

RESEARCH ARTICLE OPEN ACCESS

Circular Economy Disclosure and ESG Performance: Signal, Substance, or Symbol?

Chiara Leggerini¹  | Martina Percuoco²  | Irene Ricciardi²  | Anna Prisco² ¹Department of Mechanical and Industrial Engineering, University of Brescia, Brescia, Italy | ²Department of Economics, Management, Institutions, University of Naples Federico II, Naples, Italy**Correspondence:** Chiara Leggerini (chiara.leggerini@unibs.it)**Received:** 2 August 2025 | **Revised:** 17 September 2025 | **Accepted:** 17 October 2025**Funding:** This study was funded by the European Union—NextGenerationEu, in the framework of the GRINS—Growing, Resilient, INclusive and Sustainable project (Codice Progetto MUR:PE00000018—CUPE63C22002140007).**Keywords:** circular economy disclosures | corporate governance | ESG performance | external audit | greenwashing | institutional theory | signaling theory

ABSTRACT

The study examines whether circular economy (CE) disclosures lead to tangible environmental improvements reflected in ESG performance or primarily serve reputational objectives linked to greenwashing. It investigates how disclosures on energy efficiency, resource reduction, water efficiency, and emission reduction influence ESG performance and whether external audits enhance disclosure credibility. Using a quantitative design, the analysis covers 1247 European firms (2015–2024) with data from Thomson Reuters, sustainability reports, and Orbis. Multiple regression models assess the relationship between CE disclosures and ESG performance, considering the moderating role of external audits. CE disclosures are positively associated with ESG performance, with energy efficiency and resource reduction showing the strongest effects. Water and emission disclosures also yield positive impacts, though the former is weakened when paired with external audits. Overall, external audits are positively related to ESG performance and strengthen the effect of energy and emission disclosures but may reduce the effectiveness of water-related disclosures, highlighting the need for context-specific assurance strategies. This study contributes to the debate on greenwashing by showing that external verification can strengthen the effectiveness of CE disclosures in improving ESG performance. It underscores the importance of transparent and verifiable reporting for corporate governance, investment decisions, and policy frameworks promoting genuine environmental progress.

1 | Introduction

The growing urgency of environmental degradation and resource scarcity has intensified public and institutional pressure on firms to adopt sustainable strategies (Leggerini and Bannò 2025; Ellen MacArthur Foundation 2015; Geisendorf and Pietrulla 2018). Among these, the circular economy (CE) has emerged as a transformative approach to reduce environmental impact by minimizing waste, reusing materials, and improving resource efficiency throughout the product life cycle (Geissdoerfer et al. 2017; Prisco et al. 2025). CE adoption is now central to sustainability strategies, contributing not only to

environmental goals but also to firms' competitive positioning (Kirchherr et al. 2018).

In parallel, the number of firms disclosing CE-related initiatives has increased due to regulatory developments such as the European Green Deal and the Corporate Sustainability Reporting Directive (CSRD).

However, scholars and practitioners have raised concerns over the credibility of such disclosures, especially in light of greenwashing practices, that is, presenting symbolic sustainability narratives without substantial actions (Di Pillo et al. 2025;

This is an open access article under the terms of the [Creative Commons Attribution](https://creativecommons.org/licenses/by/4.0/) License, which permits use, distribution and reproduction in any medium, provided the original work is properly cited.

© 2025 The Author(s). *Business Strategy and the Environment* published by ERP Environment and John Wiley & Sons Ltd.

Delmas and Burbano 2011; Kim and Lyon 2014). Recent estimates suggest that approximately 7% of medium- and large-cap firms engage in greenwashing strategies, with particularly high incidence in the energy, utilities, and materials sectors (Keresztúri et al. 2025). It therefore becomes essential to assess whether the disclosure of CE genuinely enhances ESG performance or merely serves as a reputational tool lacking substantive commitment (De Freitas Netto et al. 2020). The literature on greenwashing has emphasized the discrepancy between CE claims and actual ESG performance, showing that many firms use CE disclosure as a symbolic rather than a substantive practice (Delmas and Burbano 2011; Hummel and Schlick 2016; Lyon and Montgomery 2015; Marquis et al. 2016).

Although a growing body of literature has addressed ESG disclosure more broadly, the specific link between CE disclosure and ESG performance remains underexplored. Moreover, little attention has been paid to the role of independent assurance mechanisms, such as external audits, in enhancing the credibility and effectiveness of CE disclosure. This is a critical gap, as external verification may distinguish substantive practices from symbolic reporting, thereby influencing ESG performance (Simnett et al. 2009; Wijen 2014; Li et al. 2023).

To address these gaps, this paper investigates whether CE disclosures, specifically on energy efficiency, resource reduction, water efficiency, and emission reduction, are associated with improved ESG performance. In addition, it examines the moderating role of external audits in strengthening the credibility and impact of these disclosures. To guide our analysis, we combine three complementary perspectives. Institutional theory highlights the coercive, mimetic, and normative pressures that drive firms to disclose sustainability-related information (DiMaggio and Powell 1983). Signaling theory further explains how CE disclosure can function as a strategic device to reduce information asymmetries, providing short-term reputational benefits but also exposing firms to legitimacy crises and reputational damage once stakeholders perceive such communication as misleading (Spence 1973; Connelly et al. 2011; Bernini and La Rosa 2024). In parallel, the greenwashing literature allows us to distinguish between symbolic and substantive disclosure practices, clarifying whether CE disclosure reflects genuine environmental engagement or reputational strategies (Delmas and Burbano 2011). Taken together, these perspectives provide a comprehensive framework to interpret both the external drivers of disclosure and the internal authenticity and credibility of reporting.

Building on these premises, we explore whether CE disclosure reflects substantive environmental engagement or primarily serves symbolic legitimization purposes in response to coercive, mimetic, and normative pressures. Methodologically, the study adopts a quantitative approach based on panel regression analysis using data from 1247 listed European firms over a 10-year period (2015–2024), integrating CE disclosure indicators, ESG performance scores, and firm-level controls.

Our study makes several contributions. First, it provides novel empirical evidence on the differentiated impact of distinct CE disclosure dimensions (i.e., energy efficiency, resource reduction, water efficiency, and emission control) on firms' ESG

performance. This disaggregated perspective allows for a more granular understanding. Second, the study examines the moderating effect of external audits, highlighting the conditions under which assurance mechanisms either enhance the credibility of disclosures or introduce rigidities that undermine their effectiveness. The results add to the growing debate about the role of verification in curbing greenwashing and building stakeholder trust. Third, by grounding the analysis in institutional theory (DiMaggio and Powell 1983) and signaling theory (Spence 1973; Connelly et al. 2011) and by empirically testing their assumptions, the paper contributes to the theorization of how external pressures and strategic communication interact in shaping firm sustainability behavior. Although institutional theory clarifies how coercive, mimetic, and normative forces drive disclosure, signaling theory highlights how firms use sustainability communication to reduce information asymmetries, with potential short-term reputational gains but also the risk of legitimacy challenges when signals are perceived as misleading. Fourth, the study offers policy-relevant insights by identifying which disclosure practices are most impactful under external audit conditions, informing regulatory frameworks such as the CSRD, and guiding firms toward more substantive and effective reporting strategies. Lastly, it contributes to the greenwashing literature by demonstrating that transparent and verifiable practices can transform symbolic disclosures into credible communication.

2 | Theoretical Background

This section develops the theoretical background of the study, drawing on institutional theory to explain how coercive, mimetic, and normative pressures shape firms' approaches to CE disclosure. Building on this foundation, we incorporate signaling theory to clarify how firms use disclosure to reduce information asymmetries while acknowledging that the signaling power of sustainability communication may provide short-term reputational benefits but also expose firms to legitimacy risks when perceived as misleading. We further examine the role of external audit in strengthening the credibility of sustainability reporting. Finally, we discuss how these pressures and mechanisms interact with the risk of symbolic disclosure and greenwashing. Together, these perspectives establish the conceptual foundation for testing the hypotheses.

2.1 | Institutional Theory

According to institutional theory, firms are conceived as actors embedded within social systems of norms, values, and expectations (Oliver 1997). DiMaggio and Powell (1983) identify three main mechanisms through which institutional isomorphism occurs, referring to the process of convergence among firms operating within the same context, which ultimately renders them similar over time. These mechanisms take the form of coercive pressures, mimetic pressures, and normative pressures.

2.1.1 | Coercive Isomorphism

Coercive isomorphism originates from formal and informal pressures that organizations experience from entities they depend on

or from societal expectations. These pressures can be explicit, such as environmental regulations, or implicit, like expectations from institutional stakeholders. Coercive pressures, such as regulations and laws, significantly influence environmental practices and promote the adoption of sustainability initiatives in firms (Masocha and Fatoki 2018). However, the effectiveness of these pressures varies across countries; in some cases, regulations are less effective in enhancing the environmental performance of multinational corporations (Peng et al. 2023).

The growing regulatory emphasis on CE disclosures may represent a new coercive pressure, pushing firms to disclose practices related to it. In this sense, coercive pressures can lead to substantive disclosure when firms comply through concrete sustainability actions or to symbolic disclosure when reporting is adopted mainly to satisfy external demands and gain legitimacy.

2.1.2 | Mimetic Isomorphism

Mimetic isomorphism occurs in contexts of uncertainty, leading organizations to imitate peers perceived as successful to gain legitimacy and reduce uncertainty (Peng et al. 2023). When goals are unclear or technologies are poorly defined, firms adopt the practices of others perceived as legitimate, using imitation as a fast and cost-effective response. Mimetic behavior influences sustainable development practices, shaping economic, environmental, and social outcomes (Masocha and Fatoki 2018). Environmental disclosure often follows mimetic patterns, varying across countries and industries, with weak links to actual environmental performance (Cormier and Gomez-Gutierrez 2018). As such, mimetic isomorphism is widespread in sustainability strategies but may lack effectiveness, requiring critical evaluation.

In this context, CE disclosure may act as a mimetic response in uncertain environments, where firms adopt CE metrics to align with perceived sustainability leaders without implementing deep operational changes.

Accordingly, mimetic pressures may foster substantive disclosure when imitation is coupled with real operational improvements and external verification, but they may also generate symbolic disclosure when firms imitate disclosure practices without substantive changes.

2.1.3 | Normative Isomorphism

Normative isomorphism relates to professionalization processes, where professional groups collectively establish standards, legitimize competencies, and seek autonomy. This process is driven by the spread of shared formal education and professional networks across organizations (DiMaggio and Powell 1983).

In management, normative isomorphism standardizes managerial profiles across firms, serving as a tool for legitimization. Firms use normative isomorphism to legitimize their social and environmental reporting. External audits and assurance

practices associated with CE disclosures represent normative mechanisms that can enhance the credibility of ESG reports while mitigating greenwashing risks (Dissanayake et al. 2020; Simnett et al. 2009). However, the influence of external audits on CE disclosure is still underexplored in the literature. The interaction between institutional pressures, governance structures, and ESG performance is complex and varies across contexts. Normative and regulatory pressures are significant drivers for adopting environmental practices, especially for firms with an environmental performance gap compared to industry peers (Berrone et al. 2013). Regulatory bodies, customers, and local communities all push firms to integrate sustainable practices into their strategies (Delmas and Toffel 2004). Complying with institutional pressures not only enhances legitimacy and resilience but can also lead to competitive advantages (Colwell and Joshi 2013). Therefore, normative pressures may underpin substantive disclosure when professional standards and independent audits ensure accuracy and credibility, and they may also encourage symbolic disclosure if assurance mechanisms are adopted mainly for reputational or legitimizing purposes.

2.2 | Signaling Theory

Signaling theory was developed to explain communication dynamics in the presence of information asymmetry, that is, when one party holds relevant information that is inaccessible to the other. In this context, the party possessing the information, the signaler, may choose whether to transmit signals regarding qualities that are not immediately observable, whereas the counterpart, the receiver, must interpret and evaluate their credibility (Spence 1973; Connelly et al. 2011). The model is based on three main elements. The first is the signaler, who holds privileged information about an individual, a product, or an organization (Spence 1973; Kirmani and Rao 2000; Ross 1977) and who in the business context typically corresponds to the firm. The second is the signal, namely, the object of communication, which to be credible must be both observable and costly (Connelly et al. 2011). Observability refers to the extent to which the signal can be perceived, whereas cost represents the barrier that makes imitation difficult for those who do not truly possess the underlying quality. However, in some cases, if the perceived benefits outweigh the costs, a firm may engage in false signaling practices (Connelly et al. 2011). Finally, the third element is the receiver, namely, the stakeholders, who do not have access to the same information as the firm but base their decisions on the perceived quality conveyed through the signals received (Connelly et al. 2011).

Originally developed within the field of information economics, the theory has progressively been applied to several domains, including management, entrepreneurship, and organizational behavior (Choudhury 2024). In more recent studies on sustainability and the CE, signaling theory has been used to examine how firms communicate their circular practices and how such signals affect firm value and stakeholder engagement. For instance, Blasi et al. (2021) demonstrate that the ability of Italian manufacturing firms to send credible signals of CE through institutional communication is positively associated with

economic performance, with particularly significant effects for lower performing firms. Finally, Liu et al. (2018) confirm the theoretical relevance of signaling theory by identifying it as one of the main approaches applied in studies on green supply chain management and the CE, underlining its potential as a conceptual framework to interpret firm communication strategies aimed at sustainability.

2.3 | Greenwashing, Institutional Theory, and Signaling Theory

Institutional theory provides a valuable perspective for analyzing greenwashing dynamics, showing how firms may adopt symbolic sustainability practices to comply with social and normative expectations without genuine environmental commitment (Carbone and Moatti 2011). This risk emerges, for instance, when frameworks such as the Sustainable Development Goals (SDGs) are used primarily for reputational purposes rather than for substantive action (Lashitew 2021). As a response, new measurement and regulatory systems are introducing institutional changes to enhance transparency in sustainability reporting (Lashitew 2021). Empirical evidence confirms that stricter climate-related regulations reduce the likelihood of greenwashing, as firms operating in highly regulated contexts are less prone to opportunistic disclosure (Mateo-Márquez et al. 2022).

Recent research has further highlighted the role of institutional pressures in shaping environmental disclosure. Zhang et al. (2025) show that regulative, normative, and cognitive pressures significantly constrain symbolic disclosure, whereas Huang et al. (2022) emphasize how isomorphic mechanisms, especially at the regional level, foster its diffusion. Similarly, Li et al. (2025) and Can and Turker (2025) demonstrate that coercive, normative, and imitative pressures stimulate symbolic actions aimed at gaining legitimacy, framing greenwashing as a form of decoupling in CSR reporting. In this sense, CE disclosure may be interpreted as a symbolic adoption intended to meet institutional expectations rather than to generate real improvements (Meyer and Rowan 1977; Westphal and Zajac 1998). This interpretation raises questions as to whether CE disclosure serves primarily as a tool of symbolic legitimization or as a means of enhancing ESG performance. Recent studies indicate that coercive and mimetic pressures positively influence CE disclosure among European firms (Pozzoli et al. 2024). However, the impact of CE disclosure on ESG performance remains uncertain, as does the moderating role of external assurance.

Closely connected to this, signaling theory offers a complementary perspective, focusing on the information asymmetries between firms and stakeholders. According to Bernini and La Rosa (2024), environmental disclosure acts as a signal of commitment that can strengthen reputation and social value; however, in the case of greenwashing, its signaling power derives precisely from information asymmetries, allowing even poor environmental performers to convey misleading messages. Empirical research supports this dualism: Uyar et al. (2021) found that firms with stronger CSR performance are more likely to issue reports, thereby supporting

signaling theory and countering greenwashing practices. Similarly, Torelli et al. (2020) showed that different levels of misleading environmental disclosure significantly shape stakeholders' perceptions through mechanisms linked to both legitimacy and signaling. In short, the signaling power of green disclosure may provide short-term reputational benefits but risks triggering legitimacy crises and reputational damage once stakeholders perceive its misleading nature (Bernini and La Rosa 2024).

Building on these insights, this study develops an empirical analysis grounded in institutional theory and signaling theory, enriched by reflections on the risk of greenwashing. The integration of these perspectives makes it possible to distinguish between substantive disclosure, based on concrete and verifiable actions, and symbolic disclosure, adopted primarily for legitimacy purposes. On this basis, the following section introduces our research hypotheses, focusing on four key dimensions of CE disclosure (energy efficiency, resource reduction, water efficiency, and emission reduction) and assessing whether their impact on ESG performance reflects genuine sustainability practices or symbolic reporting.

3 | Hypothesis Development

3.1 | Energy Efficiency and ESG Performance

Energy efficiency plays a central role in corporate sustainability strategies and is widely recognized as a credible indicator of environmental performance (Clarkson et al. 2008; Sun et al. 2024). In line with both institutional theory (DiMaggio and Powell 1983) and signaling theory (Spence 1973; Connelly et al. 2011), firms adopt energy efficiency disclosure both as a response to regulatory and societal pressures and as a communicative signal to stakeholders aimed at reducing information asymmetries and reinforcing perceptions of environmental commitment. When such disclosure reflects concrete actions such as the adoption of efficient technologies or process optimization, it can positively influence ESG performance, as transparency and tangible results are valued by rating agencies and stakeholders (Fatemi et al. 2015; Husted and Sousa-Filho 2017). Empirical evidence confirms that detailed and credible reporting on energy initiatives enhances perceived responsibility and attracts favorable evaluations from investors and analysts (Fatemi et al. 2015; Hummel and Schlick 2016; Ioannou and Serafeim 2019). For forward-looking firms, integrating energy efficiency into strategic operations is key to achieving ESG excellence (He et al. 2021). Recent studies also warn that discrepancies among third-party ESG ratings can undermine corporate energy efficiency, as shown by Wang et al. (2025), although green innovation and cleaner production can mitigate these effects. This highlights the importance of not only disclosing energy efficiency but also ensuring the consistency and reliability of ESG assessments to fully capture its impact. In this sense, energy efficiency disclosure can evolve from a symbolic compliance tool to a credible signal of substantive commitment, especially when verified through standardized and auditable metrics such as kWh saved or CO₂ avoided.

Based on this evidence, the following hypothesis is proposed:

Hypothesis 1. *Energy efficiency disclosure has a positive effect on ESG performance.*

3.2 | Resource Reduction and ESG Performance

In line with institutional theory, disclosure on resource reduction practices can be interpreted as a strategic response to regulatory and societal expectations, whereas from a signaling theory perspective, it also represents a communicative device through which firms attempt to reduce information asymmetries and convey their environmental commitment to stakeholders. However, when grounded in concrete initiatives, it also reflects an actual operational transformation aimed at optimizing production processes and minimizing waste. Waste reduction, when supported by targeted investments in resources such as equipment, skilled personnel, and R&D, represents a proactive pathway that generates tangible benefits in terms of cost savings, environmental impact, and strategic positioning (Simpson 2012). When communication on resource reduction stems from real activities, such as the adoption of circular processes, material reuse, or the optimization of input utilization, it becomes a substantive indicator of positive environmental performance, which is typically rewarded in ESG performance (Testa et al. 2018). Therefore, it is hypothesized that resource reduction disclosure, when associated with measurable interventions, significantly contributes to the improvement of ESG performance. Firms that communicate their commitments and achievements in resource reduction in a detailed and transparent manner are generally perceived as more trustworthy and sustainability-oriented, thereby having higher ESG performance (Michelon and Rodrigue 2015). The adoption of sustainability accounting systems that include the measurement of environmental impacts and resource reduction performance serves as an additional mechanism of environmental accountability (Burritt and Schaltegger 2010).

Li et al. (2024) further reinforce this argument by demonstrating that climate change intensifies the effects of resource misallocation, leading to a reduction in ESG performance. Their findings suggest that efficient allocation and reduction of resources are essential to maintaining competitiveness and achieving sustainable outcomes.

Based on this evidence, the following hypothesis is proposed:

Hypothesis 2. *Resource reduction disclosure has a positive effect on firm ESG performance.*

3.3 | Water Efficiency and ESG Performance

Efficient water resource management is a critical component of corporate sustainability, especially in the face of growing water scarcity and environmental pressures. Disclosure of water efficiency initiatives can signal a firm's genuine commitment to reducing environmental impact and enhancing ESG performance. When based on concrete actions such as water recovery technologies, consumption monitoring systems, and optimization processes, this disclosure reflects substantive operational improvements that generate measurable environmental, social,

and governance benefits. Structured and systematic reporting of water efficiency also enables a deeper understanding of corporate water use and supports more effective management strategies (CEO Water Mandate 2014). By monitoring and communicating water data, firms can activate internal control mechanisms and drive continuous improvement, resulting in reduced withdrawals and stronger environmental governance (Chen and Huang 2023; Lambooy 2011). Furthermore, stakeholder expectations and institutional legitimacy pressures encourage firms to adopt rigorous water policies, improving the quality and credibility of disclosure (Chen and Huang 2023). In line with this, Jalil et al. (2024) provide evidence on the global relevance of water disclosure under the SDGs, underscoring its role in enhancing ESG accountability across industries and countries. However, compared to energy or emission disclosure, water practices are often less standardized and more context-dependent, which reduces their auditability. This lower verifiability explains why external audits may sometimes generate rigidities or highlight measurement gaps, thereby moderating the positive effect of disclosure. The effectiveness of water efficiency disclosure in improving ESG performance depends on its alignment with measurable and verifiable actions. Inauthentic or symbolic communication undermines credibility, reducing its impact.

Based on this, the following hypothesis is proposed:

Hypothesis 3. *Water efficiency disclosure has a positive effect on firm ESG performance.*

3.4 | Emission Reduction and ESG Performance

Disclosure on emission reduction is a critical tool through which firms signal their engagement in the low-carbon transition. When supported by concrete interventions, such as verified greenhouse gas (GHG) reductions, this type of communication reflects a substantive organizational commitment and can enhance ESG performance. Rather than being merely symbolic, emission-related disclosure can represent a tangible shift toward sustainable practices (Li and Xu 2024; Meng et al. 2024). The literature underscores the central role of carbon reduction strategies in improving ESG performance while also reinforcing organizational resilience and stakeholder relationships. Moreover, empirical evidence suggests that stringent regional environmental policies further strengthen the ESG performance of firms in regulated, high-emission sectors (Chen and Wang 2024). He and Wang (2025) provide further support, showing that low-carbon city pilot policies in China significantly improve ESG performance through mechanisms such as internal controls, green innovation, and emission restraint, with particularly strong effects for SOEs and mature firms.

The credibility and effectiveness of emission disclosure rely on verifiable actions and institutional context. Without measurable results, such claims risk becoming symbolic, weakening their impact, and damaging trust. Based on this, the following hypothesis is proposed:

Hypothesis 4. *Emission reduction disclosure has a positive effect on ESG performance.*

3.5 | The Role of External Audit

CE disclosure has become central to firm strategies. However, the effectiveness of such disclosure in enhancing ESG performance is contingent upon the quality, accuracy, and verifiability of the information provided. In this context, external audit plays a vital role in ensuring the credibility of CE disclosure and in limiting greenwashing behavior (Moroney et al. 2012; Simnett et al. 2009). This audit serves as a governance mechanism that enforces accountability and helps prevent firms from using CE communication for purely symbolic purposes without operational backing. Empirical research indicates that the presence of an external audit is associated with lower levels of greenwashing and better alignment between sustainability disclosures and actual environmental performance (Martínez-Ferrero and García-Sánchez 2018). By offering independent oversight, these bodies improve informational transparency, build stakeholder trust, and positively moderate the relationship between CE disclosure and ESG outcomes (Wijen 2014). At the same time, the literature suggests that the effectiveness of audits is contingent upon the degree of verifiability of the underlying practices. Recent contributions further support this view: Asante-Appiah and Lambert (2023) highlight the role of external auditors in managing ESG reputation risk, whereas von Rosing et al. (2025) underline the growing importance of external ESG auditing in ensuring credible and consistent reporting across private and public organizations. For example, in the case of water efficiency disclosure, guidelines such as the CEO Water Mandate (2014) have promoted common metrics to improve transparency and comparability, whereas recent studies highlight that such practices remain less consolidated compared to other areas of sustainability (Chen and Huang 2023). In these cases, external audits may have ambivalent effects: although they can strengthen credibility when clear and standardized indicators exist (e.g., energy use and emissions), they may also introduce bureaucratic rigidities, expose measurement gaps, or struggle to capture context-dependent nuances (e.g., water stewardship), thereby reducing the positive impact of disclosure on legitimacy and organizational learning. This distinction further clarifies the theoretical mechanism suggested in the title of the paper: Disclosure may remain symbolic in the absence of verification, become a credible signal when verifiable and externally audited, and reflect substantive action when grounded in measurable and auditable practices.

Based on this evidence, the following hypothesis is proposed:

Hypothesis 5. *The presence of an external audit positively moderates the relationship between CE disclosure and ESG performance.*

Below, the framework illustrated in Figure 1 depicts the theoretical model underlying our study.

4 | Data and Variables

The empirical analysis relies on a panel of 1247 listed European firms observed over the period 2015–2024. The dataset integrates three complementary sources. First, sustainability reports were systematically examined to capture information on CE disclosures, ensuring direct alignment with firms' own reporting practices. Second, Thomson Reuters Eikon/Refinitiv provided standardized and comparable ESG performance indicators as well as information on External Audit, which identifies whether firms subject their sustainability reporting to independent external assurance. Third, Orbis supplied detailed financial and governance variables, which allowed us to control for firm-specific heterogeneity in size, profitability, board characteristics, and industry. This integrated approach enhances the validity of our analysis, offering a robust foundation to examine the relationship between CE disclosure and ESG performance while mitigating the risk of relying on a single data source.

Table 1 reports the sources and definitions of the dependent, independent, and control variables.

4.1 | Dependent Variables

The focus of our analysis is on the *ESG performance* (0–100), which summarizes a firm's environmental, social, and governance performance across the three pillars. A higher score denotes better ESG performance (e.g., Gregory 2024).

For robustness, we re-estimate all models using the ESG Combined Score (0–100), which integrates ESG controversies by

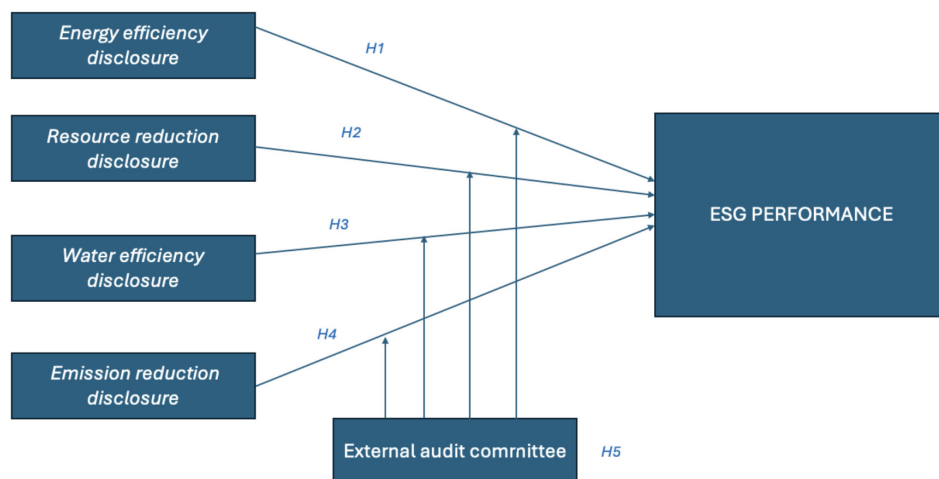


FIGURE 1 | Research model. Source: Authors' own work.

TABLE 1 | Variable definitions.

Variable	Definition	Source
Dependent variables		
ESG performance	Measures a firm's environmental, social, and governance performance, providing an overall sustainability assessment (score from 0 to 100)	Thomson Reuters
ESG combined score	Score from 0 to 100 represents the ESG performance of a firm considering the ESG controversies	Thomson Reuters
Independent variables		
External audit	Dummy variable taking the value 1 if a firm undergoes an external audit for CSR report and 0 otherwise	Thomson Reuters
Energy efficiency disclosure	Dummy variable taking the value 1 if a firm has implemented energy efficiency policies and 0 otherwise	Sustainability report
Resource reduction disclosure	Dummy variable taking the value 1 if a firm has policies aimed at reducing resource consumption and 0 otherwise	Sustainability report
Water efficiency disclosure	Dummy variable taking the value 1 if a firm has water efficiency measures in place and 0 otherwise	Sustainability report
Emission reduction disclosure	Dummy variable taking the value 1 if a firm has an emission reduction policy and 0 otherwise	Sustainability report
Control variables		
Firm age	Number of years since the firm was founded	ORBIS
Board size	Total number of directors on the firm's board	Thomson Reuters
Board gender	Percentage of women directors	Thomson Reuters
Firm size	Number of employees	ORBIS
ROA (return on assets)	Ratio of income to total assets, representing firm profitability	ORBIS
Industry variables	Dummy variables indicating the sector in which the firm operates (i.e., accommodation, administration, agriculture, arts, construction, electricity, estate, finance, health, IT, manufacturing, mining and quarrying, services, professions, public administration, trade, and transportation)	ORBIS

Source: Authors' own work.

penalizing firms for material negative events related to environmental, social, or governance issues. This makes it a more stringent, event-adjusted measure of ESG performance (e.g., Priem and Gabellone 2024).

4.2 | Independent Variables

The variable *External audit* represents a measure of transparency: indicating whether the firm undergoes an external audit for a sustainability report is a signal of commitment to more responsible governance and attention to CSR, as also evidenced in the literature (Dixon-Fowler et al. 2017; Spitzeck 2009).

The variables *Energy efficiency disclosure*, *Resource reduction disclosure*, *Water efficiency disclosure*, and *Emission reduction disclosure* are dummies that attest to the adoption of specific CE policies. They provide evidence of whether and how firms are addressing issues related to energy efficiency, resource management, water use, and emission reduction (Huang and

Yang 2021). The CE disclosure dummies were coded through a manual content analysis of firms' sustainability reports (Fenk 2025; Guerrero-Baena et al. 2024; Torelli et al. 2020; Landrum and Ohsowski 2018). A value of 1 was assigned only when the report contained explicit evidence of a formal and documented commitment to the specific CE practice, such as the presence of a dedicated section, a stated policy, or quantitative targets (e.g., energy efficiency plans, waste reduction initiatives, water-saving technologies, or emission reduction goals). Generic mentions or isolated keywords were not considered sufficient to assign a value of 1. In the absence of such formal evidence, the variable was coded 0. This approach ensures that the dummies capture substantive reporting practices.

4.3 | Control Variables

Firm age provides an indication of maturity and operating experience, elements that can influence ESG performance (Agnese et al. 2024).

Board characteristics, expressed through *Board size* and *Board gender*, are important proxies for diversity and quality of governance, factors that have been shown to positively affect ESG performance (Bannò et al. 2024; Leggerini et al. 2025).

Firm size and *Return on assets (ROA)* are included to control for the effect of resources and profitability, recognizing that larger and more profitable firms may have greater means to invest in ESG performance (Pan et al. 2021).

Sector variables (dummies related to different industries) are essential to account for sector specificities, as each sector faces specific ESG challenges and opportunities (Guo et al. 2023).

5 | Methodology

We adopt a quantitative linear panel data approach to analyze listed European firms disclosing CE (Greene 2011). Panel techniques are particularly appropriate in this context, as they exploit the longitudinal dimension of the data and help control for unobserved firm-specific characteristics that remain stable over time (Wooldridge 2019). A key methodological issue in this type of analysis concerns potential endogeneity. Prior research has shown that governance and ESG performance are often not fully exogenous: firms with a strong orientation toward ESG may at the same time implement CE initiatives, disclose them, improve their ESG performance, and voluntarily undergo external audits (Adams et al. 2010; Wintoki et al. 2012). This raises concerns about reverse causality and omitted variable bias.

To mitigate these risks, we introduced a 1-year lag for the explanatory variables. This approach reduces simultaneity, ensuring that disclosure and audit variables precede the ESG performance, and it also reflects the fact that firm initiatives generally take time to produce observable effects (Liang et al. 2013). Although the use of lagged variables cannot completely eliminate endogeneity, it represents a widely adopted and effective strategy to control it (Liang et al. 2013).

We estimate multiple regression models and test both fixed effects (FE) and random effects (RE) to control for unobserved heterogeneity (Greene 2011). Based on the Hausman test, RE is preferred, as firm-level effects are uncorrelated with regressors, making estimation more efficient (Greene 2011). The RE model allows us to capture firm-level unobserved heterogeneity while retaining variables that are constant over time, such as sectoral affiliation.

Combined with a rich set of firm- and industry-level controls, this design offers a balanced and reliable framework for examining the association between CE disclosure, audits, and ESG performance.

The disclosure is captured through four dimensions: energy efficiency, resource reduction, water efficiency, and emission reduction.

To analyze the relationship between CE disclosure and ESG performance, we used:

Model 1: $ESG\ performance = f(Energy\ efficiency\ disclosure + Control\ variables)$.

Model 3: $ESG\ performance = f(Resource\ reduction\ disclosure + Control\ variables)$.

Model 5: $ESG\ performance = f(Water\ efficiency\ disclosure + Control\ variables)$.

Model 7: $ESG\ performance = f(Emission\ reduction\ disclosure + Control\ variables)$.

To determine the influence of external audits, models of interaction between CE disclosure and external audits were considered:

Model 2: $ESG\ performance = f(Energy\ efficiency\ disclosure * External\ audit + Control\ variables)$.

Model 4: $ESG\ performance = f(Resource\ reduction\ disclosure * External\ audit + Control\ variables)$.

Model 6: $ESG\ performance = f(Water\ efficiency\ disclosure * External\ audit + Control\ variables)$.

Model 8: $ESG\ performance = f(Emission\ reduction\ disclosure * External\ audit + Control\ variables)$.

6 | Results

To assess multicollinearity, we examined variance inflation factors, which were all below the conservative threshold of 5 (O'Brien et al. 2007). In addition, correlation levels among independent variables were inspected and found to be moderate, indicating that multicollinearity is not a concern in our models.

Table 2 provides a comprehensive summary of the descriptive statistics for the full sample.

Table 3 provides the results.

The coefficient for *External audit* is positive and significant across all models (3.461–5.649; $p < 0.001$), suggesting it enhances *ESG performance* by signaling transparency and governance quality. *Energy efficiency disclosure* also shows a positive effect (1.815 and 1.503; $p < 0.001$), further amplified when combined with external audits (1.547; $p < 0.05$), likely boosting stakeholder trust.

Resource reduction disclosure yields strong positive effects (2.262 and 2.225; $p < 0.001$), but the interaction with audits is not significant (0.407), implying limited added value from verification.

Water efficiency disclosure is significant (3.233 and 4.396; $p < 0.001$), yet negatively moderated by audits (−2.667; $p < 0.001$), possibly due to rigid procedures constraining implementation.

Emission reduction disclosure also improves *ESG performance* (1.839 and 1.411; $p < 0.001$), with audits reinforcing its effect (2.338; $p < 0.001$).

TABLE 2 | Descriptive statistics.

Variable	Obs.	Mean	Std. dev.	Min.	Max.
ESG performance	16,211	49.332	20.914	0.627	95.681
ESG combined score	16,211	48.101	19.697	0	94.702
External audit	16,211	0.252	0.434	0	1
Energy efficiency disclosure	16,211	0.925	0.263	0	1
Resource reduction disclosure	16,211	0.955	0.207	0	1
Water efficiency disclosure	16,211	0.241	0.427	0	1
Emission reduction disclosure	16,211	0.915	0.279	0	1
Firm age	16,211	74.059	42.096	0	123
Board size	16,211	8.919	3.693	2	31
Board gender	16,211	29.078	14.773	0	80
Firm size	16,211	17854.925	51610.052	1	733,000
ROA	16,211	3.168	14.438	−99.775	98.713
Accommodation	16,211	0.009	0.094	0	1
Administration	16,211	0.02	0.14	0	1
Agriculture	16,211	0.004	0.063	0	1
Arts	16,211	0.01	0.102	0	1
Construction	16,211	0.032	0.176	0	1
Electricity	16,211	0.039	0.194	0	1
Estate	16,211	0.043	0.202	0	1
Finance	16,211	0.108	0.311	0	1
Health	16,211	0.018	0.135	0	1
IT	16,211	0.11	0.313	0	1
Manufacturing	16,211	0.399	0.49	0	1
Mining quarrying	16,211	0.016	0.126	0	1
Service	16,211	0.01	0.098	0	1
Professions	16,211	0.062	0.241	0	1
Public administration	16,211	0.004	0.063	0	1
Trade	16,211	0.075	0.263	0	1
Transportation	16,211	0.036	0.187	0	1

Source: Authors' own work.

We also computed marginal effects to better illustrate the interaction between CE disclosure and external audits. These marginal effects refer to the main regression models (Models 2, 4, 6, and 8) and depict how the presence of an external audit modifies the impact of each CE disclosure dimension on ESG performance (Figure 2).

6.1 | Robustness Check

As a robustness check, we re-estimated the models using the *ESG Combined Score*, which integrates controversies into the

ESG performance. This alternative dependent variable offers a more stringent measure of ESG performance, as it penalizes firms involved in environmental, social, or governance disputes (Priem and Gabellone 2024). The results remain consistent with the baseline models, reinforcing the validity of our findings and showing that the relationship between CE disclosure, external audits, and ESG performance is not sensitive to the choice of ESG metric (Table 4).

The marginal effect test shows that the presence of an external audit changes the impact of CE disclosure on *ESG combined score* (Figure 3).

TABLE 3 | Regression results.

Variables	Model 1 ESG performance	Model 2 ESG performance	Model 3 ESG performance	Model 4 ESG performance	Model 5 ESG performance	Model 6 ESG performance	Model 7 ESG performance	Model 8 ESG performance
External audit	5.649*** (0.244)	4.217*** (0.668)	5.591*** (0.242)	5.194*** (1.187)	3.848*** (0.298)	4.901*** (0.361)	5.613*** (0.243)	3.461*** (0.647)
Energy efficiency disclosure	1.815*** (0.309)	1.503*** (0.351)						
Energy efficiency disclosure * External audit		1.547** (0.687)						
Resource reduction disclosure			2.262*** (0.346)	2.225*** (0.366)				
Resource reduction disclosure * External audit				0.407 (1.193)				
Water efficiency disclosure					3.233*** (0.300)	4.396*** (0.380)		
Water efficiency disclosure * External audit						-2.667*** (0.562)		
Emission reduction disclosure							1.839*** (0.275)	1.411*** (0.295)
Emission reduction disclosure * External audit								2.338*** (0.678)
Firm age	-0.00903 (0.0108)	-0.0104 (0.0109)	-0.0112 (0.0108)	-0.0113 (0.0108)	-0.0330*** (0.0104)	-0.0383*** (0.0104)	-0.00653 (0.0108)	-0.00878 (0.0109)
Board size	-0.0365 (0.0759)	-0.0351 (0.0759)	-0.0418 (0.0760)	-0.0419 (0.0760)	-0.0454 (0.0749)	-0.0481 (0.0747)	-0.0479 (0.0759)	-0.0458 (0.0761)
Board gender	0.150*** (0.0162)	0.150*** (0.0162)	0.151*** (0.0161)	0.151*** (0.0161)	0.148*** (0.0162)	0.149*** (0.0162)	0.148*** (0.0161)	0.148*** (0.0161)

(Continues)

TABLE 3 | (Continued)

Variables	Model 1 ESG performance	Model 2 ESG performance	Model 3 ESG performance	Model 4 ESG performance	Model 5 ESG performance	Model 6 ESG performance	Model 7 ESG performance	Model 8 ESG performance
Firm size	6.05e-05*** (1.17e-05)	6.03e-05*** (1.17e-05)	6.13e-05*** (1.17e-05)	6.13e-05*** (1.17e-05)	5.83e-05*** (1.15e-05)	5.96e-05*** (1.14e-05)	5.98e-05*** (1.17e-05)	5.93e-05*** (1.17e-05)
ROA	0.00560 (0.00707)	0.00539 (0.00707)	0.00605 (0.00708)	0.00598 (0.00710)	0.00620 (0.00698)	0.00677 (0.00699)	0.00533 (0.00702)	0.00539 (0.00702)
Accommodation food	1.315 (7.357)	1.302 (7.351)	1.386 (7.382)	1.387 (7.382)	1.722 (7.393)	1.760 (7.419)	1.312 (7.359)	1.349 (7.365)
Administration	-21.23*** (5.593)	-21.19*** (5.592)	-21.21*** (5.623)	-21.21*** (5.624)	-20.07*** (5.717)	-20.13*** (5.730)	-21.35*** (5.585)	-21.24*** (5.603)
Agriculture	-12.40 (9.238)	-12.40 (9.220)	-12.32 (9.228)	-12.32 (9.228)	-11.89 (9.018)	-11.88 (8.962)	-12.48 (9.264)	-12.42 (9.248)
Arts	-12.67* (7.150)	-12.67* (7.148)	-12.60* (7.193)	-12.60* (7.194)	-11.40 (7.169)	-11.43 (7.160)	-12.70* (7.194)	-12.56* (7.187)
Construction	-2.595 (5.434)	-2.579 (5.431)	-2.467 (5.470)	-2.465 (5.471)	-1.500 (5.579)	-1.402 (5.609)	-2.690 (5.425)	-2.601 (5.442)
Electricity gas	-1.819 (5.614)	-1.813 (5.609)	-1.758 (5.650)	-1.758 (5.651)	-1.053 (5.731)	-0.927 (5.760)	-2.017 (5.610)	-1.962 (5.624)
Estate	-4.031 (5.290)	-4.008 (5.285)	-3.882 (5.327)	-3.879 (5.328)	-2.873 (5.424)	-2.809 (5.448)	-4.057 (5.277)	-3.968 (5.294)
Finance insurance	-4.246 (5.049)	-4.216 (5.045)	-4.108 (5.088)	-4.102 (5.090)	-2.853 (5.200)	-2.842 (5.224)	-4.316 (5.036)	-4.207 (5.055)
Health	-15.27*** (5.868)	-15.20*** (5.865)	-15.17*** (5.890)	-15.16** (5.890)	-13.97** (5.944)	-13.98** (5.953)	-15.36*** (5.860)	-15.19*** (5.879)
IT	-10.13** (5.037)	-10.12** (5.033)	-10.05** (5.076)	-10.05** (5.077)	-8.955* (5.183)	-8.990* (5.206)	-10.19** (5.026)	-10.09** (5.044)

(Continues)

TABLE 3 | (Continued)

Variables	Model 1 ESG performance	Model 2 ESG performance	Model 3 ESG performance	Model 4 ESG performance	Model 5 ESG performance	Model 6 ESG performance	Model 7 ESG performance	Model 8 ESG performance
Manufacturing	-6.090 (4.903)	-6.062 (4.899)	-5.990 (4.944)	-5.987 (4.945)	-5.064 (5.054)	-4.984 (5.079)	-6.183 (4.890)	-6.072 (4.909)
Quarrying	2.531 (6.429)	2.589 (6.423)	2.575 (6.456)	2.579 (6.456)	3.362 (6.512)	3.527 (6.536)	2.317 (6.423)	2.453 (6.429)
Services	-9.937 (6.881)	-9.913 (6.875)	-9.842 (6.901)	-9.839 (6.901)	-8.853 (6.962)	-8.853 (6.992)	-10.06 (6.873)	-9.942 (6.876)
Professions	-9.799* (5.230)	-9.785* (5.226)	-9.727* (5.268)	-9.726* (5.269)	-8.856* (5.369)	-8.886* (5.391)	-9.849* (5.220)	-9.765* (5.238)
Public administration	-9.403 (7.888)	-9.332 (7.853)	-9.313 (7.909)	-9.310 (7.909)	-7.230 (7.867)	-7.313 (7.759)	-9.511 (7.902)	-9.343 (7.863)
Trade	-8.981* (5.073)	-8.947* (5.069)	-8.904* (5.112)	-8.901* (5.113)	-7.642 (5.222)	-7.601 (5.246)	-9.069* (5.060)	-8.967* (5.078)
Transportation	-7.322 (5.387)	-7.322 (5.384)	-7.240 (5.426)	-7.239 (5.427)	-6.356 (5.541)	-6.368 (5.568)	-7.399 (5.373)	-7.345 (5.391)
Constant	48.60***	48.96***	48.22***	48.26***	50.82***	51.04***	48.68***	49.13***
R ²	(4.938)	(4.934)	(4.990)	(4.991)	(5.074)	(5.098)	(4.923)	(4.940)
Observations	0.3552 16,211	0.3563 16,211	0.3559 16,211	0.3560 16,211	0.3700 16,211	0.3668 16,211	0.3511 16,211	0.3537 16,211
Number of firms	1247	1247	1247	1247	1247	1247	1247	1247

Source: Authors' own work.

***p < 0.01,

**p < 0.05,

*p < 0.1.

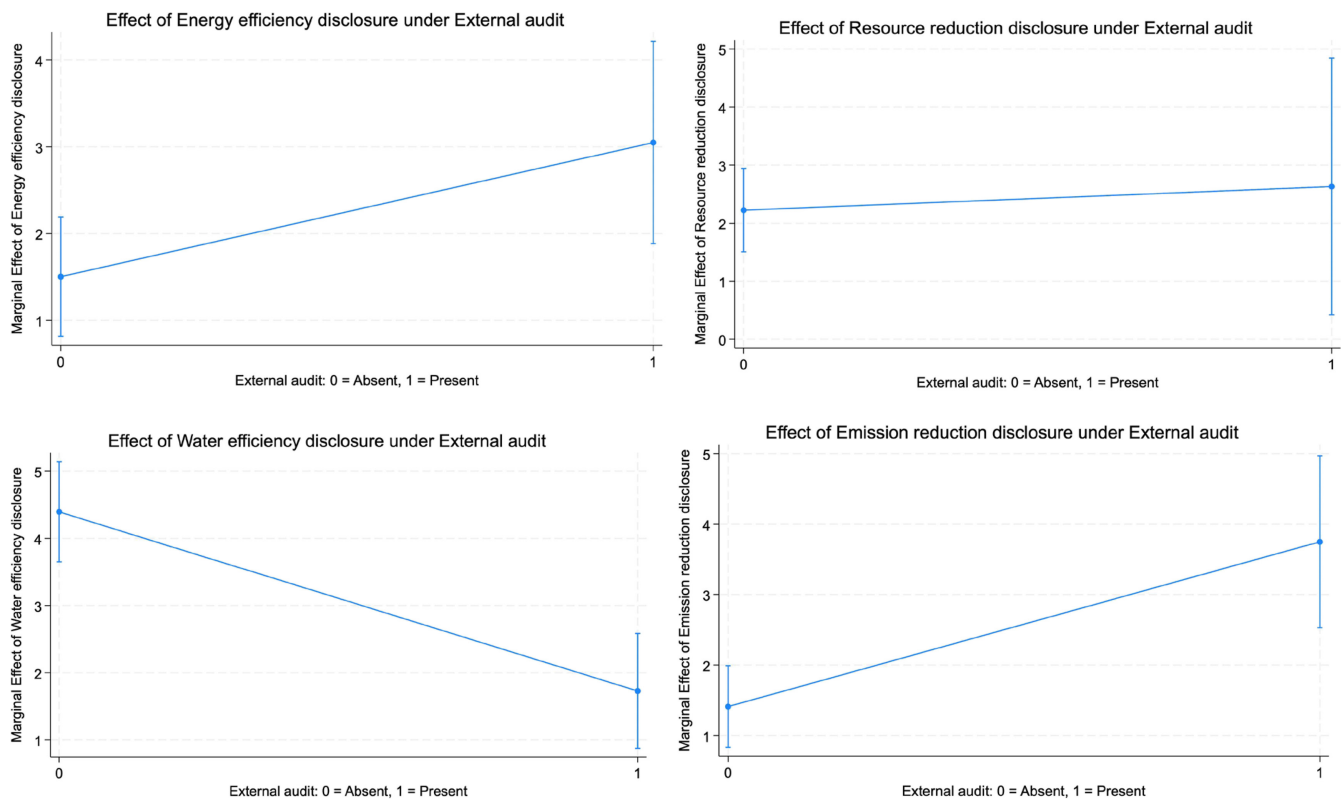


FIGURE 2 | Marginal effect of disclosure on ESG performance. *Source:* Authors' own work.

7 | Discussion

Energy efficiency-related reporting emerges as a primary driver of ESG performance, aligning with literature that highlights energy efficiency as a credible practice generating environmental benefits and improving corporate image (Clarkson et al. 2008; Fatemi et al. 2015; Hummel and Schlick 2016). This effect aligns with coercive and mimetic isomorphism, where firms adopt and report efficiency practices to meet regulatory and reputational expectations (DiMaggio and Powell 1983).

Resource reduction disclosure also shows a significant positive link with ESG performance, confirming that waste minimization is considered an authentic CE strategy, consistent with studies on sustainability accounting and stakeholder pressure (Burritt and Schaltegger 2010; Michelon and Rodrigue 2015; Simpson 2012).

External audits are associated with higher ESG performance, suggesting they may play a role in enhancing the credibility of disclosures. However, this association could also reflect firms' underlying sustainability orientation, which simultaneously drives both substantive practices and the voluntary choice of external audits. Therefore, although our results are consistent with the interpretation that audits are associated with disclosure effectiveness, they should be interpreted with caution.

Water efficiency disclosure has a positive impact on ESG performance, but this effect is weaker and partly offset by external audits. Despite growing attention to sustainable water efficiency (CEO Water Mandate 2014; Chen and Huang 2023),

water efficiency practices are less established or prioritized, and audits may introduce rigidity or highlight challenges in measurement, reducing legitimacy (Chen and Huang 2023). This indicates that when disclosure is less mature or standardized, rigid audits may hinder rather than support learning and legitimacy.

Emission reduction disclosure is confirmed as a key lever for ESG performance, consistent with literature emphasizing its strategic sustainability role (Chen and Wang 2024; Huang and Yang 2021). This effect is amplified by audits, which validate commitments and mitigate greenwashing risks (Wijen 2014). In strict regulatory environments and carbon-intensive sectors, transparent emissions reporting with independent verification supports legitimacy and competitiveness, demonstrating that under strong institutional pressure, third-party audits enhance perceived authenticity and align reporting with substantive performance.

Overall, the role of external audits is ambivalent and contingent on the type of environmental disclosure. For established, measurable practices like energy efficiency and emission reduction, audits enhance credibility, strengthen reporting effectiveness, and reduce greenwashing (Keresztúri et al. 2025; Wijen 2014), building stakeholder trust and aligning disclosures with real practices. Conversely, for less mature and harder-to-verify practices like water efficiency, audits can introduce bureaucratic rigidities, reducing disclosure effectiveness. These findings emphasize that audit effectiveness is not automatic but depends on the quality and measurability of reported content and the adaptability of assurance mechanisms to corporate

TABLE 4 | Robustness test.

	Model 9	Model 10	Model 11	Model 12	Model 13	Model 14	Model 15	Model 16
Variables	ESG combined score	ESG combined score	ESG combined score	ESG combined score	ESG combined score	ESG combined score	ESG combined score	ESG combined score
External audit	4.975*** (0.255)	4.255*** (0.715)	4.925*** (0.253)	5.456*** (1.212)	3.252*** (0.305)	4.598*** (0.364)	4.943*** (0.253)	3.562*** (0.667)
Energy efficiency disclosure	1.597*** (0.319)	1.440*** (0.362)						
Energy efficiency disclosure* External audit		0.777 (0.737)						
Resource reduction disclosure			2.185*** (0.365)	2.234*** (0.387)				
Resource reduction disclosure* External audit				−0.546 (1.219)				
Water efficiency disclosure					3.080*** (0.309)	4.566*** (0.379)		
Water efficiency disclosure* External audit						−3.412*** (0.582)		
Emission reduction disclosure							1.699*** (0.283)	1.425*** (0.307)
Emission reduction disclosure* External audit							1.499** (0.698)	
Control variables	YES	YES	YES	YES	YES	YES	YES	YES
Constant	46.96*** (4.876)	47.14*** (4.877)	46.41*** (4.920)	46.35*** (4.920)	48.88*** (4.999)	49.15*** (5.028)	46.94*** (4.845)	47.22*** (4.855)
R ²	0.3101	0.3104	0.3117	0.3115	0.3209	0.3162	0.3072	0.3084
Observations	16,211	16,211	16,211	16,211	16,211	16,211	16,211	16,211
Number of firms	1247	1247	1247	1247	1247	1247	1247	1247

Source: Authors' own work.

*** $p < 0.01$,

** $p < 0.05$,

* $p < 0.1$.

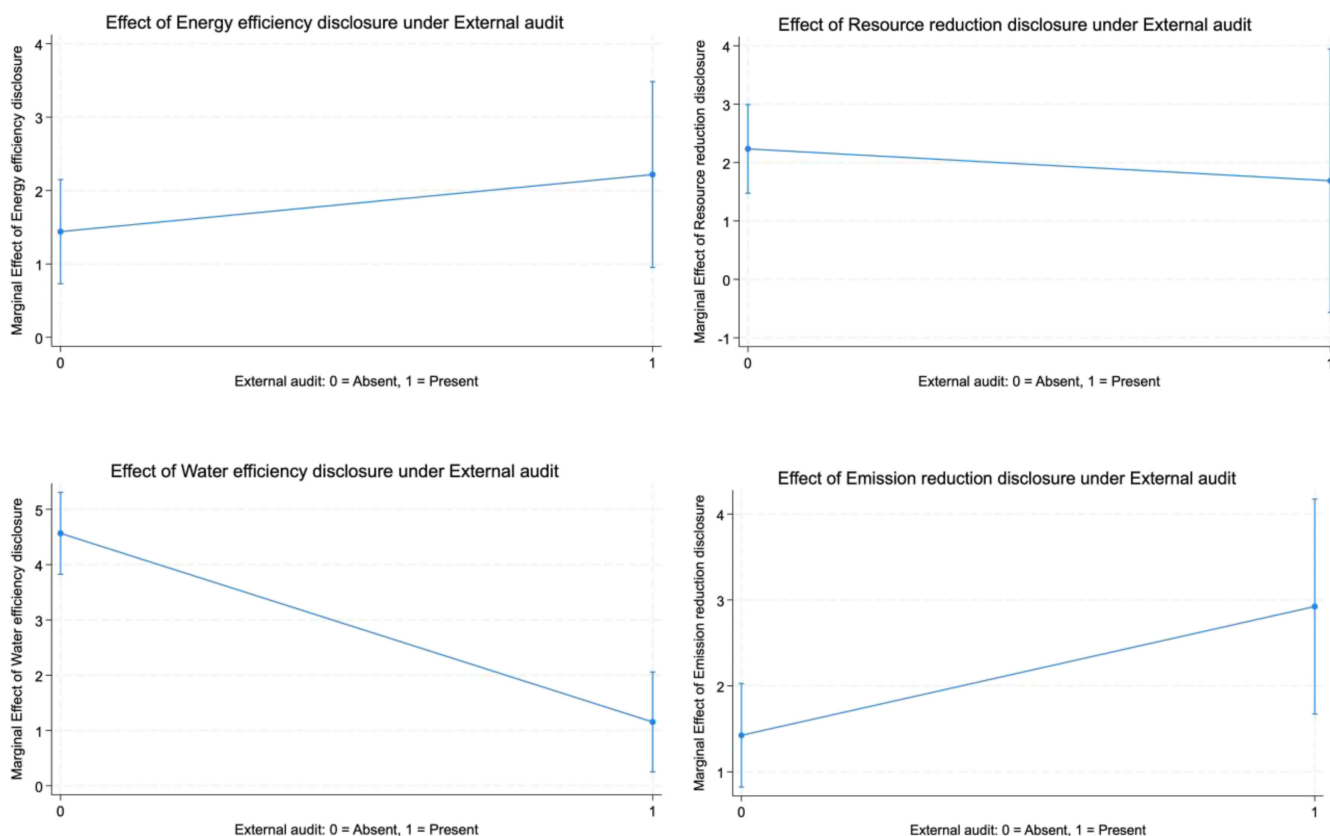


FIGURE 3 | Marginal effect of disclosure on ESG combined score. *Source:* Authors' own work.

sustainability contexts. These results can also be interpreted through the lens of signaling theory. According to this perspective, CE disclosures act as signals whose effectiveness depends on their cost and observability (Spence 1973; Connelly et al. 2011). Energy and emission disclosures represent strong signals because they are standardized, measurable, and costly to imitate, which explains their positive association with ESG performance and the reinforcement effect of audits. In contrast, water disclosures function as weak signals: less standardized and harder to verify; they are more vulnerable to being perceived as symbolic, and audits may even amplify skepticism. This distinction between strong and weak signals provides a complementary explanation of why disclosure effectiveness varies across CE domains.

The findings can also be interpreted through institutional theory. The evidence reflects the mechanisms of coercive, mimetic, and normative isomorphism that informed the hypotheses in different ways. Coercive pressures, such as regulatory requirements and societal expectations, appear consistent with the strong and positive effects of energy efficiency and emission disclosures, particularly when reinforced by external audits. Mimetic dynamics may explain the broad diffusion of practices like water efficiency disclosure, yet the weaker and sometimes negative interaction with audits suggests that imitation without substantive operational change can limit effectiveness and legitimacy. Normative pressures emerge in the role of professional assurance, with external audits enhancing credibility in mature and measurable domains while creating rigidities in less standardized areas. Taken together, these insights show that institutional mechanisms do not uniformly strengthen disclosure

effectiveness but operate in contingent ways depending on the maturity and measurability of the CE domain. Integrating these findings more explicitly with institutional theory reinforces the theoretical contribution of the study and demonstrates a stronger alignment between the conceptual framework and the results.

8 | Theoretical and Practical Implications

From a theoretical perspective, the research advances institutional theory (DiMaggio and Powell 1983) by showing that external pressures interact with corporate responses in context-specific ways, depending on the maturity and measurability of CE practices. It also refines the concept of isomorphism, suggesting that legitimacy-seeking strategies are more impactful when externally validated, especially in symbolically compliant areas like carbon disclosure (Greenwood et al. 2011). In addition, the study contributes to signaling theory by differentiating between strong and weak signals. Disclosures related to energy and emissions act as credible, costly, and observable signals that stakeholders reward, whereas water-related disclosures remain weaker, less standardized signals that may even backfire under audit conditions. This highlights that the signaling value of CE reporting is contingent on the measurability and costliness of the information disclosed.

The study further integrates insights from greenwashing literature, revealing that external audits are context-dependent and not universally effective (Wijen 2014), reinforcing calls for a shift from formalistic to substantive ESG interpretations (De Freitas Netto et al. 2020). Embedding sustainability governance

within core business functions through cross-functional coordination, data systems, and decision-making structure is essential for impactful disclosure.

On the managerial side, the results underscore the need for firms to base CE disclosure on concrete, verifiable actions. Effective ESG performance requires integrating CE into operations and strategy through structured policies on energy, resources, water, and emissions (Fatemi et al. 2015). Aligning CE disclosure with measurable results increases internal coherence and the likelihood of real ESG performance. External audits, while enhancing credibility, should be carefully calibrated: they are more effective when applied to mature practices and may introduce rigidities in less structured domains. Firms should therefore design adaptive audit systems that balance compliance with flexibility (Wijen 2014). Disclosure strategies should also be tailored to sectoral and organizational maturity. From a signaling perspective, managers should prioritize disclosures that operate as credible signals, those that are costly to imitate, standardized, and easily verifiable, while avoiding reliance on weak signals that risk being perceived as symbolic. Designing disclosure strategies through this lens reduces information asymmetry, mitigates reputational risk, and strengthens stakeholder trust. Modular and adaptive approaches can align communication with stakeholder expectations and avoid excessive standardization (DiMaggio and Powell 1983; Greenwood et al. 2011). From a policy standpoint, the study calls for stronger regulatory frameworks that prioritize substance over form in CE disclosure. Policymakers should promote clear and comparable CE reporting standards, verifiable indicators, and stakeholder engagement to reduce information asymmetry and limit greenwashing (Choudhury et al. 2024; De Freitas Netto et al. 2020). Independent assurance should be gradually mandated and tailored by sector to ensure audit quality and avoid symbolic practices. Public incentives, such as tax benefits or green finance access, should reward firms with genuine, outcome-based CE actions, promoting transparency and discouraging compliance for appearance's sake.

The findings also carry implications for current European policy developments, particularly the Corporate Sustainability Reporting Directive (CSRD). The evidence that external audits enhance the credibility of energy and emission disclosures indicates that the goals of the CSRD are aligned with practices that can generate substantive improvements in ESG performance. However, the weaker and sometimes negative interaction between audits and water-related disclosures suggests that a uniform assurance model may not be equally effective across all CE domains. These results point to the need for a more differentiated regulatory approach that adapts assurance requirements to the maturity and measurability of the underlying practices. In this way, the study contributes not only to academic debates but also to the refinement of EU reporting standards, offering guidance for policymakers aiming to strengthen the credibility and effectiveness of sustainability disclosure.

9 | Conclusion and Future Research

This study indicates that CE disclosure improves ESG performance when grounded in measurable practices, especially in energy, resource use, and emissions. External audits generally

enhance credibility, though their effectiveness depends on the maturity of the CE domain.

However, the study acknowledges several limitations: the potential for endogeneity despite time-lagged variables; the limited generalizability due to the focus on listed European firms; and the lack of differentiation in audit quality or type. Future research should examine how these dynamics vary by geography, firm type, and regulatory environment. Comparative studies across sectors and countries could clarify whether the role of audits is universal or context-specific, depending on institutional settings and regulatory environments. Disaggregating audit characteristics and exploring the role of digital technologies (e.g., blockchain and IoT) could provide new insights into verification processes. In addition, qualitative analyses (e.g., interviews and case studies) could investigate the decision-making processes behind CE disclosure practices, capturing the nuanced motivations and challenges faced by firms. Stakeholder perception studies could further examine how investors, customers, and NGOs interpret and respond to CE disclosures and associated audit practices.

Future research should adopt more advanced causal identification strategies to disentangle these dynamics. Natural experiments based on regulatory changes mandating external audits (e.g., the CSRD implementation) would allow for difference-in-differences designs. Alternatively, instrumental variable approaches leveraging exogenous variation in audit availability or cost, or propensity score matching to balance treated and untreated firms, could provide stronger evidence of causality.

By uncovering the conditional role of external audits in shaping the effectiveness of CE disclosures, our study advances the theoretical understanding of institutional pressures and offers actionable guidance for firms and policymakers committed to substantive CE performance.

Acknowledgments

This study was funded by the European Union—NextGenerationEu, in the framework of theGRINS—Growing, Resilient, INclusive and Sustainable project (Codice Progetto MUR:PE00000018—CUP E63C22002140007). Open access publishing facilitated by Università degli Studi di Brescia, as part of the Wiley - CRUI-CARE agreement.

Disclosure

The views and opinions expressed in this study are solely those of the authors and do not necessarily reflect those of the European Union. The European Union is not responsible for them.

Conflicts of Interest

The authors declare no conflicts of interest.

Consent

The authors have nothing to report.

References

Adams, R. B., B. E. Hermlin, and M. S. Weisbach. 2010. "The Role of Boards of Directors in Corporate Governance: A Conceptual Framework

- and Survey." *Journal of Economic Literature* 48, no. 1: 58–107. <https://doi.org/10.1257/jel.48.1.58>.
- Agnese, P., F. R. Arduino, M. Cerciello, and S. Taddeo. 2024. "Does Board Knowledge Matter for ESG Performance in the European Banking Industry?" *Corporate Social Responsibility and Environmental Management* 31: csr.2811. <https://doi.org/10.1002/csr.2811>.
- Asante-Appiah, B., and T. A. Lambert. 2023. "The Role of the External Auditor in Managing Environmental, Social, and Governance (ESG) Reputation Risk." *Review of Accounting Studies* 28, no. 4: 2589–2641.
- Bannò, M., E. Filippi, and C. Leggerini. 2024. "Gender Quota Laws and Firm Performance: Is There a Trade-Off?" *Corporate Governance: The International Journal of Business in Society* 24, no. 8: 237–260.
- Bernini, F., and F. La Rosa. 2024. "Research in the Greenwashing Field: Concepts, Theories, and Potential Impacts on Economic and Social Value." *Journal of Management and Governance* 28, no. 2: 405–444.
- Berrone, P., A. Fosfuri, L. Gelabert, and L. R. Gomez-Mejia. 2013. "Necessity as the Mother of 'Green' Inventions: Institutional Pressures and Environmental Innovations." *Strategic Management Journal* 34, no. 8: 891–909. <https://doi.org/10.1002/smj.2041>.
- Blasi, S., B. Crisafulli, and S. R. Sedita. 2021. "Selling Circularity: Understanding the Relationship Between Circularity Promotion and the Performance of Manufacturing SMEs in Italy." *Journal of Cleaner Production* 303: 127035.
- Burritt, R. L., and S. Schaltegger. 2010. "Sustainability Accounting and Reporting: Fad or Trend?" *Accounting, Auditing & Accountability Journal* 23, no. 7: 829–846. <https://doi.org/10.1108/09513571011080144>.
- Can, O., and D. Turker. 2025. "Institutional Pressures and Greenwashing in Social Responsibility: Reversing the Link With Hybridization Capability." *Management Decision* 63, no. 1: 187–216.
- Carbone, V., and V. Moatti. 2011. "Towards Greener Supply Chains: An Institutional Perspective." *International Journal of Logistics Research and Applications* 14, no. 3: 179–197. <https://doi.org/10.1080/13675567.2011.609160>.
- CEO Water Mandate. 2014. "Corporate Water Disclosure Guidelines".
- Chen, X., and J. Wang. 2024. "The Impact of Regional Carbon Emission Reduction on Corporate ESG Performance in China." *Sustainability* 16, no. 13: 5802. <https://doi.org/10.3390/su16135802>.
- Chen, Y., and M. Huang. 2023. "Water Usage Reduction and CSR Committees: Taiwan Evidence." *Corporate Social Responsibility and Environmental Management* 30, no. 3: 1070–1081. <https://doi.org/10.1002/csr.2404>.
- Choudhury, M. 2024. "Signaling Theory." *Journal of Accounting, Business and Management (JABM)* 31, no. 2: 98–120.
- Choudhury, R. R., A. F. Islam, and M. Sujaudin. 2024. "More Than Just a Business Ploy? Greenwashing as a Barrier to Circular Economy and Sustainable Development: A Case Study-Based Critical Review." *Circular Economy and Sustainability* 4, no. 1: 233–266. <https://doi.org/10.1007/s43615-023-00288-9>.
- Clarkson, P. M., Y. Li, G. D. Richardson, and F. P. Vasvari. 2008. "Revisiting the Relation Between Environmental Performance and Environmental Disclosure: An Empirical Analysis." *Accounting, Organizations and Society* 33, no. 4–5: 303–327. <https://doi.org/10.1016/j.aos.2007.05.003>.
- Colwell, S. R., and A. W. Joshi. 2013. "Corporate Ecological Responsiveness: Antecedent Effects of Institutional Pressure and Top Management Commitment and Their Impact on Organizational Performance." *Business Strategy and the Environment* 22, no. 2: 73–91. <https://doi.org/10.1002/bse.732>.
- Connelly, B. L., S. T. Certo, R. D. Ireland, and C. R. Reutzel. 2011. "Signaling Theory: A Review and Assessment." *Journal of Management* 37, no. 1: 39–67.
- Cormier, D., and L. Gomez-Gutierrez. 2018. "On the Search for Mimetic Patterns in Environmental Disclosure: An International Perspective." *International Journal of Sustainable Development and World Ecology* 25, no. 7: 655–671. <https://doi.org/10.1080/13504509.2018.1439849>.
- De Freitas Netto, S. V., M. F. F. Sobral, A. R. B. Ribeiro, and G. R. D. L. Soares. 2020. "Concepts and Forms of Greenwashing: A Systematic Review." *Environmental Sciences Europe* 32, no. 1: 19. <https://doi.org/10.1186/s12302-020-0300-3>.
- Delmas, M., and M. W. Toffel. 2004. "Stakeholders and Environmental Management Practices: An Institutional Framework." *Business Strategy and the Environment* 13, no. 4: 209–222. <https://doi.org/10.1002/bse.409>.
- Delmas, M. A., and V. C. Burbano. 2011. "The Drivers of Greenwashing." *California Management Review* 54, no. 1: 64–87. <https://doi.org/10.1525/cmr.2011.54.1.64>.
- Di Pillo, F., G. Palombi, and S. Strazzullo. 2025. "Does Greenwashing Wash Away Gen Z's Green Purchase Intention?" *Business Strategy and the Environment*. <https://doi.org/10.1002/bse.70064>.
- DiMaggio, P. J., and W. W. Powell. 1983. "The Iron Cage Revisited: Institutional Isomorphism and Collective Rationality in Organizational Fields." *American Sociological Review* 48, no. 2: 147. <https://doi.org/10.2307/2095101>.
- Dissanayake, T., S. Dellaportas, and P. W. S. Yapa. 2020. "The Diffusion-Adoption of Accrual Accounting in Sri Lankan Local Governments." *Financial Accountability & Management* 36, no. 3: 261–277. <https://doi.org/10.1111/faam.12222>.
- Dixon-Fowler, H. R., A. E. Ellstrand, and J. L. Johnson. 2017. "The Role of Board Environmental Committees in Corporate Environmental Performance." *Journal of Business Ethics* 140, no. 3: 423–438. <https://doi.org/10.1007/s10551-015-2664-7>.
- Ellen MacArthur Foundation. 2015. "Towards a Circular Economy: Business Rationale for an Accelerated Transition".
- Fatemi, A., I. Fooladi, and H. Tehrani. 2015. "Valuation Effects of Corporate Social Responsibility." *Journal of Banking & Finance* 59: 182–192. <https://doi.org/10.1016/j.jbankfin.2015.04.028>.
- Fenk, L. 2025. "Environmental Photograph Use in Corporate Sustainability Reporting: A Machine-Supported Visual Content Analysis." *Business Strategy and the Environment* 34, no. 1: 1097–1112.
- Geisendorf, S., and F. Pietrulla. 2018. "The Circular Economy and Circular Economic Concepts-A Literature Analysis and Redefinition." *Thunderbird International Business Review* 60, no. 5: 771–782. <https://doi.org/10.1002/tie.21924>.
- Geissdoerfer, M., P. Savaget, N. M. P. Bocken, and E. J. Hultink. 2017. "The Circular Economy—A New Sustainability Paradigm?" *Journal of Cleaner Production* 143: 757–768. <https://doi.org/10.1016/j.jclepro.2016.12.048>.
- Greene, W. H. 2011. *Econometric Analysis*. Prentice Hall.
- Greenwood, R., M. Raynard, F. Kodeih, E. R. Micelotta, and M. Lounsbury. 2011. "Institutional Complexity and Organizational Responses." *Academy of Management Annals* 5, no. 1: 317–371. <https://doi.org/10.5465/19416520.2011.590299>.
- Gregory, R. P. 2024. "The Influence of Firm Size on ESG Score Controlling for Ratings Agency and Industrial Sector." *Journal of Sustainable Finance & Investment* 14, no. 1: 86–99. <https://doi.org/10.1080/20430795.2022.2069079>.
- Guerrero-Baena, M. D., F. Castilla-Polo, and P. Rodríguez-Gutiérrez. 2024. "Motivations for Social and Environmental Reporting in Spanish SMEs: An Inductive Content Analysis." *Business Strategy and the Environment* 33, no. 5: 4130–4144.
- Guo, X., K. Guo, and L. Kong. 2023. "Industrial Agglomeration and Corporate ESG Performance: Empirical Evidence From Manufacturing

- and Producer Services." *Sustainability* 15, no. 16: 12445. <https://doi.org/10.3390/su151612445>.
- He, P., Y. Sun, H. Niu, C. Long, and S. Li. 2021. "The Long and Short-Term Effects of Environmental Tax on Energy Efficiency: Perspective of OECD Energy Tax and Vehicle Traffic Tax." *Economic Modelling, Elsevier BV* 97: 307–325. <https://doi.org/10.1016/j.econmod.2020.04.003>.
- He, Y., and H. Wang. 2025. "The Impact of Carbon Emission Reduction Policies on Corporate ESG Performance: Evidence From Low-Carbon City Pilots." *Applied Economics*: 1–18. <https://doi.org/10.1080/00036846.2025.2484027>.
- Huang, R., X. Xie, and H. Zhou. 2022. "'Isomorphic' Behavior of Corporate Greenwashing." *Chinese Journal of Population, Resources and Environment* 20, no. 1: 29–39.
- Huang, Z., and X. Yang. 2021. "Carbon Emissions and Firm Innovation." *Economic Analysis and Policy* 69: 503–513. <https://doi.org/10.1016/j.eap.2021.01.009>.
- Hummel, K., and C. Schlick. 2016. "The Relationship Between Sustainability Performance and Sustainability Disclosure—Reconciling Voluntary Disclosure Theory and Legitimacy Theory." *Journal of Accounting and Public Policy* 35, no. 5: 455–476. <https://doi.org/10.1016/j.jaccpubpol.2016.06.001>.
- Husted, B. W., and J. M. D. Sousa-Filho. 2017. "The Impact of Sustainability Governance, Country Stakeholder Orientation, and Country Risk on Environmental, Social, and Governance Performance." *Journal of Cleaner Production* 155: 93–102. <https://doi.org/10.1016/j.jclepro.2016.10.025>.
- Ioannou, I., and G. Serafeim. 2019. "The Consequences of Mandatory Corporate Sustainability Reporting." In *The Oxford Handbook of Corporate Social Responsibility*, edited by A. McWilliams, D. E. Rupp, D. S. Siegel, G. K. Stahl, and D. A. Waldman, 451–489. Oxford University Press. <https://doi.org/10.1093/oxfordhb/9780198802280.013.20>.
- Jalil, M. A., S. Gaia, and C. She. 2024. "SDG Water Disclosure Around the Globe." In *Research Handbook on Sustainability Reporting*, 418–430. Edward Elgar Publishing.
- Keresztúri, J. L., E. Berlinger, and Á. Lublőy. 2025. "Environmental Policy and Stakeholder Engagement: Incident-Based, Cross-Country Analysis of Firm-Level Greenwashing Practices." *Corporate Social Responsibility and Environmental Management* 32, no. 1: 192–211. <https://doi.org/10.1002/csr.2945>.
- Kim, E.-H., and T. P. Lyon. 2014. "Brownwash vs. Greenwash: Exaggeration and Undue Modesty in Corporate Sustainability Disclosure", SSRN Electronic Journal, Elsevier BV. doi: <https://doi.org/10.2139/ssrn.2546497>.
- Kirchherr, J., L. Piscicelli, R. Bour, et al. 2018. "Barriers to the Circular Economy: Evidence From the European Union (EU)." *Ecological Economics* 150: 264–272. <https://doi.org/10.1016/j.ecolecon.2018.04.028>.
- Kirmani, A., and A. R. Rao. 2000. "No Pain, no Gain: A Critical Review of the Literature on Signaling Unobservable Product Quality." *Journal of Marketing* 64, no. 2: 66–79.
- Lambooy, T. 2011. "Corporate Social Responsibility: Sustainable Water Use." *Journal of Cleaner Production* 19, no. 8: 852–866. <https://doi.org/10.1016/j.jclepro.2010.09.009>.
- Landrum, N. E., and B. Ohsowski. 2018. "Identifying Worldviews on Corporate Sustainability: A Content Analysis of Corporate Sustainability Reports." *Business Strategy and the Environment* 27, no. 1: 128–151.
- Lashitew, A. A. 2021. "Corporate Uptake of the Sustainable Development Goals: Mere Greenwashing or an Advent of Institutional Change?" *Journal of International Business Policy* 4, no. 1: 184–200. <https://doi.org/10.1057/s42214-020-00092-4>.
- Leggerini, C., and M. Bannò. 2025. "From Tweets to Insights: Social Opinion Mining on Corporate Social Responsibility." *Corporate Social Responsibility and Environmental Management* 32: 5996–6015.
- Leggerini, C., L. L. Preiato, and M. Bannò. 2025. "Assessing Support for Gender Equality Certification in Italian Lombard Companies", in *Proceedings of the 7th International Conference on Gender Research*. Academic Conferences and Publishing Limited.
- Li, C., W. Tang, F. Liang, and Z. Wang. 2024. "The Impact of Climate Change on Corporate ESG Performance: The Role of Resource Misallocation in Enterprises." *Journal of Cleaner Production* 445: 141263.
- Li, J., and X. Xu. 2024. "Can ESG Rating Reduce Corporate Carbon Emissions? – An Empirical Study From Chinese Listed Companies." *Journal of Cleaner Production* 434: 140226. <https://doi.org/10.1016/j.jclepro.2023.140226>.
- Li, W., W. Li, V. Seppänen, and T. Koivumäki. 2023. "Effects of Greenwashing on Financial Performance: Moderation Through Local Environmental Regulation and Media Coverage." *Business Strategy and the Environment* 32, no. 1: 820–841.
- Li, X., J. Hao, Z. Ding, J. Yang, and Y. Yao. 2025. "Unveiling the Driving Mechanism of Greenwashing Behaviors: An Agent-Based Modeling Approach Integrating New Institutionalism and Halo Effect Theories." *Humanities and Social Sciences Communications* 12, no. 1: 1–16.
- Liang, Q., X. Li, X. Yang, D. Lin, and D. Zheng. 2013. "How Does Family Involvement Affect Innovation in China?" *Asia Pacific Journal of Management* 30, no. 3: 677–695. <https://doi.org/10.1007/s10490-012-9320-x>.
- Liu, J., Y. Feng, Q. Zhu, and J. Sarkis. 2018. "Green Supply Chain Management and the Circular Economy: Reviewing Theory for Advancement of Both Fields." *International Journal of Physical Distribution and Logistics Management* 48, no. 8: 794–817.
- Lyon, T. P., and A. W. Montgomery. 2015. "The Means and End of Greenwash." *Organization & Environment* 28, no. 2: 223–249. <https://doi.org/10.1177/1086026615575332>.
- Marquis, C., M. W. Toffel, and Y. Zhou. 2016. "Scrutiny, Norms, and Selective Disclosure: A Global Study of Greenwashing." *Organization Science* 27, no. 2: 483–504. <https://doi.org/10.1287/orsc.2015.1039>.
- Martínez-Ferrero, J., and I.-M. García-Sánchez. 2018. "The Level of Sustainability Assurance: The Effects of Brand Reputation and Industry Specialisation of Assurance Providers." *Journal of Business Ethics* 150, no. 4: 971–990. <https://doi.org/10.1007/s10551-016-3159-x>.
- Masocha, R., and O. Fatoki. 2018. "The Role of Mimicry Isomorphism in Sustainable Development Operationalisation by SMEs in South Africa." *Sustainability* 10, no. 4: 1264. <https://doi.org/10.3390/su10041264>.
- Mateo-Márquez, A. J., J. M. González-González, and C. Zamora-Ramírez. 2022. "An International Empirical Study of Greenwashing and Voluntary Carbon Disclosure." *Journal of Cleaner Production* 363: 132567. <https://doi.org/10.1016/j.jclepro.2022.132567>.
- Meng, B., Q. Zang, and G. Li. 2024. "Study on the Impact of Corporate Social Responsibility on Carbon Performance in the Background of Carbon Peaking and Carbon Neutrality." *Business Ethics, the Environment & Responsibility* 33, no. 3: 416–430. <https://doi.org/10.1111/beer.12614>.
- Meyer, J. W., and B. Rowan. 1977. "Institutionalized Organizations: Formal Structure as Myth and Ceremony." *American Journal of Sociology* 83, no. 2: 340–363. <https://doi.org/10.1086/226550>.
- Michelon, G., and M. Rodrigue. 2015. "Demand for CSR: Insights From Shareholder Proposals." *Social and Environmental Accountability Journal* 35, no. 3: 157–175. <https://doi.org/10.1080/0969160X.2015.1094396>.
- Moroney, R., C. Windsor, and Y. T. Aw. 2012. "Evidence of Assurance Enhancing the Quality of Voluntary Environmental Disclosures: An

- Empirical Analysis." *Accounting and Finance* 52, no. 3: 903–939. <https://doi.org/10.1111/j.1467-629x.2011.00413.x>.
- O'Brien, R. M. 2007. "A Caution Regarding Rules of Thumb for Variance Inflation Factors." *Quality & quantity* 41, no. 5: 673–690.
- Oliver, C. 1997. "Sustainable Competitive Advantage: Combining Institutional and Resource-Based Views." *Strategic Management Journal* 18, no. 9: 697–713. [https://doi.org/10.1002/\(SICI\)1097-0266\(199710\)18:9<697::AID-SMJ909>3.0.CO;2-C](https://doi.org/10.1002/(SICI)1097-0266(199710)18:9<697::AID-SMJ909>3.0.CO;2-C).
- Pan, X., P. Sinha, and X. Chen. 2021. "Corporate Social Responsibility and Eco-Innovation: The Triple Bottom Line Perspective." *Corporate Social Responsibility and Environmental Management* 28, no. 1: 214–228. <https://doi.org/10.1002/csr.2043>.
- Peng, X., X. Cui, Y. Bai, and Y. Xu. 2023. "Institutional Isomorphism Pressure and Multinational Corporations' Environmental and Social Performance." *Applied Economics Letters* 30, no. 17: 2424–2434. <https://doi.org/10.1080/13504851.2022.2097628>.
- Pozzoli, M., F. Paolone, E. De Nuccio, and R. Tiscini. 2024. "Does Financial Materiality Judgement Matter in Reporting Intellectual Capital? A Systematic Literature Review and Future Research Trends." *Journal of Intellectual Capital* 25, no. 7: 87–108. <https://doi.org/10.1108/jic-03-2024-0083>.
- Priem, R., and A. Gabbellone. 2024. "The Impact of a Firm's ESG Score on Its Cost of Capital: Can a High ESG Score Serve as a Substitute for a Weaker Legal Environment." *Sustainability Accounting, Management and Policy Journal* 15: 676–703. <https://doi.org/10.1108/SAMPJ-05-2023-0254>.
- Prisco, A., I. Ricciardi, M. Percuoco, and V. Basile. 2025. "Sustainability-Driven Fashion: Unpacking Generation z's Second-Hand Clothing Purchase Intentions." *Journal of Retailing and Consumer Services* 85: 104306.
- Ross, S. A. 1977. "The Determination of Financial Structure: The Incentive-Signalling Approach." *Bell Journal of Economics* 8: 23–40.
- Simnett, R., A. Vanstraelen, and W. F. Chua. 2009. "Assurance on Sustainability Reports: An International Comparison." *Accounting Review* 84, no. 3: 937–967. <https://doi.org/10.2308/accr.2009.84.3.937>.
- Simpson, D. 2012. "Knowledge Resources as a Mediator of the Relationship Between Recycling Pressures and Environmental Performance." *Journal of Cleaner Production* 22, no. 1: 32–41. <https://doi.org/10.1016/j.jclepro.2011.09.025>.
- Spence, M. 1973. "Job Market Signaling." *Quarterly Journal of Economics* 87: 355–374.
- Spitzeck, H. 2009. "The Development of Governance Structures for Corporate Responsibility." *Corporate Governance: The International Journal of Business in Society* 9, no. 4: 495–505. <https://doi.org/10.1108/14720700910985034>.
- Sun, S., S. F. A. Batista, M. Menéndez, Y. Wang, and S. Zhang. 2024. "Powering Up Urban Mobility: A Comparative Study of Energy Efficiency in Electric and Diesel Buses Across Various Lane Configurations." *Sustainable Cities and Society* 101: 105086. <https://doi.org/10.1016/j.scs.2023.105086>.
- Testa, F., I. Miroshnychenko, R. Barontini, and M. Frey. 2018. "Does It Pay to Be a Greenwasher or a Brownwasher?" *Business Strategy and the Environment* 27, no. 7: 1104–1116. <https://doi.org/10.1002/bse.2058>.
- Torelli, R., F. Balluchi, and K. Furlotti. 2020. "The Materiality Assessment and Stakeholder Engagement: A Content Analysis of Sustainability Reports." *Corporate Social Responsibility and Environmental Management* 27, no. 2: 470–484.
- Uyar, A., C. Kuzey, M. Kilic, and A. S. Karaman. 2021. "Board Structure, Financial Performance, Corporate Social Responsibility Performance, CSR Committee, and CEO Duality: Disentangling the Connection in Healthcare." *Corporate Social Responsibility and Environmental Management* 28, no. 6: 1730–1748.
- von Rosing, M., L. Shepperson, and H. Czichos. 2025. "External ESG Auditing: The What, Why, Who, and How." In *The Sustainability Handbook, Volume 1*, 661–669. Elsevier.
- Wang, Y., Y. Wang, Z. Chen, and H. Shen. 2025. "The Flip Side of ESG: Do ESG Rating Discrepancies Undermine Corporate Energy Efficiency?—A Comprehensive Assessment Using Double Machine Learning." *Applied Economics Letters*: 1–11. <https://doi.org/10.1080/13504851.2024.2449545>.
- Westphal, J. D., and E. J. Zajac. 1998. "The Symbolic Management of Stockholders: Corporate Governance Reforms and Shareholder Reactions." *Administrative Science Quarterly* 43, no. 1: 127. <https://doi.org/10.2307/2393593>.
- Wijen, F. 2014. "Means Versus Ends in Opaque Institutional Fields: Trading Off Compliance and Achievement in Sustainability Standard Adoption." *Academy of Management Review* 39, no. 3: 302–323. <https://doi.org/10.5465/amr.2012.0218>.
- Wintoki, M. B., J. S. Linck, and J. M. Netter. 2012. "Endogeneity and the Dynamics of Internal Corporate Governance." *Journal of Financial Economics* 105, no. 3: 581–606. <https://doi.org/10.1016/j.jfineco.2012.03.005>.
- Wooldridge, J. M. 2019. *Introductory Econometrics*. Cengage.
- Zhang, Z., X. Zheng, Q. Lv, and X. Meng. 2025. "How Institutional Pressures Influence Corporate Greenwashing Strategies: Moderating Effects of Campaign-Style Environmental Enforcement." *Journal of Environmental Management* 373: 123914.