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Environmental sustainability practices and ROA: A configurational analysis of IBEX 35 firms in Energy and Industry & Construction

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Abstract

Background: The transition from voluntary sustainability narratives to more standardised and auditable disclosure requirements in Europe (CSRD/ESRS) has intensified the need for evidence on how observable environmental practices relate to financial outcomes. Persistent disagreement among commercial sustainability ratings, especially on environmental components, reinforces the case for using auditable indicators in sustainability-performance research.
Purpose: This study identifies which configurations of environmental sustainability practices are associated with high financial performance in Spanish IBEX-listed firms, and whether those pathways differ across Energy and Industry & Construction.
Study design: Using hand-collected data from 2023 corporate reports for 15 IBEX-listed firms, we calibrate three environmental conditions, renewable energy share, waste recovery, and EMAS maturity, and apply fuzzy-set Qualitative Comparative Analysis (fsQCA) to examine pathways to high return on assets (ROA).
Findings: No single environmental practice emerges as necessary for high ROA. Sufficiency differs by sector: in Energy, no stable sufficient configuration is retained under the adopted consistency threshold, suggesting ROA is shaped by additional drivers beyond this parsimonious set. In Industry & Construction, two sufficient pathways highlight equifinality: one combines high waste recovery with EMAS maturity despite low renewable share, while the alternative one links high renewable share to high ROA in the absence of both waste recovery and EMAS maturity. These results support a non-additive view within the environmental pillar; social and governance dimensions are outside the scope of the present design.
Limitations/implications: The study is scoped to the environmental pillar and a single fiscal year; future research should extend the design to multi-year panels, incorporate assurance/verification quality, and test broader ESG dimensions as European reporting standards evolve.

Keywords
Environmental sustainability, environmental practices, fsQCA, IBEX 35, ROA, CSRD/ESRS, EU Taxonomy

Introduction

Environmental sustainability has become a strategic cornerstone for companies. This study examines how configurations of environmental practices are associated with financial performance among Spanish IBEX 35 firms, using fuzzy-set Qualitative Comparative Analysis (fsQCA) to identify sector-specific combinations linked to HIGH_ROA (high return on assets). Sustainability responds to regulatory and societal pressures and can also be a source of competitive advantage (Li, 2025), while growing climate concerns have spurred the use of environmental sustainability criteria in reporting and investment frameworks (Hales, 2021). In this study, we focus on the environmental pillar and treat "ESG" as an umbrella term referring to the broader reporting and capital-market context.

The Sustainable Development Goals (SDGs) (ONU, 2015), the Paris Agreement (UNFCCC, 2015) and the European Green Deal (European Commission, 2019) offer a common framework in Europe. IBEX 35 companies report under the Non-Financial Reporting Directive (NFRD) (Parlamento Europeo y Consejo de la Unión Europea, 2014) and, increasingly, the Corporate Sustainability Reporting Directive (CSRD) (Parlamento Europeo y Consejo de la Unión Europea, 2022), which introduces European Sustainability Reporting Standards (ESRS) as mandatory reporting standards. Evidence on whether environmental management improves financial performance is mixed (Orellana et al., 2025). Some practices yield benefits and customer loyalty (Whelan et al., 2021), but implementation can entail short-term costs. Differences by industry, regulation, policy maturity, and stakeholder perceptions help explain this lack of consensus (Roffé & Ignacio González, 2024). In this paper, "financial performance" is operationalized as ROA, a relative indicator that supports cross-firm comparability by relating earnings to the asset base employed.

A key reason for the lack of consensus in the sustainability-performance literature is that environmental outcomes and economic outcomes are often not shaped by single practices in isolation. Firms typically deploy interdependent initiatives (e.g., operational circularity, renewable sourcing, and verified environmental management systems) whose effects may be complementary, contingent, and non-linear. In such settings, additive approaches that estimate independent "net effects" of single indicators can miss conjunctural dynamics, where a practice is only performance-relevant when combined with other practices. This motivates a configurational approach that is able to represent equifinality (more than one configuration may align with the same outcome) and causal asymmetry (the configurations associated with high performance may differ from those associated with low performance).

Commercial environmental ratings (e.g., Bloomberg, Refinitiv) face methodological discrepancies and rely on heterogeneous, self-reported data, increasing greenwashing risk (Marquis et al., 2016; Berg et al., 2022). Recent evidence shows that disagreement across ESG/environmental rating providers is economically meaningful (valuation/returns effects) and can blur greenwashing signals, reinforcing the case for transparent, directly observable indicators (Hu et al., 2023; Kim & Koo, 2023; Sun et al., 2024; Anselmi & Petrella, 2025). Against this backdrop, this study relies on transparent, report-based indicators that are available for listed firms under the European reporting regime, and it evaluates how their configurations relate to financial performance within sector-specific contexts.

Despite abundant sustainability-performance and ESG-performance research, few studies examine how small sets of core environmental practices combine (rather than add up) to align with stronger financial performance in comparable listed-firm samples. This is the research problem addressed here: whether, within a harmonized European disclosure environment and within environmentally material sectors, distinct combinations of environmental practices are systematically associated with higher ROA, and whether such combinations differ between Energy and Industry & Construction. Our sample covers energy and industrial IBEX 35 firms, high-impact sectors in the low-carbon transition facing strong regulatory and societal scrutiny. We apply fsQCA (Ragin, 2009) to the 2023 disclosures and audited accounts of 15 firms, conducting sector-specific analyses to preserve comparability within each sector.

The article combines a theoretical and sectoral lens drawing on the resource-based view and institutional/stakeholder perspectives to explain why observable environmental practices may (or may not) translate into financial performance under the European disclosure regime (Barney, 1991; Hart, 1995; Susen & Etter, 2024). Organizational change, potentially involving culture, leadership, and stakeholder engagement, is used as an interpretive lens in the Discussion, while the empirical model relies on auditable environmental practice indicators. In this framing, organizational culture is treated as an enabling condition: a sustainability-oriented culture can support the implementation consistency, internal coordination, and credibility of environmental initiatives, which may in turn shape their association with financial performance. Accordingly, culture is discussed as a contextual driver that can help explain why comparable environmental practices may not translate into comparable outcomes across firms. Importantly, we do not model organizational culture as a separate fsQCA condition in this study. Given the small-N configurational design and the goal of relying on auditable, comparable indicators, culture is treated as an interpretive mechanism. We partially capture the institutionalization of environmental routines through EMAS_MAT (environmental management and verification maturity), and we use the culture lens in the Discussion to interpret heterogeneity in the observed practice–performance associations.

The paper is structured as follows: Section 1 reviews the literature and research questions; Section 2 outlines the regulatory context; Section 3 details data, QCA rationale, and calibration; Section 4 presents results; Section 5 discusses the findings; Section 6 concludes; and Section 7 outlines limitations and future research.

1. Theoretical framework

1.1. Environmental sustainability

Environmental sustainability has become a core pillar of corporate strategy, especially in resource-intensive sectors such as energy and industry (Ji et al., 2019). It entails the efficient use of natural resources to minimize ecological impact, commonly tracked through indicators of CO_2 emissions, energy and water consumption, waste generation, and the use of sustainable raw materials. Adoption and monitoring of these indicators are guided by widely recognized frameworks, including the United Nations Global Compact, ISO 14001 environmental management systems (ISO, 2015; Zubeltzu-Jaka et al., 2024; Valero-Gil et al., 2024; Benzidia et al., 2025), the Carbon Disclosure Project (CDP) recommendations, and the SDGs, which increasingly shape corporate objectives and reporting practices. In Europe, environmental performance is disclosed through sustainability reports and NFIS mandated by the NFRD and reinforced by the CSRD (Leal Filho et al., 2025). These directives, applicable to listed companies such as those in the IBEX 35, require transparency and alignment with internationally recognized standards, while the requirements for independent external assurance were more heterogeneous under the NFRD, depending on member-state transposition and national implementation (Kotsantonis et al., 2016; Parlamento Europeo y Consejo de la Unión Europea, 2022, 2014). The CSRD strengthens this framework and progressively makes assurance more systematic and mandatory across the EU (Parlamento Europeo y Consejo de la Unión Europea, 2022). Together, these elements embed environmental sustainability into corporate governance and strategy, turning it from an isolated set of practices into a systematized management approach. Within the EU sustainable finance package, the EU Taxonomy has also shaped how firms classify and communicate environmentally sustainable activities (Tonnarello et al., 2025; Brabec & Macháč, 2025).

1.2. Relationship between environmental sustainability and financial performance

The link between environmental sustainability and corporate financial performance has been debated for decades. Early views framed environmental initiatives primarily as a cost imposed by regulatory pressure and stakeholder demands, with a presumed negative impact on margins. Subsequent evidence paints a more complex picture, and one that can be favourable, suggesting that environmental initiatives may support risk management, process efficiency, reputational capital, and market differentiation (Orlitzky et al., 2003; Wu, 2023). Yet the empirical record remains mixed (Corrales-Cano & Gómez-Zapata, 2023). Some studies show that firms with greater potential for improvement capture outsized gains from adopting sustainable practices (Chaihuaque, 2021), while others find no direct effect of Corporate Social Responsibility (CSR) on financial outcomes unless mediated by factors such as explicit environmental strategies, eco-innovation, or operational capabilities (Surroca et al., 2010). These discrepancies point to strong contextual contingencies: sector dynamics, regulatory regime, company size, and competitive intensity all shape whether and how sustainability investments pay off.

Overall, a proactive and strategically integrated approach appears more likely to yield financial benefits, especially when environmental objectives are embedded in core processes rather than treated as peripheral compliance tasks. At the same time, an institutional and critical lens cautions that some commitments may be largely symbolic responses to external expectations, disconnected from substantive operational change. Distinguishing genuine transformation from superficial adaptation is therefore essential, both analytically and in practice, to understand when environmental initiatives translate into superior financial performance and when they primarily serve legitimacy.

1.3. Sustainable organizational culture: strategic conversation

Organizational culture is central to translating environmental ambition into performance. In Denison's model, culture comprises shared practices, beliefs, and values that shape organizational effectiveness (Denison, 1990). A sustainability-oriented culture engages employees in environmental goals, aligns systems and incentives with ecological performance, anticipates regulatory shifts, and embeds environmental protection into the organization's mission. Rather than a stand-alone program, sustainability becomes a cross-cutting strategic conversation that reaches all levels and functions (Hart, 1995). Senior leadership plays a catalytic role: articulating a coherent vision that links financial and environmental objectives, allocating resources, ensuring regulatory compliance, and stewarding corporate reputation, thereby creating opportunities for long-term competitive advantage (Rojo-Suárez et al., 2024).

However, culture is difficult to observe directly with consistent, auditable indicators across firms, and small-N configurational designs require parsimony. Therefore, we do not operationalize culture as a standalone condition in the fsQCA model. Instead, we treat sustainability-oriented culture as an enabling mechanism that supports the routinization, coordination, and credibility of environmental initiatives (Hu et al., 2023; Sneideriene & Legenzova, 2025). In empirical terms, we focus on observable manifestations of such institutionalization: renewable energy deployment (REN_SHARE), operational circularity outcomes (WASTE_REC), and the maturity of formal environmental management and verification systems (EMAS_MAT), which captures the degree to which environmental practices are embedded in management routines and externally validated.

1.4. From the Triple Bottom Line (TBL) to institutional theory

Multiple theoretical perspectives inform the sustainability–performance nexus. TBL framework (Elkington, 1997) broadens corporate success metrics to include environmental and social dimensions, encouraging firms to evaluate outcomes beyond traditional financial indicators (García-Sánchez et al., 2020; Orlitzky et al., 2003). Recent scholarship emphasizes the strategic integration of the SDGs and the institutionalization of non-financial reporting as levers to embed sustainability into decision making (Adams, 2017; Leal Filho et al., 2025).

From the resource-based view (RBV), environmental capabilities, such as pollution prevention routines, clean-tech know-how, and stakeholder engagement processes, can be valuable, rare, and hard to imitate, thereby supporting sustained competitive advantage (Hart, 1995). Complementing this, Stakeholder Theory highlights that proactively addressing stakeholder expectations may reduce conflict, secure critical resources, and enhance financial outcomes (Donaldson & Preston, 1995; Freeman, 2010). Institutional Theory explains why firms converge on sustainability practices: coercive, normative, and mimetic pressures encourage adoption to gain legitimacy and meet evolving regulatory and societal norms (DiMaggio & Powell, 1983; Meyer & Rowan, 1977). In practice, these perspectives are not mutually exclusive; they illuminate how sustainability can be simultaneously a source of innovation and efficiency (RBV), a response to stakeholder claims, and a reflection of institutionalized expectations.

Building on these literatures, we adopt a configurational approach that recognizes complexity, equifinality (multiple paths to similar outcomes), and conjunctural causation (outcomes emerging from combinations of conditions rather than single factors). QCA is well suited to uncover such patterns, allowing us to examine how specific bundles of environmental practices align with high financial performance (ROA) across different contexts.

Building on the above literature, we address the gap in understanding how configurations of environmental practices relate to financial success. The following research questions (RQ) are formulated to guide the analysis:

- RQ1: Are there differences in the combinations of environmental practices associated with high ROA between the energy and industrial industries?
- RQ2: Which environmental conditions appear most frequently in the sufficient configurations retained under the adopted consistency criterion (if any are retained) in each sector?
- RQ3: What sufficient configurations (if any) of environmental practices are

associated with high ROA in IBEX 35 companies in the Energy and Industry & Construction sectors under the adopted calibration and consistency criteria?

2. Regulatory framework

Environmental reporting by large European companies is shaped by an evolving regime that seeks greater transparency and comparability. For the period relevant to this study (reporting year 2023), Spanish listed firms fell under the NFRD (Parlamento Europeo y Consejo de la Unión Europea, 2014). In Spain, Law 11/2018 (Gobierno de España, 2018) implemented the NFRD by requiring public-interest entities, such as IBEX 35 companies, to publish annual NFIS covering environmental, social, and governance topics. The NFRD permitted use of internationally accepted standards, notably the Global Reporting Initiative (GRI), which many IBEX 35 firms have historically adopted to structure sustainability disclosures and key environmental indicators.

Looking ahead, the CSRD substantially expands the scope and depth of sustainability reporting and strengthens requirements related to standardisation and assurance. The European Sustainability Reporting Standards are set out in the Commission Delegated Regulation (EU) 2023/2772 (European Commission, 2023), which specifies detailed disclosure requirements intended to enhance consistency, materiality assessment, and auditability. Although these standards were adopted in 2023, their application is phased in across reporting cycles starting with financial years after 2023 for the first wave of in-scope undertakings.

This regulatory evolution is complemented by the European Green Deal (European Commission, 2019), which anchors the EU's climate-neutrality ambition and drives related measures in sustainable finance and industrial policy. Among these, the EU Taxonomy Regulation (Regulation (EU) 2020/852) (European Parliament and Council of the European Union, 2020) defines criteria for environmentally sustainable economic activities, shaping corporate strategy and investor expectations and reinforcing demand for robust, decision-useful sustainability information.

Against this backdrop, our study employs indicators and criteria largely consistent with GRI and other established frameworks for two pragmatic reasons. First, the 2023 data analysed were prepared under the NFRD regime, frequently using GRI Standards, enabling comparability across IBEX 35 firms. Second, while ESRS promises greater standardization, it was not yet in force for the period studied. Using GRI-aligned metrics therefore grounds our analysis in actually disclosed information while remaining coherent with the NFIS content required by NFRD/CSRD. We acknowledge that ESRS will likely supersede GRI in the European context; future research should incorporate ESRS-based datasets as they become available, but for this study the chosen approach best reflects the regulatory and reporting realities of 2023.

3. Methodology

This study uses a configurational approach to examine how bundles of environmental practices relate to financial performance among IBEX 35 firms. The underlying idea is that environmental practices are often implemented as complementary packages, which makes fuzzy-set Qualitative Comparative Analysis (fsQCA) suitable. fsQCA models graded set-memberships and allows the exploration of alternative configurations linked to the same outcome (equifinality), while also accommodating potential differences between the drivers of high and low performance (causal asymmetry).

The unit of analysis is the firm. The sample includes 15 IBEX 35 firms split into two sectors: Energy (N=9) and Industry & Construction (N=6). To facilitate traceability, cases are referenced using anonymized codes (EN1–EN9 and IND1–IND6). Table 1 shows the sample structure and the case-coding scheme.

Table 1 Sample and case coding (N=15)

Sector	Code	Cases
Energy (N=9)	EN	EN1–EN9
Industry & Construction (N=6)	IND	IND1–IND6

Source: the authors

These sectors were selected to ensure within-sector comparability and environmental materiality. Both sectors are closely related to key sustainability dimensions (energy transition, circularity, and management/verification systems), which provides meaningful variation in environmental practices within each sector. Analyses are conducted by sector to limit structural heterogeneity associated with business models and asset structures, and to keep comparisons coherent.

The analysis focuses on fiscal year 2023, ensuring temporal alignment between the environmental practices reported and the financial performance measured, and avoiding cross-year mixes where reporting and verification criteria may vary. The study relies on audited consolidated financial statements and corporate disclosures published for the same year.

Financial performance is operationalized through ROA (Return on Assets). ROA is appropriate for cross-firm comparisons because it relates earnings to the asset base employed. The outcome is HIGH_ROA, defined as graded membership in the set of firms with “high ROA”, rather than a binary classification.

$$ROA = \frac{Net\ income}{Total\ assets}\ x\ 100$$

Condition selection balances substantive relevance, comparability, and empirical feasibility in a configurational design. Priority is given to proportional indicators (less dominated by firm scale), complemented by an ordinal indicator capturing environmental verification/management maturity. The final specification uses three conditions per sector, which supports interpretability and limits the proliferation of uninformative combinations. Organizational culture is conceptualized as a latent enabling context rather than a measured condition in this design. EMAS_MAT is included as an observable indicator of management-system institutionalization and verification maturity, which is closely related to the embedding of environmental routines within the organization. Table 2 summarizes the operationalization of the outcome and conditions.

Table 2 Model variables and operationalization

Type	Variable	Definition / raw measure	Data type
Outcome	HIGH_ROA	ROA 2023 (%) → fuzzy membership	Continuous
Condition	REN_SHARE	% renewable energy	Continuous (%)
Condition	WASTE_REC	% waste recovered	Continuous (%)
Condition	EMAS_MAT	EMAS status: no / partial / yes	Ordinal

Source: the authors

Calibration transforms raw measures into fuzzy memberships (0–1) using the direct method with three anchors: full non-membership (0.05), crossover (0.50), and full membership (0.95). For sector coherence, anchors for continuous variables are set using the sector-specific empirical distribution for 2023 (P25, median, P75). The ordinal condition EMAS_MAT is calibrated directly (0 = no EMAS; 0.67 = partial/limited EMAS; 1 = full EMAS). Table 3 reports the anchors used.

Table 3 Calibration anchors (P25 / median / P75) by sector (2023)

Sector	Variable	Full-out (0.05)	Crossover (0.50)	Full-in (0.95)
Energy (N=9)	REN_SHARE (%)	42.0	71.00	96.6
	WASTE_REC (%)	75.0	92.50	95.8
	HIGH_ROA (%)	3.20	4.03	5.14
Industry & Construction (N=6)	REN_SHARE (%)	22.9	32.00	47.5
	WASTE_REC (%)	69.6	79.88	86.0
	HIGH_ROA (%)	3.98	4.97	5.87
		Low	Medium	High
Both (assigned membership scores)	EMAS_MAT	0	0.67	1

Source: the authors

EMAS_MAT is an ordinal indicator calibrated by direct assignment (0, 0.67, 1), not by percentile-based anchors

If a value is not available for a given condition in a specific case, its membership score is treated as missing only in the analyses that include that condition. Raw values are reported in Appendix 1, and calibrated membership scores in Appendix 2.

For instance, WASTE_REC is missing for EN8 (Energy), so Energy analyses involving WASTE_REC use an effective N=8 for that condition.

Based on calibrated memberships, sector-specific truth tables are constructed to identify configurations sufficient for HIGH_ROA. A minimum frequency of 1 per configuration is applied, with a consistency threshold in the 0.80-0.85 range. Consistency and coverage (raw and unique) are reported. Solutions are obtained using Quine–McCluskey minimization in fsQCA 3.1, reporting intermediate and parsimonious solutions.

Necessity analysis was conducted prior to sufficiency assessment by sector, reporting necessity consistency and coverage for each condition (REN_SHARE, WASTE_REC, EMAS_MAT). Following common practice, conditions were considered potentially necessary only if necessity consistency approached high levels (≈0.90). As reported in Appendix 3, none of the single conditions reaches this benchmark; therefore, we do not identify any necessary environmental practice for HIGH_ROA under the current specification.

To illustrate causal asymmetry, we also conducted a mirror sufficiency assessment using the negated outcome (~HIGH_ROA; i.e., LOW_ROA = 1 − m(HIGH_ROA)) with the same condition set, calibration, and consistency criteria. The observed configurations and their metrics for LOW_ROA are reported in Appendix 4.

4. Results

This section reports, for each sector, the environmental configurations associated with HIGH_ROA (high return on assets, expressed as fuzzy scores between 0 and 1). Using the calibrated scores (Appendix 2), a sector-specific truth table was constructed. For each row (configuration), we report sufficiency consistency (the extent to which the configuration behaves as a subset of HIGH_ROA) and coverage (the share of HIGH_ROA explained by the configuration). For readability, configurations are displayed in Boolean form (presence/absence) using an operational 0.5 threshold.

The Table 4 presents the observed configurations in each sector and their main metrics (frequency, consistency, and coverage), together with an indicator of whether they meet the adopted selection criterion (consistency ≥ 0.80).

Table 4 Observed configurations and sufficiency metrics (fsQCA, by sector)

Sector	Configuration	Frequency (X>0.5)	Consistency	Coverage (raw)	Selected (≥0.80)
Energy	~REN_SHARE * WASTE_REC * ~EMAS_MAT	3	0.73	0.49	No
Energy	REN_SHARE * ~WASTE_REC * EMAS_MAT	1	0.57	0.19	No
Energy	~REN_SHARE * ~WASTE_REC * EMAS_MAT	1	0.53	0.16	No
Energy	REN_SHARE * WASTE_REC * ~EMAS_MAT	1	0.36	0.13	No
Energy	REN_SHARE * ~WASTE_REC * ~EMAS_MAT	1	0.31	0.12	No
Industry & Construction	~REN_SHARE * WASTE_REC * EMAS_MAT	1	1.00	0.17	Yes
Industry & Construction	REN_SHARE * ~WASTE_REC * ~EMAS_MAT	3	0.80	0.65	Yes
Industry & Construction	~REN_SHARE * WASTE_REC * ~EMAS_MAT	2	0.15	0.11	No

In fsQCA, 0.5 represents the crossover point (maximum ambiguity), indicating neither membership nor non-membership in a set. Therefore, when reporting truth-table frequencies and case membership in configurations, we follow standard practice and count/list only cases with configuration membership **greater than 0.5**. Cases scoring exactly **0.5** are treated as crossover and are not considered as supporting either the presence or the negation of a condition in the case listings.

Source: the authors

Because traceability matters in small-N designs, the Table 5 lists the case codes supporting each configuration and provides additional diagnostic indicators (PRI and ΣX) that complement the main table. We use sufficiency consistency (≥0.80) as the primary inclusion criterion for selecting configurations. PRI is reported as a diagnostic of whether a configuration is more consistent with HIGH_ROA than with its negation; given the small-N setting and the aim of transparency, we do not impose a hard PRI cutoff, but interpret configurations with modest PRI more cautiously.

Table 5 Case traceability and additional diagnostics by configuration (PRI and ΣX)

Sector	Configuration	Cases (codes)	PRI	ΣX (empirical relevance)
Energy	~REN_SHARE * WASTE_REC * ~EMAS_MAT	EN3, EN6, EN9	0.51	2.33
Energy	REN_SHARE * ~WASTE_REC * EMAS_MAT	EN7	0.17	1.17
Energy	~REN_SHARE * ~WASTE_REC * EMAS_MAT	EN4	-0.77	1.11
Energy	REN_SHARE * WASTE_REC * ~EMAS_MAT	EN2	-1.20	1.32
Energy	REN_SHARE * ~WASTE_REC * ~EMAS_MAT	EN5	-1.54	1.38
Industry & Construction	~REN_SHARE * WASTE_REC * EMAS_MAT	IND3	0.40	0.51
Industry & Construction	REN_SHARE * ~WASTE_REC * ~EMAS_MAT	IND1, IND4, IND5	0.72	2.46
Industry & Construction	~REN_SHARE * WASTE_REC * ~EMAS_MAT	IND2, IND6	-4.68	2.22

Source: the authors

In Energy (N=9), none of the observed configurations reaches the sufficiency threshold (consistency ≥0.80). The best-fitting row is ~REN_SHARE * WASTE_REC * ~EMAS_MAT (consistency=0.73; coverage=0.49), but it remains below the selected criterion. Accordingly, for this sector the results do not allow the identification of "sufficient recipes" under a strict consistency standard using these three conditions. This constitutes an informative null result for the Energy sector under the current specification. Because no configurations are retained as sufficient (consistency ≥0.80), RQ2 cannot be assessed for Energy in terms of "frequently appearing conditions" within sufficient recipes, and RQ3 yields no stable sufficient configuration under the current condition set. The best-fitting row (~REN_SHARE * WASTE_REC * ~EMAS_MAT; consistency=0.73; coverage=0.49) is reported descriptively as the closest empirical pattern, but it remains below the adopted sufficiency threshold.

In Industry & Construction (N=6), two configurations meet the sufficiency criterion for HIGH_ROA (consistency ≥0.80). Based on these rows, minimization does not further reduce terms (with three conditions, the pattern is already compact), so the intermediate solution coincides with the two selected configurations. In the Table 6, we report these configurations along with their fit metrics and the supporting cases.

Table 6 Sufficient configurations for HIGH_ROA in Industry & Construction (intermediate solution)

Configuration (intermediate solution)	Frequency (X>0.5)	Cases	Consistency	PRI	Coverage (raw)
~REN_SHARE * WASTE_REC * EMAS_MAT	1	IND3	1.00	0.40	0.17
REN_SHARE * ~WASTE_REC * ~EMAS_MAT	3	IND1, IND4, IND5	0.80	0.72	0.65

Source: the authors

At the solution level (the fuzzy union of the terms), the Industry & Construction solution reaches consistency=0.836 and coverage=0.827. Descriptively, the first configuration combines a low renewable share with high waste recovery and higher EMAS maturity, whereas the second combines a high renewable share with low waste recovery and lower EMAS maturity. In this section we report these patterns as configurational results; their substantive interpretation is developed in the Discussion.

4.1 Sensitivity analysis (robustness)

Robustness was assessed through reasonable variations in two elements of the procedure: the calibration anchors (alternative percentiles) and the consistency threshold used to retain sufficient rows. Accordingly, three sensitivity scenarios were considered. The baseline specification uses sector-specific anchors (P25/Median/P75) and a consistency cutoff of 0.80. Scenario S1 keeps the same cutoff (0.80) but applies alternative sector-specific anchors (P20/Median/P80). Scenario S2 retains the baseline anchors (P25/Median/P75) and increases the consistency cutoff to 0.85.

In the Table 7, we report, by sector, whether the retained configurations change across scenarios and how the main fit indicators (consistency and coverage) are affected.

Table 7 Sensitivity analysis summary (robustness diagnostics)

Scenario	Energy: effect on solutions	Industry & Construction: effect on solutions
Base	No sufficient configurations retained (best row: ~REN_SHARE * WASTE_REC * ~EMAS_MAT; consistency = 0.739; coverage = 0.494)	Two sufficient configurations retained: ~REN_SHARE * WASTE_REC * EMAS_MAT and REN_SHARE * ~WASTE_REC * ~EMAS_MAT (solution consistency = 0.836; coverage = 0.827; no change in terms)
S1	No sufficient configurations retained (best row: ~REN_SHARE * WASTE_REC * ~EMAS_MAT; consistency = 0.745	Same two configurations retained; fit changes slightly (solution consistency = 0.844; coverage = 0.817; no change in terms)
S2	No sufficient configurations retained (best row remains below cutoff: consistency = 0.739)	Only ~REN_SHARE * WASTE_REC * EMAS_MAT retained; the second term is dropped (solution consistency = 1.000; coverage = 0.171)

Source: the authors

Overall, the sensitivity analysis suggests that, for Industry & Construction, the structure of the solution is stable under moderate changes in calibration anchors (Base vs. S1), with only small shifts in fit. When a more stringent consistency cutoff is applied (S2), the solution becomes more restrictive: only the perfectly consistent term is retained, and coverage decreases accordingly. For Energy, no sufficient configurations are retained under the baseline or alternative-anchor specifications, and the best-performing row remains below the sufficiency threshold, indicating weaker configurational evidence for HIGH_ROA within the current condition set.

5. Discussion

This study adopts a configurational perspective to examine how bundles of environmental practices are associated with higher financial performance (HIGH_ROA). This approach is particularly suitable in corporate sustainability research because environmental practices rarely operate in isolation. Firms typically implement interdependent initiatives that can reinforce each other or, in some cases, act as substitutes. A configurational lens therefore helps describe how different combinations align with performance within a given sectoral and institutional setting.

The results differ by sector. In Energy, none of the observed configurations reaches the sufficiency threshold under the selected condition set. This absence of retained sufficient configurations is substantively meaningful: it suggests that, under the current condition set and strict consistency criterion, high ROA in Energy is not consistently aligned with any stable environmental "recipe," making the identification of recurrent conditions within sufficient configurations (RQ2) not applicable for this sector. This does not imply that environmental practices are unrelated to financial outcomes. Rather, it indicates that, in this subsample and year, HIGH_ROA is not consistently aligned with a stable bundle defined by renewable energy share, waste recovery, and EMAS maturity. A plausible interpretation is that the Energy sector combines heterogeneous operating profiles and additional performance drivers that are not captured by the parsimonious model, which may limit the emergence of sufficiently consistent "recipes" for HIGH_ROA.

In Industry & Construction, two sufficient configurations are identified. Their coexistence illustrates equifinality: different environmental bundles can be compatible with higher ROA within the same sectoral setting. Interpreting this equifinality through the culture lens, the pathway combining high waste recovery with EMAS maturity (despite low renewable share) is consistent with a more institutionalized, routinized approach to environmental management, i.e., practices embedded in systems, audits, and operational discipline. By contrast, the alternative pathway in which high renewable share aligns with high ROA in the absence of both waste recovery and EMAS maturity suggests a more "structural" route, potentially driven by energy sourcing choices or asset mix rather than deep internalization. This interpretation is consistent with our conceptualization of culture as an enabling mechanism rather than a modelled condition. This contrast reinforces our argument that environmental outcomes can be achieved through different logics, and that the role of internal embedding (culture/routines) may vary across pathways.

One configuration emphasizes operational circularity and verified environmental management, while the other canters on renewable energy share with weaker alignment on the other two dimensions. The key implication is not that one bundle is "better," but that high-performing cases may align with different combinations depending on materiality, governance choices, and implementation sequencing.

The mirror analysis for LOW_ROA (Appendix 4) yields different sufficient patterns than those associated with HIGH_ROA, supporting the causal asymmetry logic motivating the configurational approach.

The sensitivity checks support a cautious reading. In Industry & Construction, the solution structure remains stable under moderate shifts in calibration anchors, with only small changes in fit. When the consistency cutoff is raised, the solution becomes more restrictive and coverage decreases as expected. In Energy, the absence of sufficient configurations persists across tested specifications, indicating weaker configurational evidence for HIGH_ROA within the current condition set.

From a managerial standpoint, the findings support a bundle-based view of environmental strategy. Rather than relying on isolated "best practices," firms may align environmental actions with operational realities and governance arrangements. At the same time, the absence of stable configurations in Energy suggests that sector-specific diagnostics are needed before drawing prescriptive conclusions.

Conclusions

This study contributes to the sustainability–financial performance literature by applying fsQCA to assess how combinations of environmental practices are associated with higher ROA in a comparable set of IBEX 35 firms. The findings are sector-specific. In Energy, no sufficient configuration emerges under the selected condition set, indicating limited configurational regularities within this model. In Industry & Construction, two sufficient configurations are identified, highlighting equifinality and the relevance of bundle-based interpretations. Overall, the results suggest that environmental strategy is better approached as a set of interdependent practices whose alignment with financial performance depends on sector context, governance arrangements, and implementation choices.

Limitations and future research

This study has several limitations. First, it focuses on a single year (2023), which limits the ability to capture dynamics, lagged effects, and temporal shifts in reporting practices. Second, the case base is small (N=15) and split by sector, so the results should be interpreted as configurational evidence within the sample rather than as generalizable sector-wide claims. Third, the model is intentionally parsimonious (three conditions) to preserve interpretability and avoid overfitting, but this may omit relevant environmental dimensions, particularly for Energy. Fourth, environmental indicators may differ across firms in measurement boundaries, assurance levels, and disclosure choices, which can introduce noise even among highly visible listed companies. Fifth, we do not directly measure sustainability-oriented culture or leadership processes; future research could incorporate explicit culture proxies (e.g., validated textual measures or mixed-method case evidence) and examine how cultural embedding moderates the practice-performance relationship.

Future research can extend this design in several ways. A natural step is to increase the number of cases by adding years and/or comparable firms, which would support more stable truth tables and stronger cross-case patterns. Researchers may also test alternative financial outcomes (e.g., ROS or ROE) and incorporate intensity-based environmental indicators where feasible. Finally, mixed-method follow-ups (e.g., focused case comparisons or expert-informed validation of specific bundles) could help explain why different configurations emerge within the same sector.

Declarations

Availability of data and materials

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

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Appendices

Appendix 1. Raw values by case (2023)

Case	ROA (%)	REN_SHARE (%)	WASTE_REC (%)	EMAS status
EN1	1.71	71.00	77.00	yes
EN2	3.57	97.00	97.00	no
EN3	1.80	42.00	93.00	no
EN4	4.03	13.46	92.00	yes
EN5	3.20	96.60	69.00	no
EN6	5.24	37.00	95.40	no
EN7	5.14	91.00	40.00	partial
EN8	6.52	100.00		no
EN9	4.76	61.10	98.40	no
IND1	3.74	37.00	79.76	no
IND2	2.14	3.14	88.00	no
IND3	5.22	27.00	80.00	yes
IND4	6.08	68.53	66.30	no
IND5	12.92	51.00	47.50	no
IND6	4.71	21.55	97.00	no

Appendix 2. Calibrated set-membership scores by case (2023)

Case	m(HIGH_ROA)	m(REN_SHARE)	m(WASTE_REC)	m(EMAS_MAT)	HIGH_ROA (>0.5)	REN_SHARE (>0.5)	WASTE_REC (>0.5)	EMAS_MAT (>0.5)
EN1	0.000	0.500	0.069	1.000	0	C	0	1
EN2	0.164	0.952	0.982	0.000	0	1	1	0
EN3	0.000	0.050	0.610	0.000	0	0	1	0
EN4	0.500	0.003	0.479	1.000	C	0	0	1
EN5	0.050	0.950	0.019	0.000	0	1	0	0
EN6	0.961	0.031	0.930	0.000	1	0	1	0
EN7	0.950	0.909	0.000	0.670	1	1	0	1
EN8	0.999	0.966		0.000	1	1		0
EN9	0.874	0.268	0.995	0.000	1	0	1	0
IND1	0.025	0.721	0.491	0.000	0	1	0	0
IND2	0.000	0.000	0.980	0.000	0	0	1	0
IND3	0.694	0.165	0.514	1.000	1	0	1	1
IND4	0.974	0.999	0.020	0.000	1	1	0	0
IND5	1.000	0.974	0.000	0.000	1	1	0	0
IND6	0.316	0.033	1.000	0.000	0	0	1	0

"C" denotes the **crossover point** in fsQCA (m = 0.500), i.e., maximum ambiguity: the case is classified as neither a member nor a non-member of the set. In the coded columns, we assign **1** when **m > 0.5**, **0** when **m < 0.5**, and **C** when **m = 0.5**. Blank cells indicate **missing data** (not available values).

Appendix 3. Necessary condition analysis for HIGH_ROA (by sector)

Sector	Condition	N	Necessity consistency	Necessity coverage
Energy	REN_SHARE	9	0.532	0.517
Energy	WASTE_REC	8	0.705	0.604
Energy	EMAS_MAT	9	0.260	0.438
Industry & Construction	REN_SHARE	6	0.722	0.751
Industry & Construction	WASTE_REC	6	0.291	0.291
Industry & Construction	EMAS_MAT	6	0.231	0.694

Necessity consistency values are well below commonly used "necessity" benchmarks (≈0.90), indicating that no single condition is necessary for HIGH_ROA in either sector

Appendix 4. Mirror sufficiency analysis for ~HIGH_ROA (LOW_ROA), by sector

Sector	Configuration	Frequency (X>0.5)	Consistency	Coverage (raw)	Selected (≥0.80)
Energy	~REN_SHARE * ~WASTE_REC * EMAS_MAT	1	0.944	0.233	Yes
Energy	REN_SHARE * WASTE_REC * ~EMAS_MAT	1	0.805	0.236	Yes
Energy	REN_SHARE * ~WASTE_REC * ~EMAS_MAT	1	0.798	0.245	No
Energy	REN_SHARE * ~WASTE_REC * EMAS_MAT	1	0.471	0.123	No
Energy	~REN_SHARE * WASTE_REC * ~EMAS_MAT	3	0.360	0.187	No
Industry & Construction	~REN_SHARE * WASTE_REC * ~EMAS_MAT	2	0.873	0.650	Yes
Industry & Construction	~REN_SHARE * WASTE_REC * EMAS_MAT	1	0.595	0.102	No
Industry & Construction	REN_SHARE * ~WASTE_REC * ~EMAS_MAT	3	0.217	0.179	No