Inzinerine Ekonomika-Engineering Economics, 2023, 34(2), 205–222

Drivers of Firms' Financial Performance in the Energy Sector: A Comparative Approach between the Conventional and Renewable Energy Fields

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https://doi.org/10.5755/j01.ee.34.2.31274

Given the sizeable importance of companies from the energy sector, and the economic, social, and environmental implications generated by their activity, an in-depth assessment of the relationship between financial performance and Corporate Social Responsibility (CSR) initiatives becomes essential for this sector. In this paper, we investigate the shaping factors of the financial performance of companies in the energy field, with a particular focus on the renewable energy sector, in a comparative approach with the conventional ones. The data were gathered from the Refinitiv Eikon database. The methodology applied consists of several advanced econometric procedures, namely robust regression and structural equation modelling. Our findings bring to the fore the distinctiveness of the main drivers of financial performance of companies from the renewable energy sector, compared with the conventional ones, for which specific policies and strategies are needed to comply with the CSR dimensions, as predictors of financial performance in the energy sector.

Keywords: *Fossil Fuels Companies; Renewable Energy; Corporate Social Responsibility; Financial Performance; Econometric Procedures.*

Introduction

The need to manage climate change has generated a new energy transition, which poses many economic, social, environmental, and technical challenges, but also creates multiple opportunities for energy companies and other categories of stakeholders, such as local communities, financial institutions, or consumers. The energy sector, at the global level, is currently in the process of transitioning to "green energy", the challenges being generated, on the one hand, by the effort to reduce greenhouse gas emissions and the promotion of renewable sources, and, on the other hand, by ensuring the security of electricity supply at affordable costs for final consumers (Abbasi *et al.*, 2021; Morina *et al.*, 2021a; Morina *et al.*, 2021b; Ponce & Khan, 2021; Balsalobre-Lorente *et al.*, 2022; Zheng *et al.*, 2022). Access to clean energy is one of the goals of sustainable development, the reduction of energy poverty being a concern of public authorities, especially in the context of crises generated by the geopolitical risk caused by the recent invasion of Ukraine by the Russian army. The energy transition puts pressure on companies in areas that need to change their energy mix, considering the technical and economic conditions that investments in renewable energy require, and can generate an increase in energy prices (Wang *et al.*, 2021).

In this context in which companies in the energy sector, besides the crisis induced by Russia's invasion of Ukraine, face several challenges (such as climate change, pollution or scarce resources), they must understand the social, environmental, and economic impact of their activity, pressure from stakeholders being significantly enhanced (Waddock & Graves, 1997; Krause, 2017; Tariq *et al.*, 2022). Thus, energy companies integrate into their activity a wide range of socially responsible actions that go beyond the legal requirements (Agudelo *et al.*, 2020; Kludacz-Alessandri & Cyganska, 2021). In this frame of setting, non-financial performance has developed into a major component of annual reporting by companies, either through sustainability or Corporate Social Responsibility (CSR) actions and reports, namely the environmental, social, and governance (ESG) measures, since ESG-

responsible investments are becoming a benchmark in global markets (Dziadkowiec & Daszynska-Zygadlo, 2021; Nirino *et al.*, 2021; Zheng *et al.*, 2022).

The adoption of CSR in response to pressures on energy companies has also created a broader framework for applying ESG measures, preventing and managing the living world, health and safety risks, which is essential for the success and long-term existence of corporations (Arslan-Ayaydin & Thewissen, 2016; Gonenc & Scholtens, 2017; Stjepcevic & Siksnelyte, 2017; Jiang *et al.*, 2018; Dwekat *et al.*, 2020; Mahmood *et al.*, 2020; Lan *et al.*, 2021; Larcker *et al.*, 2022).

Although there is a rich literature on ESG issues in the context of the financial performance of the energy sector (Pätäri *et al.*, 2014; Arslan-Ayaydin & Thewissen, 2016; Gonenc & Scholtens, 2017; Jiang *et al.*, 2018; Kludacz-Alessandri & Cyganska, 2021; Çankaya, 2022; Shaikh, 2022; Behl *et al.*, 2022), the relationship between ESG actions and financial performance of energy companies, on a comparative approach on the renewable and conventional energy fields, is not studied, although it may provide an insight into the scale of actions taken by companies for these areas of activities.

On this framework, *the general objective* of our paper is to appraise the implications (direct and overall) of ESG actions, including extended human resources landmarks, on the financial performance of companies from the energy field, in a comparative approach of the conventional sectors (such as coal, oil, gas companies – fossil fuels) with the renewable energy ones. Therefore, the data, collected from the Refinitiv Eikon (2021) database, are grouped into two distinctive samples, one with a total number of 503 companies from the conventional energy fields, and the other with 39 companies from the renewable energy sectors. The headquarters of the energy companies, which reported CSR actions and were included in the Refinitiv Eikon database, are geographically located in Europe, Africa, and Eurasia (Russia). The novelty of our study is generated by the comparative analysis of the relationship between financial performance versus non-financial performance for both conventional energy companies (fossil fuels) and renewable energy ones, given the need for extending the advanced energy resources and their support in sustainable development. Moreover, the behavior of these two types of companies is different considering the externalities they generate in economic, social, and environmental terms.

The methodology applied consists of several advanced econometric procedures, namely robust regression models and structural equation modelling, in order to bring to the fore the distinctiveness of main drivers (ESG measures and reporting) of companies' financial performance operating in energy sectors (conventional and renewable fields).

After introducing the background of this issue, with the importance and novelty of our research, the remaining paper encloses relevant reviews of the literature on the synergy of CSR actions - financial performance, followed by data used and the econometric procedures. The results obtained and discussions on the two samples, conventional and renewable energy, follow further. Conclusions with strategies implications, distinctively for conventional and renewable energy companies, gather the main evidence of our research.

Literature Review

According to "the slack resource theory" (Waddock & Graves, 1997; Tariq *et al.*, 2022), which relates the stakeholders' interests to the level of companies' resources - more responsive pressure to stakeholders being registered in the case of companies with significant resources than the limited ones – a number of scholars (Georgopoulou *et al.*, 2003; Streimikiene *et al.*, 2009; Borozan & Starcevic, 2016; Xiao *et al.*, 2018; Agudelo *et al.*, 2020; Pirtea *et al.*, 2021; Adomako & Tran, 2022; Elmghaamez & Olarewaju, 2022; Andersson *et al.*, 2022; Gull *et al.*, 2022) have put forward the inclusion of corporate social responsiveness in the activities and performance of companies, from different sectors, countries and regions. On these lines, Behl *et al.* (2022) attest that, in the energy sector, ESG investments reduce firm risk and improve company reputation in the long run since the markets penalize companies with irresponsible environmental management behavior that do not disclose such activities. Moreover, the same authors evidence that, for the Indian energy sector, their findings "do not support the slack resources hypothesis" (Behl *et al.*, 2022, p. 244).

On the synergy of CSR actions - financial performance, many authors (Pätäri *et al.*, 2014; Arslan-Ayaydin & Thewissen, 2016; Gonenc & Scholtens, 2017; Jiang *et al.*, 2018; Kludacz-Alessandri & Cyganska, 2021; Baran *et al.*, 2022; Adamkaite *et al.*, 2022; Ang *et al.*, 2022) examined how the CSR actions can produce effects on the financial performance of energy companies.

As much, according to claims that financial performance influences the CSR performance of corporations, Kludacz-Alessandri and Cyganska (2021) analyzed the relationship between financial performance indicators (return on assets – ROA, Earnings Before Interest, Taxes, return on equity - ROE, Earnings Before Interest and Taxes – EBIT, Depreciation, and Amortization - EBITDA) and the adoption of CSR in the energy sector, based on a sample of 219 companies from 32 countries at the level of 2020. The empirical results obtained showed a significant relationship between the CSR strategies adopted by the energy companies and their financial performance, according to each financial performance indicator. If there were no indications of companies' ability to generate economic profitability (measured by ROE) correlated with their CSR actions applied, the other selected financial indicators (EBIT and ROA) were higher for companies that adopted CSR actions. Opposite, EBITDA values were lower in the case of energy companies that adopted CSR.

Ang *et al.* (2022) have assessed the impact of CSR actions (measured by the Hexun index) on financial performance (proxied by ROA) in the case of 6,306 heavily polluting companies in China. The authors attested that CSR could induce positive effects on corporate financial performance, with differentials that depend on the ownership structure. In a similar approach, by analyzing a sample of 5195 publicly listed firms from pollution-intensive industries in China, Li *et al.* (2022) have attested that CSR reduces the cost of debt by downsizing business risk and thus improves financial performance through better management and effective use of resources.

Pätäri *et al.* (2014) evidenced that the CSR actions, followed distinctively on their strengths and concerns, have different effects on the financial performance of energy companies over the world included in the Thomson ONE database (period 1991–2009), the effects being dependent also on how the financial performance is measured (profitability - by ROE, vs. market value). Therefore, the results obtained suggested that between ROE and CSR there were no implications in terms of CSR strengths, on the one hand, and negative effects, when concerns of CSR were analyzed. Overall, the authors (Patari *et al.*, 2014) did not confirm the hypothesis, called a "virtuous circle", of bidirectional causality between CSR actions, especially on social directions, and financial performance. Consequently, CSR investments can have positive effects on the good reputation, social performance, and managerial performance of energy companies, which could lower operating costs as waste is reduced, while increasing employee productivity is occurred (Patari *et al.*, 2014; Kludacz-Alessandri & Cyganska, 2021).

As regards ESG overall actions, considered the main drivers of CSR, Baran *et al.* (2022) investigated the link between the financial performance of energy companies from Poland and the overall ESG score, and their research evidenced no direct interplay between these credentials. Contrariwise, Zhao *et al.* (2018) evidenced that China's listed power generation companies improved their financial performance (measured as return on capital employed – ROCE, which is related to EBIT and capital) through good ESG performance. In a similar approach, Naeem and Çankaya (2022) examined the impact of ESG performance on the financial performance of 192 energy and power generation firms analyzed during 2008–2019. Their findings entail that ESG performance has positive effects on firms' profitability, but also a negative impact on the market values of these corporations. Moreover, focusing on a sample of ESG scores from 510 firms across 17 countries, Shaikh (2022) also evidenced a lower valuation of the firm, and a decline in ROA and ROE (negative and statistically significant estimated coefficients across all financial performance proxies), as a result of sustainability implementation and adverse ESG measures, more pronounced in the case of environmental and social sub-dimensions of ESG score. The author further highlights that „ESG compliance is more pronounced in European companies", while „Asian firms are more disciplined concerning the energy sector" (Shaikh, 2022, p. 218).

In addition, several studies show that energy companies have different strategies to meet ESG requirements and identify the impact of the ESG determinants on financial performance (Arslan-Ayaydin & Thewissen, 2016; Gonenc & Scholtens, 2017; Jiang *et al.*, 2018). Considering the environmental actions, Jiang *et al.* (2018) evidenced positive impact of environmental responsibility (measured by an index including five dimensions of environmental CSR measures), on financial performance (measured by ROA) for energy companies from China. Arslan-Ayaydin & Thewissen (2016) analyzed the impact of environmental performance on the financial performance of companies from the stock market, on a two-fold comparison, energy companies vs. non-energy ones. In the case of non-energy companies, environmental actions did not generate higher financial performance for these companies on the stock market, while for companies from the energy field, Arslan-Ayaydin & Thewissen (2016) evidenced cyclical positive direct implications, given the uncertainties that marked the period under review (2000–2011). Gonenc & Scholtens (2017) focused on bidirectional implications between the environmental (measured by CO2 emissions, resource reduction, and product innovation) and financial performance (expressed by ROE, ROCE and Tobin's Q) of international fossil fuel firms, within a comparative analysis with non-fossil ones. In addition, differences in the environmental-financial performance relationship are observed taking into account the field of activity, in each chemical, oil, gas, and coal sector. The results suggested that fossil fuels companies developed better policies on environmental protection than non-fossil ones, but no significant impact performance (for ROE) was noticed. As regards renewable energy companies, Gupta (2017) investigated the financial performance (measured by the Winder Hill Clean Energy Index, ECO index, and stock returns) of alternative energy firms from 26 countries, under the impact of cultural, social and technological innovations, with positive impacts on the stock market returns.

In terms of corporate governance, Shahbaz *et al.* (2020) provide a wealth of empirical evidence on the positive link between board orientation and CSR actions, as well as between the CSR dimensions (ESG scores) and the performance achieved (measured by ROA and Tobin's Q ratio) by the global energy companies with data on the Refinitiv Eikon database (2011–2018 period). Board gender diversity and board size induced pronounced favorable impacts on environmental and governance pillars of the ESG, with overall positive impacts on financial performance expressed by ROA. The ESG measures do not ensure upper financial performance.

Given that board members are responsible for developing companies' policies and strategies, including social and environmental policies (Bear *et al.*, 2010; Marinova *et al.*, 2016), gender diversity takes different shares within the energy company. In the literature, several authors (Gardazi *et al.*, 2020; Atif *et al.*, 2021) suggest that the presence of women on the board of energy companies positively influences the actions of CSR and orients the decisions toward the adoption of more robust socially responsible policies, contributing to the growth of the company's reputation, consumption, and performance.

In summary, the literature underpinnings on the subject of the conjunction between CSR measures – the financial performance the energy companies revealed that: there are studies that approached this synergy for distinctive sectors of energy (fossil fuels, specific sectors, or renewable energy) or in a comparative consideration, energy companies vs. non-energy companies, but none of them tackled the conventional vs. alternative energy samples; as regards the implication on CSR actions/ESG dimensions on financial performance, there are diverse findings, favorable, unfavorable or any implications; the indicators used for measuring the CSR actions/ESG dimensions and financial performance are various; board attributes (meetings, gender or size) have good implications on CSR policies and performance.

Finally, to complement the classical literature review and for a better understanding of the main terms and research directions approached in recent studies on the drivers of financial performance in the energy sector and the role of sustainability coordinates, we have performed a bibliometric analysis. Hence, data on 432 scientific articles published during 2019–2022 and available in Scopus on this topical subject have been extracted and analyzed with VOSviewer (Figure 1).

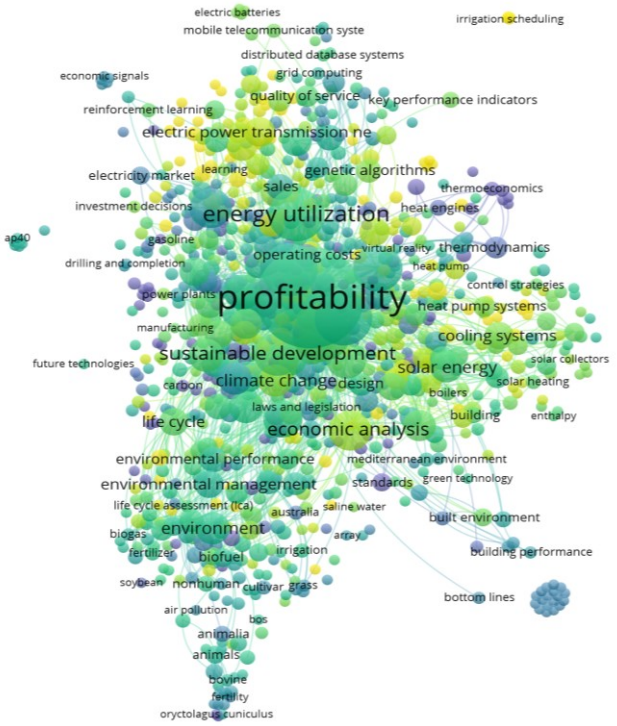

Figure 1. Co-Occurrence and Links between Terms/ Keywords Approached in Relevant Recent Literature on Firm Performance in the Energy Sector

Source: created by authors in VOSviewer, using Scopus indexed articles

Figure 1 reveals that profitability, sustainable development, energy utilization, environmental performance and management, are at the core of similar studies on this topical subject. At the same time, solar energy, biofuel, and green technology are correlated with profitability, thus revealing the keen focus of recent studies on renewable energies. Nevertheless, to the best of our knowledge, a comprehensive study with advanced empirical evidence on the drivers of financial performance for energy companies in a comparative approach between conventional and renewable energy fields has been less considered. Our paper seeks to fill this gap and brings new empirical evidence and strategic landmarks for policy-makers, practitioners, companies, and investors on the decisive role of ESG coordinates and human capital landmarks in shaping the profitability of energy companies, separately for conventional and renewable energy sectors.

Data and Methodology

Based on the scarce underpinnings in the literature as regards conventional vs. renewable energy approach, data, collected from the Refinitiv Eikon (2021) database, encloses energy fields, distinctively for these two fields, for one fiscal year (2020).

The sample of conventional energy companies includes the following allocation sectors: coal; electric utilities; electrical components and equipment; heavy electrical equipment; independent power producers; integrated oil and gas; mining support services and equipment; natural gas utilities; oil and gas drilling; oil and gas exploration and production; oil and gas transportation services; oil and gas refining and marketing; oil-related services and equipment; specialty mining and metals; uranium (Refinitiv Eikon, 2021). This sample collected a total number of 503 companies, with headquarters located as follows: the United Kingdom (138), Germany (38), France (33), Italy (32), Spain (15) and Denmark (6), Russia (224) and South Africa (17).

The sample of renewable energy companies includes the following allocation sectors: renewable fuels; and renewable energy equipment and services. This sample gets together a total number of 39 companies, with headquarters located in: France (9), Denmark (2), Germany (15), Italy (4), Spain (3), and the United Kingdom (6).

The selected variables (Refinitiv Eikon, 2021) were grouped into three categories of indicators, as follows:

1. *Financial performance indicators* (absolute and relative size): "earnings before interest and taxes *(EBIT)*" (USD, millions); "return on assets (*ROA*)" (%); "return on equity (*ROE*)" (%);

2. *ESG measures and indicators* (scores 1-100): "targets diversity and opportunity score (*Targets_Diversity*)"; "policy bribery and corruption score (*Bribery_corrupt*)"; "bribery, corruption and fraud controversies score (*Bribery_corrupt_fraud*)"; "CSR sustainability reporting score (*CSR_report*)"; "CSR strategy score (*CSR_strategy*)"; "ESG score (*ESG*); total CO2 equivalent emissions to revenues (*CO2_emissions*)"; "targets emissions score (*Targets_emissions*)"; "policy emissions score (*Policy_emissions*)"; "environmental products score (*Env_Products*)";

3. *Human capital indicators – board and employees:* "board size (*Board_size*) (number)"; "board meetings (*No_board_meet*) (number)"; "board gender diversity (*Board_diversity*) (percent score)"; "women employees (*Women_empl*) (score 1 to 100)"; "average training hours (*Training_h*) (score 1 to 100)"; "compensation committee independence (*Compens_com_indep*) (score 1 to 100)".

For the financial performance, we choose these indicators to disclose its absolute values (for EBIT) and relative terms (for ROA and ROE), related to those applied in the literature (Pirtea *et al.*, 2021). The descriptive statistics of the selected indicators for each panel of energy companies (conventional and renewable) are enclosed in Table 1, respectively Table 2. These results revealed that the mean values of EBIT, ROA, and ROE are positive for all conventional energy companies, while for the renewable category were negative, except for ROA. Though, ROA was higher for the renewable energy companies than for the conventional ones. As regards ESG indicators, for the renewable energy companies, there are no reported data for the targets' diversity and opportunity score (*Targets_Diversity*). The overall ESG score (*ESG*) was higher for conventional energy companies (over 57) than for

renewable energy companies (over 47). The environmental ESG measures products are almost similar for the two considered groups of energy companies, with a slight difference in the favor of the renewable energy group of companies (higher target emissions and environmental products scores).

Table 1

Summary Statistics – Conventional Energy Companies

Variables	Count	Mean	Standard deviation	Minimum	Maximum
EBIT	458	221.6629	1449.829	-13306	21641.77
ROA	503	0.4022664	4.005386	-35.79	51.67
ROE	503	1.221909	12.93769	-188.44	89.05
CO2_emissions	87	54.46092	28.46184	1.85	98.99
Targets_emissions	101	50.52762	39.64419	0	90
Policy_emissions	102	55.86441	20.22077	0	70.21
Targets_diversity	84	29.625	43.32106	0	95.31
Env_products	101	39.25446	35.22349	0	89.08
Training_h	57	48.76123	26.44682	1.6	92.02
CSR_report	102	53.76235	12.69261	0	64.71
Women_empl	90	55.023	28.4286	3.29	98.44
Bribery_corrupt	102	52.44412	19.6516	0	70
Bribery_corrupt_fraud	102	50.33794	24.18083	0.05	62.26
Compens_com_indep	92	51.49772	27.76211	0.24	96.1
No_board_meet	87	11.35632	9.284868	2	53
Board_size	102	10.21569	2.741783	5	19
Board_diversity	102	43.23137	28.9219	1.44	98.73
CSR_strategy	102	57.69824	29.06292	0	97.56
ESG	102	57.33059	21.74808	5.15	92.17
N total	503				

Source: processed by authors

Table 2

Summary Statistics – Renewable Energy Companies

Variables	Count	Mean	Standard deviation	Minimum	Maximum
EBIT	30	-1.072002	220.8397	-557.78	929.41
ROA	22	1.407273	5.35201	-11.83	15.5
ROE	22	-9.240909	40.51504	-159.38	35.45
CO2_emissions	7	54.10571	34.73445	14.71	97.06
Targets_emissions	11	60.93364	39.30547	0	88.1
Policy_emissions	11	52.62545	33.98971	0	74.36
Targets_diversity	0	.	.	.	.
Env_products	11	45.78636	22.84233	0	64.71
CSR_report	11	36.44091	28.98142	0	62.35
CSR_strategy	11	33.75364	25.95532	0	87.35
ESG	11	47.84545	22.70815	18.08	78.51
Training_h	4	43.66	32.10307	7.14	81.25
Women_empl	7	63.17429	24.53596	19.44	85
Board_diversity	11	37.49909	31.52429	7.46	90.59
Board_size	11	7.818182	3.429816	3	13
No_board_meet	8	11.25	7.146428	5	25
Bribery_corrupt	11	43.79454	34.72715	0	70.59
Bribery_corrupt_fraud	11	62.04818	0.5391991	60.7	62.93
Compens_com_indep	4	22.3175	25.13491	1.87	58.89
N total	39				

Source: processed by authors

The research methodology encloses *two econometric procedures*, which are complementing each other, from assessing direct influences, to global connections of the ESG actions, including extended human resources landmarks, with the financial performance (in absolute and relative size), organized in a two-fold analysis, distinctively for conventional and renewable energy companies.

Specifically, we used the following econometric models: *models of robust regression (RREG),* to shape the direct impacts of the ESG actions on each dimension of financial performance (EBIT, ROA, and ROE); *models of structural equations (SEM)*, to appraise the all-embracing interlinkages of the ESG actions on each dimension of the considered financial performance. As such, for each type of econometric procedure, we built two models, one for companies in the fields of conventional energy, and the other for companies in the fields of renewable energy.

Models of RREG are shown in Equation 1, including as dependent variables, alternatively, each of the considered indicators of financial performance, namely EBIT (in

absolute size), ROA, and ROE (in relative size), thus, resulting in 6 econometric models overall, for both panels (conventional and renewable energy companies):

$$EBIT/ROA/ROE = \beta_0 + \beta_1 CO2\_emissions + \\ + \beta_2 Targets\_emissions + \beta_3 Policy\_emissions + \\ + \beta_4 CSR\_strategy + \beta_5 Training\_h + \\ + \beta_6 Women\_empl + \beta_7 Board\_diversity + \\ + \beta_8 No\_board\_meet + \beta_9 Bribery\_corrupt + \\ + \beta_{10} Compens\_com\_indep + \theta_i + \varepsilon \quad (1)$$

Robust regression enhances the advantage of providing robust estimates by removing the outliers within the sample through two types of iterations, namely Huber and biweight iterations, thus coping with potential distortions in the estimated coefficients.

Econometric modelling based on SEM represents an advanced and comprehensive model, bringing together multiple variables in their *direct, indirect, and total relationships*, as well as *latent hypothetical elements* that can be represented by groups of observed variables (Hoyle, 1995).

SEM is generated by the Maximum likelihood estimation (MLE) method, and the graphical construction of the model is shown in Figure 2. SEMs are built for each of the three financial performance indicators considered as a dependent variable (EBIT, ROA, and ROE), which we generically noted with "Financial_performance". As in the case of RREG models, we have 6 SEM models for both panels, conventional and renewable energy companies. The independent variables that we kept in the model are based on manifold simulations that we made, for which the model was supportive.

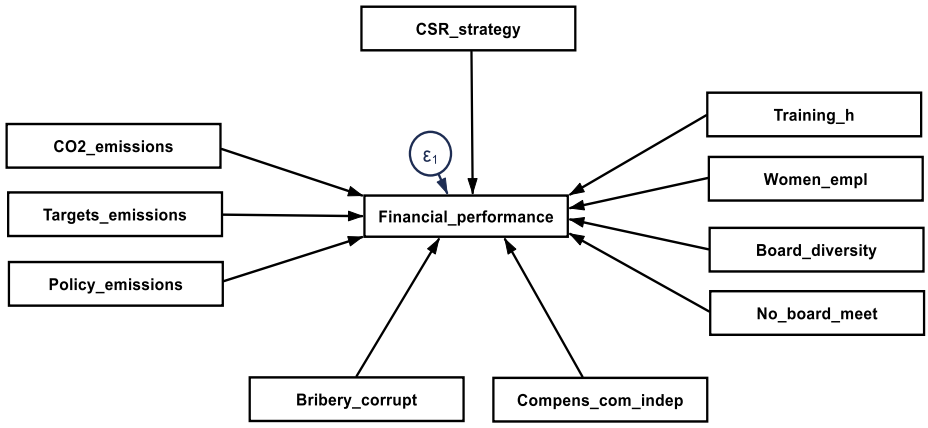

Figure 2. General Representation of the SEM Models

Based on the summary of the literature review and the methodology applied, the research hypotheses are:

- H1. ESG actions directly and notably shape the financial performance of energy companies, both conventional and renewable ones;
- H2. Human capital (board and employees) dimensions directly and significantly influence the financial performance of energy companies, both conventional and renewable ones;
- H3. ESG actions, within global interlinkages with human capital dimensions, notably influence the financial performance of energy companies, both conventional and renewable ones.

Results and Discussions

Robust Regression Models (RREG)

The association among variables for ***the conventional energy companies*** discloses high connections for financial performance expressed both in absolute terms (EBIT), and relative ones (only for ROA), with R^2 values around 0.9 (model 1 for EBIT, R^2 = 0.925; model 2 for ROA, R^2 = 0.893). In the case of ROE, R^2 reveals medium values of association among variables (model 3 for ROE, R^2 = 0.613).

As regards financial performance in absolute terms expressed by EBIT (model 1 in Table 3), favorably direct impacts (revealed by positive and statistically significant coefficients) were induced by emissions measures - namely, concrete ESG actions, CO2 to revenues (*CO2_emissions*), targets (*Targets_Emissions*) and policy emissions (*Policy_Emissions*), but also by gender diversity in favor of women employees' inclusion (*Women_empl*). In the case of financial performance in relative terms expressed by ROA (model 2 in Table 3), favorable direct impacts were registered only for women employees' inclusion (*Women_empl*) and training of employees (*Training_h*), while in case of financial performance expressed by ROE (model 3 in Table 3), the only favorable and statistically significant influence was determined by including of targets emissions (*Targets_Emissions*).

Opposite, unfavorably direct impacts (disclosed by negative and statistically significant coefficients) upon EBIT (model 1 in Table 3) were induced by environmental products (*Env_Products*), CSR sustainability reporting (*CSR_report*) and policy bribery and corruption (*Bribery_corrupt*), as ESG measures, on the one hand, and board gender diversity (*Board_diversity*) and compensation committee independence (*Compens_com_indep*), as human capital dimensions, on the other hand.

As for the financial performance in relative terms expressed by ROA (model 2 in Table 3), there are the unfavorable direct impacts also for environmental products (*Env_Products*), reporting of CSR sustainability (*CSR_report*) and other two factors of human capital dimensions as in the case of EBIT, namely diversity of the

board gender diversity (*Board_diversity*) and compensation committee independence (*Compens_com_indep*). Therefore, compared with the findings obtained in the literature, the effects of environmental measures on the financial performance of conventional energy companies were opposite to Jiang et al. (2018) which proved the positive impacts of environmental responsibility on financial performance (measured by ROA) of energy companies from China. Besides these variables, upon ROA were induced unfavorable influences also by targets diversity and opportunity score (*Targets_Diversity*), size of the board (*Board_size*) and number of board meetings (*No_board_meet*). These results are also diverse to evidence obtained by Shahbaz *et al.* (2020) that proved overall positive impacts of board gender diversity and board size on ROA for the global energy companies with data on the Refinitiv Eikon database, and any associations with board meetings.

In the case of financial performance expressed by ROE (model 3 in Table 3), there were not registered any statistically significant unfavorable influences. The results are in line with those obtained by Gonenc and Scholtens (2017) which evidenced no significant impact of environmental performance on ROE in the case of fossil fuels companies, but also with those of Pätäri *et al.* (2014) that analyzed CSR actions, through their strengths and weaknesses, and evidenced no implications in terms of ROE and CSR strength, with overall evidence of no bidirectional causality between CSR actions and financial performance.

Table 3

Results of Robust Regression Multifactorial Models (RREG) for Energy Companies – Conventional Fields

Variables	(1)	(2)	(3)
	EBIT	**ROA**	**ROE**
CO2_Emissions	36.16***	0.0142	-0.0367
	(8.703)	(0.0161)	(0.0884)
Targets_Emissions	36.43**	0.0410	0.361**
	(10.98)	(0.0199)	(0.109)
Policy_Emissions	140.3*	0.0946	-0.310
	(53.78)	(0.0977)	(0.537)
Targets_Diversity	-2.946	-0.0383**	-0.0588
	(6.124)	(0.0111)	(0.0611)
Env_Products	-32.97**	-0.0574**	0.0129
	(8.784)	(0.0155)	(0.0854)
CSR_report	-460.4***	-1.015***	1.138
	(110.3)	(0.202)	(1.111)
CSR_strategy	6.187	-0.0395	-0.167
	(14.03)	(0.0234)	(0.129)
ESG	-36.31	0.0706	-0.390
	(31.51)	(0.0567)	(0.312)
Training_h	13.04	0.0948***	-0.0233
	(10.98)	(0.0192)	(0.105)
Women_empl	57.82***	0.0964***	0.0874
	(9.418)	(0.0161)	(0.0886)
Board_diversity	-69.48***	-0.0324*	0.0273
	(7.572)	(0.0137)	(0.0754)
Board_size	14.05	-0.814***	-1.380
	(92.34)	(0.164)	(0.901)
No_board_meet	-30.70	-0.156*	-0.121
	(33.73)	(0.0584)	(0.321)
Bribery_corrupt	22.59	0.0136	0.0159
	(21.24)	(0.0310)	(0.171)
Bribery_corrupt_fraud	-21.08*	-0.0157	-0.107
	(8.805)	(0.0159)	(0.0873)
Compens_com_indep	-36.56**	-0.0587**	0.122
	(9.683)	(0.0157)	(0.0865)
_cons	18321.9*	58.13***	-5.699
	(7992.8)	(14.63)	(80.41)
N	32	36	36
R^2	0.925	0.893	0.613

*Note: „Standard errors in parentheses: *p<0.05, **p<0.01, ***p<0.001". Source: authors' research*

In the case of renewable energy companies (Table 4), the targets diversity and opportunity score (*Targets_ Diversity*) was omitted from the model, because this variable has no observations, and the other variables, which were not included in the model compared to the panel of conventional energy companies, were removed due to multicollinearity, namely: environmental products score (*Env_Products*); CSR sustainability reporting score (*CSR_report*); ESG score (*ESG*); board size (*Board_size*); and bribery, corruption and fraud controversies score (*Bribery corrupt fraud*). On these remained variables, the association among them expressed high connections for all models, both in absolute terms (model 1 for EBIT, $R^2 = 0.908$), and relative ones (model 2 for ROA, $R^2 = 0.803$; model 3 for ROE, $R^2 = 0.997$).

Among the *ESG measures/ group of indicators* kept in the models (Table 4), CSR strategy score (*CSR_strategy*) registered significant statistical influences and entailed unfavorable implications upon all variables considered as proxies for financial performance, both in absolute terms (model 1 for EBIT), and in relative terms (model 2 for ROA, model 3 for ROE), while for the policy bribery and corruption (*Bribery_corrupt*), the implications were favorable for all these variables (EBIT, ROA, and ROE). Only in the case of ROE (model 3, Table 4), the single variables from the ESG group of indicators that statistically influenced financial performance were targets emissions, with favorable impacts, and policy emissions, with unfavorable implications.

Table 4

Results of Robust Regression Multifactorial Models (RREG) for Energy Companies – Renewable Fields

Variables	(1)	(2)	(3)
	EBIT	**ROA**	**ROE**
CO2_emissions	-0.0824 (0.235)	-0.0240 (0.0499)	0.127 (0.127)
Targets_emissions	0.460 (0.245)	-0.0353 (0.0519)	1.090*** (0.132)
Policy_emissions	-0.384 (0.284)	0.0426 (0.0602)	-0.603*** (0.153)
CSR_strategy	-3.545*** (0.629)	-0.484** (0.133)	-4.674*** (0.340)
Training_h	2.176** (0.721)	0.597*** (0.153)	-3.088*** (0.390)
Women_empl	2.459*** (0.655)	0.507** (0.139)	-3.901*** (0.354)
Board_diversity	-0.781*** (0.198)	0.0240 (0.0420)	0.378** (0.107)
No_board_meet	-5.909*** (0.773)	-0.704*** (0.164)	-1.480** (0.418)
Bribery_corrupt	3.838*** (0.481)	0.397*** (0.102)	2.013*** (0.260)
Compens_com_indep	-0.544* (0.245)	0.131* (0.0520)	1.588*** (0.132)
_cons	-173.4* (67.52)	-50.62** (14.32)	309.2*** (36.46)
N	39	39	39
R^2	0.908	0.803	0.997

*Note: „Standard errors in parentheses: *p<0.05, **p<0.01, ***p<0.001". Source: authors' research*

Comparing the implications generated in the case of ESG actions for the 2 panels, companies from the conventional and renewable fields of energy, we observe similar results only for targets emissions that induced favorable direct effects on financial profitability (expressed by ROE). As regards the overall inference of ESG, measured by ESG score, the results evidenced that any direct implications were registered on the financial performance both for conventional companies and renewable ones, being similar to those obtained by Baran *et al.* (2022) for the energy companies from Poland.

Thus, the first hypothesis, *H1. ESG actions directly and notably shape the financial performance of energy companies, both conventional and renewable ones,* and are partially fulfilled, with diverse results for companies from conventional and renewable fields of energy, respectively for profitability in absolute and relative terms.

Among *human capital indicators,* the same statistically significant implications (favorable) upon all considered variables of financial performance were induced only by the number of board meetings (*No_board_meet*), while for the other variables, the impacts were diverse among the absolute and relative forms of financial performance. Thereby, board gender diversity (*Board_diversity*) induced unfavorable impacts on EBIT (model 1), and favorable ones on ROE (model 3). Similar favorable results were obtained by Atif *et al.* (2021) in the case of women's implications on the renewable energy companies' board, for the financial performance expressed in ROE and Tobin's Q, by interaction with the consumption of renewable energy. Also, the compensation committee independence (*Compens_com_indep*) exerted unfavorable influences on absolute terms of financial performance (EBIT, model 1), and favorable ones on relative forms of financial performance (ROA and ROE, models 2 and 3). Opposite,

training hours (*Training_h*) and women employees (*Women_empl*) led to favorable impacts for EBIT (model 1) and financial performance connected with assets (ROA, model 2), while for financial performance connected with equity (ROE, model 3), the influences were unfavorable.

Therefore, as regards human capital dimensions, similar results for both panels, conventional and renewable, were obtained for the following indicators: training activities that exerted favorable direct effects on economic profitability (expressed by ROA); share of women employees in the companies, which generated favorable impacts on financial performance expressed by EBIT and ROA, while their involvement in the board committee (board gender diversity) induced unfavorable impacts on EBIT; the number of board meetings that exerted also unfavorable implications on economic profitability (expressed by ROA); and compensation committee independence, which induced unfavorable impacts on EBIT.

Thus, the 2nd hypothesis, *H2. Human capital (board and employees) dimensions directly and significantly influence the financial performance of energy companies, both conventional and renewable ones,* is also partially fulfilled, with different impacts for energy companies from conventional and renewable sectors. Therefore, we propose specific policies and strategies to comply with the CSR dimensions, as predictors of financial performance, tailored to each panel, renewable and conventional energies.

Structural Equation Models (SEM)

To assess the global interlinkages of ESG actions and human capital dimensions with the financial performance of energy companies, both for conventional and renewable fields (hypothesis H_3), we obtained 6 models of SEM for each field and variable of financial performance, built on the general representation configured in Figure 2.

SEMs were processed by the MLE method, with missing values. To validate SEM results, we first applied a series of specific tests, such as the „Wald test for each equation", „the good-fit tests (Likelihood ratio, Information criteria, Baseline comparison, Size of residuals)", and we have also calculated the Alpha Cronbach per item and per total scale (Annexes, Tables A1-A4).

As regards the conventional energy companies, we obtained 3 models, namely, for EBIT (Figure 3, Table 5 - model 1), ROA (Figure 4, Table 5 - model 2), and ROE (Figure 5, Table 5 - model 3).

In the case of the results for the financial performance in absolute size (EBIT, Figure 3, Table 5 – model 1), none of these are statistically significant, while for the financial performance in relative size (ROA, Figure 4, Table 5 – model 2, respectively, ROE, Figure 5, Table 5 – model 3), there were favorable impacts induced by women employees inclusion (*Women_empl*), and negative ones for CSR strategy (*CSR_strategy*). Thereto, training hours (*Training_h*) exerted positive inferences upon the financial performance in relative size (statistically significant only for ROE, Table 5 – model 3). These results are diverse from those obtained by Kludacz-Alessandri and Cyganska (2021) that evidenced, for the year 2020, no relationships between CSR strategies adopted by the energy companies and ROE, and positive interlinkages with EBIT and ROA.

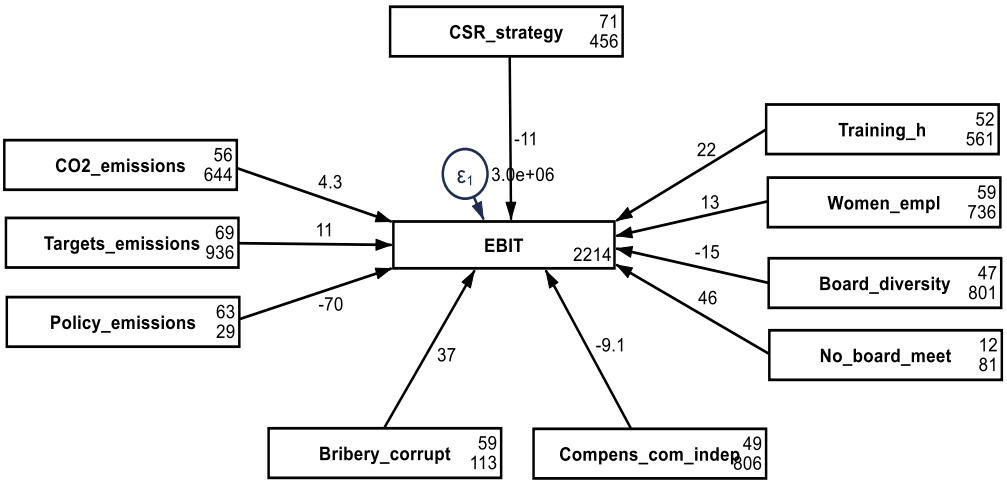

Figure 3. SEM for EBIT, Energy Companies – Conventional Fields

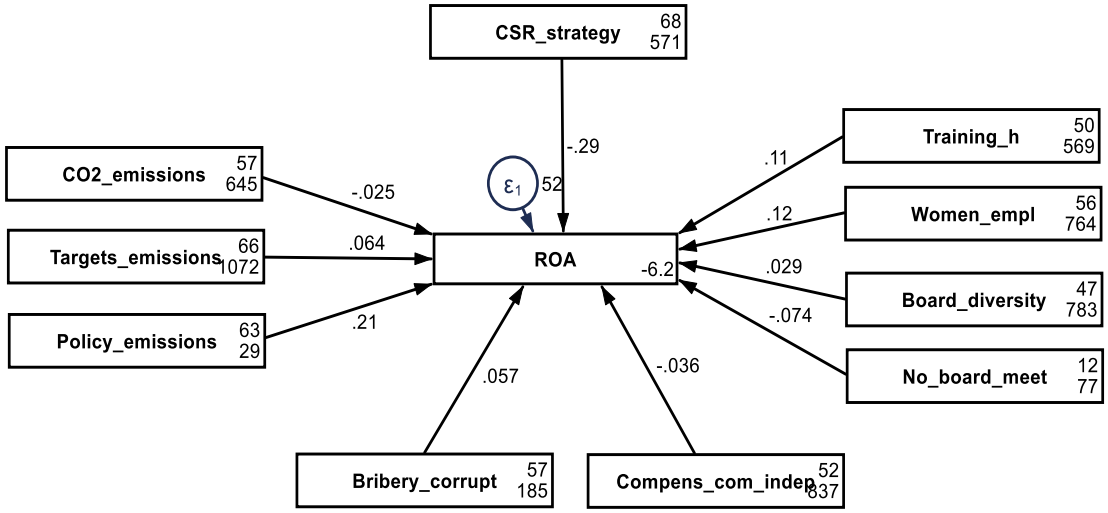

Figure 4. SEM for ROA, Energy Companies – Conventional Fields

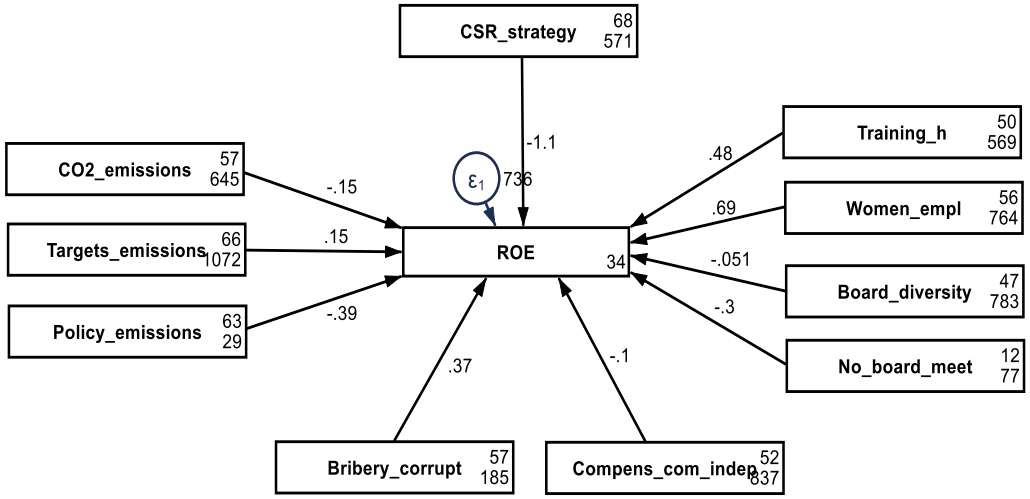

Figure 5. SEM for ROE, Energy Companies – Conventional Fields

Table 5

Results of SEM for Energy Companies – Conventional Fields

Variables	(1)	(2)	(3)
	EBIT	ROA	ROE
CO2_emissions	4.327 (13.84)	-0.0246 (0.0555)	-0.146 (0.208)
Targets_emissions	11.17 (13.09)	0.0640 (0.0498)	0.151 (0.187)
Policy_emissions	-70.19 (60.98)	0.210 (0.244)	-0.392 (0.914)
Bribery_corrupt	36.75 (32.91)	0.0566 (0.105)	0.372 (0.394)
Training_h	22.42 (14.27)	0.106 (0.0568)	0.479* (0.213)
Women_empl	13.11 (11.99)	0.123** (0.0472)	0.686*** (0.177)
Board_diversity	-14.82 (11.51)	0.0287 (0.0456)	-0.0510 (0.171)
No_board_meet	45.66 (40.77)	-0.0738 (0.163)	-0.304 (0.613)
Compens_com_indep	-9.096 (12.11)	-0.0360 (0.0462)	-0.104 (0.173)
CSR_strategy	-10.73 (16.22)	-0.290*** (0.0627)	-1.124*** (0.235)

Variables	(1)	(2)	(3)
	EBIT	**ROA**	**ROE**
_cons	2214.3 (4468.5)	-6.156 (16.70)	34.41 (62.61)
/			
var(e.ebit)	2956356.0*** (687338.8)		
var(e.roa)		52.39*** (11.57)	
var(e.roe)			736.4*** (162.6)
N	37	41	41

*Note: „Standard errors in parentheses: *p<0.05, **p<0.01, ***p<0.001". Source: authors' research*

As regards ***the energy companies from the renewable fields***, the results of global interlinkages of ESG actions and human capital dimensions with the financial performance of energy companies are enclosed in the 3 models obtained, namely, for EBIT (Figure 6, Table 6 – model 1), ROA (Figure 7, Table 6 – model 2), and ROE (Figure 8, Table 6 – model 3).

The results for the financial performance in absolute size (EBIT, Figure 6, Table 6 – model 1), attest significant statistical influences induced only for the compensation committee independence (*Compens com indep*). For the financial performance in relative size, the implications were slightly diverse for economic profitability, related to specific dimensions of these companies (ROA, Figure 7, Table 6 – model 2), compared with the financial profitability, related to equity/shareholders' participation (ROE, Figure 8, Table 6 - model 3).

Thereby, for economic profitability (ROA, Figure 7, Table 6 – model 2), favorable impacts were exerted by policy bribery and corruption score (*Bribery_corrupt*), as CSR measures, on the one hand, and women employees (*Women_empl*), training hours of employees (*Training_h*) and compensation committee independence (*Compens_com_indep*), as human capital dimensions, on the other hand. Unfavorable interlinkages with economic profitability were generated by the CSR strategy (*CSR_strategy*) and the number of board meetings (*No_board_meet*).

Regarding financial profitability (ROE, Figure 8, Table 6 - model 3), favorable interlinkages were exerted only by targets emissions (*Targets_emissions*), as CSR measures, while for the human capital dimensions were induced only unfavorable global impacts, by the share of women employees (*Women_empl*) and training hours of employees (*Training_h*).

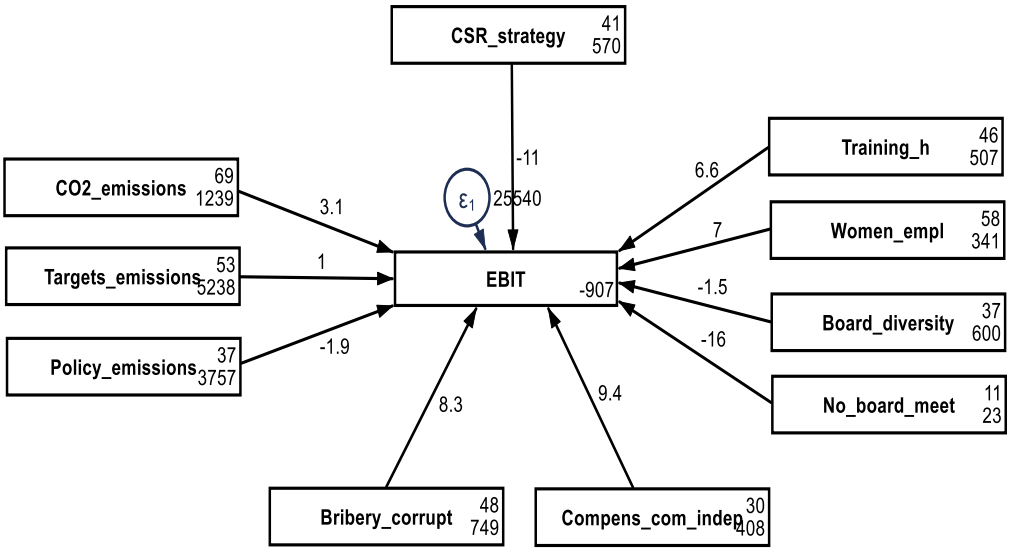

Figure 6. SEM for EBIT, Energy Companies – Renewable Fields

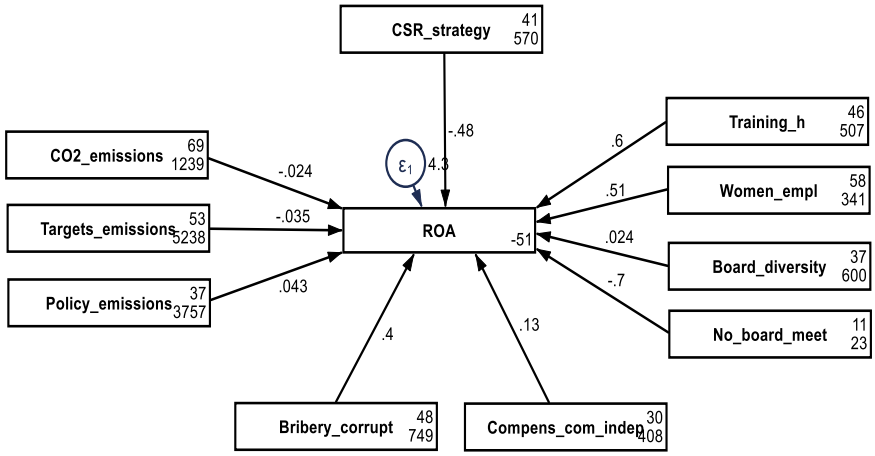

Figure 7. SEM for ROA, Energy Companies – Renewable Fields

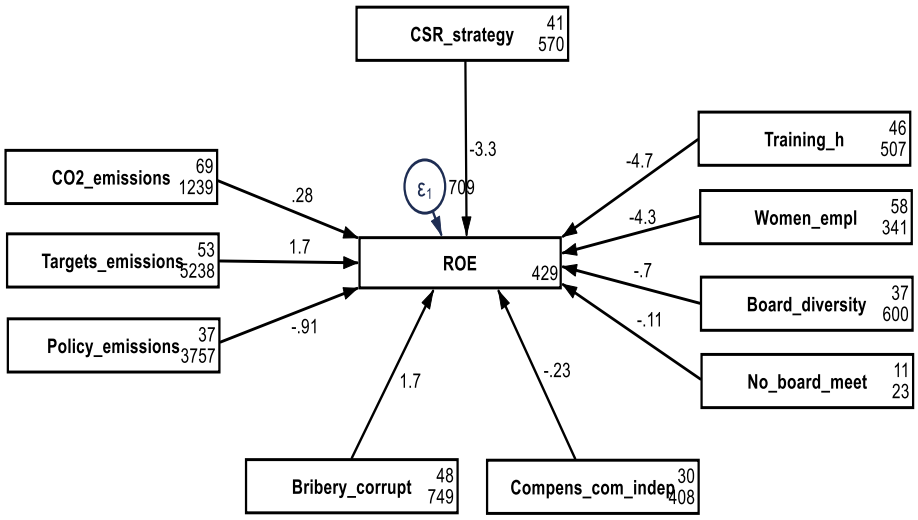

Figure 8. SEM for ROE, Energy Companies – Renewable Fields

Table 6

Results of SEM for Energy Companies – Renewable Fields

Variables	(1)	(2)	(3)
	EBIT	ROA	ROE
main			
CO2_emissions	3.062 (3.276)	-0.0240 (0.0423)	0.283 (0.546)
Targets_emissions	1.034 (3.409)	-0.0353 (0.0440)	1.658** (0.568)
Policy_emissions	-1.862 (3.950)	0.0426 (0.0510)	-0.906 (0.658)
Bribery_corrupt	8.263 (6.691)	0.397*** (0.0864)	1.747 (1.115)
Training_h	6.648 (10.04)	0.597*** (0.130)	-4.704** (1.673)
Women_empl	7.013 (9.122)	0.507*** (0.118)	-4.341** (1.520)
Board_diversity	-1.490 (2.756)	0.0240 (0.0356)	-0.697 (0.459)
No_board_meet	-16.16 (10.77)	-0.704*** (0.139)	-0.106 (1.793)
Compens_com_indep	9.434** (3.412)	0.131** (0.0440)	-0.225 (0.568)
CSR_strategy	-10.95 (8.755)	-0.484*** (0.113)	-3.345* (1.458)

Variables	(1)	(2)	(3)
	EBIT	**ROA**	**ROE**
_cons	-907.1 (940.0)	-50.62*** (12.13)	428.9** (156.6)
/			
var(e.EBIT)	25539.7*** (5783.6)		
var(e.ROA)		4.254*** (0.963)	
var(e.ROE)			708.6*** (160.5)
N	39	39	39

*Note: „Standard errors in parentheses: *p<0.05, **p<0.01, ***p<0.001". Source: authors' research*

Comparing the results obtained for the 2 panels, companies from the conventional and renewable energy fields, we observe similar results for both, only in the case of the following variables: CSR strategies that overall induced negative implications on financial profitability (both for ROA and ROE); and the share of women employees in the activity that exerted unfavorable impact for economic profitability (ROA). For financial profitability (expressed by ROE), human capital indicators - training activities and share of women employees in the activity – globally induced favorable impacts for conventional energy companies, while for the renewable fields, the results were unfavorable.

Thus, the 3rd hypothesis, *H3. ESG actions, within global interlinkages with human capital dimensions, notably influence the financial performance of energy companies, both conventional and renewable ones,* is partially fulfilled, with diverse results for companies from conventional and renewable fields of energy, respectively for profitability in absolute and relative terms. Therefore, we propose distinct policies for these specific situations.

Conclusions

In a race with many economic, social, environmental, and technical challenges, companies are the most important players, their behavior being in a process of metamorphosis considering, on the one hand, the pressures of shareholders to maximize financial performance, and, on the other hand, the actions of other stakeholders who sanction less environmentally and socially responsible behavior of these entities. The companies' business strategies have been reshaped in recent decades by incorporating ESG aspects, promoting CSR actions, and, more recently, by raising awareness of the importance of non-financial performance. Public authorities must provide the legal and institutional framework for the transposition of international agreements at the national level.

Therefore, in this paper, we evidenced the implications of ESG actions, including human resources attributes, on the financial performance of companies in the energy field. Our focus was on energy companies, conventional vs. renewable ones, in view of the ongoing energy transition process, given their support in sustainable development, and the different externalities they generate in economic, social, and environmental terms, but also the crises generated by the geopolitical risk caused by the recent invasion of Ukraine by the Russian army. We assessed three hypotheses to evidence direct and overall interlinkages for the two samples of companies.

Regarding the direct impacts of the ESG measures on financial performance, assessed by 1st hypothesis (H_1), for *conventional energy companies*, we propose the following strategies related to potential risks induced by the results obtained (unfavorable implications induced): including better policies for environmental products, especially these companies generate significant negative externalities; ensuring transparency in reporting of CSR sustainability; tight policy for bribery and corruption. As for *renewable energy companies*, related to the risks for the ESG measures, we propose the following strategies: development of complex CSR programs to increase the score of CSR strategy; and extension for all companies of the policy emissions. Given the positive impact of non-financial performance on the financial results of energy companies, their interest in promoting CSR programs will be growing, but stakeholders need to quickly sanction any greenwashing strategies detected. The standardization of non-financial reporting by energy companies would be a beneficial solution for stakeholders that could make it easier to compare the social and environmental performance of different entities.

With respect to the direct impacts of human capital credentials on financial performance, assessed by the 2nd hypothesis (H_2), associated with potential risks evidenced by the results obtained, we propose the following strategies for both *conventional and renewable energy companies*: more implications of women on the board companies and better independence of compensation committee. Moreover, *for conventional energy companies,* the strategies are associated also with better targets for diversity and opportunity, and strategies considering the size and more board attendings focused on CSR actions and programs. Distinctively, for *renewable energy companies*, there is a need for including training hours for employees and women employees, which are more reliable for these kinds of products, since the presence of women, both inboard and as employees, will induce greater renewable energy consumption, with impact on higher financial performance, as Atif *et al.* (2021) also mentioned.

With reference *to the overall interlinkages of the ESG measures and human capital dimensions on financial performance, assessed by 3rd hypothesis (H_3),* for *conventional energy companies*, we propose better CSR strategies, grounded on the risks induced by our results, but stakeholders need to quickly sanction any greenwashing strategies detected since these strategies are practiced only to improve the image among stakeholders (Palazzo & Siano, 2019). For the *renewable fields*, also extending the CSR

strategy, jointly with extending board meetings, the inclusion of more women employees, and offering training hours, due to this specific field.

The behavior of energy companies is also shaped by the concrete actions of portfolio investors and stock exchanges. Portfolio investors have become increasingly demanding of the social and environmental performance of companies, and in the developed markets they are true promoters of the principles of sustainable development. Sustainability reports published by energy companies have become increasingly complex to meet the need to inform stakeholders about the non-financial performance of companies with a negative impact on the environment. Overall, we can say that we are witnessing a process of corporate divestment in traditional energy sources, and the growing interest in renewable energy with less or no impact on the environment.

Policy-makers, practitioners, and investors could benefit from the main findings of this research, as we evidenced the decisive importance of ESG actions in the energy sector and the positive interplay with financial performance. Energy companies and managers should be aware that low ESG performance could attract a negative screening as an investment strategy and hence the exclusion from investment portfolios. Investors may tend to exclude companies with low ESG scores in this sector since they are keen to make sustainable investments through better management of ESG-related risks as Sahin *et al.* (2022) also outlined. Moreover, another implication of our research for practitioners is related to the fact that sustainability strategies are essential for risk management disclosure in the energy sector, hence tailored and transparent CSR sustainability reporting, programs and policies, better environmental policies that limit negative externalities, and tighter policies for bribery and corruption should play a key role in a comprehensive strategic direction for companies operating in both conventional and renewable energy sector. Hence, corporations, policy-makers, regulators, and investors should consider a more attentive approach to embed stakeholders' interests into the corporate strategy and overall planning process as Larcker *et al.* (2022) also highlighted.

Main limitations of the research undertaken in this paper consist of the lack of certain statistical data that are accurate in revealing the amplitude of the ESG processes and no distinctions among various sources of energy for the renewable energy companies. Coping with these limitations, future research will focus on the non-financial performance of conventional and renewable companies for the European Union (EU) countries. Two considerations are taken into account: (1) Directive 2014/95 on non-financial reporting obliges large companies to be more and more careful regarding their social and environmental performance and the way they inform stakeholders; (2) EU countries are important actors in supporting the process of energy transition considering the steps taken to create the energy union.

Annexes

Table A1

Cronbach's Alpha for SEMs – Conventional Energy Panel

Item	Obs.	Sign	Item-test correlation	Item-rest correlation	Average interitem correlation	Alpha
CO2_emission	87	-	0.3954	0.1555	0.1517	0.6167
Targets_emissions	101	+	0.6970	0.5559	0.1042	0.5114
Policy_emissions	102	+	0.6592	0.4788	0.1197	0.5503
Bribery_corrupt	102	+	0.5481	0.3459	0.1312	0.5762
Training_h	57	+	0.4956	0.2844	0.1352	0.5846
Women_empl	90	+	0.5278	0.3091	0.1363	0.5868
Board_diversity	102	+	0.3623	0.1535	0.1534	0.6199
No_board_meet	87	+	0.3338	0.1207	0.1532	0.6194
Compens_com_indep	92	-	0.1297	-0.1096	0.1805	0.6647
CSR_strategy	102	+	0.7264	0.5950	0.1007	0.5020
Total scale					**0.1368**	**0.6131**

Source: authors' contribution

Table A2

Cronbach's Alpha for SEMs – Renewable Energy Panel

Item	Obs	Sign	Item-test correlation	Item-rest correlation	Average interitem correlation	Alpha
CO2_emission	7	+	0.4874	0.2013	0.0879	0.4644
Targets_emissions	11	+	0.7000	0.4873	0.0873	0.4627
Policy_emissions	11	+	0.7382	0.5540	0.0720	0.4112
Bribery_corrupt	11	+	0.4760	0.1805	0.0805	0.4406
Training_h	4	-	0.4516	0.2422	0.0974	0.4928
Women_empl	7	+	0.1297	-0.1589	0.1340	0.5820
Board_diversity	11	+	0.8016	0.6470	0.0483	0.3138
No_board_meet	8	+	0.5832	0.3183	0.0872	0.4625
Compens_com_indep	4	-	-0.0889	-0.3165	0.1093	0.5248
CSR_strategy	11	-	-0.2152	-0.4662	0.1963	0.6874
Total scale					**0.1003**	**0.5270**

Source: authors' contribution

Table A3

Wald Tests for Equations Associated with the SEMs

	Conventional energy fields						Renewable energy fields					
	SEM 1		SEM 2		SEM 3		SEM 4		SEM 5		SEM 6	
Variables	**Chi²**	***p*-value**	**Chi²**	***p*-value**	**Chi²**	***p*-value**	**Chi²**	***p*-value**	**Chi²**	***p*-value**	**Chi²**	***p*-value**
EBIT	18.92	0.0413	-	-	-	-	16.55	0.0850	-	-	-	-
ROA	-	-	30.29	0.0000	-	-	-	-	158.93	0.000	-	-
ROE	-	-	-	-	36.16	0.0001	-	-	-	-	379.32	0.000

Source: authors' contribution

Table A4

Goodness-of-Fit Tests for the SEMs

Description	Conventional energy fields			Renewable energy fields		
	SEM 1	**SEM 2**	**SEM 3**	**SEM 4**	**SEM 5**	**SEM 6**
Likelihood ratio						
Baseline vs. saturated chi²_bs (10)	15.282	22.679	25.924	13.794	63.349	92.535
p > chi²	0.122	0.012	0.004	0.183	0.000	0.000
Information criteria						
AIC (Akaike's information criterion)	3810.96	3797.591	3905.955	3549.781	3210.480	3409.980
BIC (Bayesian information criterion)	3830.29	3818.153	3926.518	3569.744	3230.443	3429.943
Baseline comparison						
CFI (Comparative fit index)	1.000	1.000	1.000	1.000	1.000	1.000
TLI (Tucker–Lewis index)	1.000	1.000	1.000	1.000	1.000	1.000
Size of residuals						
SRMR	0.000	0.000	0.000	0.000	0.000	0.000
CD (Coefficient of determination)	0.338	0.425	0.469	0.298	0.803	0.907

Source: authors' contribution

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The article has been reviewed.
Received in April 2022; accepted in December 2022.