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Do renewable energy mutual funds advance towards clean energy-related sustainable development goals?

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ABSTRACT

This study examines the effects of sustainable energy-focused institutional shareholders on corporate sustainable energy performance. It employs a sample of 43 renewable energy mutual funds and 1074 portfolio firms covering 2006 to 2019. To examine this relationship appropriately, the study adopts Petersen's (2009) panel data approach and clusters standard errors by firm and year. The results indicate that institutional investors lead firms to improve their corporate sustainable energy and environmental performance. Therefore, investment decisions adopted by renewable energy mutual funds achieve positive outcomes in the real world. This has policy implications, showing that economic policies focused on financing the transition of the real economy towards sustainability and improving the financial sector's contribution to sustainability goals are being achieved.

1. Introduction

Institutional investors play an important role in sustainable development by implementing socially responsible strategies during the portfolio selection process [1–4]. Among the strategies adopted, themed strategies focused on one of the United Nations' sustainable development goals have received increased attention from institutional investors [5–9]. The European assets under management tied to themed strategies grew to 462.34% from 2007 to 2017, reaching €148.84 billion in 2017 [7,8]. The assets managed by renewable energy-themed funds represented 12% of the amount invested in all themed strategies at the end of 2017 [8]. These single-themed mutual funds implement renewable energy screenings in their equity selection process to meet the increasing demands of clients who consider sustainable energy issues in their investment decisions, thereby sacrificing their short-term financial performance [10–15]. This may encourage renewable energy mutual funds, as institutional shareholders, to improve the environmental outcomes of the firms in which they invest [16–18].

Renewable energy mutual funds may exercise their voting power and take advantage of their superior managerial skills to integrate sustainable energy and socially responsible activities into the core business strategies of firms in which they invest [19]. This can reduce environmental risk and enhance the long-term environmental (or social) performance of portfolio firms and renewable energy mutual funds. These improvements in environmental fund performance allow managers to satisfy the needs of a niche market of individual investors concerned about sustainable energy, environmental, and social responsibility issues, favouring that mutual funds, as shareholders, contribute to the progress towards an affordable and clean energy-related sustainable development goal (SDG7) [20]. Thus, investment decisions result in positive real-world outcomes, which contribute to achieving the goals of the European Union (EU) Renewed Sustainable Finance Strategy. This strategy focuses on financing the transition of the real economy towards sustainability and improving the contribution of the financial sector to sustainability goals [21].

Despite the influential role of renewable energy mutual funds in implementing regional economic policies, such as the EU Renewed Sustainable Finance Strategy, to achieve the clean energy sustainable development goal (SDG7), finance literature has not paid attention to their influence on sustainable energy, environmental, and social improvements achieved by portfolio firms. To fill this knowledge gap, this study analyses the effect of renewable energy mutual funds as institutional investors on the sustainable energy, environmental, and socially responsible performance of portfolio firms worldwide.

This is the first study to examine the behaviour of renewable energy mutual funds towards the adoption of sustainable energy

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systems in portfolio firms. The findings of this study indicate that renewable energy mutual funds are important long-term oriented institutional investors. They make investment decisions based on explicit renewable energy criteria, contributing to financing the transition of the real economy towards sustainability and to achieving an affordable and clean energy-related sustainable development goal (SDG7).

This study contributes to the literature by investigating how institutional investors influence socially responsible practices adopted by firms in which they invest. Dyck et al. [1] show that institutional investors drive firms to improve their environmental and social performance. However, corporate social responsibility (CSR) subcategories do not have equal importance for institutional investors, as Chen et al. [20] showed that institutional investors promote CSR improvements that have financial value for portfolio firms. Following this line of research, this study shows that institutional investors focusing on renewable energy issues lead firms to improve their corporate sustainable energy and environmental performance.

The remainder of this paper is organised as follows. Section 2 presents a literature review and hypotheses. Section 3 describes the sample, variables, and model. Section 4 reports and discusses the results of this study. Finally, section 5 presents the main conclusions and implications of this study.

2. Literature review

Green finance plays an important role in providing financial resources to firms carrying out renewable energy projects [4,22]. These renewable energy-related firms usually have difficulties in accessing finance mainly due to the existence of risks, low short-term returns, lack of long-term financing and lack of capacity by market actors [23,24]. However, renewable energy mutual funds could be an efficient green finance tool for several reasons. First, they accumulate large amounts of money that allows them to invest in firms with large renewable energy projects and have sufficient voting power to exert influence to improve the corporate environmental activities of their portfolio firms [1,10,11]. Second, renewable energy mutual funds have a long-term investment horizon because their investors are mainly worried about environmental issues in the long-term investment horizon [13]. However, to the best of our knowledge previous literature has not paid attention to the ability of institutional investors to drive the sustainable energy performance of firms worldwide.

Renewable energy mutual funds, as institutional investors, make their investment decisions considering a firm's financial performance and sustainable energy performance, which is a component of corporate environmental performance. The effect of the implementation of environmental practices such as renewable energy systems on firms' financial performance remains controversial. Previous literature examining the financial cost and benefits of improving firms' sustainable energy performance achieves mixed results [1,25,26]. Investments in sustainable energy practices could generate a competitive advantage for firms by differentiating their products and reducing their environmental risks. Alternatively, investments to improve firms' sustainable energy performance could cause agency problems [27]. Large shareholders without financial preferences may not perceive the costs of renewable energy commitments pressuring firms to enhance their sustainable energy systems. If a firm's managers care about these pressures they will increase the investments in renewable energy activities to satisfy the needs of these large shareholders but if the managers are not worried about institutional owners' pressures they will not improve sustainable energy performance, prioritising the short-term shareholder value to enhance their reputation [1].

According to agency theory [27], ownership separation in the hands of renewable energy mutual funds (principals) and control in the hands of a firm's managers (agents) can generate an agency problem because their interests diverge. Renewable energy mutual funds commit to their long-term oriented clients (individual investors) to invest in firms that achieve high sustainable energy standards. This is based on the adoption and monitoring of sustainable energy policies, targets, indicators, and processes, whose long-term profitability is detrimental to short-term financial performance from the natural-resource-based view of a firm [28]. This interest in renewable energy mutual funds to enhance firms' sustainable energy outcomes at the expense of forgoing short-term financial performance does not agree with firms' managers. According to managerial opportunism theory, firm managers prioritise short-term shareholder value to enhance their reputation as managers and maximise short-term private profits when management's compensation schemes are linked to the firm's strong stock price behaviour [20,29].

Institutional investors can restrain this managerial opportunism with large block shareholder positions having sufficient voting power to exert pressure on the board and make critical corporate decisions about adopting sustainable energy strategies [30]. A similar theoretical argument that ownership concentration influences CSR decision-making has been empirically supported by Oh et al. [19], Chen et al. [20], and Chung et al. [29]. This suggests that large institutional shareholders invest in improving the long-term competitiveness of firms by pressuring them to adopt rare and inimitable CSR practices to reduce environmental risk, differentiate their products, and consequently improve their long-term corporate financial performance. They cannot disinvest their large holdings without severely reducing their investment value. This alignment in the long-term investment horizon was discovered by Oikonomou et al. [32], Boubaker et al. [33], and Panicker [34]. Similarly, focusing on one dimension of corporate social performance, Dyck et al. [1] showed that institutional investors contribute to enhancing environmental and social outcomes. Conversely, Kim et al. [35] found a negative relationship between toxic release facilities, as a corporate environmental performance (CEP) measure, and institutional ownership, which depends on external pressures from the community and is congruent with the institutional theory [36]. Thus, it is hypothesised that:

H1. Mutual renewable energy funds positively affect the renewable energy outcomes of portfolio firms.

External pressure from stakeholders may play an important role in encouraging firms and mutual funds to adopt environmental strategies, such as those focused on sustainable energy practices, to gain social legitimacy, making it easier to achieve long-term profitability and survival [36,37]. According to institutional theory, government signatories that ratified environmental agreements, such as the Paris Agreement, exert coercive pressure on civil society and firms' environmental behaviour by promulgating mandatory environmental laws, monitoring, and levying sanctions. The Paris Agreement is a legally binding global treaty on climate change adopted by 197 countries at the Paris Climate Conference in December 2015 and enforced in November 2016. Adopting this agreement has led governments to promulgate environmental laws that promote energy efficiency and renewable energy resources to suppliers and customers.

These coercive measures favour many clients with environmental concerns who demand sustainable energy products and services from firms and mutual funds. To satisfy this demand, as institutional investors, mutual funds may pressure firms to implement green production processes to offer a differentiated sustainable energy product categorised as alternative energy mutual funds

by rating agencies such as Morningstar and Lipper Global. These rating agencies exert normative pressure on mutual funds and discredit non-compliers, moved from this alternative energy category. These agencies also legitimise the renewable energy mutual funds and provide an identity marker that distinguishes them from other thematic mutual funds. This attracts activists and clients who perceive that renewable energy mutual fund shares enable progress towards sustainable development [38]. Consequently, alternative energy categorisation allows mutual funds to attract clients concerned with renewable energy. It increases fund flows together with managers' earnings, usually linked to assets under management. It favours the imitation of mutual funds by pressuring firms in their portfolios to adopt sustainable energy strategies [36,37]. Thus, it is hypothesised that:

H2. Firms with greater institutional ownership display better environmental outcomes from the adoption of the Paris Agreement.

Long-term institutional investors can pay attention to other socially responsible activities adopted by renewable energy-related firms in which they invest. This is because it is likely that these CSR activities improve the long-term fundamental value and ultimately the financial performance of mutual funds investing in them. Prior studies show that sustainability compliance allows fund managers to reduce portfolio risk from negative corporate externalities and improve long-term fund financial performance [39–41]. Furthermore, institutional investors improving firms' social, environmental, and governance outcomes may attract individual investors concerned about the environmental, social, and corporate governance impacts of their investments, thereby increasing fund flows. This allows managers to increase the value of the assets under management (on which management fees are based). Therefore, institutional investors may only exert efforts to change environmental, social, and corporate governance issues that allow them to capitalise on investor demand for fund flows. Institutional investors lead firms to improve corporate social responsibility issues receiving attention from investors concerned about renewable energy issues [20,42]. Martí-Ballester [13] points out that renewable energy fund investors do not react to past financial performance, derive their utility from non-financial attributes associated with sustainable energy practices, or consider other ethical issues when making investment decisions. Considering that renewable energy attributes are a specific dimension of CEP, investors' preferences for sustainable energy attributes can lead institutional investors to improve their portfolio firms' environmental activities. However, this effect can confound the relationship between the proportion of institutional investors and corporate social responsibility performance [43]. Thus, it is hypothesised that:

H3. As shareholders, renewable energy mutual funds do not drive firms to engage in all CSR dimensions.

This study contributes to the literature in several ways. First, this is the first study to examine the behaviour of renewable energy mutual funds towards adopting sustainable energy systems in portfolio firms. Renewable energy mutual funds are important long-term oriented institutional investors that make investment decisions based on explicit renewable energy criteria. They contribute to financing the transition of the real economy towards sustainability and achieving the affordable and clean energy-related sustainable development goal (SDG7). However, this effect is not perceptible in other studies that consider mutual funds and other types of financial entities. They treat them as a homogeneous group, despite the different types of institutional owners having different preferences, risk tolerances, and investment horizons that determine their attitudes towards implementing environmental and socially responsible practices in portfolio firms [20,32,34]. Second, this study examines the effect of institutional investors' ownership on the sustainable energy, environmental, and social responsibility practices of portfolio firms worldwide. In contrast, previous studies only treat the impact of institutional investors on the full or sub-dimensions of corporate social performance [1,19,20,31].

3. Research method

This section describes the sample construction, data sources, key variables used, and proposed models.

3.1. Sample

This study obtains data on the annual portfolio holdings of 43 alternative energy equity mutual funds labelled as primary funds from 2006 to 2018 using the alternative energy filter available in Refinitiv Eikon Lipper fund database. Alternative energy equity mutual funds invest mainly in the stocks of firms that promote the use of renewable and sustainable energy technologies designed to avoid the burning of fossil fuels, which cause global warming. This sample includes liquidated, merged, and active renewable energy funds; therefore, it is free of survivorship biases. The Refinitiv Eikon Lipper database has been a leading provider of independent fund content related to fund classifications, metrics for risk management, and fund portfolio holdings for over 40 years. It covers more than 340,000 share classes in more than 80 markets, including mutual funds.

This study also collects data of 1266 firms, in which renewable energy funds invest, related to social performance, environmental performance, corporate governance performance, and sustainable energy items from 2007 to 2019 from Refinitiv ASSET4 ESG database. This database measures the environmental, social, and corporate governance performance of over 6000 firms, collecting information from publicly available sources (company websites, annual reports, and corporate social responsibility reports) across ten main themes. They are emissions, environmental product innovation, resource use, workforce, community, product responsibility, human rights, shareholders, corporate social responsibility strategy, and management from 2002.

This study obtains annual economic and financial data of these 1266 firms, including the industry type, country, total assets, current assets, return on assets, total debt, property, plant and equipment investment, research and development expenditures, sales, Tobin's Q, and total common shares outstanding of firms between 2006 and 2018 from Refinitiv Datastream database. This database provides historical economic and financial data for over 100,000 equities listed on stock markets worldwide.

To ensure data quality, this study excludes firms with incomplete data by year and winsorizes the independent and control variables at 0.5% at both tails, with the exception of the research and development (R&D) variable, which is winsorised at 0.5% at the top tail. The final sample includes 3843 firm-year observations and 1074 firms from 39 countries from 2006 to 2019.

3.2. Variables

3.2.1. Dependent variables

This study uses corporate sustainable energy, environmental, social, governance, and CSR performance as dependent variables. An index was constructed to measure firms' sustainable energy performance (CSEP). First, specific items related to sustainable energy systems implementation are identified from Refinitiv ASSET4 database, as shown in Table 1. All items are transformed

Table 1
Sustainable energy items.

Item	Definition
ENRRDP0122	Does the company have a policy to improve its energy efficiency?
ENRRDP046	Does the company make use of renewable energy?
ENPIDP066	Does the company develop products or technologies for use in the clean, renewable energy (such as wind, solar, hydro and geothermal and biomass power)?
ENRRDP0192	Has the company set targets or objectives to be achieved on energy efficiency?
ENPIDP015	Does the financial company have a public commitment to divest from fossil fuel?
ENRRDP052	Does the company report about environmentally friendly or green sites or offices?
ENPIDP040	Does the company construct nuclear reactors, produce nuclear energy or is active in another way in the nuclear energy industry?

into binary variables, corresponding to the value of one for each question that firms answer positively (e.g. firms that have a policy to improve their energy efficiency, set targets to be achieved on energy efficiency, make use of renewable energy, divest from fossil fuel, and report on environmentally friendly green buildings), and zero otherwise. The only exception is the question related to nuclear energy production, which corresponds to a value of zero when firms produce nuclear energy, and one otherwise. Subsequently, an equally weighted performance measure was constructed. According to Martí-Ballester [25], adopting sustainable energy practices does not impact corporate financial performance using Tobin's q measure as a proxy.

This study also uses the environmental, social, governance, and CSR performance scores provided by ASSET4, whose values oscillate between 0 and 100 points, and measures firm performance relative to all other firms by year from 2007. It ranges these values from 0 to 1 by dividing the value provided by ASSET4 by 100 to mitigate the concern of extreme outliers.

3.2.2. Independent variable

To examine the effect of institutional ownership (IO) on corporate sustainable energy and environmental, social, and governance performance, this study considered the independent variable IO. This variable is measured as the number of outstanding shares of firm i owned by renewable energy funds as a group at the end of year t-1 over the total number of shares outstanding at the firm's year-end [44]. These data are obtained from Refinitiv Eikon Lipper fund and Refinitiv Datastream databases.

3.2.3. Moderator variable

Firms with high institutional ownership at the time of the Paris Agreement can subsequently increase their corporate renewable energy and environmental and socially responsible performance. Mutual funds exercise their voting power to pressure firms in which they invest in implementing sustainable energy practices. This study introduces the PARIS variable, which takes a value of one for 2016, 2017, 2018, and 2019, and zero otherwise. Furthermore, the interaction term between institutional ownership and PARIS variables is included.

3.2.4. Control variables

This study also considers control variables commonly used in studies, such as firm size, leverage, liquidity, profitability, R&D intensity, tangibility, capital intensity, and Tobin's q [1,30,42,45]. Large firms are more visible and receive more pressure from stakeholders to improve their CEP. Controlling for this, firm size (Size) variable is measured as the Napierian logarithm of a firm's total assets. According to slack-resources theory, firms with more slack resources may increase their investment in environmental practices [19]. Several variables were included to control for this effect. Leverage represents the ratio of a firm's total debt to its total assets to mitigate concerns about extreme outliers. Liquidity is measured using (1) net cash flow (NCF), which represents the ratio of net cash receipts and disbursements resulting from the operations of the firm to total assets, and (2) the current ratio (CR), which is the ratio of total current assets to total current liabilities. Tangibility is the ratio of investment in property, plants, and equipment to the total assets. Capital intensity (capital) is the ratio of capital expenditures to total assets.

Poor past financial performance can lead firms to adopt conservative behaviour [34]. This is controlled for profitability (ROA) and Tobin's q variables. ROA denotes the return on assets, measured as income before tax interest expenses to total assets. Tobin's q represents the market capitalization of equity plus the total debt-to-total assets ratio. Firms can differentiate their products by incorporating green attributes that require investment in corporate environmental responsibility. This is controlled for research and development intensity (R&D) variable. R&D refers to the ratio of R&D expenditures to total assets. Country is a dummy variable with 39 categories indicating the country in which the firm is located. The industry is a dummy variable with 11 categories indicating the economic sector to which each firm belongs. Countries and industries were included to control for changes. All variables are summarized in Table 2.

Table 3 reports the descriptive statistics of dependent, independent, and control variables. Table 4 presents the correlation matrix among independent and control variables used in this study, whose values are less than 0.8, indicating that multicollinearity is not a problem.

3.3. Methodology

To test the hypotheses of this study, the following model is run:

$$Score_{f,t} = \propto + \beta IO_{f,t-1} + \delta Z_{f,t-1} + Year_t + Industry_f + Country_f + \varepsilon_{f,t} \quad (1)$$

where $Score_{f,t}$ is the CSEP, CEP, CSP, CGP, and overall CSR performance scores of firm f in year t; $IO_{f,t-1}$ denotes the percentage of total renewable energy fund ownership for firm f at time t-1; $Z_{f,t-1}$ represents a set of control variables for firm f at time t-1; $Year_t$ is a dummy variable that takes the value of one if the dependent variable data corresponds to time t and zero otherwise; $Industry_f$ is a dummy variable that takes the value of one if firm f belongs to the economic sector indicated and zero otherwise; and $Country_f$ is a dummy variable that takes the value of one if firm is located in the country indicated and zero otherwise. This study includes firm size, tangibility, leverage, net cash flow from operating activities, current ratio, capital expenditure ratio, R&D expenditure ratio, ROA, and Tobin's q in Model [1] as control variables. All independent and control variables were lagged by one year to mitigate the possible endogeneity between the dependent and independent variables or control variables, as in Dick et al. [1] and Oikonomou et al. [32]. This study adopts Petersen's [46] approach to cluster standard errors by firm and year.

To test the hypothesis that external pressures favour institutional investors focused on sustainable energy issues to lead to changes in corporate sustainable energy performance, this study introduces the Paris Agreement in Models (2) and (3) as follows:

$$Score_{f,t} = \propto + \beta X_{f,t-1} + \gamma X_{f,t-1} PARIS_t + \delta Z_{f,t-1} + Year_t + Industry_f + Country_f + \varepsilon_{f,t} \quad (2)$$

$$Score_{f,t} = \propto + \beta X_{f,t-1} + \gamma PARIS_t + \gamma X_{f,t-1} PARIS_t + \delta Z_{f,t-1} + Industry_f + Country_f + \varepsilon_{f,t} \quad (3)$$

where $Score_{f,t}$ is the CSEP, CEP, CSP, CGP, and overall CSR performance scores of firm f in year t, and $Paris_t$ is a dummy variable that takes the value of one for the 2016–2019 period and zero otherwise. $X_{f,t-1}$ $Paris_t$ represents the interaction term which measures the relationship between institutional ownership and corporate sustainable energy performance following the Paris Agreement. The other variables were similar to those in the model (1).

4. Results

This section presents the main empirical findings of this study, which first examines the effect of renewable energy fund ownership on firms' sustainable energy practices, and the impact of the Paris Agreement on the relationship between institutional ownership and corporate sustainable energy performance. This study considers full CSR performance scores and dimension-level CSR (environmental, social, and governance) performance scores to explain whether institutional ownership promotes other social responsibility activities in firms,.

4.1. The effect of institutional ownership on firms' sustainable energy practices

Table 5 reports the results for the regression Models (1), (2), and (3), where the dependent variable is the corporate sustainable energy performance score. The institutional ownership proportion (IO) coefficient is positive and significant at the 1% level for all the models, thus, supporting H1. This indicates that firms with greater institutional ownership subsequently achieve higher levels of corporate sustainable energy performance. Specifically, 1% change in institutional ownership predicts a 4.26% increase in corporate sustainable energy performance and improves this percentage in Models (2) and (3). Thus, renewable energy mutual funds are a driving force responsible for sustainable energy performance of firms in which they invest worldwide.

Models (2) and (3) in Table 5 capture the effect of institutional investors' proportion on corporate sustainable energy performance after the Paris Agreement through the interaction term, ParisxOI. For both models, the coefficient estimate for the interaction term ParisxOI is negative but statistically insignificant, not supporting H2. This finding suggests that institutional investors maintain pressure on firms in which they invest to engage in sustainable energy practices after the Paris Agreement. However, the positive and significant coefficient of the Paris variable in Model (3) of Table 5 indicates that firms' sustainable energy performance increased after the Paris Agreement was ratified in 2016. This result suggests that other stakeholder groups, such as governments and policymakers, have increased their pressure on firms to implement sustainable energy practices since the Paris Agreement. Because of the Paris Agreement, governments worldwide have promulgated energy laws and established subsidies that encourage firms to implement sustainable energy practices to improve corporate energy performance [47].

Regarding the control variables, the size variable has a positive and significant impact on subsequent corporate sustainable energy performance in the three models, indicating that large firms achieve better corporate sustainable energy performance. This is probably because large firms are more visible and subject to more external pressure, as stated by Panicker [34]. This study also found a positive and statistically significant effect of the R&D variable on subsequent corporate sustainable energy performance in the three models, suggesting that firms developing R&D projects achieve higher corporate sustainable energy performance. This is likely because renewable energy-related firms invest in environmental innovation to reduce operational costs and improve product differentiation [27,34]. Conversely, the CR variable is negatively related to subsequent corporate sustainable energy performance, indicating that risk-averse firms adopt more efficient sustainable energy practices, thereby enhancing corporate sustainable energy performance. The remaining control variables were statistically insignificant.

For robustness, this study tests the Granger causality between sustainable energy practices and institutional investor proportion using the approach of Xiao et al. [48]. The null hypothesis of non-causality is not rejected at the 5% significance level.

4.2. The effect of institutional ownership on corporate environmental activities

Table 6 reports the results for the regression Models (1), (2), and (3), where the dependent variable is the CEP score. The institutional ownership proportion (IO) coefficient is positive and significant at

Table 2
Variable description.

Variable	Definition
OI_{t-1}	Number of firm i's outstanding shares owned by renewable energy funds as a group at the end of year t-1 over the number of total shares outstanding at the firm's year end
Paris	Dummy variable taking the value of one for the years 2016, 2017, 2018 and 2019 and zero
$Size_{t-1}$	Napierian logarithm of a firm's total assets at time t-1
$Tangibility_{t-1}$	Investment in property, plant, and equipment to total assets at time t-1
NCF_{t-1}	Net cash receipts and disbursements resulting from the operations of the firm to total assets at time t-1
$R\&D_{t-1}$	Research and development expenditures to total assets at time t-1
CE_{t-1}	Capital expenditures to total assets at time t-1
$Leverage_{t-1}$	Ratio of the firm's total debt to total assets at time t-1
ROA_{t-1}	Net income plus after-tax interest expenses to total assets at time t-1
$TobinsQ_{t-1}$	Market capitalization of equity plus total debt to total assets at time t-1
CR_{t-1}	Total current assets to total current liabilities at time t-1
Country	Dummy variable with thirty-nine categories indicating the country in which firm is located
Industry	Dummy variable with eleven categories indicating the economic sector to which each firm belongs
Year	Dummy variable with thirteen categories taking value of 1 for year t and 0 otherwise.
CEP_t	Corporate environmental performance score at time t, ranging from 0 to 1.
CGP_t	Corporate governance performance score at time t, ranging from 0 to 1.
CSP_t	Corporate social performance score at time t, ranging from 0 to 1.
CSR	CSR performance score at time t, ranging from 0 to 1.
$CSEP_t$	Corporate sustainable energy performance at time t, ranging from 0 to 1.

Table 3
Summarized statistics.

Variable	Observations	Mean	Standard deviation	Minimum	Maximum
OI_{t-1}	3843	0.002	0.004	0.000	0.050
$Size_{t-1}$	3843	16.057	1.377	12.187	19.551
$Tangibility_{t-1}$	3843	0.321	0.230	0.008	0.931
CF_{t-1}	3843	0.095	0.058	−0.164	0.326
$R\&D_{t-1}$	3843	0.020	0.030	0.000	0.199
CE_{t-1}	3843	0.050	0.038	0.001	0.276
$Leverage_{t-1}$	3843	0.258	0.150	0.000	0.710
ROA_{t-1}	3843	0.064	0.056	−0.309	0.304
$TobinsQ_{t-1}$	3843	0.014	0.008	0.004	0.068
CR_{t-1}	3843	0.017	0.010	0.003	0.101
CEP_t	3843	0.560	0.257	0.000	0.985
CGP_t	3843	0.557	0.217	0.029	0.985
CSP_t	3843	0.559	0.239	0.006	0.981
$CSRP_t$	3843	0.533	0.186	0.018	0.929
$CSEP_t$	3843	0.493	0.199	0.000	0.857

Table 4
Correlation matrix for regression variables.

	1. OIT	2	3	4	5	6	7	8	9	10	11
2.$ParisxOI_{t-1}$	0.469										
3.Paris	−0.077	0.286									
4.$Size_{t-1}$	−0.216	−0.174	−0.064								
5.$Tangibility_{t-1}$	0.025	−0.005	−0.070	0.167							
6.CF_{t-1}	−0.124	−0.089	−0.026	−0.161	−0.008						
7.$R\&D_{t-1}$	−0.014	0.065	0.066	−0.142	−0.327	0.239					
8.CE_{t-1}	0.026	−0.021	−0.109	0.038	0.583	0.199	−0.084				
9.$Leverage_{t-1}$	0.020	−0.009	0.030	0.238	0.368	−0.289	−0.328	0.122			
10.ROA_{t-1}	−0.148	−0.105	−0.041	−0.150	−0.127	0.621	0.118	0.058	−0.252		
11.$TobinsQ_{t-1}$	−0.096	−0.028	0.098	−0.328	−0.184	0.562	0.345	0.030	−0.216	0.574	
12.CR_{t-1}	0.024	0.069	0.083	−0.370	−0.263	0.208	0.335	−0.125	−0.397	0.200	0.357

the 5% and 10% level for all the models, suggesting that firms with greater institutional ownership achieve higher levels of CEP. However, institutional investors show a weaker role in improving the firms' environmental performance than corporate sustainable energy performance. Specifically, a 1% change in institutional ownership predicts a 2.69% increase in CEP and improves this percentage up to 3.37% and 3.36% in Models (2) and (3), respectively. These results show that institutional ownership only improves those environmental issues that may lead firms to implement sustainable energy strategies, thus, supporting H1 and H3.

Models (2) and (3) in Table 6 capture the effect of institutional investors' proportion on CEP after the Paris Agreement through the interaction term ParisxOI. For both models, the coefficient estimate for the interaction term ParisxOI was negative but statistically insignificant. This finding suggests that institutional investors have maintained pressure on firms that invest in environmental activities related to sustainable energy issues after the Paris Agreement ratification. However, the positive and significant coefficient of the Paris variable in Model (3) of Table 6 indicates that firms' environmental performance increases after the Paris Agreement ratification. This result suggests that other stakeholder groups have increased pressure on firms to implement environmental practices beyond adopting sustainable energy systems.

Regarding the control variables, there is a positive and significant relationship between size, R&D variables, and CEP variables, while the CR variable is negatively associated with CEP. The remaining control variables were statistically insignificant.

For robustness, this study tests the Granger non-causality between environmental practices and institutional investor proportion using Xiao et al.'s [48] approach. The null hypothesis of non-causality is not rejected at the 5% significance level.

Table 5
Renewable energy mutual funds and firms' sustainable energy performance.

DV: CSEP	Coefficient Model 1		Coefficient Model 2		Coefficient Model 3	
OI_{t-1}	4.2641	***	4.6902	***	4.6186	***
	(1.1380)		(1.2356)		(1.2362)	
$ParisxOI_{t-1}$	—		−1.6512		−1.5402	
			(1.6780)		(1.6684)	
Paris	—		—		0.0289	***
					(0.0060)	
$Size_{t-1}$	0.0601	***	0.0599	***	0.0601	***
	(0.0045)		(0.0045)		(0.0045)	
$Tangibility_{t-1}$	0.0295		0.0308		0.0312	
	(0.0392)		(0.0392)		(0.0390)	
CF_{t-1}	−0.1249		−0.1278		−0.1429	
	(0.1242)		(0.1247)		(0.1263)	
$R\&D_{t-1}$	0.9672	***	0.9761	***	0.9695	***
	(0.2415)		(0.2428)		(0.2426)	
CE_{t-1}	0.0263		0.0248		0.0126	
	(0.1503)		(0.1501)		(0.1484)	
$Leverage_{t-1}$	−0.0297		−0.0307		−0.0308	
	(0.0430)		(0.0427)		(0.0428)	
ROA_{t-1}	0.0728		0.0739		0.0797	
	(0.1122)		(0.1126)		(0.1121)	
$TobinsQ_{t-1}$	−0.2258		−0.2532		−0.0941	
	(0.8263)		(0.8287)		(0.8065)	
CR_{t-1}	−1.3576	**	−1.3606	**	−1.3610	**
	(0.5577)		(0.5575)		(0.5553)	
Constant	−0.5377	***	−0.5290	***	−0.5532	***
	(0.1072)		(0.1085)		(0.1050)	
Industry	Yes		Yes		Yes	
Year	Yes		Yes		No	
Country	Yes		Yes		Yes	
R-squared	0.2848		0.2850		0.2834	
Number of firms	1074		1074		1074	
Number of observations	3843		3843		3843	

4.3. The effect of institutional ownership on corporate governance dimension of CSR performance

Table 7 reports the results for the regression models (1), (2), and (3), where the dependent variable is the corporate governance performance score. The institutional ownership proportion (IO) coefficient is negative but statistically insignificant at the 10% level for all the models. This indicates no relation between share ownership and firms' corporate governance performance. Therefore, institutional investors focused on sustainable energy issues do not drive changes in corporate governance policies, thus, supporting H3. Furthermore, the results show that firms with greater institutional ownership during the Paris Agreement do not exert effort to improve their portfolio firms' corporate governance activities as revealed by the insignificant positive coefficient of ParisxIO. These findings are consistent with the understanding that institutional investors drive firms to improve certain corporate social responsibility issues that receive attention from investors concerned about renewable energy issues. However, the significant positive coefficient of Paris in model (3) of Table 7 suggests that other stakeholders exert effort to improve the firms' corporate governance practices after the Paris Agreement ratification.

Regarding the control variables, there is a positive and significant relationship between size and R&D variables and the CGP variable, while the leverage variable is negatively associated with CGP in models (1) and (2) of Table 7. The remaining control variables were statistically insignificant.

4.4. The effect of institutional ownership on social dimension of CSR performance

Table 8 reports the results for the regression models (1), (2), and (3), where the dependent variable is the corporate social performance score. The institutional ownership proportion (IO) coefficient is positive but statistically insignificant at the 10% level for all the models. This indicates no relation between share ownership and firms' social performance. This supports H3. Therefore, institutional investors focused on sustainable energy issues do not drive changes in firms' social policies. Furthermore, the results show that firms with greater institutional ownership during the Paris Agreement do not exert effort to improve their portfolio firms' social activities as shown by the insignificant negative coefficient of ParisxIO. These findings are consistent with institutional investors driving firms to improve specific corporate social responsibility issues that receive attention from investors concerned about renewable energy issues. However, the significant positive coefficient of Paris in model (3) of Table 8 suggests that other stakeholders exert effort to change firms' social practices after the implementation of the Paris Agreement.

Regarding the control variables, there is a positive and significant relationship between size, R&D variables, and CSP variables, while leverage and CR variables are negatively associated with CSP. The remaining control variables were statistically insignificant.

4.5. The effect of institutional ownership on corporate social responsibility performance

Table 9 reports the results for the regression Models (1), (2), and (3) where the dependent variable is the CSR performance score. The institutional ownership proportion (IO) coefficient is positive but statistically insignificant at the 10% level for all the models. This indicates no relation between share ownership and CSR performance. This finding supports hypothesis H3, suggesting that institutional investors lead firms to adopt sustainable energy practices that do not generate synergies between environmental,

Table 6
Renewable energy mutual funds and firms' environmental performance.

DV: CEP	Coefficient Model 1		Coefficient Model 2		Coefficient Model 3	
OI_{t-1}	2.6918	*	3.3705	**	3.3566	**
	(1.3732)		(1.3518)		(1.3138)	
$ParisxOI_{t-1}$	—		−2.6300		−2.5645	
			(2.0508)		(2.0172)	
Paris	—		—		0.0471	***
					(0.0065)	
$Size_{t-1}$	0.0989	***	0.0986	***	0.0986	***
	(0.0054)		(0.0055)		(0.0054)	
$Tangibility_{t-1}$	−0.0151		−0.0130		−0.0130	
	(0.0467)		(0.0468)		(0.0466)	
CF_{t-1}	0.0501		0.0455		0.0381	
	(0.1315)		(0.1326)		(0.1332)	
$R\&D_{t-1}$	1.0616	***	1.0759	***	1.0720	***
	(0.2974)		(0.2985)		(0.2973)	
CE_{t-1}	−0.1105		−0.1130		−0.1189	
	(0.1720)		(0.1718)		(0.1706)	
$Leverage_{t-1}$	−0.0805		−0.0820		−0.0812	
	(0.0538)		(0.0537)		(0.0537)	
ROA_{t-1}	0.0071		0.0087		0.0095	
	(0.1198)		(0.1202)		(0.1204)	
$TobinsQ_{t-1}$	0.2068		0.1632		0.2525	
	(1.0163)		(1.0210)		(0.9860)	
CR_{t-1}	−2.4226	***	−2.4272	***	−2.4088	***
	(0.6793)		(0.6773)		(0.6748)	
Constant	−1.0214	***	−1.0075	***	−1.0669	***
	(0.1674)		(0.1686)		(0.1587)	
Industry	Yes		Yes		Yes	
Year	Yes		Yes		No	
Country	Yes		Yes		Yes	
R-squared	0.4540		0.4544		0.4531	
Number of firms	1074		1074		1074	
Number of observations	3843		3843		3843	

Table 7
Renewable energy mutual funds and firms' governance performance.

DV: CGP	Coefficient Model 1		Coefficient Model 2		Coefficient Model 3	
OI_{t-1}	−0.0921		−0.1068		−0.2630	
	(1.4931)		(1.5075)		(1.4737)	
$ParisxOI_{t-1}$	—		0.0567		0.3066	
			(2.6897)		(2.6820)	
Paris	—		—		0.0214	**
					(0.0104)	
$Size_{t-1}$	0.0582	***	0.0582	***	0.0582	***
	(0.0063)		(0.0063)		(0.0063)	
$Tangibility_{t-1}$	0.0315		0.0315		0.0301	
	(0.0406)		(0.0413)		(0.0414)	
CF_{t-1}	0.0255		0.0256		0.0216	
	(0.1272)		(0.1290)		(0.1257)	
$R\&D_{t-1}$	0.5832	**	0.5829	**	0.5844	**
	(0.2502)		(0.2530)		(0.2545)	
CE_{t-1}	−0.2528		−0.2527		−0.2484	
	(0.1685)		(0.1689)		(0.1702)	
$Leverage_{t-1}$	−0.0855	*	−0.0855	*	−0.0836	
	(0.0517)		(0.0517)		(0.0522)	
ROA_{t-1}	0.1488		0.1487		0.1577	
	(0.1080)		(0.1086)		(0.1081)	
$TobinsQ_{t-1}$	−0.3289		−0.3279		−0.2854	
	(0.9343)		(0.9463)		(0.8820)	
CR_{t-1}	−0.6583		−0.6582		−0.6259	
	(0.6463)		(0.6455)		(0.6470)	
Constant	−0.3336	***	−0.3339	***	−0.3661	***
	(0.1141)		(0.1156)		(0.1119)	
Industry	Yes		Yes		Yes	
Year	Yes		Yes		No	
Country	Yes		Yes		Yes	
R-squared	0.1812		0.1812		0.1781	
Number of firms	1074		1074		1074	
Number of observations	3843		3843		3843	

Table 8
Renewable energy mutual funds and firms' social performance.

DV: CSP	Coefficient Model 1		Coefficient Model 2		Coefficient Model 3	
OI_{t-1}	0.4224		0.9075		0.6296	
	(0.9508)		(1.0212)		(1.0330)	
$ParisxOI_{t-1}$	—		−1.8797		−1.4868	
			(1.2933)		(1.2525)	
Paris	—		—		0.0867	***
					(0.0111)	
$Size_{t-1}$	0.0902	***	0.0899	***	0.0895	***
	(0.0052)		(0.0053)		(0.0052)	
$Tangibility_{t-1}$	−0.0403		−0.0388		−0.0387	
	(0.0416)		(0.0416)		(0.0412)	
CF_{t-1}	0.0785		0.0752		0.0665	
	(0.1225)		(0.1229)		(0.1218)	
$R\&D_{t-1}$	0.8109	***	0.8211	***	0.8213	***
	(0.2317)		(0.2324)		(0.2338)	
CE_{t-1}	−0.0446		−0.0464		−0.0751	
	(0.1909)		(0.1910)		(0.1929)	
$Leverage_{t-1}$	−0.1278	***	−0.1289	***	−0.1236	***
	(0.0475)		(0.0474)		(0.0469)	
ROA_{t-1}	0.1610		0.1621		0.1385	
	(0.1035)		(0.1038)		(0.1131)	
$TobinsQ_{t-1}$	0.7229		0.6918		0.9060	
	(0.9788)		(0.9804)		(0.9342)	
CR_{t-1}	−1.7678	***	−1.7712	***	−1.6777	***
	(0.6093)		(0.6076)		(0.6175)	
Constant	−0.2951		−0.2851		−0.4346	**
	(0.1916)		(0.1917)		(0.1859)	
Industry	Yes		Yes		Yes	
Year	Yes		Yes		No	
Country	Yes		Yes		Yes	
R-squared	0.4945		0.4947		0.4886	
Number of firms	1074		1074		1074	
Number of observations	3843		3843		3843	

Table 9
Renewable energy mutual funds and firms' environmental, social and governance performance.

DV: CSRP	Coefficient Model 1		Coefficient Model 2		Coefficient Model 3	
OI_{t-1}	0.7461		1.2706		0.9266	
	(0.9664)		(0.9285)		(0.9454)	
$ParisxOI_{t-1}$	—		−2.0325		−1.6028	
			(1.5717)		(1.5587)	
Paris	—		—		0.0602	***
					(0.0098)	
$Size_{t-1}$	0.0576	***	0.0573	***	0.0571	***
	(0.0048)		(0.0048)		(0.0049)	
$Tangibility_{t-1}$	−0.0109		−0.0093		−0.0098	
	(0.0347)		(0.0347)		(0.0344)	
CF_{t-1}	0.0636		0.0600		0.0451	
	(0.1084)		(0.1089)		(0.1114)	
$R\&D_{t-1}$	0.5988	***	0.6098	***	0.6093	***
	(0.2230)		(0.2235)		(0.2235)	
CE_{t-1}	−0.1653		−0.1672		−0.1914	
	(0.1537)		(0.1539)		(0.1579)	
$Leverage_{t-1}$	−0.0726	*	−0.0738	*	−0.0691	*
	(0.0397)		(0.0397)		(0.0389)	
ROA_{t-1}	0.1778	*	0.1790	*	0.1586	
	(0.0966)		(0.0967)		(0.1027)	
$TobinsQ_{t-1}$	0.0179		−0.0157		0.2530	
	(0.8401)		(0.8398)		(0.8239)	
CR_{t-1}	−1.6237	***	−1.6273	***	−1.5509	***
	(0.5734)		(0.5715)		(0.5827)	
Constant	−0.1827		−0.1720		−0.2810	**
	(0.1227)		(0.1228)		(0.1194)	
Industry	Yes		Yes		Yes	
Year	Yes		Yes		No	
Country	Yes		Yes		Yes	
R-squared	0.3536		0.3540		0.3460	
Number of firms	1074		1074		1074	
Number of observations	3843		3843		3843	

social, and corporate governance dimensions of CSR performance. Moreover, the positive impact of institutional investors on CEP is blurred in the aggregate measure of CSR performance as a result of different institutional investor impacts associated with specific dimensions of social responsibility. Furthermore, the results show that firms with greater institutional ownership during the Paris Agreement do not exert effort to improve their portfolio firms' CSR activities, evidenced by the insignificant negative coefficient of ParisxIO. These findings are consistent with the understanding that institutional investors drive firms to improve the CSR issues that receive attention from investors concerned about renewable energy issues. However, the significant positive coefficient of Paris in Model (3) of Table 9 suggests that other stakeholders exert effort to change firms' environmental, social, and corporate governance practices after implementing the Paris Agreement.

Regarding the control variables, there is a positive and significant relationship between size, R&D, ROA variables, and the CSRP variable, whereas leverage and CR variables are negatively associated with CSRP. The remaining control variables are statistically insignificant.

The results indicate that renewable energy mutual funds drive portfolio firms to improve their corporate sustainability and environmental performance. However, other stakeholders have improved in corporate governance and social performance.

5. Conclusions and discussion

Renewable energy mutual funds play an important role in the progress towards sustainable development by enhancing the sustainable energy performance of firms worldwide. This study examined whether institutional investors focus on the renewable energy sector lead firms to improve sustainable energy practices and other socially responsible activities. The sample data consisted of 1074 firms from 39 countries in which 43 renewable energy mutual funds were invested from 2006 to 2018. Next, panel data models clustering the standard errors by firm and year [46] were adopted. The empirical findings show that institutional investors worldwide pressure firms to improve their corporate sustainable energy performance. The institutional investor's impact on firms' sustainable energy activities remained constant after implementing the Paris Agreement in 2016, suggesting that these mutual funds invest to align fund investments with their investors' sustainable energy ideals. Furthermore, these improvements in firms' sustainable energy practices extend to other environmental activities, implying that greater institutional ownership is associated with better environmental performance. However, this effect on firms' social and corporate governance performance is insignificant. Consequently, the changes caused by institutional investors on firms' environmental performance are blurred in the aggregate measure of CSR performance. This effect remained constant after the Paris Agreement came into effect in 2016.

Although institutional investors did not increase their efforts to improve firms' corporate socially responsible activities after the Paris Agreement, the empirical findings show that renewable energy-related firms are more reactive in enhancing sustainable energy, environmental, social, corporate governance, and socially responsible performance in the following years. This suggests that other stakeholders have a stronger effect on promoting socially responsible practices in renewable energy-related firms after the Paris Agreement ratification. Renewable energy-related firms have since adhered to their commitments and the sustainable development goals, thus improving their full CSR performance scores and dimension-level CSR (environmental, social, and governance) performance scores.

These findings have practical implications for governments and

policymakers seeking mechanisms that promote the large-scale reallocation of financial resources towards a more sustainable real economy. This study shows that renewable energy mutual funds are an effective instrument to finance the transition of the real economy towards sustainability. They contribute to achieving the UN sustainable development goal related to the progress towards an affordable and clean energy-related sustainable development goal (SDG7), as well as others related to this, such as responsible production and consumption (SDG12) concerned with efficient use of energy, the reduction of waste generation or the rationalisation of fossil fuel subsidies; decent work and economic growth (SDG8) related to the improvement of global resource efficiency in consumption and production activities; and industry, innovation, and infrastructure (SDG9), which promotes increasing resource-use efficiency and greater adoption of clean and environmentally sound technologies and industrial processes in firms. Policymakers and governments can stimulate investments in renewable energy mutual funds to establish tax benefits for retail investors. Furthermore, this study shows that institutional shareholders do not drive firms to enhance their governance or social performance. However, other stakeholders pressure firms to improve their corporate governance and social practices. Policymakers and governments should incentivise renewable energy-related firms to adopt a holistic approach to generate synergies between the environmental, social, and corporate governance subdimensions. Improvements in social and corporate governance subdimensions should also be considered when policymakers and governments provide renewable energy-related grants and subsidies.

This study had some limitations. It did not consider the country in which the institutional investors are located. Future research should examine whether institutional investors in countries with stronger renewable and efficient energy-related norms affect firms' sustainable energy performance similar to institutional shareholders in countries with weak norms. This study did not consider the impact of COVID-19 on the relationship between institutional shareholders and corporate sustainable energy performance. Future research should extend the database to analyse whether institutional investors drive firms to improve their socially responsible practices during the COVID-19 pandemic. It could also study the effect of the COVID-19 pandemic on the financial performance of renewable energy funds.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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