10.34659/2021/3/26>
- Dempere, J., Udjo, E., & Mattos, P. (2024). The Entrepreneurial Impact of the European Directive on Corporate Sustainability Due Diligence. *ADMINISTRATIVE SCIENCES*, 14(10). <https://doi.org/10.3390/admsci14100266>
- Dicuonzo, G., Donofrio, F., & Rinaldo, S. (2022). *The Jungle of Sustainability Frameworks and Standards: Evidence from European Listed Companies* (P. Sklias, P. Polychronidou, A. Karasavoglou, V. Pistikou, & N. Apostolopoulos, Eds.; WOS:000865799400003; pp. 53–72). https://doi.org/10.1007/978-3-031-05351-1_3

- Dimes, R., & Molinari, M. (2024). Non-financial reporting and corporate governance: A conceptual framework. *SUSTAINABILITY ACCOUNTING MANAGEMENT AND POLICY JOURNAL*, 15(5), 1067–1093. <https://doi.org/10.1108/SAMPJ-04-2022-0212>
- Dinh, T., Husmann, A., & Melloni, G. (2023). Corporate Sustainability Reporting in Europe: A Scoping Review. *ACCOUNTING IN EUROPE*, 20(1), 91–119. <https://doi.org/10.1080/17449480.2022.2149345>
- Doni, F., Corvino, A., & Martini, S. (2025). ESG disclosure and financial performance in the European oil and gas industry. *INTERNATIONAL JOURNAL OF BUSINESS ENVIRONMENT*, 16(1). <https://doi.org/10.1504/IJBE.2025.143097>
- Dragomir, V., Dumitru, M., Chersan, I., Gorgan, C., & Paunescu, M. (2024). Double Materiality Disclosure as an Emerging Practice: The Assessment Process, Impacts, Risks, and Opportunities. *ACCOUNTING IN EUROPE*. <https://doi.org/10.1080/17449480.2024.2339264>
- Du Toit, E. (2024). Thirty Years of Sustainability Reporting: Insights, Gaps and an Agenda for Future Research Through a Systematic Literature Review. *Sustainability*, 16(23), 10750. <https://doi.org/10.3390/su162310750>
- Dumay, J., La Torre, M., & Farneti, F. (2019). Developing trust through stewardship Implications for intellectual capital, integrated reporting, and the EU Directive 2014/95/EU. *JOURNAL OF INTELLECTUAL CAPITAL*, 20(1), 11–39. <https://doi.org/10.1108/JIC-06-2018-0097>
- Elamer, A., & Boulhaga, M. (2024). ESG controversies and corporate performance: The moderating effect of governance mechanisms and ESG practices. *CORPORATE SOCIAL RESPONSIBILITY AND ENVIRONMENTAL MANAGEMENT*, 31(4), 3312–3327. <https://doi.org/10.1002/csr.2749>
- Emborg, M., Lloyd, S., & Olsen, S. (2023). Why process-level Scope 3 accounting is needed for delivering supply chain greenhouse gas emission reduction. *Integrated Environmental Assessment and Management*, 19(5), 1165–1167. <https://doi.org/10.1002/ieam.4816>

European Commission. (2021). *European Green Deal: Commission proposes transformation of EU economy and society to meet climate ambitions*. https://ppl-ai-file-upload.s3.amazonaws.com/web/direct-files/attachments/23288063/347f2c88-d4a7-4e64-a7d2-b33b42198a00/European_Green_Deal__Commission_proposes_transformation_of_EU_economy_and_society_to_meet_climate_ambitions.pdf

European Commission. (2025a). *Proposal for a Directive of the European Parliament and of the Council amending Directives 2006/43/EC, 2013/34/EU, (EU) 2022/2464 and (EU) 2024/1760 as regards certain corporate sustainability reporting and due diligence requirements* (No. COM(2025) 81 final). European Commission. <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52025PC0081>

European Commission. (2025b). *Proposal for a regulation of the European Parliament and of the Council amending Regulations (EU) 2015/1017, (EU) 2021/523, (EU) 2021/695 and (EU) 2021/1153 as regards increasing the efficiency of the EU guarantee under Regulation (EU) 2021/523 and simplifying reporting requirements* (No. COM(2025) 84 final). European Commission. <https://ppl-ai-file-upload.s3.amazonaws.com/web/direct-files/attachments/23288063/68dcd703-9d54-4583-be0e-322bd0a767e5/2025-Omnibus-Package.pdf>

European Financial Reporting Advisory Group. (2024). *EFRAG Annual Review 2023: Thought leadership, transparency and public accountability*. EFRAG. https://ppl-ai-file-upload.s3.amazonaws.com/web/direct-files/attachments/23288063/7b67f162-8149-45e4-ba41-bb72da90a992/EFrag_AR2023_template_web.pdf

Farbstein, Evan, Seidel, & Taylor. (2024). *Decoding CSRD: Your handbook for the Corporate Sustainability Reporting Directive*. Normative. <https://ppl-ai-file-upload.s3.amazonaws.com/web/direct-files/attachments/23288063/f2502d04-2698-4861-bda7-cd730e0e8f05/CSRD-White-paper-25-09-2024.pdf>

- Ferrer, E., López-Arceiz, F., & del Rio, C. (2020). Sustainability disclosure and financial analysts' accuracy: The European case. *BUSINESS STRATEGY AND THE ENVIRONMENT*, 29(8), 2939–2952.
<https://doi.org/10.1002/bse.2549>
- Fiandrino, S., di Trana, M., Tonelli, A., & Lucchese, A. (2022). The multi-faceted dimensions for the disclosure quality of non-financial information in revising directive 2014/95/EU. *JOURNAL OF APPLIED ACCOUNTING RESEARCH*, 23(1), 274–300. <https://doi.org/10.1108/JAAR-04-2021-0118>
- Fiechter, P., Hitz, J., & Lehmann, N. (2022). Real Effects of a Widespread CSR Reporting Mandate: Evidence from the European Union's CSR Directive. *JOURNAL OF ACCOUNTING RESEARCH*, 60(4), 1499–1549. <https://doi.org/10.1111/1475-679X.12424>
- Fitriana, S., & Wardhani, R. (2020). The effect of enterprise risk management and sustainability reporting quality on performance: Evidence from Southeast Asia countries. *International Journal of Economic Policy in Emerging Economies*, 13(4), 344.
<https://doi.org/10.1504/IJEPEE.2020.109588>
- Fontaine, J., del Campo, C., & Urquia-Grande, E. (2024). What Are Investors Most Interested in about Sustainability? An Approach from the Scientific Literature. *SUSTAINABILITY*, 16(8).
<https://doi.org/10.3390/su16083393>
- Fritsch, A., Bauer, L., Dittrich, F., Graf, D., Schischke, K., & Teusch, C. (2024). Scope 3 Data in Electronics Supply Chains: How to Address Common Challenges and Pitfalls. *2024 Electronics Goes Green 2024+ (EGG)*, 1–4. <https://doi.org/10.23919/EGG62010.2024.10631250>
- García-Benau, M., Bolas-Araya, H., & Sierra-García, L. (2022). Non-financial reporting in Spain. The effects of the adoption of the 2014 EU Directive. *REVISTA DE CONTABILIDAD-SPANISH ACCOUNTING REVIEW*, 25(1), 3–15. <https://doi.org/10.6018/rcsar.392631>
- García-Sánchez, I., Ortiz-Martínez, E., Marín-Hernández, S., & Aibar-Guzmán, B. (2023). How does the European Green Deal affect the disclosure of environmental information? *CORPORATE SOCIAL*

RESPONSIBILITY AND ENVIRONMENTAL MANAGEMENT, 30(6), 2766–2782.

<https://doi.org/10.1002/csr.2514>

Gebhardt, M., Schneider, A., Seefloth, M., & Zülch, H. (2024). Institutional investors' information needs in the context of the sustainable finance disclosure regulation (EU/2019/2088): The implications for companies' sustainability reporting. *Journal of Applied Accounting Research*, 25(5), 913–942. <https://doi.org/10.1108/JAAR-11-2022-0303>

Godt, C. (2023). Climate Protection and Supply Chain Civil Liability. *EUROPEAN JOURNAL OF COMPARATIVE LAW AND GOVERNANCE*, 10(3–4), 330–364. <https://doi.org/10.1163/2134514-bja10059>

Gopalakrishnan, S. (2022). The why and how of assigning responsibility for supply chain emissions. *Nature Climate Change*, 12(12), 1075–1077. <https://doi.org/10.1038/s41558-022-01543-x>

Gshayish, J., & Faik, Z. (2023). The impact of artificial intelligence systems and technology on the sustainability of the quality of financial reports. *Al Kut Journal of Economics and Administrative Sciences*, 469–488. <https://doi.org/10.29124/kjeas.1549.21>

Habermann, F. (2021). Corporate social performance and over-investment: Evidence from Germany. *JOURNAL OF GLOBAL RESPONSIBILITY*, 12(3), 347–363. <https://doi.org/10.1108/JGR-11-2020-0095>

Heichl, V., & Hirsch, S. (2023). Sustainable fingerprint—Using textual analysis to detect how listed EU firms report about ESG topics. *JOURNAL OF CLEANER PRODUCTION*, 426. <https://doi.org/10.1016/j.jclepro.2023.138960>

Hoepner, A., & Schneider, F. (2023). EU Green Taxonomy Data—A First Vendor Survey. *ECONOMISTS VOICE*, 19(2), 221–234. <https://doi.org/10.1515/ev-2022-0022>

- Horn, M. (2024). The European green deal, retail investors and sustainable investments: A perspective article covering economic, behavioral, and regulatory insights. *CURRENT RESEARCH IN ENVIRONMENTAL SUSTAINABILITY*, 7. <https://doi.org/10.1016/j.crsust.2024.100241>
- Hummel, K., & Bauernhofer, K. (2024). Consequences of sustainability reporting mandates: Evidence from the EU taxonomy regulation. *ACCOUNTING FORUM*, 48(3), 374–400. <https://doi.org/10.1080/01559982.2024.2301854>
- Hummel, K., & Jobst, D. (2024). An Overview of Corporate Sustainability Reporting Legislation in the European Union. *ACCOUNTING IN EUROPE*, 21(3), 320–355. <https://doi.org/10.1080/17449480.2024.2312145>
- Huq, A., Cieslak, K., & Sundberg, K. (2024). Board governance drivers of corporate sustainability levels in private firms: Evidence from Sweden. *SUSTAINABILITY ACCOUNTING MANAGEMENT AND POLICY JOURNAL*, 15(7), 106–132. <https://doi.org/10.1108/SAMPJ-04-2024-0402>
- Janik, A., Ryszko, A., & Szafraniec, M. (2020). Greenhouse Gases and Circular Economy Issues in Sustainability Reports from the Energy Sector in the European Union. *ENERGIES*, 13(22). <https://doi.org/10.3390/en13225993>
- Jilková, P., & Kotesovcová, J. (2023). ESG Performance and Disclosure: National Composite Indicators for Monitoring Sustainable Growth Conditions in the EU-27. *TEM JOURNAL-TECHNOLOGY EDUCATION MANAGEMENT INFORMATICS*, 12(3), 1845–1852. <https://doi.org/10.18421/TEM123-68>
- Juthi, S., Kamrujjaman, M., Mistry, A. M., & Alauddin, M. (2024). SUSTAINABLE FINANCE AND DATA ANALYTICS: A SYSTEMATIC REVIEW OF ESG DATA IN INVESTMENT DECISIONS. *ACADEMIC JOURNAL ON BUSINESS ADMINISTRATION, INNOVATION & SUSTAINABILITY*, 4(04), 70–88. <https://doi.org/10.69593/ajbais.v4i04.130>

- Kishan, K., & Azhar, Z. (2024). Greenwashing in Sustainability Reporting: A Bibliometric Review and Direction for Future Research. *International Journal of Academic Research in Accounting, Finance and Management Sciences*, 14(4), Pages 1241-1263.
<https://doi.org/10.6007/IJARAFMS/v14-i4/23743>
- Kiyani, M. S. (2023). ROLE OF TECHNOLOGICAL INTEGRATION IN BUSINESS SUSTAINABILITY. *Journal of Research in Social Development and Sustainability*, 2(1), 73–83.
<https://doi.org/10.56596/jrsds.v2i1.104>
- Klimczak, K., Hadro, D., & Meyer, M. (2023). Executive communication with stakeholders on sustainability: The case of Poland. *ACCOUNTING IN EUROPE*, 20(3), 281–303.
<https://doi.org/10.1080/17449480.2023.2213242>
- Krasodomska, J., Zarzycka, E., & Zieniuk, P. (2024). Voluntary sustainability reporting assurance in the European Union before the advent of the corporate sustainability reporting directive: The country and firm-level impact of Sustainable Development Goals. *SUSTAINABLE DEVELOPMENT*, 32(3), Article 3. <https://doi.org/10.1002/sd.2744>
- Krasodomska, J., Zieniuk, P., & Kostrzewska, J. (2023). Reporting on Sustainable Development Goals in the European Union: What drives companies' decisions? *COMPETITIVENESS REVIEW*, 33(1), 120–146. <https://doi.org/10.1108/CR-12-2021-0179>
- Kristofík, P., Lament, M., & Musa, H. (2016). THE REPORTING OF NON-FINANCIAL INFORMATION AND THE RATIONALE FOR ITS STANDARDIZATION. *E & M EKONOMIE A MANAGEMENT*, 19(2), 157–175. <https://doi.org/10.15240/tul/001/2016-2-011>
- Lombardi, R., Schimperna, F., Paoloni, P., & Galeotti, M. (2022). The climate-related information in the changing EU directive on non-financial reporting and disclosure: First evidence by Italian large companies. *JOURNAL OF APPLIED ACCOUNTING RESEARCH*, 23(1), 250–273.
<https://doi.org/10.1108/JAAR-04-2021-0117>

- Markova-Karpuzova, M., Marinov, E., & Kotzev, N. (2024). SUSTAINABLE SOLUTIONS: ADVANCING IN TECH-BASED ESG REPORTING PLATFORMS. *ENVIRONMENT. TECHNOLOGIES. RESOURCES. Proceedings of the International Scientific and Practical Conference, 1*, 235–241.
<https://doi.org/10.17770/etr2024vol1.7947>
- Martinčević, I., & Dorić, B. (2024). Corporate Sustainability Reporting Directive (CSRD): Obligations, Challenges and Requirements for Companies. *ENTRENOVA - ENTERprise REsearch InNOVation, 10*(1), 317–327. <https://doi.org/10.54820/entrenova-2024-0026>
- Martínez-Torres, V. (2024). Regulatory Developments on Sustainability Issues in Light of Delegated Regulation (EU) 2023/2772 (ESRS). *REVIEW OF EUROPEAN AND COMPARATIVE LAW*.
<https://doi.org/10.31743/recl.17459>
- Matuszak, L., & Rózanska, E. (2021). Towards 2014/95/EU directive compliance: The case of Poland. *SUSTAINABILITY ACCOUNTING MANAGEMENT AND POLICY JOURNAL, 12*(5), 1052–1076.
<https://doi.org/10.1108/SAMPJ-02-2020-0042>
- Mezzanotte, F. (2023). Corporate sustainability reporting: Double materiality, impacts, and legal risk. *JOURNAL OF CORPORATE LAW STUDIES, 23*(2), 633–663.
<https://doi.org/10.1080/14735970.2024.2319058>
- Mieszkowska, J. (2024). THE UNINTENDED CONSEQUENCES OF THE EU CORPORATE SUSTAINABILITY DUE DILIGENCE DIRECTIVE. *AJIL UNBOUND, 118*, 291–296. <https://doi.org/10.1017/aju.2024.48>
- Miettinen, M. (2024). Are materiality determination practices evolving in the wake of increasing legislation on sustainability reporting? Findings from EU pharmaceutical companies' reports. *INTERNATIONAL JOURNAL OF LAW AND MANAGEMENT, 66*(3), 363–392.
<https://doi.org/10.1108/IJLMA-09-2023-0221>
- Mio, C., Fasan, M., Marcon, C., & Panfilo, S. (2020). The predictive ability of legitimacy and agency theory after the implementation of the EU directive on non-financial information. *CORPORATE SOCIAL*

RESPONSIBILITY AND ENVIRONMENTAL MANAGEMENT, 27(6), 2465–2476.

<https://doi.org/10.1002/csr.1968>

Moneva, J., Scarpellini, S., Aranda-Usón, A., & Etxeberria, I. (2023). Sustainability reporting in view of the European sustainable finance taxonomy: Is the financial sector ready to disclose circular economy? *CORPORATE SOCIAL RESPONSIBILITY AND ENVIRONMENTAL MANAGEMENT*, 30(3), 1336–1347. <https://doi.org/10.1002/csr.2423>

Moya, S. (2024). Sustainability reporting regulation: Current situation and future developments. In L. Parrondo & O. Amat (Eds.), *Research Handbook on Financial Accounting* (pp. 121–137). Edward Elgar Publishing. <https://doi.org/10.4337/9781803920597.00015>

Nampoothiri, M., Entrop, O., & Annamalai, T. (2024). Effect of mandatory sustainability performance disclosures on firm value: Evidence from listed European firms. *CORPORATE SOCIAL RESPONSIBILITY AND ENVIRONMENTAL MANAGEMENT*, 31(6), 5220–5235. <https://doi.org/10.1002/csr.2860>

Nowak, M., Martineau, S., Sobottka, T., Ansari, F., & Schlund, S. (2024). An indicator scheme for improving measurability of Sustainable Development Goals in manufacturing enterprises. In F. Longo, W. Shen, & A. Padovano (Eds.), *Technische Universität Wien* (WOS:001196800600065; Vol. 232, pp. 655–664). <https://doi.org/10.1016/j.procs.2024.01.065>

Odobasa, R., & Marosevic, K. (2023). *EXPECTED CONTRIBUTIONS OF THE EUROPEAN CORPORATE SUSTAINABILITY REPORTING DIRECTIVE (CSRD) TO THE SUSTAINABLE DEVELOPMENT OF THE EUROPEAN UNION* (T. Petrusevic, D. Duic, & A. Novokmet, Eds.; WOS:001230052800023; Vol. 7, pp. 593–612).

Opferkuch, K., Walker, A., Lindgreen, E., Caeiro, S., Salomone, R., & Ramos, T. (2023). Towards a framework for corporate disclosure of circular economy: Company perspectives and

- recommendations. *CORPORATE SOCIAL RESPONSIBILITY AND ENVIRONMENTAL MANAGEMENT*, 30(5), 2457–2474. <https://doi.org/10.1002/csr.2497>
- Ostojic, S., Simone, L., Edler, M., & Traverso, M. (2024). How Practically Applicable Are the EU Taxonomy Criteria for Corporates?-An Analysis for the Electrical Industry. *SUSTAINABILITY*, 16(4). <https://doi.org/10.3390/su16041575>
- Ottenstein, P., Erben, S., Jost, S., Weuster, C., & Zulch, H. (2022). From voluntarism to regulation: Effects of Directive 2014/95/EU on sustainability reporting in the EU. *JOURNAL OF APPLIED ACCOUNTING RESEARCH*, 23(1), 55–98. <https://doi.org/10.1108/JAAR-03-2021-0075>
- Paccès, A. (2021). Will the EU Taxonomy Regulation Foster Sustainable Corporate Governance? *SUSTAINABILITY*, 13(21). <https://doi.org/10.3390/su132112316>
- Pantazi, T. (2024). The Introduction of Mandatory Corporate Sustainability Reporting in the EU and the Question of Enforcement. *EUROPEAN BUSINESS ORGANIZATION LAW REVIEW*, 25(3), 509–532. <https://doi.org/10.1007/s40804-024-00320-x>
- Partiti, E. (2024). Addressing the Flaws of the Sustainable Finance Disclosure Regulation: Moving from Disclosures to Labelling and Sustainability Due Diligence. *EUROPEAN BUSINESS ORGANIZATION LAW REVIEW*, 25(2), 299–332. <https://doi.org/10.1007/s40804-024-00317-6>
- Patchell, J. (2018). Can the implications of the GHG Protocol's scope 3 standard be realized? *Journal of Cleaner Production*, 185, 941–958. <https://doi.org/10.1016/j.jclepro.2018.03.003>
- Paun, A., Dura, C., Mihailescu, S., Moraru, R., & Isac, C. (2020). OHS Disclosures Within Non-Financial Reports: The Romanian Case. *SUSTAINABILITY*, 12(5). <https://doi.org/10.3390/su12051963>
- Paz, M. J., & Ruiz Gálvez, M. E. (2020). Effects of modular platforms on suppliers companies: Evidence from Volkswagen Polo manufacturing in Navarra (Spain). *Journal of Manufacturing Technology Management*, 32(2), 337–355. <https://doi.org/10.1108/JMTM-02-2020-0057>

- Perevoznic, F., & Dragomir, V. (2024). Achieving the 2030 Agenda: Mapping the Landscape of Corporate Sustainability Goals and Policies in the European Union. *SUSTAINABILITY*, 16(7).
<https://doi.org/10.3390/su16072971>
- Petrova, P. (2024). *Accounting for Impacts: Exploring Sustainability Reporting in Bulgarian Companies under the CSRD* (WOS:001262087900017). 18(1), 2172–2182. <https://doi.org/10.2478/picbe-2024-0182>
- Pizzi, S., Principale, S., Fasiello, R., & Imperiale, F. (2023). The institutionalisation of social and environmental accounting practices in Europe. *JOURNAL OF APPLIED ACCOUNTING RESEARCH*, 24(5), 816–838. <https://doi.org/10.1108/JAAR-07-2022-0190>
- Posadas, S., Ruiz-Blanco, S., Fernandez-Feijoo, B., & Tarquinio, L. (2023). Institutional isomorphism under the test of Non-financial Reporting Directive. Evidence from Italy and Spain. *MEDITARI ACCOUNTANCY RESEARCH*, 31(7), 26–48. <https://doi.org/10.1108/MEDAR-02-2022-1606>
- Pozzoli, M., Nastari, R., Pisano, S., & Venuti, M. (2023). How Circular Economy Disclosure Responds to Institutional Determinants Empirical Evidences in Non-Financial European Firms. *SUSTAINABILITY*, 15(22). <https://doi.org/10.3390/su152216069>
- Primec, A., & Belak, J. (2022). Sustainable CSR: Legal and Managerial Demands of the New EU Legislation (CSRD) for the Future Corporate Governance Practices. *SUSTAINABILITY*, 14(24).
<https://doi.org/10.3390/su142416648>
- Principale, S., & Pizzi, S. (2023). The Determinants of TCFD Reporting: A Focus on the Italian Context. *ADMINISTRATIVE SCIENCES*, 13(2). <https://doi.org/10.3390/admsci13020061>
- Raith, D. (2023). The contest for materiality. What counts as CSR? *JOURNAL OF APPLIED ACCOUNTING RESEARCH*, 24(1), 134–148. <https://doi.org/10.1108/JAAR-04-2022-0093>

- Rane, N., Choudhary, S., & Rane, J. (2024). Artificial intelligence driven approaches to strengthening Environmental, Social, and Governance (ESG) criteria in sustainable business practices: A review. *SSRN Electronic Journal*. <https://doi.org/10.2139/ssrn.4843215>
- Raucci, D., & Tarquinio, L. (2020). Sustainability Performance Indicators and Non-Financial Information Reporting. Evidence from the Italian Case. *ADMINISTRATIVE SCIENCES*, 10(1). <https://doi.org/10.3390/admsci10010013>
- Rísquez Ramos, M., & Ruiz-Gálvez, M. E. (2024). The transformation of the automotive industry toward electrification and its impact on global value chains: Inter-plant competition, employment, and supply chains. *European Research on Management and Business Economics*, 30(1), 100242. <https://doi.org/10.1016/j.iedeen.2024.100242>
- Ruohonen, J., & Kullas, H. (2024). The Assurance of Corporate Sustainability Reports and the Renewed Role of Certified Auditors. *EUROPEAN COMPANY AND FINANCIAL LAW REVIEW*, 21(3–4), 442–471. <https://doi.org/10.1515/ecfr-2024-0013>
- Seretakis, A., & Mezzanotte, F. (2023). Corporate Sustainability Reporting and Blockchain. *EUROPEAN COMPANY LAW*, 20(5), 97–102.
- Siemens AG. (2024). *Sustainability at Siemens: Scaling sustainability impact 2024* (p. 170). Siemens AG. Siemens AG. <https://ppl-ai-file-upload.s3.amazonaws.com/web/direct-files/attachments/23288063/ee811529-3ce3-4b86-9bcc-8fed24a6f81e/Sustainability-at-Siemens-2024-Final.pdf>
- Siri, M., & Zhu, S. (2019). Will the EU Commission Successfully Integrate Sustainability Risks and Factors in the Investor Protection Regime? A Research Agenda. *SUSTAINABILITY*, 11(22). <https://doi.org/10.3390/su11226292>

- Stefanescu, C. (2022). Linking sustainability and non-financial reporting directive 2014/95/EU through isomorphism lens. *MEDITARI ACCOUNTANCY RESEARCH*, 30(6), 1680–1704.
<https://doi.org/10.1108/MEDAR-09-2020-1019>
- Ștefănescu, C. A. (2024). Exploring the Interplay Between Digitalization, Corporate Governance, and SDG Reporting: A Pathway to Sustainable Development. *Studia Universitatis Babes-Bolyai Oeconomica*, 69(3), 24–42. <https://doi.org/10.2478/subboec-2024-0013>
- Stojanović-Blab, M., & Blab, D. (2024). MANDATORY SUSTAINABILITY REPORTING – EVOLUTION OF REGULATION IN THE EUROPEAN UNION. *Facta Universitatis, Series: Economics and Organization*, 241. <https://doi.org/10.22190/FUEO240730016S>
- Tettamanzi, P., Tedeschi, R., & Murgolo, M. (2024). The European Union (EU) green taxonomy: Codifying sustainability to provide certainty to the markets. *ENVIRONMENT DEVELOPMENT AND SUSTAINABILITY*, 26(11), 27111–27136. <https://doi.org/10.1007/s10668-023-03798-6>
- Tonello, M. (2025, April 12). Regulatory Shifts in ESG: What Comes Next for Companies? *The Harvard Law School Forum on Corporate Governance*.
<https://corpgov.law.harvard.edu/2025/04/12/regulatory-shifts-in-esg-what-comes-next-for-companies/>
- TotalEnergies. (2025). *Sustainability & Climate 2025 Progress Report*. TotalEnergies. https://ppl-ai-file-upload.s3.amazonaws.com/web/direct-files/attachments/23288063/bdb5da21-1cc4-4cb8-a673-a57a2f64023e/totalenergies_sustainability-climate-2025-progress-report_2025_en.pdf
- Truant, E., Corazza, L., & Scagnelli, S. D. (2017). *Sustainability and Risk Disclosure: An Exploratory Study on Sustainability Reports*.
- Vandenbroucke, S. (2024). THE EVOLUTION OF CODES OF CONDUCT TO ENSURE LABOR RIGHTS IN GLOBAL SUPPLY CHAINS. *AJIL UNBOUND*, 118, 297–302. <https://doi.org/10.1017/aju.2024.45>

- Vander Bauwhede, H., & Van Cauwenberge, P. (2022). Determinants and Value Relevance of Voluntary Assurance of Sustainability Reports in a Mandatory Reporting Context: Evidence from Europe. *SUSTAINABILITY*, 14(15). <https://doi.org/10.3390/su14159795>
- Velte, P. (2023). Does sustainable board governance drive corporate social responsibility? A structured literature review on European archival research. *JOURNAL OF GLOBAL RESPONSIBILITY*, 14(1), 46–88. <https://doi.org/10.1108/JGR-05-2022-0044>
- Velte, P. (2024). Sustainable board governance and environmental performance: European evidence. *BUSINESS STRATEGY AND THE ENVIRONMENT*, 33(4), 3397–3421. <https://doi.org/10.1002/bse.3654>
- Vieira, L. C., Longo, M., & Mura, M. (2024). Impact pathways: The hidden challenges of Scope 3 emissions measurement and management. *International Journal of Operations & Production Management*, 44(13), 326–334. <https://doi.org/10.1108/IJOPM-01-2024-0049>
- Villiers, C. (2022). New Directions in the European Union’s Regulatory Framework for Corporate Reporting, Due Diligence and Accountability: The Challenge of Complexity. *EUROPEAN JOURNAL OF RISK REGULATION*, 13(4), 548–566. <https://doi.org/10.1017/err.2022.25>
- Vodonick, J. (2018). The Key to Organizational Sustainability: Nurturing a Culture of Change. *Systems Research and Behavioral Science*, 35(4), 458–468. <https://doi.org/10.1002/sres.2539>
- Wijethilake, C., Upadhaya, B., & Lama, T. (2023). The role of organisational culture in organisational change towards sustainability: Evidence from the garment manufacturing industry. *Production Planning & Control*, 34(3), 275–294. <https://doi.org/10.1080/09537287.2021.1913524>
- Xu, W., Li, M., & Xu, S. (2023). Unveiling the “Veil” of information disclosure: Sustainability reporting “greenwashing” and “shared value.” *PLOS ONE*, 18(1), e0279904. <https://doi.org/10.1371/journal.pone.0279904>

Yébenes, M. (2024). Climate change, ESG criteria and recent regulation: Challenges and opportunities.

EURASIAN ECONOMIC REVIEW, 14(1), 87–120. <https://doi.org/10.1007/s40822-023-00251-x>

Zhao, J. (2023). How the EU should to respond to the challenge of greenwashing? *Journal of Education,*

Humanities and Social Sciences, 24, 798–810. <https://doi.org/10.54097/mhg0b981>