

Article

ESG Practices and the Economic and Financial Performance of Energy Companies: A Multi-Method Analysis

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Abstract

The relationship between environmental, social and governance (ESG) performance and corporate financial performance (CFP) remains an open question, particularly in capital-intensive sectors exposed to regulatory pressures and long-term transition costs. This study analyses the relationship between ESG ratings and financial performance using accounting data from 59 listed European energy companies over the period 2014–2023. ESG ratings were obtained from standardised sustainability scores available on Yahoo Finance and are therefore used as proxies for corporate sustainability performance. Financial data were extracted from Orbis Europe Full. The empirical design adopts an exploratory multi-method approach combining correlation analysis, multiple linear regression (OLS) and structural equation modelling (SEM). In the SEM model specification, ROE, ROA and ROCE are modelled as reflective indicators of a latent construct termed ‘economic performance’, whilst financial leverage is treated as a distinct observed variable representing firms’ financing structure. The results show that traditional linear models have limited explanatory power in explaining ESG ratings. The SEM analysis indicates that the latent construct of economic performance has a positive but statistically insignificant association with ESG ratings, whilst financial leverage shows a marginally significant positive association. Factor loadings confirm that ROE, ROA and ROCE consistently represent the common dimension of economic performance. Overall, the results suggest that ESG ratings in the European energy sector are explained not solely by short-term accounting profitability but also by broader strategic, organisational, governance, and financing conditions. The study contributes to research on the ESG-CFP relationship by proposing an exploratory structural equation modelling approach to modelling economic performance as a latent accounting construct. It offers food for thought for managers and policymakers evaluating sustainability strategies in capital-intensive transition contexts.

Keywords: ESG; corporate financial performance (CFP); energy sector; structural equation (SEM) modelling; ROCE; trade-off theory; energy transition



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1. Introduction

The growing global urgency, driven by the climate crisis and social pressures, has placed environmental, social, and governance (ESG) factors at the heart of corporate strategies and investor decision-making (Eccles et al., 2014). In this context, interest in the two-way relationship between corporate sustainability performance, measured through ESG ratings, and corporate financial performance (CFP) has generated a vast but inconclusive academic debate (Griffin & Mahon, 1997; Marom, 2006).

Although the main meta-analyses in the literature tend to confirm a non-negative and, in many cases, positive relationship between ESG performance and corporate financial performance (CFP), the causal link remains controversial and is highly dependent on the sectoral context, the time horizon considered, and the metrics used to measure sustainability and financial performance (Friede et al., 2015).

1.1. Sectoral Context and Relevance

The European energy sector is a key area of study for several reasons:

1. *Environmental and regulatory impact.* Energy companies are at the heart of the energy transition and of the European Union's policy implementation.
2. *Green Deal.* Companies in the sector face unprecedented regulatory pressure (e.g., the Taxonomy Regulation, the CSRD) and are the primary targets for emissions reduction. Their ESG performance is not only a reputational factor but also a prerequisite for access to capital.
3. *Capital intensity.* Activities in this sector are characterised by very high capital intensity and long investment cycles. The transition to renewable energy requires substantial capital expenditure that does not generate immediate returns, potentially creating financial strain in the short and medium term.
4. *Empirical contradictions.* Empirical evidence in the energy sector is particularly heterogeneous and often contradictory. Whilst stakeholder theory suggests that integrating sustainability can generate competitive advantages and create long-term value, the trade-off hypothesis (Graafland, 2002) highlights that sustainability-oriented investments can entail high short-term costs, particularly in sectors characterised by high capital intensity. Studies in the energy sector show that financial performance indicators are particularly sensitive to such efficiency constraints, often producing conflicting results regarding the relationship between sustainability and corporate profitability (Pătări et al., 2014; Ozata Canli & Sercemeli, 2025).

1.2. The Research Gap and the Scope of the Study

Much of the existing literature has used multiple linear regression (OLS) to examine the relationship between ESG and financial performance using accounting metrics (i.e., those based on financial statements) such as ROE and ROA. However, such approaches may be limited when the phenomenon under analysis involves multidimensional, highly intercorrelated factors.

In light of this limitation, the primary objective of this study is to assess whether and to what extent financial performance, modelled using accounting indicators, is associated with the ESG ratings of major European energy companies (2014–2023), going beyond a simple linear relationship to employ a multi-method approach based on correlation analysis, multiple regression and structural equation modelling (SEM) to examine the structural associations between ESG ratings and economic and financial performance.

1.3. Contribution and Structure of the Article

This article aims to make three main contributions to the existing body of knowledge:

1. *Methodological validation:* The study adopts an approach based on structural equation modelling (SEM) to represent economic performance as a latent construct measured through ROE, ROA and ROCE. In this context, path analysis is used as an operational component of the SEM model rather than as a standalone technique aimed at identifying causal relationships. This approach allows for a more consistent treatment of the high correlation between accounting profitability indicators and enables an analysis of the relationships among economic performance, financial leverage, and ESG ratings.

2. *Empirical contribution*: To provide evidence on the explanatory power of accounting indicators of economic and financial performance with respect to ESG ratings in the European energy sector over the period 2014–2023, highlighting the limited explanatory power of traditional accounting indicators with respect to ESG scores.

3. *Sectoral contribution*: To contribute to the understanding of ESG–CFP dynamics in a sector characterised by high capital intensity and profound transformations linked to the energy transition.

The article is structured as follows. Section 2 presents the literature review and identifies the research gap. Section 3 formulates the research hypotheses. Section 4 describes the materials and methods used, including correlation analysis, OLS multiple regression, and structural equation modelling (SEM). Section 5 presents the descriptive analysis of the sample. Sections 6 and 7 report the correlation analysis, the results of the OLS regression and those of the SEM model, respectively. Section 8 discusses the results in light of the assumptions made and the theoretical framework. Finally, Section 9 presents the conclusions, the theoretical and managerial implications, the study’s limitations, and prospects for future research. Section 5 presents a descriptive analysis of the sample. Section 6 presents a descriptive analysis of the main financial ratios. Section 7 presents the econometric analysis, comprising the correlation analysis, OLS multiple regression and structural equation modelling (SEM). Section 8 discusses the results in light of the hypotheses formulated. Finally, Section 9 presents the conclusions, theoretical and managerial implications, the study’s limitations, and avenues for future research.

2. Literature Review

2.1. Bibliometric Analysis and Identification of the Research Gap

To help identify research gaps and situate this study within the scientific debate on the theoretically bidirectional relationship between ESG performance and corporate financial performance (CFP) in the energy sector, an exploratory bibliometric analysis was conducted in Scopus.

The research, carried out in November 2025 using a search string focused on ESG issues, corporate sustainability, the energy sector, and economic performance, identified 43 relevant scientific papers, predominantly from the disciplinary areas of Business, Management and Accounting, and Economics, Econometrics and Finance.

The analysis highlights three main aspects.

Firstly, the literature on the ESG–CFP link in the energy sector has grown significantly in recent years, underscoring the topic’s increasing relevance both academically and in management practice.

Secondly, the empirical results remain heterogeneous and often contradictory, with no established consensus emerging regarding the nature and direction of the relationship between sustainability and economic and financial performance.

Thirdly, most studies rely on traditional linear econometric approaches, whilst the application of methodologies that can simultaneously capture direct and indirect relationships and interdependencies between financial variables and ESG indicators remains limited.

This evidence confirms the existence of a twofold gap.

On the one hand, uncertainty persists regarding the relationship between ESG ratings and accounting performance indicators in capital-intensive sectors; on the other hand, analytical approaches to the structural representation of the relationships between economic performance and sustainability remain largely unexplored.

For the sake of brevity, the detailed results of the bibliometric analysis, including descriptive statistics, citation analysis, author mapping and keyword co-occurrence, are provided in Appendix A.

2.2. The Main Issues Addressed

2.2.1. The Theoretical Foundations of the ESG-CFP Nexus

The relationship between corporate social responsibility (CSR), now measured primarily through ESG criteria, and a company's economic and financial performance is one of the most extensively studied constructs in finance and business management, in both directions of causality. The theoretical debate, far from being resolved, continues to unfold between value creation and trade-off hypotheses (Marom, 2006).

(a) On the one hand, the value creation hypothesis is supported by stakeholder theory and the resource-based view (RBV). Companies with high ESG performance are perceived as more sustainable, better equipped to manage regulatory and reputational risks, and are more likely to attract talent and capital (Berman et al., 1999). This approach suggests that integrating sustainability into operational processes leads to long-term competitive advantage (Eccles et al., 2014). Historically, influential studies, such as those by Waddock and Graves (1997), have found a positive correlation between social and financial performance, supporting the idea that 'doing good is good' in both social and economic terms.

(b) On the other hand, the trade-off hypothesis (Graafland, 2002) argues that ESG investments, whilst ethically desirable, represent additional costs that absorb resources and reduce short-term profitability, especially if not managed efficiently. This view is partially supported by less conclusive analyses, such as that of Aupperle et al. (1985), which found no significant correlation between social responsibility and financial performance.

(c) Finally, a third line of research, to which the concept of the Unified Relationship (Marom, 2006) applies, suggests that the direction of the link is complex and often endogenous. For example, it has been shown that a strong track record of economic performance can be a precursor to future corporate social responsibility, as only financially strong firms can afford the costly investments required for social responsibility (McGuire et al., 1988; Waddock & Graves, 1997). Therefore, the contradictory nature of empirical findings often stems from the nonlinearity of the relationship (Griffin & Mahon, 1997).

2.2.2. Sectoral Specificity and Measurement of the CFP

The energy sector represents a particularly sensitive research context for three reasons (Larrinaga-González, 2011): its high capital intensity, its strategic importance (as it involves critical infrastructure) and its high exposure to regulatory risk arising from the energy transition.

Empirical evidence in the energy sector suggests that the impact of sustainability is closely linked to the type of financial metric used. Larrinaga-González (2011), in a study of the energy industry, highlighted how the positive link between sustainable development and economic performance tends to emerge mainly when economic performance is measured through market capitalisation (market-based measures), which reflect investors' future expectations, rather than through accounting-based measures (accounting measures) such as ROE and ROA, which reflect past efficiency.

This distinction is fundamental:

- Accounting indicators (such as ROE, ROA and ROCE) are more heavily influenced by the short-term costs associated with ESG investments (Graafland, 2002), making the trade-off more apparent.
- Market indicators (such as enterprise value) tend to incorporate the benefits derived from risk reduction and high-quality ESG reporting (Fatemi et al., 2018), rewarding the long-term strategy.

2.2.3. The Methodological Gap and the Adoption of a Structural Approach

A significant proportion of the literature analysing the relationship between ESG performance and corporate financial performance (CFP) relies on multiple linear regression and correlation analysis. These approaches have made a significant contribution to the empirical understanding of the phenomenon, enabling the estimation of the association between sustainability indicators and economic and financial measures. However, the results obtained often remain heterogeneous and sometimes contradictory, both in the strength and direction of the observed relationship (Griffin & Mahon, 1997; Marom, 2006).

This heterogeneity stems from the multidimensional nature of sustainability and economic performance. Traditional indicators such as ROE, ROA, and ROCE are not independent; they are strongly correlated, which, when used simultaneously in models, generate multicollinearity and interpretative problems, thereby limiting their explanatory power (O'Brien, 2007; Hair et al., 2019).

This issue appears particularly relevant in the energy sector, characterised by high capital intensity, significant long-term investments and growing regulatory pressure stemming from energy transition processes. In this context, the relationship between economic performance and ESG ratings can be influenced by multiple economic, financial, and strategic factors, which are difficult to represent by simple linear relationships among observable variables.

To address this complexity, this study integrates correlation analysis and multiple regression using a structural equation modelling (SEM) approach. The aim is not to regard SEM as a substitute for, or necessarily superior to, traditional linear models, nor to use it as a tool for causal identification. Instead, SEM is adopted as a complementary methodology that enables the representation of latent constructs that are not directly observable and the simultaneous analysis of associations among multiple correlated variables (Anderson & Gerbing, 1988; Hair et al., 2019).

Consistent with this approach, ROE, ROA and ROCE are interpreted as observable indicators of a common latent dimension defined as 'economic performance'. This methodological choice allows us to capture the shared component of corporate profitability and reduce the analytical fragmentation that arises from examining individual accounting indicators in isolation. The relationship between this latent construct, financial leverage, and the ESG rating is therefore examined using a structural model that provides a more coherent representation of the interdependencies among the variables.

The model specification, therefore, does not assume a mechanical causal chain between the individual accounting indicators, nor does it assume that ROE, ROA, and ROCE act as independent variables in a hierarchical order. On the contrary, these indicators are considered as observable manifestations of the same underlying economic and financial dimension.

Financial leverage is considered an autonomous dimension of the financial structure rather than a performance dimension. In the energy sector, characterised by heavy investment, constraints and risks directly influence the ability to sustain the transition and the associated ESG rating (Titman & Wessels, 1988; Fatemi et al., 2018).

This specification allows a clear distinction between the measurement and structural models. In the measurement model, ROE, ROA, and ROCE are indicators of the latent variable 'economic performance'. In the structural model, 'economic performance' and financial leverage are related to the ESG rating to examine whether corporate sustainability is associated with the firm's overall economic and financial soundness and its financing structure. In this sense, the model does not aim to demonstrate a unidirectional causal sequence but rather to represent a theoretically grounded set of structural associations among performance, capital, and sustainability (Figure 1).

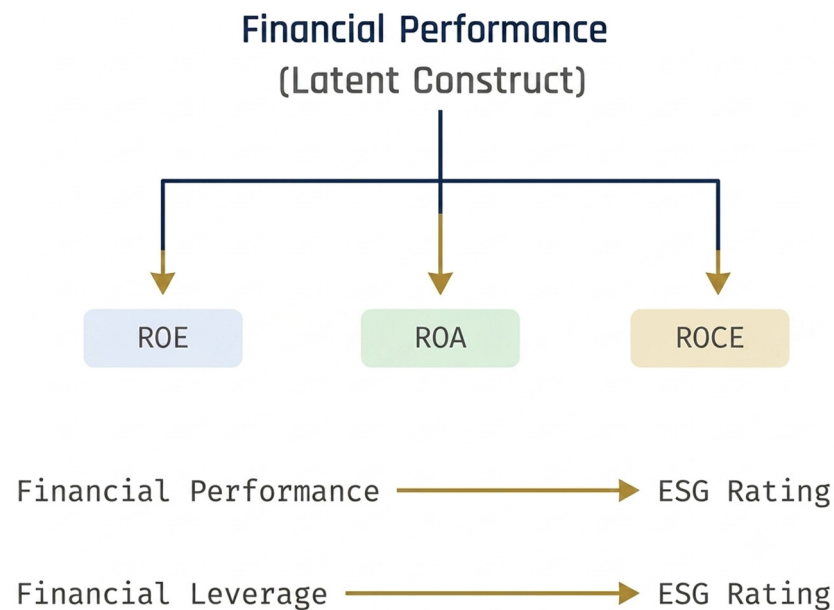


Figure 1. Conceptual framework of the ESG–CFP structural model. **Note:** Financial performance is specified as a latent construct reflected by ROE, ROA, and ROCE. Financial leverage is modelled as a distinct observed variable representing the firm’s financing structure. The framework illustrates theoretically grounded structural associations adopted in the SEM specification and should not be interpreted as a fully identified causal model.

The latest evidence suggests that ESG outcomes depend not only on a company’s economic performance but also on organisational mechanisms, governance processes, resource allocation methods, and strategic decisions, which operate through interconnected relationships that are not always directly observable (Song et al., 2025). From this perspective, structural analysis can offer a representation that better captures the complexity of the phenomenon than an approach based solely on direct relationships between individual variables.

Although some recent studies have adopted structural approaches or SEM models in the field of corporate sustainability, these applications have predominantly focused on analysing governance mechanisms, innovation processes, the quality of ESG disclosure, or specific mediating effects (e.g., Song et al., 2025; Aich et al., 2021). In contrast, the literature analysing the ESG–CFP relationship in the energy sector continues to rely heavily on linear regression models that treat ROE, ROA and ROCE as separate indicators of corporate performance (Ozata Canli & Sercemeli, 2025; Cortez & Kelly, 2025).

The methodological contribution of this study, therefore, does not lie in introducing SEM as a technique in the absolute sense, but rather in modelling economic performance as a latent construct measured by strongly correlated accounting indicators. This approach enables overcoming the interpretative fragmentation arising from the separate use of traditional profitability indicators and analysing the relationship with the ESG rating at the level of overall economic and financial performance.

In light of these considerations, the methodological gap this study aims to address concerns the limited use of structural approaches to examine the associations among latent economic and financial performance, financial leverage, and ESG ratings in the European energy sector. The study’s contribution, therefore, is to propose an exploratory analysis of the associations among ESG ratings, latent economic performance, and financial leverage, providing an integrated understanding of the phenomenon without claiming to identify definitive causality.

A further source of ambiguity in the ESG–CFP literature concerns the direction of the relationship itself. Whilst numerous studies analyse the impact of ESG performance on financial results, other contributions suggest that firms with greater economic and financial resources are more likely to undertake sustainability investments and improve their ESG performance. In line with the Slack Resources Hypothesis, this study adopts the latter perspective and examines whether economic and financial conditions are associated with ESG ratings in European energy companies.

3. Formulation of Research Hypotheses

The literature on the relationship between environmental, social, and governance (ESG) factors and corporate financial performance (CFP) has yielded mixed and often contradictory results. Some studies highlight a positive relationship between sustainability and financial performance, consistent with stakeholder theory and the resource-based view (Berman et al., 1999; Eccles et al., 2014). Other studies, however, emphasise the costs associated with ESG investments, particularly in capital-intensive sectors, and highlight possible negative effects on short-term profitability (Graafland, 2002; Pätäri et al., 2014).

In the energy sector, the relationship between sustainability and economic performance is particularly complex due to high investment requirements, long time horizons for economic returns, and growing regulatory pressures associated with the energy transition. In this context, economic performance cannot be interpreted solely through individual accounting indicators, but rather as a multidimensional concept that reflects the firm's overall ability to generate economic results through the efficient use of its financial and operational resources.

Consistent with this approach, this study interprets ROE, ROA and ROCE as observable indicators of a common latent dimension termed “economic performance”.

Based on these considerations, the following hypotheses are formulated.

Hypothesis 1 (H1). *Economic performance is positively associated with the ESG rating of European energy companies.*

According to the Slack Resources Hypothesis and the resource-based view, companies with greater availability of economic and financial resources have a higher capacity to sustain sustainability-oriented investments, absorb the costs of the energy transition and develop long-term ESG strategies (Waddock & Graves, 1997; Eccles et al., 2014; Bhandari et al., 2022). Higher economic performance is a condition for adopting more advanced ESG practices.

Hypothesis 2 (H2). *ROE, ROA and ROCE represent consistent observable indicators of a common latent dimension of economic performance.*

ROE, ROA and ROCE measure different aspects of corporate profitability: return on equity, asset efficiency and return on invested capital. Although they refer to different perspectives, these indicators share a common conceptual basis: the company's ability to generate economic results by using its resources. Their high theoretical and empirical correlation, therefore, suggests the presence of a common underlying dimension that represents the firm's overall economic–financial performance (Hair et al., 2019; Anderson & Gerbing, 1988).

Hypothesis 3 (H3). *Leverage is associated with the ESG rating of European energy companies.*

In the energy sector, investments required for the sustainable transition often involve external financing. Leverage can therefore reflect both the company's ability to mobilise resources to support ESG investments and the presence of financial constraints that may limit such investments. Consistent with the trade-off hypothesis and with the literature on the financial structure of firms, it is hypothesised that there is a significant relationship between leverage and ESG ratings, the direction of which must be empirically verified (Graafland, 2002; Titman & Wessels, 1988; Fatemi et al., 2018).

4. Materials and Methods

This study is based on the processing of financial data extracted from the Orbis Europe Full platform, managed by Moody's. The survey covers the period 2014–2023 and analyses a sample of 59 listed energy companies. The dataset is structured as an unbalanced panel, as the availability of ESG data and economic and financial variables is inconsistent across companies and years under consideration. Some firms are therefore only present in specific time periods, depending on the availability of information in the databases used, particularly for ESG ratings extracted from Yahoo Finance. The empirical analyses are conducted using firm-year observations, consistent with the dataset's unbalanced panel structure. Any descriptive aggregations by country are used solely for illustrative and exploratory purposes and should not be interpreted as macroeconomic indicators or structural comparisons between national economies.

The dataset used in the inferential analyses is structured at the firm-year level. Economic and financial indicators, such as ROE, ROA, ROCE, and financial leverage, vary annually over the period 2014–2023, whilst the ESG rating available on Yahoo Finance is associated with the individual firm and is held constant across annual observations for the same company. This approach preserves the temporal variability of economic and financial indicators. However, the presence of repeated observations for the same firm may generate intra-firm correlation. Therefore, the inferential results are interpreted in an exploratory and associative manner and not as definitive causal evidence.

The study analyses the following economic and financial performance ratios:

- ROE (return on equity);
- ROA (Return on Assets);
- ROCE (return on capital employed);
- Leverage.

The economic and financial data collected were subjected to a preliminary descriptive statistical analysis. The aim is to synthesise the distributions of the main performance and sustainability indicators using fundamental descriptive statistics, such as the mean, median, standard deviation, sample variance, skewness, minimum, and maximum values (Hair et al., 2019). These statistics provide a preliminary picture of the dataset's dispersion and heterogeneity, offering methodological support for subsequent inferential analysis. To reduce the influence of outliers on statistical and econometric analyses, the economic and financial variables under consideration were winsorised at the 5th and 95th percentiles. Values below the 5th and above the 95th percentile, in particular, were capped at their respective thresholds, thereby preserving the sample size and limiting potential distortion of the descriptive statistics and econometric estimates. All the econometric analyses presented in the following sections (Correlation, OLS regression and SEM) were carried out using the winsorised variables.

Regarding the dependent variable, each company included in the sample was assigned an ESG rating (ESG rating), derived from the collection and standardisation of data available on the Yahoo Finance platform, a platform used in several recent empirical studies to analyse the relationship between sustainability and economic performance (He et al., 2023).

Although less comprehensive than specialised databases (Refinitiv, Bloomberg, MSCI), Yahoo Finance provides standardised and comparable data, ideal for international comparative analysis. The choice of this source is motivated by its widespread use in recent empirical research and the availability of consistent ESG data across the entire sample analysed (Shobhwani & Lodha, 2023; Balan et al., 2026).

The ESG scores used in this study are derived from sustainability data available on Yahoo Finance and are interpreted as an ESG risk rating. Under this metric, higher values indicate a greater level of unmanaged ESG risk, whilst lower values indicate a more favourable ESG profile. Therefore, the ESG rating is not interpreted as a direct measure of ‘better ESG performance’, but rather as a proxy for the company’s overall ESG risk. Consequently, in the empirical analyses, a positive coefficient indicates an association with higher ESG risk, whilst a negative coefficient indicates an association with lower ESG risk.

This choice, however, entails certain methodological limitations, particularly regarding the transparency of the criteria used to construct the ratings and their comparability with those of other specialised ESG providers. The results must therefore be interpreted with due caution. Future research could replicate the analysis using ESG scores from specialised providers to assess the robustness of the observed associations.

To analyse the relationships between ESG ratings and economic and financial performance indicators, a multi-method approach was adopted, comprising three complementary statistical techniques: correlation analysis, OLS multiple regression, and path analysis using structural equation modelling (SEM) (Hair et al., 2019). This approach should not be interpreted as a hierarchical progression towards causal identification, but rather as a set of different analytical tools used to observe the phenomenon from complementary statistical perspectives. The aim is to provide a more detailed representation of the interdependencies between economic and financial variables and ESG ratings.

1. Multiple Correlation Analysis

The initial phase was devoted to multiple correlation analysis. This technique enabled us to map the interrelationships among all the variables and quantify the strength and direction of the linear associations. This exploratory approach is useful for identifying potential multicollinearity issues (O’Brien, 2007) and for providing a preliminary picture of the statistical relationships among the variables under consideration.

2. Multiple Regression (OLS)

Subsequently, multiple regression (OLS) was applied, an inferential technique widely used in econometric analysis (Hair et al., 2019). Regression was used to estimate the statistical associations between a set of independent accounting variables (ROE, ROA, ROCE and financial leverage) and the ESG rating (dependent variable). This phase provided a quantitative measure of the association between each explanatory factor and the ESG rating, offering an initial interpretative framework of the linear relationships between the variables (hypothesis H1).

3. Structural Equation Modelling (SEM)

The adopted SEM model incorporates a path analysis structure, allowing simultaneous analysis of relationships between observed variables and latent constructs within a unified structural framework (Anderson & Gerbing, 1988).

In the proposed model, a latent variable termed ‘economic performance’ was defined and measured using the ROE, ROA, and ROCE indicators. The structural model was used to analyse the relationships among economic performance, financial leverage, and ESG ratings.

The model’s fit was assessed using the main fit indices commonly employed in the SEM literature, including the Comparative Fit Index (CFI), Tucker–Lewis Index (TLI),

Root Mean Square Error of Approximation (RMSEA) and Standardised Root Mean Square Residual (SRMR) (Hair et al., 2019).

The combined use of these techniques therefore allows for the integration of descriptive, inferential and structural evidence, offering a more nuanced understanding of the relationships between sustainability and economic and financial performance in the European energy sector (Hair et al., 2019).

5. Descriptive Analysis of the Sample

ESG (environmental, social and governance) criteria are becoming increasingly important in shaping the industrial and financial strategies of the European energy sector. In line with the objectives of the European Green Deal and the energy transition directives, companies in the sector are called upon to financial statments profitability with environmental sustainability. The progressive decarbonisation of energy sources, the development of renewable energy and the adoption of energy-efficiency technologies are all outcomes of a focus on the environment. The sector is responsible for ensuring managerial transparency, ethical conduct, and compliance with EU regulations, whilst, at a social level, it is committed to providing safe working conditions, inclusion, and equitable access to energy.

This study examines the relationship between economic and financial performance and ESG ratings in the European energy sector, with a particular focus on the role of these practices in supporting a sustainable transition, operational efficiency and a reduction in environmental impact. Between 2014 and 2023, 59 listed companies operating in the European energy sector were selected, based on the availability of certified ESG ratings in the Yahoo Finance databases.

A sectoral analysis of the sample (Figure 2) shows an apparent prevalence of companies operating in traditional sectors: around 42% are active in the gas and oil sectors, 36% in services and equipment related to these energy sources, whilst 19% belong to the renewable energy sector and 3% to the uranium sector. This empirical distribution confirms the persistent imbalance between fossil and sustainable energy sources, despite regulatory and market pressures encouraging the transition.

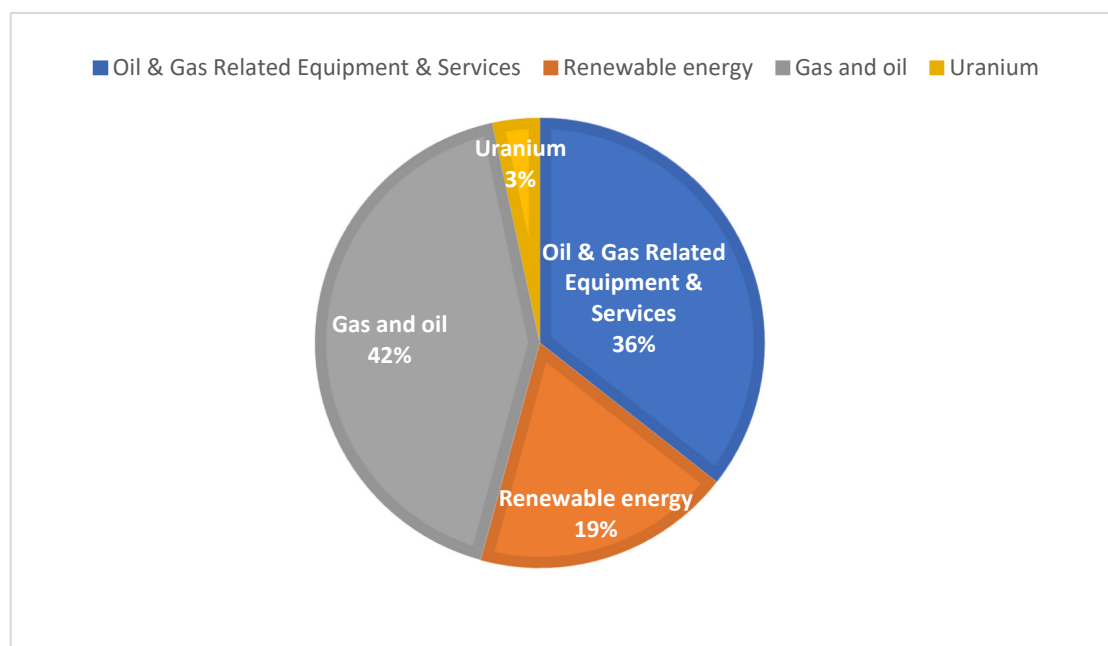


Figure 2. Distribution in the European energy sector of the sample (Source: Our elaboration).

Table 1 describes the sample of companies, broken down by European country, for which ESG data is available.

Table 1. ESG business sample.

<i>Country</i>	<i>N.</i>
Austria	1
Belgium	2
Germany	6
Denmark	1
Estonia	1
Spain	3
Finland	1
France	8
United Kingdom	16
Republic of Ireland	2
Italy	5
Luxembourg	1
Netherlands	2
Norway	8
Portugal	1
Russia	1
Total	59

Source: Our elaboration.

Analysis of the sample reveals a marked concentration of representation in a few key markets. The sample shows a greater presence of companies based in the United Kingdom, France, Norway, Germany and Italy, reflecting the availability of ESG and financial data in the databases used; it should not be interpreted as representative of the overall structure of the European energy sector.

Table 2 shows the average ESG ratings of the companies included in the sample, broken down by country. Unlike a cumulative aggregate, the values presented have been calculated as the arithmetic mean of the ESG scores of the companies belonging to each country, according to the following formula:

$$\overline{ESG}_j = \frac{\sum_{i=1}^{n_j} ESG_{ij}}{n_j}$$

where:

- represents the average ESG rating of country j ;
- represents the ESG rating of the individual company i belonging to the country j ;
- n_j indicates the number of businesses observed in country j .

The descriptive analysis reveals moderate variation in the distribution of average ESG ratings among companies in different European countries. The highest average values are observed in Portugal (38.2), Belgium (34.4) and the United Kingdom (32.8), whilst relatively lower values are found in Denmark (16.3) and the Republic of Ireland (11.9).

As the score is interpreted as an ESG risk rating, higher values indicate greater ESG risk, not better sustainability performance. Therefore, in the sample analysed, countries with higher average values have a higher average ESG risk profile, whilst lower values indicate a relatively more favourable ESG profile.

Analysis of the ESG components also reveals different patterns in the composition of the scores. In many cases, the environmental component (E) is the dominant factor, consistent with the growing importance of energy transition and environmental sustainability policies in the European energy sector. In Denmark and the Netherlands, however, the

social component (S) accounts for a relatively higher proportion than the environmental dimension, highlighting a greater focus on social and governance aspects.

The absence of complete data for certain ESG components, such as in Estonia and the Republic of Ireland, reflects the limitations of the databases used and confirms the unbalanced nature of the panel analysed.

Table 2. ESG country rating score.

<i>Country</i>	<i>Average ESG Rating</i>	<i>E</i>	<i>S</i>	<i>G</i>
Austria	28.9	16.2	6	6.8
Belgium	34.4	16.9	11.6	5.9
Germany	27.4	4.2	4.8	2.6
Denmark	16.3	3.8	8.6	3.9
Estonia	34.3	-	-	-
Spain	24	12.5	5.6	6
Finland	21.1	11.5	7.5	2.1
France	26.3	7.4	6.3	3.9
United Kingdom	32.8	15.3	8.3	4.5
Republic of Ireland	11.9	-	-	-
Italy	30.4	7.5	5.7	3.5
Luxembourg	23.6	8.7	7.1	7.8
Netherlands	21.6	7	8.6	6.1
Norway	27.7	9.7	6.9	4.1
Portugal	38.2	16.5	13.4	8.4
Russia	20.5	10.2	8.4	2

Source: Our elaboration.

These differences, however, must be interpreted with caution; indeed, the reported values derive from an unbalanced sample of firms and reflect solely the characteristics of the companies included in the dataset and the availability of ESG information in the various geographical contexts observed. The country-level aggregations are therefore used exclusively for descriptive and exploratory purposes and do not represent national macroeconomic indicators, nor do they allow for structural comparisons between European economies.

Overall, the descriptive analysis of the sample highlights significant heterogeneity in the distribution of ESG characteristics among the companies considered, confirming the structural complexity of the relationship between sustainability and economic and financial performance in the European energy sector. On this basis, the following sections delve deeper into the econometric analysis of the relationships between ESG ratings and corporate performance ratios.

6. Analysis of the Main Financial Statements Ratios

6.1. ROE

Return on equity (ROE) is a financial indicator that measures the profitability of an investment in a company's equity. It is calculated as $(\text{net profit/equity}) \times 100$.

This ratio summarises the overall cost-effectiveness of the business and thus assesses the performance of senior management. Table 3 presents the descriptive statistics.

The descriptive statistical analysis of ROE reveals significant variation in the profitability of the companies in the sample analysed. The average values show a mixed trend over time, ranging from particularly low or negative levels, such as 2015 (−4.29%), to very high levels in subsequent years, notably 2022 (30.58%) and 2023 (27.82%).

The decline in profitability observed in 2020, with an average value of 1.73%, may reflect the effects of the pandemic crisis on the economic and financial performance of companies in the European energy sector.

Table 3. Descriptive ROE statistics.

ROE	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Average	10.61	−4.29	11.47	20.59	12.60	16.61	1.73	17.23	30.58	27.82
Standard error	3.24	6.14	5.29	5.38	5.08	3.59	4.98	4.50	5.57	4.76
Median	11.02	3.87	7.45	10.49	15.01	13.38	2.89	16.12	18.56	16.41
Mode	−21.29	45.07	110.47	118.33	84.09	89.05	76.93	93.88	162.00	−16.54
Standard deviation	20.97	40.28	36.68	38.02	36.62	26.14	37.24	33.99	40.91	35.33
Sample variance	439.80	1622.36	1345.21	1445.66	1340.94	683.12	1386.57	1155.38	1673.45	1247.93
Kurtosis	0.33	2.34	1.88	1.82	2.54	2.19	0.52	1.52	4.32	3.33
Skewness	0.64	−1.61	0.85	1.38	−0.79	1.41	0.00	−0.02	2.01	1.80
Range	80.72	156.92	160.80	150.69	175.03	108.40	156.47	156.61	175.93	148.40
Minimum	−21.29	−111.85	−50.33	−32.36	−90.94	−19.35	−79.54	−62.73	−13.93	−16.54
Maximum	59.43	45.07	110.47	118.33	84.09	89.05	76.93	93.88	162.00	131.86
Sum	445.72	−184.27	550.75	1029.61	655.25	880.58	96.77	982.39	1651.10	1530.10
Count	42	43	48	50	52	53	56	57	54	55

Source: Our elaboration.

The high standard deviations and wide range between the minimum and maximum values highlight significant dispersion in profitability among the companies under consideration. This variability suggests the presence of significantly different operational, financial, and strategic conditions within the analysed sample.

The kurtosis and skewness values also indicate non-normal distributions and the presence of extreme observations. In particular, the positive skewness coefficients recorded across several financial years point to companies with exceptionally high profitability, whilst the negative values observed in some years highlight particularly unfavourable results. Similarly, the high kurtosis values suggest a concentration of observations around the mean, with outliers.

Overall, the descriptive results confirm a high degree of heterogeneity in the economic and financial conditions of the firms in the sample, highlighting differences in profitability and operational risk over the period under consideration.

6.2. ROA

Return on Assets (ROA) measures a company's ability to generate a revenue stream by effectively managing its businesses, thereby making them profitable. It is calculated using the following formula: $\text{net profit} / \text{total assets} \times 100$.

Table 4 presents the descriptive statistics for the report.

Table 4. Descriptive ROA statistics.

ROA	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Average	3.78	−0.10	2.60	5.68	4.66	5.19	0.10	7.65	9.65	8.48
Standard error	1.10	1.45	1.30	1.32	1.42	1.06	1.49	1.52	1.80	1.27
Median	3.07	1.21	2.64	4.56	5.48	4.14	1.34	5.65	5.47	7.13
Mode	18.79	17.16	21.03	27.27	23.99	−6.96	20.77	−8.90	−9.27	31.18
Standard deviation	7.11	9.75	9.22	9.55	10.34	7.82	11.25	11.49	13.45	9.50
Sample variance	50.55	94.97	85.09	91.18	106.91	61.14	126.61	131.95	181.03	90.33
Kurtosis	0.08	0.53	−0.25	0.03	0.74	0.47	0.17	2.05	0.97	0.42
Skewness	0.54	−0.66	0.11	0.41	−0.46	0.84	−0.33	1.42	1.04	0.68
Range	26.53	39.51	34.80	38.20	43.49	30.20	45.76	47.32	53.93	38.43
Minimum	−7.74	−22.35	−13.77	−10.92	−19.50	−6.96	−24.99	−8.90	−9.27	−7.25
Maximum	18.79	17.16	21.03	27.27	23.99	23.24	20.77	38.42	44.66	31.18
Sum	158.58	−4.33	130.18	295.52	247.08	280.49	5.75	435.93	540.46	474.62
Count	42	45	50	52	53	54	57	57	56	56

Source: Our elaboration.

The analysis of ROA reveals significant variation in the companies' ability to generate profitability from their assets. The average values show a variable trend over time, ranging from particularly low levels in 2015 (−0.10%) and 2020 (0.10%) to higher values in 2022–2023, peaking at 9.65% in 2022.

The relatively high standard deviations across all the years analysed highlight marked dispersion in the observations, indicating significant differences in the firms' ability to use their assets to generate income efficiently.

The skewness coefficients indicate that, in several years, the distributions are not perfectly symmetrical, suggesting the presence of both positive and negative outliers. In particular, the positive asymmetry values observed mainly in 2021 and 2022 indicate the presence of firms with profitability levels significantly above the sample average. The kurtosis values, which are higher in some years, also signal distributions characterised by greater concentration of observations around the mean and by outliers.

This pattern highlights differences in operational efficiency and asset utilisation across the companies considered, confirming significant economic and financial variability within the European energy sector during the period analysed.

The descriptive results suggest that the distribution of ROA should be interpreted with caution, as extreme values can significantly influence aggregate statistics and the representativeness of the arithmetic mean.

6.3. ROCE

Return on capital employed (ROCE) is a long-term profitability indicator that measures how effectively a company uses its funds. It is calculated as $\text{EBIT} / \text{Invested capital} \times 100$.

Table 5 presents the main descriptive statistics.

Table 5. Descriptive ROCE statistics.

ROCE	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Average	6.46	5.38	7.31	11.92	10.20	11.75	2.28	10.07	19.02	14.49
Standard error	1.82	2.18	2.18	2.89	1.79	2.31	3.11	1.74	2.60	1.94
Median	5.97	4.05	5.31	7.24	9.06	8.50	−1.51	9.67	17.67	12.76
Mode	33.23	−16.20	34.78	66.57	−6.78	54.19	52.72	−12.46	−4.81	−12.01
Standard deviation	10.91	13.45	13.46	18.50	11.46	14.63	21.06	11.57	17.04	13.01
Sample variance	119.06	180.81	181.15	342.10	131.26	214.08	443.57	133.96	290.23	169.19
Kurtosis	0.98	0.23	−0.32	3.83	0.49	3.26	0.89	0.37	−0.05	0.45
Skewness	0.85	0.49	0.48	1.95	0.83	1.85	0.63	0.31	0.80	0.16
Range	43.34	51.26	48.93	74.72	43.43	58.41	88.60	47.41	59.78	53.14
Minimum	−10.11	−16.20	−14.15	−8.15	−6.78	−4.22	−35.88	−12.46	−4.81	−12.01
Maximum	33.23	35.06	34.78	66.57	36.66	54.19	52.72	34.95	54.97	41.13
Sum	232.70	204.25	277.77	488.61	418.00	470.06	104.87	443.27	818.00	651.90
Count	36	38	38	41	41	40	46	44	43	45

Source: Our elaboration.

The ROCE analysis highlights significant variation in the companies in the sample's ability to generate returns on invested capital. The average values show a mixed trend over time, characterised by overall growth with significant fluctuations, including a sharp decline in 2020 (2.28%) and particularly high values in 2022 (19.02%).

The high standard deviations and the wide range between the minimum and maximum values confirm marked dispersion in performance among the companies considered. This variability suggests different levels of efficiency in the use of invested capital and reflects the diversity of the operational, financial and strategic conditions that characterise the European energy sector.

The skewness coefficients, which are positive across all the financial years analysed, indicate the presence of companies with profitability levels significantly above the sample

average, a phenomenon particularly evident in 2017 and 2019. The kurtosis values, which are higher in some years, also indicate distributions characterised by outliers and a greater concentration of data around the mean.

ROCE therefore exhibits a highly variable distribution across the companies considered, suggesting caution in interpreting aggregate statistics, particularly the arithmetic mean, in the presence of extreme values.

6.4. Leverage

The leverage ratio, or debt ratio, is an indicator of the amount of debt a company or entity uses to finance its activities relative to its equity. It is calculated by dividing the total liabilities (debts) by the company's equity.

Table 6 shows the main descriptive statistics.

Table 6. Descriptive leverage statistics.

Leverage	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Average	103.01	106.12	117.05	103.17	94.02	116.02	120.60	120.78	127.77	103.90
Standard error	10.93	11.63	17.08	17.05	13.48	14.69	13.14	13.71	19.99	13.88
Median	84.96	91.46	78.95	70.89	74.63	92.95	104.88	93.65	76.23	72.00
Mode	8.92	6.62	413.05	0.35	0.08	0.37	0.26	0.32	0.49	385.27
Standard deviation	70.00	75.36	117.10	119.38	94.33	105.97	97.46	100.72	146.93	103.88
Sample variance	4900.25	5679.39	13,713.18	14,252.14	8898.75	11,228.59	9498.63	10,143.95	21,587.70	10,790.78
Kurtosis	−0.92	−0.87	1.24	2.93	1.45	1.35	−0.20	−0.82	2.58	2.01
Skewness	0.49	0.46	1.41	1.85	1.41	1.31	0.74	0.63	1.81	1.56
Align	221.36	242.53	412.86	447.34	347.04	393.70	333.71	315.59	545.55	385.26
Minimum	8.92	6.62	0.19	0.35	0.08	0.37	0.26	0.32	0.49	0.01
Maximum	230.28	249.16	413.05	447.70	347.12	394.07	333.97	315.91	546.03	385.27
Sum	4223.34	4457.24	5501.25	5055.51	4606.82	6032.83	6633.14	6521.87	6899.56	5818.63
Count	41	42	47	49	49	52	55	54	54	56

Source: Our elaboration.

The statistical analysis of financial leverage reveals significant heterogeneity in the firms' debt structures. The average leverage ratios are relatively high throughout the entire period under review, suggesting that the companies in question rely heavily on debt financing. In particular, average debt levels rose significantly between 2019 and 2022, before falling in 2023.

The marked gap between the mean and the median, observable in most years, together with high standard deviations, indicates a high degree of dispersion in the observations and suggests the presence of some firms with debt levels significantly above the sample average.

The positive skewness coefficients across all the analysed years confirm a distribution skewed towards high leverage ratios. Furthermore, the higher kurtosis values observed in some years indicate the presence of outliers and distributions more concentrated around the mean.

The distribution of financial leverage is therefore uneven, confirming the existence of different financial configurations among the firms analysed. Some firms exhibit relatively balanced capital structures, whilst others have significantly higher levels of financial exposure, resulting in different financial risk profiles.

7. Econometric Analysis

In economic research and business practice, econometric analyses examining the relationship between ESG performance and companies' economic and financial performance have become increasingly popular. These studies aim to examine empirically the extent to which implementing sustainable practices affects a company's profitability indicators and market value. The most recent empirical research suggests a positive correlation between ESG performance and long-term financial results. This link is attributed to improved

corporate reputation, reduced operational risks and increased management efficiency resulting from more responsible governance (Fatemi et al., 2018). However, several authors note that the economic effects of ESG strategies are primarily evident in the medium- to long-term and depend on the extent to which sustainability is effectively integrated into the company's overall strategy (Eccles et al., 2014).

In this study, correlation, regression and path analysis techniques—tools commonly used in the scientific literature on this subject—are employed to conduct an econometric analysis of the relationship between ESG performance and economic and financial outcomes in the European energy sector. Correlation is a statistical measure of the degree of linear association between two variables and serves as a starting point for examining whether profitability and sustainability are significantly related.

On the other hand, regression techniques allow us to estimate the strength and direction of the effects of ESG variables on economic performance, while accounting for external factors.

On the other hand, regression techniques allow estimation of the strength and direction of the associations between ESG ratings and economic and financial indicators, without attributing causal significance to the results. Finally, path analysis is used to explore more complex relationships and identify direct and indirect effects, offering a structural view of the link between sustainability and corporate value. The combined use of these methodologies, widely employed in recent empirical studies, enables robust results and allows the link between ESG practices and economic and financial performance to be validated with greater precision.

Before presenting the econometric results, it should be noted that the correlation, OLS regression, and SEM analyses were conducted at the firm-year level. The economic and financial indicators vary annually over the period 2014–2023, whilst the ESG rating available on Yahoo Finance is associated with the individual firm and is held constant across annual observations for the same company. Therefore, the results should be interpreted as exploratory evidence of statistical association rather than definitive proof of causal relationships.

One of the most common statistical tools for examining the interaction between two quantitative variables is linear correlation. Pearson's correlation coefficient (r) measures the strength and direction of the linear relationship between two quantitative variables and ranges from -1 to $+1$. Values close to $+1$ indicate a strong positive correlation, values close to -1 indicate a strong negative correlation, whilst values close to 0 indicate a weak or absent linear relationship between the variables (Pearson, 1896).

Linear correlation is often used in economics and finance, as well as in sustainability research, to examine the links between ESG variables and corporate or financial performance indicators. This constitutes a preliminary step towards identifying potential relationship patterns that warrant further investigation using regression models or multivariate approaches.

Table 7 shows the correlation between the variables under study.

Table 7. Correlation.

	<i>Value</i>	<i>ROE</i>	<i>ROA</i>	<i>ROCE</i>	<i>LEVA</i>
Value	1				
ROE	0.11704292	1			
ROA	0.17751552	0.81901992	1		
ROCE	0.0859723	0.92571133	0.78239747	1	
LEVA	0.17507054	−0.1148044	−0.2841083	−0.2578424	1

Source: Our elaboration.

The correlation matrix reveals generally weak linear associations between the ESG rating and the economic and financial indicators considered. In particular, the correlations between ESG and ROE, ROA, and ROCE are modest and positive, suggesting the absence of strong linear relationships between sustainability performance and accounting indicators in the analysed sample.

Profitability indicators, on the other hand, show particularly high positive correlations with one another, consistent with their shared economic and financial nature. In particular, ROE, ROA, and ROCE exhibit very high correlation coefficients, highlighting a strong interdependence among the measures of corporate profitability.

Leverage shows negative correlations with ROE, ROA and ROCE, suggesting that higher levels of debt may be associated with greater ESG risk, although there is no fully robust statistical evidence to support this.

Overall, the results of the correlation matrix suggest that the relationship between ESG and economic and financial performance is not attributable to simple direct linear associations, confirming the need to use more sophisticated analytical approaches to capture the interdependencies among the variables under consideration.

Table 8 shows the results of the regression analysis.

Table 8. Multiple regression.

Residues:					
Min	1Q	Medium	3° Q	Max	
−18.017	−6.317	0.383	5.676	35.721	
Coefficients:					
	Estimate	Standard Error	T-Value	Pr(> t)	
(Intercept)	22.28229	3.62028	6.155	1.84×10^{-7}	***
ROE	−0.13287	0.18552	−0.716	0.4776	
ROA	0.72239	0.37617	1.920	0.0612	.
ROCE	0.03549	0.30709	0.116	0.9085	
LEV	0.03310	0.01928	1.716	0.0930	.
Residual standard error:		10.38 on 45 degrees of freedom			
Multiple R-squared:			0.1076		
Adjusted R-squared:			0.02833		
F-statistic:			1.357 on 4 and 45 DF		
p-value:			0.2639		

Source: Our elaboration. The asterisks next to the coefficients indicate the level of statistical significance: *** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$. The presence of asterisks indicates that the coefficient is significantly different from zero at the corresponding confidence level.

Because the OLS regression is estimated using firm-year observations, potential intra-firm correlation may affect the standard errors. Therefore, the regression results are interpreted with caution and used primarily as preliminary exploratory evidence before the SEM analysis.

The results of the regression analysis highlight the model's limited explanatory power in explaining variability in ESG ratings. Indeed, the coefficient of determination ($R^2 = 0.1076$) indicates that the economic and financial variables considered explain only a small proportion of the observed variability in ESG performance. The model's overall F-test is also not statistically significant (p -value = 0.2639), suggesting no robust linear relationship between the independent variables and the ESG rating.

The intercept is positive and statistically significant ($p < 0.001$), with an estimated value of 22.28, indicating that the ESG rating maintains positive values on average even in the absence of changes in the economic and financial variables considered.

Regarding the coefficients of the individual variables, ROE and ROCE are not statistically significant, suggesting no stable linear relationship between these profitability indicators and ESG performance in the analysed sample. ROA, on the other hand, has a positive coefficient and marginal significance ($p = 0.0612$), suggesting a possible positive association between asset efficiency and ESG ratings. Similarly, financial leverage shows a positive coefficient with weak significance ($p = 0.0930$), suggesting that higher levels of debt may be associated with slightly superior ESG performance, though the evidence is not fully robust.

Overall, the results suggest that the relationship between financial performance and ESG ratings is not explained by simple, direct linear relationships, confirming the need for more sophisticated analytical approaches to capture the complexity of interdependencies among the variables under consideration. To assess multicollinearity among the independent variables, the variance inflation factor (VIF) was calculated (Table 9).

Table 9. Variance inflation factor (VIF).

VIF			
ROE	ROA	ROCE	LEVA
10.170982	3.781647	7.821095	1.380858

Source: Our elaboration.

The results show relatively high VIF values for certain variables, particularly ROE (VIF = 10.17) and ROCE (VIF = 7.82), suggesting possible multicollinearity among the profitability indicators.

This result appears consistent with the high correlations observed in the correlation matrix among ROE, ROA, and ROCE, as these are economic and financial indicators that partially overlap in measuring corporate profitability.

Financial leverage, on the other hand, has a low VIF (1.38), indicating no significant linear correlation with the other independent variables.

Although the observed levels of multicollinearity do not completely compromise model estimation, they could reduce the stability of the estimated coefficients and the statistical significance of the individual explanatory variables. This further underscores the complexity of the relationships between economic and financial indicators and ESG ratings in the analysed sample.

From an economic perspective, the results suggest that ESG performance is not directly explained by accounting indicators of profitability or financial leverage, but rather reflects sustainability-oriented strategic and governance choices, with their effects becoming apparent in the medium- to long-term. The lack of statistical significance could be due to the multidimensional nature of ESG metrics, sectoral variability, or unobservable factors, such as communication policies, corporate culture and stakeholder engagement practices.

In conclusion, the regression suggests a non-linear, complex relationship between economic performance and sustainability, consistent with the empirical literature (Friede et al., 2015; Eccles et al., 2014).

The high correlation among ROE, ROA, and ROCE, as confirmed by the variance inflation factor (VIF) values, indicates multicollinearity among the profitability indicators. This situation may compromise the stability of the estimates obtained through multiple regression and, consequently, make it difficult to identify the specific contribution of individual explanatory variables.

To overcome this methodological issue, an approach based on structural equation modelling (SEM) was adopted, which allows for the simultaneous representation of relationships among observed variables and latent constructs that cannot be directly measured.

Economic performance, in particular, was modelled as a reflective latent variable measured using three profitability indicators widely used in the financial literature (ROE, ROA and ROCE), whilst financial leverage was treated as an observed control variable. The structural model was used to assess the relationships among economic performance, financial leverage, and ESG ratings.

Table 10 shows the model structure.

Table 10. Measurement model.

Latent Construct	Indicator	Standardised Loading	<i>p</i> -Value
Economic performance	ROE	0.984	-
	ROA	0.832	<0.001
	ROCE	0.938	<0.001

The model results show high saturation coefficients for all indicators, with standardised loadings exceeding 0.80, confirming that the three variables consistently represent the latent dimension of economic performance.

Table 11 shows the results of the SEM model.

Table 11. Structural model.

Dependent Variable	Explanatory Variable	Standardised	<i>p</i> -Value
Rating ESG	Economic performance	0.146	0.291
Rating ESG	Leverage	0.194	0.082

The results of the structural model indicate that economic performance positively affects the ESG rating, but this relationship is not statistically significant ($\beta = 0.146$; $p = 0.291$). Financial leverage also has a positive coefficient and is marginally significant ($\beta = 0.194$; $p = 0.082$).

The coefficient of determination for the endogenous variable, ESG rating ($R^2 = 0.059$), indicates that economic performance and financial leverage explain 5.9% of the observed variability in the ESG rating. This result suggests that ESG scores reflect dimensions beyond traditional accounting measures of profitability, such as corporate governance, environmental policies, disclosure transparency and stakeholder relationship management.

The analysis confirms that corporate sustainability cannot be interpreted solely as a consequence of economic and financial performance but rather as an autonomous and multidimensional aspect of corporate value creation.

Table 12 shows the SEM model fit indices.

Table 12. SEM model fit indices.

Index	Value
χ^2 (df = 5)	15.029
<i>p</i> -value χ^2	0.010
CFI	0.941
TLI	0.881
RMSEA	0.184
SRMR	0.087
R^2 rating ESG	0.059

The results indicate that the model's overall fit is acceptable. The Comparative Fit Index (CFI = 0.941) exceeds the commonly used threshold of 0.90, indicating that the model adequately represents the observed relationships in the data. The value of the Standardised Root Mean Square Residual (SRMR = 0.087) is close to the threshold of acceptability generally adopted in the literature.

The Tucker–Lewis Index (TLI = 0.881) lies slightly below the reference value of 0.90, suggesting room for improvement in the model specification. The Root Mean Square Error of Approximation (RMSEA = 0.184), on the other hand, indicates a lower level of fit than conventional standards. This indicator, however, must be interpreted with caution in the presence of relatively small samples and models characterised by a low number of degrees of freedom, conditions under which the RMSEA frequently tends to overestimate the model's misfit.

Ultimately, the fit indices demonstrate the model's ability to represent the main relationships between financial performance and ESG ratings, although some indicators suggest room for improvement in the model specification.

Figure 3 represents the structure of the predicted model.

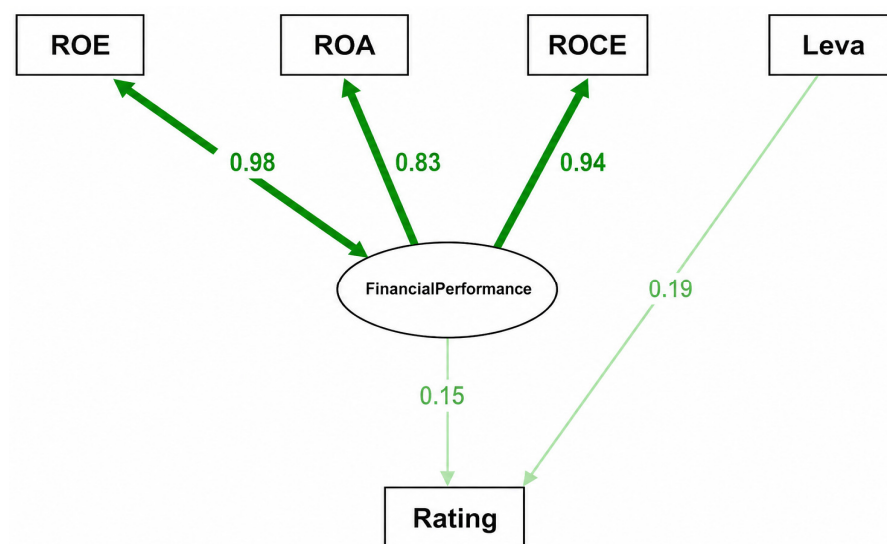


Figure 3. Path analysis (Source: Our elaboration).

Figure 3 illustrates the structure of the estimated relationships between the variables under consideration. In particular, economic performance is represented as a latent variable measured by three profitability indicators.

The standardised coefficients associated with the indicators are particularly high (ROE = 0.98; ROA = 0.83; ROCE = 0.94), confirming that the three variables share a common economic–financial dimension and consistently represent the latent construct of economic performance.

Regarding the structural model, economic performance shows a positive association with the ESG rating ($\beta = 0.15$), whilst financial leverage also shows a positive association ($\beta = 0.19$). Although these relationships are modest in strength, they suggest that companies with better economic and financial conditions tend to have higher ESG risk ratings, suggesting a possible association with greater ESG risk. This result should be interpreted with caution, particularly given its low statistical significance.

Path analysis confirms that a multidimensional structure characterises the relationship between economic performance and ESG ratings and that it cannot be interpreted solely through simple, direct linear relationships. The results suggest, in fact, that corporate

sustainability also depends on additional organisational, strategic and governance factors not directly observed in the model.

Given the firm-year structure of the dataset and the presence of repeated observations for the same company, the results should be interpreted as exploratory evidence of structural associations between the variables under consideration, rather than as definitive proof of causal relationships.

8. Hypothesis Testing and Discussion

This section presents a detailed analysis and discussion of the empirical results from the multi-method approach, with particular emphasis on the validity and implications of the research hypotheses (H1, H2, H3) for European energy companies between 2014 and 2023.

8.1. Discussion of Hypothesis 1: The Direct Linear Relationship

H1. *Economic performance is positively associated with the ESG rating of European energy companies.*

Hypothesis 1 predicted a positive association between economic performance and the ESG rating of European energy companies. However, because the ESG rating used in the study is interpreted as an ESG risk rating, higher scores indicate greater unmanaged ESG risk rather than better sustainability performance. Consequently, any positive association should be interpreted as an association with greater ESG risk, whilst a negative association would indicate lower ESG risk.

The results of the multiple OLS regressions do not provide robust empirical support for the hypothesis. The model has limited explanatory power, as indicated by the low R^2 , and the coefficients for the economic and financial indicators are not robustly significant. Even in the SEM model, economic performance shows a positive coefficient with ESG risk rating, but this relationship is not statistically significant.

It is therefore not possible to state that firms with better economic and financial conditions systematically exhibit higher or lower ESG risk. Rather, the result suggests that the ESG risk rating reflects factors beyond short-term accounting profitability, such as regulatory exposure, environmental policies, governance, disclosure transparency and sustainability risk management strategies.

In the context of the European energy sector, this evidence appears consistent with the complexity of the relationship between sustainability and economic and financial performance. Energy companies operate in an environment characterised by high capital intensity, growing regulatory pressures and significant transition costs. These factors may result in a weak or non-linear association between traditional accounting indicators and ESG risk.

8.2. Discussion of Hypothesis 2: The Structural and Complex Nature

H2. *ROE, ROA and ROCE represent consistent observable indicators of a common latent dimension of economic performance.*

Hypothesis 2 receives empirical support from the results of the SEM measurement model. ROE, ROA, and ROCE exhibit high, statistically significant standardised saturation coefficients, confirming that these indicators share a common dimension of economic performance.

This result is consistent with the conceptual nature of the indicators under consideration. ROE, ROA, and ROCE measure different aspects of corporate profitability: return on equity, asset efficiency, and return on capital employed, respectively. Although they

relate to different accounting perspectives, they reflect the same underlying economic and financial dimension.

The high correlations among the profitability indicators, already evident in the correlation matrix and confirmed by the VIF values, justify adopting an SEM model. This approach allows economic performance to be represented as a latent construct, thereby reducing the interpretative fragmentation arising from the separate analysis of individual accounting indicators.

8.3. Discussion of Hypothesis 3: Financial Structure and ESG Risk

H3. *Leverage is associated with the ESG rating of European energy companies.*

Hypothesis 3 posited the existence of an association between financial leverage and the ESG ratings of European energy companies. This hypothesis is analysed on the basis that the ESG rating used in the study is interpreted as an ESG risk rating: higher values indicate a greater level of unmanaged ESG risk, whilst lower values indicate a relatively more favourable ESG profile.

The results of the SEM model show a positive association between financial leverage and the ESG risk rating, with a standardised coefficient (β) of 0.194 and marginal significance ($p = 0.082$). This result suggests that higher levels of debt may be associated with greater ESG risk. However, as the statistical significance is only marginal, the evidence must be interpreted with caution and does not fully support the hypothesis.

In the energy sector, the relationship between financial leverage and ESG risk can be understood in the light of the highly capital-intensive nature of the companies analysed. The investments required by the energy transition, technological adaptation and regulatory compliance may entail significant capital requirements and, in some cases, greater reliance on debt. However, higher levels of financial leverage may also increase a firm's vulnerability, reducing the financial flexibility needed to manage environmental, social and governance risks effectively.

From this perspective, the result is consistent with the trade-off hypothesis cited by Graafland (2002), which holds that sustainability-oriented investments may entail short-term financial costs and constraints, particularly in highly capital-intensive sectors. The reference to Graafland (2002) is therefore interpreted as a theoretical basis for understanding the potential tension among sustainability, financial structure, and economic and financial performance, rather than as direct empirical evidence specific to the European energy sector.

Consequently, H3 is only partially supported. The results suggest a positive association between financial leverage and the ESG risk rating, indicating that more heavily indebted firms may have a higher ESG risk profile. However, the marginal significance of the coefficient and the model's exploratory nature call for caution when interpreting the results.

9. Conclusions, Implications, Limitations and Prospects

This study addressed the long-debated link between sustainability performance (ESG rating) and economic and financial performance (CFP) in the critical, capital-intensive environment of European energy companies (2014–2023), adopting a robust multi-method approach based on correlation analysis, OLS regression, and path analysis.

9.1. Conclusions and Theoretical Contribution

The results of the study show that the relationship between ESG risk ratings and economic and financial performance in the European energy sector cannot be adequately represented by simple linear models. As the ESG rating used in the study is interpreted as

an ESG risk rating, higher values indicate a greater level of unmanaged ESG risk, whilst lower values indicate a relatively more favourable ESG profile.

Hypothesis H1 is not supported, as the OLS analysis reveals that the accounting variables have limited explanatory power for the ESG Risk rating. The SEM model also shows a positive association between economic performance and the ESG Risk rating, but this relationship is not statistically significant. Therefore, it cannot be concluded that better economic and financial conditions are robustly associated with higher or lower ESG risk.

Hypothesis H2 is supported. The SEM model allows ROE, ROA and ROCE to be represented as consistent observable indicators of a common latent dimension of economic performance, confirming the multidimensional and highly interrelated nature of accounting profitability indicators.

Hypothesis H3 is only partially supported. Financial leverage shows a positive and marginally significant association with the ESG Risk rating. This result suggests that higher levels of debt may be associated with greater ESG risk, but the statistical evidence is not sufficiently robust to draw definitive conclusions.

Overall, the results indicate that the level of ESG risk among European energy companies does not depend exclusively on short-term corporate profitability, but reflects a broader set of strategic, organisational, financial, regulatory and governance factors. The theoretical contribution of the study, therefore, lies in proposing an exploratory structural representation of economic performance as a latent construct and in highlighting the need to interpret risk-based ESG ratings in a manner consistent with the scale's direction.

9.2. Management and Policy Implications

The study's findings highlight that improved financial performance does not automatically translate into higher ESG ratings. Companies in the energy sector should therefore view sustainability as a distinct management dimension to be integrated into corporate strategies through environmental, social and governance policies that are consistent with long-term objectives.

From a managerial perspective, the results highlight the need not to evaluate ESG investments solely through traditional accounting indicators, such as ROE, ROA and ROCE. In line with [Fatemi et al. \(2018\)](#), the assessment of ESG strategies should be complemented by indicators that capture the long-term effects of sustainability, such as risk reduction, the cost of capital, and the ability to attract investors.

From a public policy perspective, the results suggest the importance of promoting increasingly transparent and comparable ESG reporting standards to improve the quality of information available to investors, companies, and stakeholders. In this regard, strengthening non-financial disclosure systems can make the organisational and strategic dimensions that influence corporate sustainability more observable.

9.3. Limits and Prospects

This study has several limitations that provide opportunities for future research.

Firstly, the analysis focused exclusively on accounting-based economic and financial indicators, such as ROE, ROA, ROCE and financial leverage. Although these measures are widely used in the literature on corporate financial performance, they may not fully capture the strategic value of sustainability, particularly in capital-intensive sectors. Future research could supplement the analysis with market-based indicators, such as market capitalisation, enterprise value, cost of capital or share returns, which better reflect investor expectations and the long-term effects of ESG strategies.

Secondly, the study uses a single source for ESG measurement. The data available on Yahoo Finance is interpreted as an ESG risk rating; therefore, higher values indicate a greater

level of unmanaged ESG risk rather than better sustainability performance. This aspect calls for caution when interpreting the results, as different providers may adopt methodologies, weightings and rating scales that are not perfectly comparable. Future studies could replicate the analysis using ESG ratings from different specialist providers, consensus scores, or metrics explicitly geared towards ESG performance, to test the robustness of the results with respect to the source and direction of the scale used.

Thirdly, the dataset has an unbalanced panel structure, characterised by uneven availability of observations across firms and years. This configuration may reflect not only actual longitudinal firm dynamics, but also changes in the sample composition due to varying data availability. Furthermore, repeated observations for the same firm may introduce intra-firm correlation, potentially affecting the estimation of standard errors in inferential models.

From an econometric perspective, the possible presence of endogeneity, reverse causality, omitted variables and unobservable dynamic effects could influence the estimates obtained via OLS regression and path analysis. Although the SEM model allows for the simultaneous representation of relationships between observed variables and latent constructs, it does not, in the present research design, constitute a strategy for causal identification. The results should therefore be interpreted as exploratory evidence of statistical and structural associations between ESG risk ratings and economic and financial performance, rather than definitive proof of causal relationships.

Future research could address these limitations by employing dynamic panel models, fixed-effects or random-effects models, standard errors clustered at the firm level, instrumental-variable approaches, GMM models, or longitudinal and multilevel SEM techniques that are better suited to causal identification. Such approaches allow for a more rigorous consideration of the panel structure of the data, possible intra-firm dependence and the potentially bidirectional relationship between economic and financial conditions and ESG risk.

Finally, future research could extend the model to other capital-intensive sectors, such as telecommunications, heavy industry, transport or utilities, to ascertain whether the observed associations between economic performance, financial leverage and ESG risk are specific to the European energy sector or generalisable to other industrial contexts characterised by high investment requirements and significant regulatory pressures.

Ultimately, this study contributes to the academic debate on the complex interaction between ESG and corporate financial performance, offering an exploratory and structural analysis of the associations between latent economic performance, financial leverage and ESG risk ratings. At the same time, the results highlight the need to interpret risk-based ESG ratings with caution and to develop more robust empirical models in the future to analyse the relationships among sustainability, ESG risk, and economic and financial performance.

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Appendix A. Bibliometric Analysis of the ESG-CFP Literature in the Energy Sector

Appendix A.1. Main Sources on Scopus

This bibliometric study was conducted to outline the current state of research on the ESG-CFP link in the energy sector.

The search was conducted in November 2025 on the Scopus database using the following search string: (ESG OR “Corporate Sustainability” OR CSR) AND (“Energy Sector” OR Utilities) AND “Financial Performance”. By limiting the search to the Title, Abstract and Keywords fields, a total of 67 articles were identified. To ensure maximum relevance to the economic and business objective of this study, the subsequent analysis was restricted to articles classified under the subject areas of “Business, Management and Accounting” (32 articles) and “Economics, Econometrics and Finance” (25 articles). After eliminating overlaps, the final sample for the structural analysis consisted of 43 documents.

The temporal trend in scientific output by year (Figure A1) shows exponential growth in research output from the second half of the 2010–2019 decade onward.

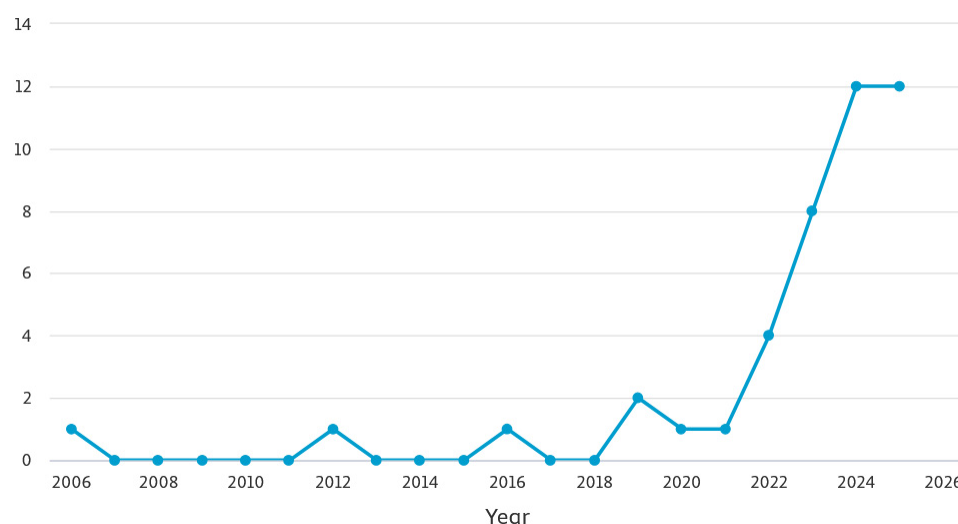


Figure A1. Documents by year (Source: Scopus).

This trend reflects the growing importance of ESG factors globally, particularly due to initiatives such as the Paris Agreement and the European Union’s regulatory push towards sustainability.

In terms of geographical distribution (Figure A2), the research reveals a significant concentration in certain regions of the world, likely those with more developed financial markets and greater regulatory pressure regarding the disclosure of non-financial information, highlighting a possible contextual heterogeneity in the empirical results.

The concentration of research is most pronounced in the fields of Business Administration, Management and Accounting, as well as Economics, Econometrics and Finance, confirming that the subject is primarily examined through the lens of corporate finance, strategic management and the assessment of economic impact (Figure A3).

By type (Figure A4), research articles are the most widespread.

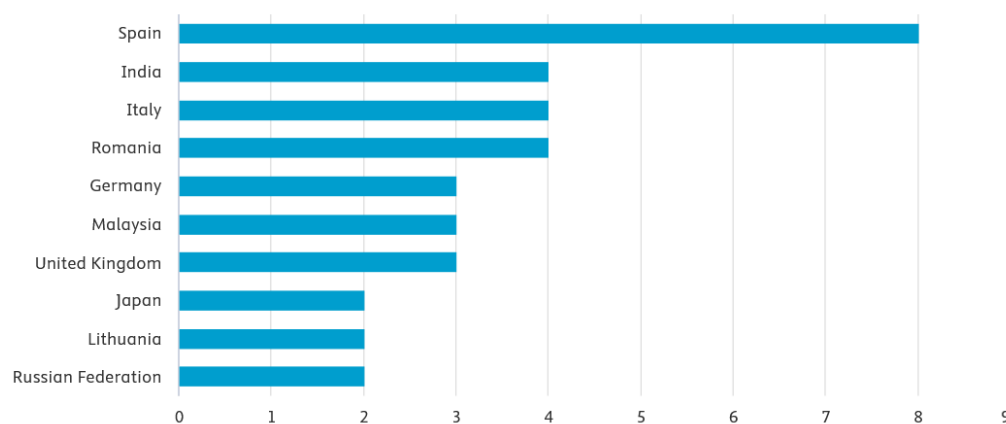


Figure A2. Documents by country or territory (Source: Scopus).

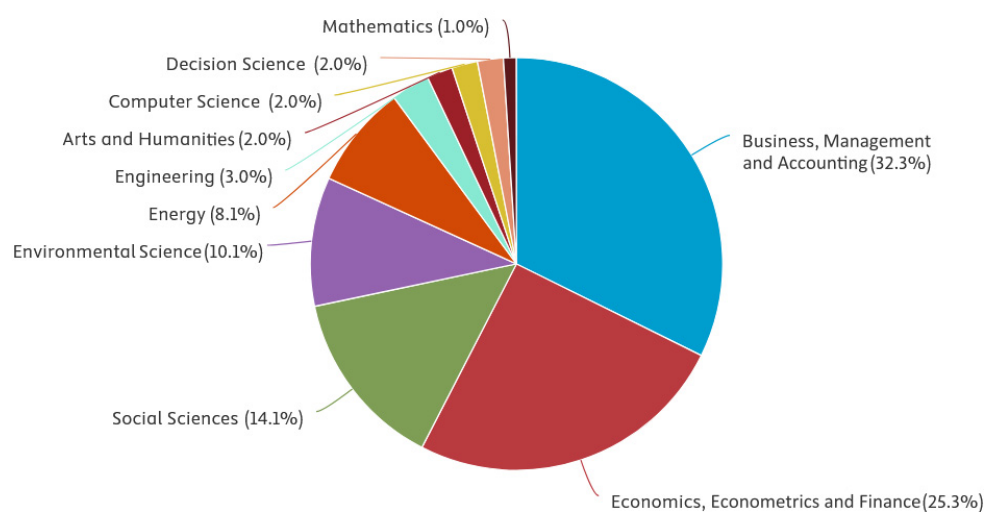


Figure A3. Documents by subject area (Source: Scopus).

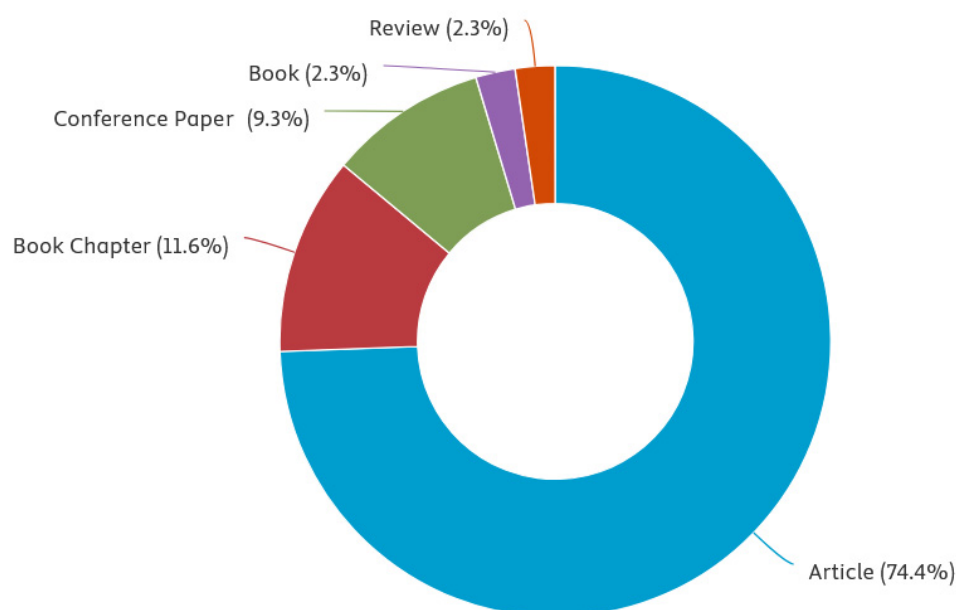


Figure A4. Documents by type (Source: Scopus).

Appendix A.2. The Most Cited Documents

The analysis of the citations, conducted on the 43 selected articles, aims to identify the works that have had the greatest theoretical and methodological impact on the debate (Table A1).

Table A1. Documents with at least 20 citations.

Document	Quotes
Marom (2006)	165
Pătări et al. (2012)	80
Hasan et al. (2022)	75
Ramírez-Orellana et al. (2023)	51
Adamkaite et al. (2023)	45
Sharma et al. (2019)	43
Makridou et al. (2024)	40
Kumar et al. (2022)	39
Lee (2021)	35
Koroleva et al. (2020)	35
Thompson (2019)	31
Pinheiro et al. (2024)	27
Mattera and Soto González (2023)	24
Remo-Diez et al. (2023)	23
Al-Hawaj et al. (2023)	20

Source: our processing of VOSviewer (Version 1.6.20) results.

Among the papers with at least 20 citations, the following stand out:

- [Marom \(2006\)](#): With 165 citations, this paper is a key reference that proposes a unified theory of the CSP-CFP link, a fundamental element for contextualising the empirical debate on the relationship between social and financial performance.
- [Pătări et al. \(2014\)](#): With 80 citations, this study undoubtedly focuses on efficiency and performance in the energy and utilities sector, reinforcing the importance of analysing sector-specific characteristics.
- [Hasan et al. \(2022\)](#) have 75 citations, representing a more recent contribution that signals the emergence of new lines of research and methodologies applied to sustainability in modern business contexts.

These works, together with other influential contributions such as those of [Ramírez-Orellana et al. \(2023\)](#), form the conceptual basis for the following section, which develops the debate and justifies the need for a structural analysis within the specific context of European energy companies.

Figure A5, generated using the VOSviewer software, illustrates the bibliographic landscape: the size of the spheres indicates the number of citations, whilst the colour represents the year of publication.

Appendix A.3. The Most Cited Authors

The number of authors who have tried to address this theme is 123. Only three of them have produced two articles (Table A2).

Table A2. Authors of at least two articles.

Author	Document	Quotes
Cristea, Mirela S.	2	11
Dott.ssa ă cea, Raluca Mihaela	2	11
Noja, Grațiela Georgiana	2	11

Source: Our processing with VOSviewer.

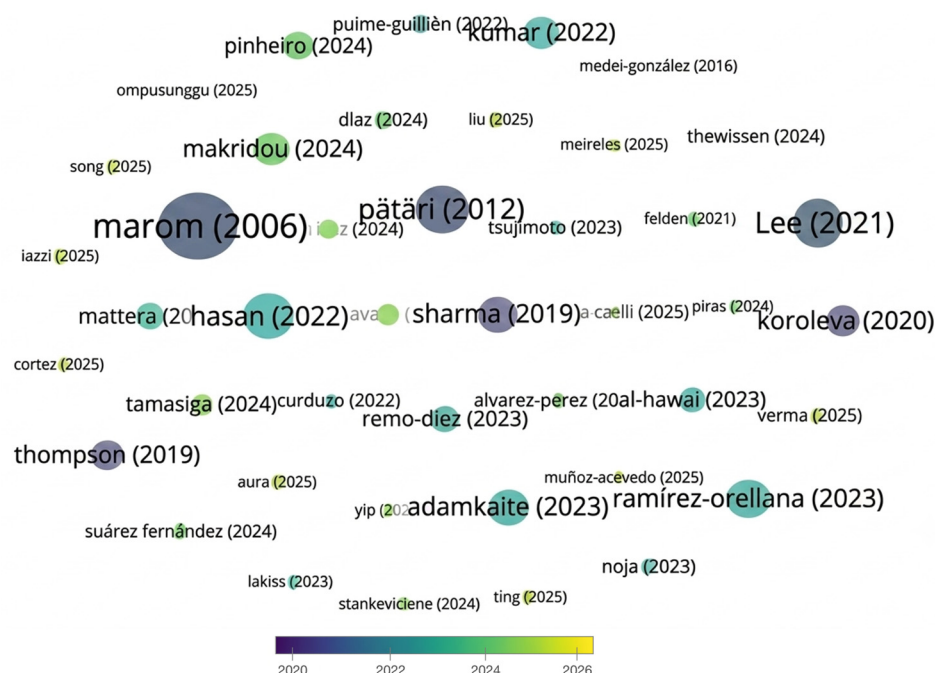


Figure A5. All 43 documents cited (Source: Our processing with VOSviewer).

There are no links between the authors, and all have a Total Link Strength (TLS) of zero.

Table A3 lists the authors in order of citations, focusing on the most-cited ones, with a total of 2201 citations.

Table A3. Authors with at least 40 citations.

Author	Document	Quotes
Marom, Isaia Yeshayahu	1	165
Jantunen, Ari	1	80
Kyläheiko, Kalevi	1	80
Pätäri, Satu	1	80
Sandström, Jaana	1	80
Hasan, Iram	1	75
Kashiramka, Smita	1	75
Singh, Shveta	1	75
Garcia-Amate, Antonio Jesús	1	51
Martínez-Victoria, María C.	1	51
Ramírez-Orellana, Alicia	1	51
Rojo Ramírez, Alfonso Andrés	1	51
Adamkaite, Judita	1	45
Rudžioniene, Kristina	1	45
Štreimikienė, Dalia	1	45
Bhattacharya, Sonali	1	43
Sharma, Dipasha	1	43
Thukral, Shagun	1	43
Doumpou, Michalis	1	40
Lemonakis, Christos	1	40
Makridou, Georgia	1	40

Source: Our processing with VOSviewer.

Figure A6 maps all authors with reference to the number of citations (size of the sphere) and the date of publication (colour).

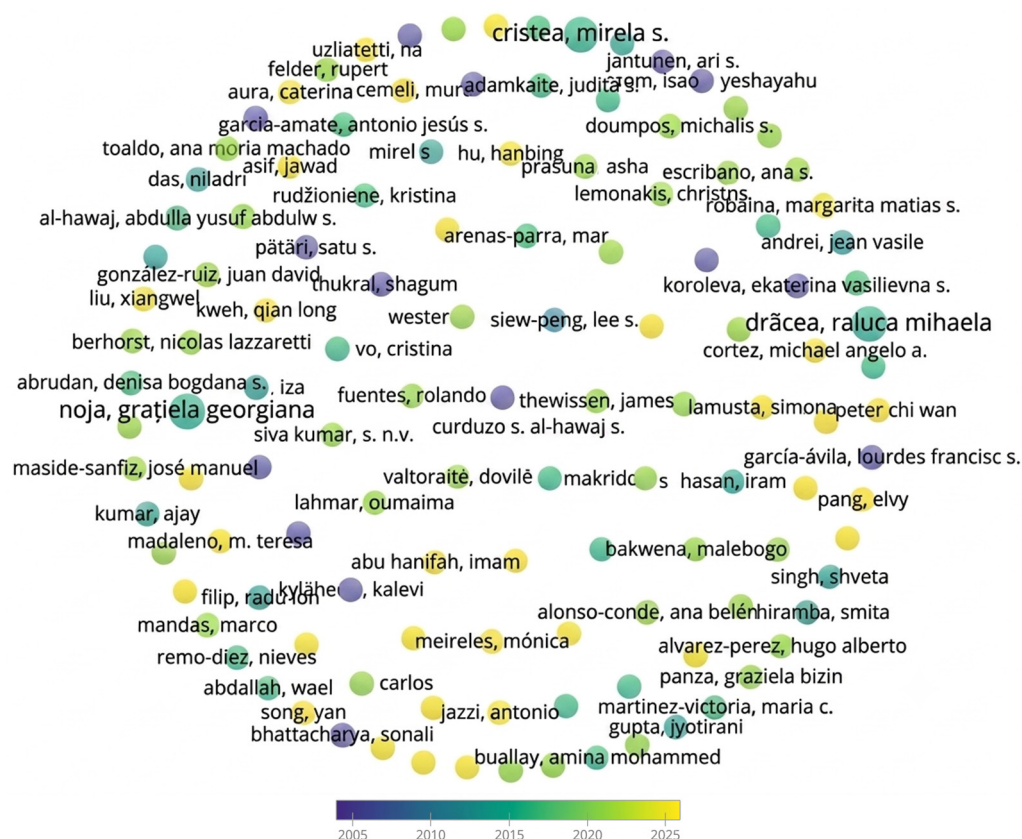


Figure A6. Map of the 123 authors cited (Source: Our processing with VOSviewer).

Appendix A.4. Keyword Analysis and Mapping

The corpus of analysed documents includes 272 keywords. Below is a selection of the most significant elements, obtained through a double ordering: by frequency of occurrence (at least five) (Table A4) and by total strength of the link (at least 50) (Table A5), i.e., the intensity of the connections between keywords in the semantic network.

Table A4. The most frequent keywords.

Keyword	Occurrences	TLS
Financial performance	16	148
ESG	12	125
Sustainable development	11	162
Corporate social responsibility	9	105
Finance	8	133
Sustainability	8	78
Energy sector	7	94
Environment	7	29
Performance	7	91
Corporate financial results	6	71
Energy	6	54
Social	5	29
Sustainability reporting	5	54

Source: Our processing with VOSviewer.

Figure A7 shows the keywords, illustrating their relevance in terms of citations and publication dates.

Table A5. Keywords with the highest TLS.

Keyword	Events	TLS
Sustainable development	11	162
Economic performance	16	148
Finance	8	133
ESG	12	125
Corporate social responsibility	9	105
Energy sector	7	94
Performance	7	91
Sustainability	8	78
Corporate financial results	6	71
Governance approach	3	65
Stakeholder	4	64
Economic and social impacts	3	63
Regression analysis	4	62
Investment company	4	58
Industrial performance	3	58
Corporate governance	3	57
Energy	6	54
Sustainability reporting	5	54
Profitability	3	54
Oil and gas	3	52

Source: Our processing with VOSviewer.

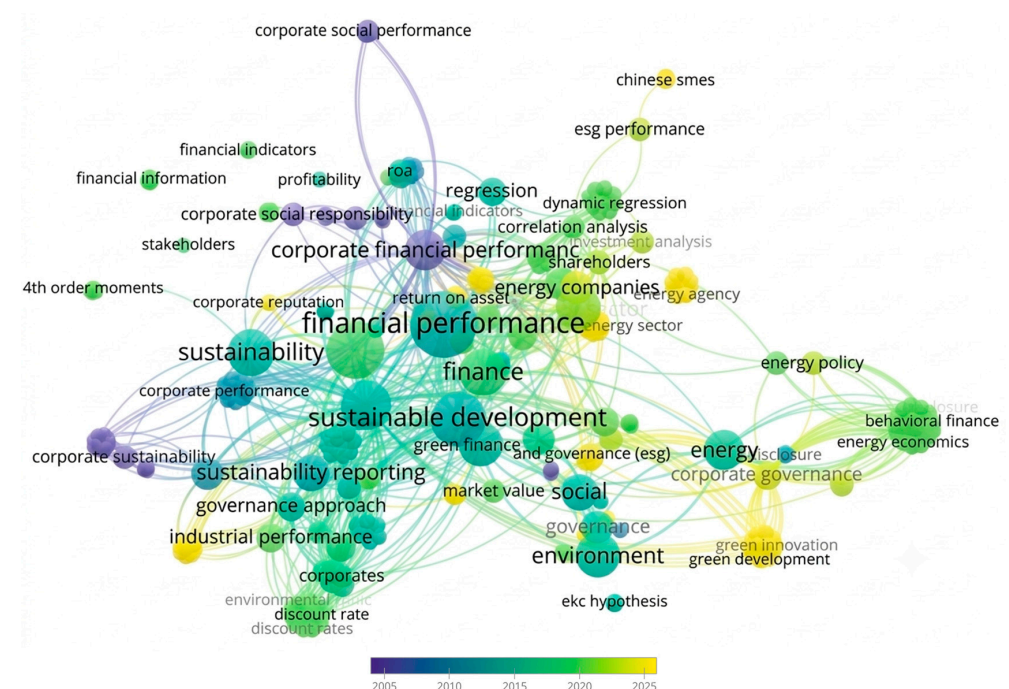


Figure A7. Map of all 272 keywords (*Source:* Our processing with VOSviewer).

Keyword analysis and mapping are the most analytical and diagnostic elements of the bibliometric section, as they reveal not only the prevailing themes but also the conceptual structure and the interconnections between the contributions.

This representation visualises the research field as a network of interconnected concepts, using tools such as co-occurrence analysis.

Three main thematic groups emerge:

1. *Historical/general cluster*, comprising terms such as ‘corporate social responsibility’ (CSR), ‘economic performance’ and ‘energy industry’. This core represents the historical

and thematic foundation of the research, confirming that the debate on the ethical-economic nexus is well-established in the energy sector.

2. *Modern/Strategic cluster: characterised by terms such as “ESG”, ‘sustainability’, ‘renewable energy’ and ‘corporate governance’.* The emergence of this cluster reflects the recent shift in the literature from a generic concept of CSR to a focus on specific ESG criteria and on the strategic and governance factors driving sustainable investment.

3. *Methodological/Metrics Cluster.* This cluster includes various measurement metrics, such as ‘ROE’, ‘ROA’, and, ideally, advanced methodological terms such as ‘structural equation modelling’ (SEM), ‘Mediation’ or ‘path analysis’.

Mapping keywords is essential for highlighting gaps in the research, thereby allowing for a better focus on them. The weak connection between key concepts (ESG, energy, accounting indicators) and advanced structural methodologies (path analysis) empirically demonstrates the methodological shortcomings of the literature. This shows that most existing work does not analyse the ESG-CFP nexus from a structural, complex perspective, but instead relies on simpler linear models.

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