From Green Governance to Verifiable Innovation: A Review of Corporate Decision Mechanisms, Environmental Outcomes, and Greenwashing Risks

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Received: April 22, 2026; Accepted: May 4, 2026; Available Online: September 30, 2026

Abstract

Corporate green commitments do not establish that innovation has been implemented or that environmental burdens have fallen. This critical narrative review examines the evidence between corporate governance, green innovation, technology deployment, and environmental outcomes. A targeted search of publisher records, institutional materials, research repositories, and reference lists was conducted. The review is selective and does not claim a systematic search or a pooled effect. It compares studies from the United States, Europe, China, Australia, Malaysia, and Vietnam and distinguishes governance arrangements, innovation inputs, patents and scores, reported adoption, and environmental measures. Selected studies associate board arrangements with green patents, innovation scores, or disclosure quality; these outcomes represent different constructs. Patent and trademark indicators miss some firm-reported innovations, while a study of process and product patents reports a significant association for the former but not the latter with an emissions-management rating. A five-stage framework connects governance decisions, resource allocation, innovation outputs, implementation, and environmental outcomes, with disclosure, assurance, feedback, and institutional context across the stages. An evidence matrix, four research propositions, and an illustrative calculation identify the observations and comparison conditions needed for narrower claims. The synthesis supports claim-specific verification but does not establish a universal causal pathway or a validated scoring system. Future research should link decision, facility, adoption, and impact data across consistent boundaries and time periods.

Keywords: *green governance; green innovation; environmental performance; corporate accountability; greenwashing; evidence assessment*

ISSN: 3067-7491 © 2026 INATGI (Institute of Advanced Technology and Green Innovation)
See: https://inatgi.in/index.php/jbgi/index for more information. https://doi.org/10.63646/RHOT3911

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1. Introduction

Environmental concerns have moved from a peripheral issue to a material component of many firms' strategic choices. Companies face decisions about energy use, product design, raw materials, suppliers, capital investment, and exposure to environmental regulation. They also face expectations from shareholders, employees, customers, lenders, and affected communities. A green commitment may therefore influence both the allocation of business resources and the criteria used to assess corporate performance. However, the relationship among an announced objective, a decision by corporate leaders, an innovation project, and a measurable environmental outcome is neither automatic nor uniform. Each stage involves distinct actors, information, time horizons, and uncertainties.

Environmental innovation encompasses new or substantially improved products, processes, organizational practices, and business models that are intended to reduce environmental burdens. Its definition is broader than a patent portfolio or a sustainability report. Rennings (2000) placed technological, social, and institutional change within eco-innovation research, while Horbach (2008) examined how market and regulatory conditions relate to environmental innovation. Hojnik and Ruzzier (2016) distinguish drivers of product, process, and organizational eco-innovation. The distinction between intended and achieved environmental benefit is central: an apparently cleaner technology may have a limited effect when it is not adopted, displaces impacts to another part of the value chain, or stimulates a larger volume of consumption.

Corporate governance matters because decisions about risk appetite, financial priorities, executive incentives, oversight, and information determine which opportunities receive attention and resources. A governance arrangement is an organizational mechanism, however, rather than an environmental outcome. Research on US antitakeover legislation associates governance conditions with firms' green patent activity (Amore & Bennedsen, 2016). Other studies relate board attributes or sustainability committees to innovation measures in different settings (Dwekat et al., 2025; Wu & Wang, 2026). These contributions are informative about possible channels, but their measures and institutional contexts differ. A positive association in a particular sample does not by itself establish that a governance reform reduces pollution in another setting.

The measurement problem is equally important. Green patents indicate that a technology falls within an environmental classification, but not all innovations are patented, and a patent grant does not establish commercial use. Based on German and Italian firm samples, Block et al. (2025) show that reliance on intellectual property indicators misses many firms that report green innovation. At a different stage, greenhouse-gas inventories describe emissions within specified organizational and value-chain boundaries. Such inventories do not automatically identify which investment or technology produced an observed change. Composite environmental, social, and governance (ESG) scores add another layer of complexity because rating providers vary in their scope, measurements, and weighting (Berg et al., 2022).

The possibility of a gap between corporate communication and underlying practice creates further challenges. Greenwashing research examines how selective or misleading communication may create an overly favorable impression of environmental performance (Delmas & Burbano, 2011; Lyon & Maxwell, 2011). A difference between a target and an outcome, however, is not

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sufficient on its own to establish deliberate deception. Unanticipated technology costs, estimation error, changes in organizational boundaries, and incomplete information may also explain a gap. Analysis requires a clear comparison between a specific claim and evidence appropriate to that claim.

Existing syntheses already examine corporate governance and green innovation. Mishra et al. (2025) review governance and innovation, whereas Essajide et al. (2026) examine ESG disclosure, innovation proxies, institutional conditions, and the risk that reporting and patenting represent symbolic activity. The latter review also considers environmental outcomes and identifies limitations in the evidence that connects innovation proxies with physical performance. Li and Loang (2026), in this journal, focus on corporate social responsibility innovation in Chinese small and medium-sized enterprises (SMEs), including institutional and resource constraints. The present review builds on these related contributions rather than claiming a wholly new subject.

The proposed distinction is a claim-specific examination of the interfaces between decision, investment, innovation, actual use, and environmental performance. The article specifies what an observation supports at each stage, what remains unobserved, and what comparison would strengthen a narrower inference. It also presents a numerical example that separates emissions intensity, absolute emissions, and a hypothetical counterfactual. These additions constitute an analytical contribution, not evidence that this is the first or the only framework to connect governance with environmental results. Table 1 states the boundaries of the comparison.

Table 1. Position of This Review in Relation to Selected Prior Syntheses

Review	Primary scope	Contribution and boundary of the present review
Mishra et al. (2025)	Corporate governance and green innovation; systematic review.	Retains governance evidence and examines what each measure says about later deployment and outcomes.
Essajide et al. (2026)	ESG disclosure, green innovation, institutional context and proxy limitations.	Makes the claim–evidence connection explicit at each interface; does not claim that prior work ignored outcomes.
Li & Loang (2026)	CSR innovation, institutions and resource constraints in Chinese SMEs.	Examines environmental innovation and verification across firm types and settings; social CSR is not the primary outcome.
Present review	Selective critical narrative review of corporate governance, innovation and environmental claims.	Offers an evidence matrix, a hypothetical calculation and testable propositions; the framework is not empirically validated.

Note: This comparison is interpretive. It does not imply that the cited reviews are exhaustive or that the present framework is the first related model.

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Four questions guide the review. First, which governance arrangements and organizational mechanisms are associated with decisions to pursue green innovation? Second, how do common indicators represent different stages of the innovation process? Third, what evidence connects innovation activity with environmental outcomes, and what limits attribution? Fourth, how might disclosure and assurance distinguish credible environmental claims from unsupported or potentially misleading ones? The article provides a structured narrative synthesis and an original analytical framework; it does not claim an exhaustive systematic search, estimate a pooled effect, or present new firm-level data.

2. Conceptual Background and Analytical Perspective

2.1 Green governance and environmental innovation

Green governance refers here to the responsibilities, decision rights, controls, incentives, and information processes through which an organization addresses environmental issues. It includes formal arrangements such as board committee mandates and management accountability, as well as operational practices such as investment review, supplier evaluation, and the escalation of noncompliance. A broad ESG governance label may also cover social and general governance matters. This review concentrates on the environmental dimension because environmental objectives and outcomes require their own boundaries, units, and evidence.

The natural-resource-based view explains why environmental capabilities may support strategic advantage when firms develop pollution prevention, product stewardship, and longer-term sustainable development capabilities (Hart, 1995). Environmental expertise, technical collaboration, and process knowledge may create resources that competitors find difficult to replicate. Yet capability is context dependent: an environmental investment may be valuable in one regulatory or production environment and uneconomic in another. The argument therefore identifies potential mechanisms rather than a universal guarantee that green activity raises profits or reduces emissions.

Porter and van der Linde (1995) challenged the assumption that environmental regulation always imposes an unavoidable trade-off between environmental improvement and competitiveness. Their argument invites attention to innovation, resource productivity, and policy design. It should not be interpreted as proof that every environmental regulation or technology produces a private and environmental win. Compliance costs, adjustment periods, limited finance, and heterogeneous firm capabilities may affect outcomes. The relevant empirical question is which conditions support joint improvements and which create real trade-offs.

An additional governance perspective concerns the allocation of authority and the control of managerial incentives. A board may approve a transition objective, but management decides how to translate that objective into project selection, procurement specifications, engineering priorities, and performance information. When those decisions are disconnected, a statement of ambition is weak evidence of implementation. Conversely, a firm may undertake useful environmental improvements without a prominent public commitment. Governance research should therefore observe actual decisions and operational processes rather than infer them exclusively from the presence of a policy or committee.

2.2 Governance, incentives, and institutional pressures

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Agency theory explains why the party that authorizes a corporate objective may not observe the effort or information available to the party responsible for implementation. Jensen and Meckling (1976) describe agency costs arising from divergent interests and imperfect monitoring. In an environmental project, a board may require a long-term investment whose operating benefits arise after a manager's performance period. A contract based on a narrow short-term indicator may shift attention toward the indicator rather than the underlying environmental objective. The theory identifies a monitoring problem; it does not imply that managers are uniformly opportunistic or that a board mandate ensures a specific result.

Executive compensation is one possible governance response. Flammer et al. (2019) examine the incorporation of corporate social responsibility criteria into executive compensation and associated corporate outcomes. A contract tied to an observable target may strengthen accountability, but its effect depends on target materiality, verification, measurement windows, and the possibility of shifting impacts elsewhere. A carbon-intensity target, for example, does not independently establish a decline in total emissions. The important mechanism is the design and use of the incentive, rather than the presence of an ESG label in a pay policy.

Institutional theory emphasizes pressures that arise from regulation, professional expectations, and organizational imitation. DiMaggio and Powell (1983) distinguish coercive, normative, and mimetic mechanisms that may encourage similarity among organizations. In the present setting, the same pressure may support substantive investment, improve measurement, or encourage a formal response whose operational effects remain uncertain. External scrutiny and technical capacity therefore condition the relationship between a policy statement and implementation. The theory should not be reduced to an assumption that every response to institutional pressure is symbolic.

The natural-resource-based view, agency theory, and institutional theory answer different questions. The first directs attention to the technical and organizational assets needed to develop or adopt an innovation; the second concerns decision rights, incentives, and information; the third describes the external context that shapes perceived legitimacy and expected behavior. These perspectives also generate competing expectations. Strong external pressure may induce investment but may also prioritize readily disclosed indicators. Only observations of budgets, deployment, and results permit the competing explanations to be assessed.

2.3 The five-stage evidence chain

Figure 1 presents the proposed evidence chain. It separates five analytical stages: governance decisions; allocation of financial and organizational resources; innovation outputs; implementation or diffusion; and verified environmental outcomes. The stages are related, but they do not imply a single chronological sequence or a deterministic causal process. Operational evidence may lead management to revise a target, and an externally developed technology may enter directly at the implementation stage. A firm may therefore be an innovator, an adopter, or both; patent ownership is not a prerequisite for adoption. The chain instead identifies the evidence needed to assess how an environmental claim travels across organizational boundaries and over time.

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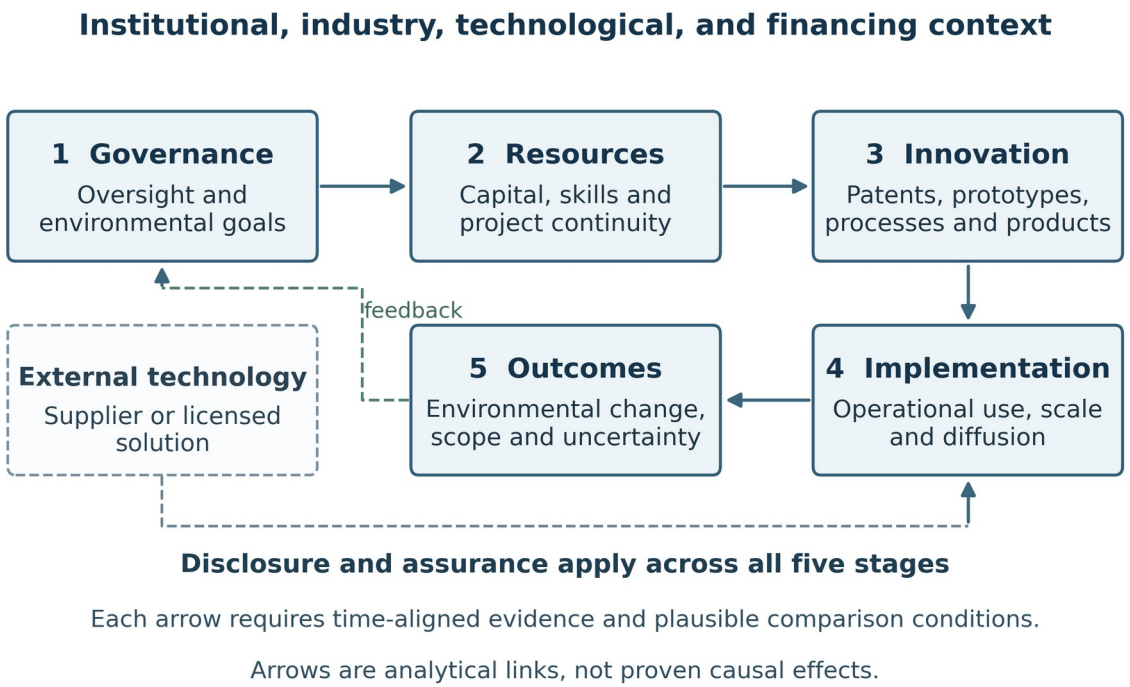

Figure 1. A Proposed Evidence Chain from Corporate Governance to Environmental Outcomes

At the governance stage, a researcher may observe a committee charter, meeting agenda, responsibility matrix, or management incentive. A useful analysis asks what authority the arrangement grants, what information reaches the decision maker, and whether an environmental consideration affects a decision. At the resource stage, relevant evidence includes approved budgets, research staff, procurement contracts, equipment expenditures, and project continuity. At the output stage, prototypes, patents, improved production processes, and redesigned products provide information about the innovation itself. The same project may produce several outputs, while other valuable changes remain unpatented.

The implementation stage concerns deployment, not simply invention. It may be represented by installation records, production volumes that use a process, supplier adoption, or customer use. Finally, environmental outcomes require an explicit outcome variable, a time period, a reference point, and a boundary. Absolute emissions, emissions intensity, energy consumption, material efficiency, and pollutant discharge are not interchangeable. Governance practices and disclosures may be assessed across all five stages, but stronger verification at one stage does not automatically validate claims at another.

2.4 Evidence interfaces and alternative explanations

The first interface connects a governance decision to resource allocation. An organization may publish a transition goal but omit a corresponding capital plan. Alternatively, its capital expenditures may be constrained by technology maturity or external finance, despite genuine commitment. The second interface links inputs to innovation outputs. Research spending may

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create knowledge without a patent, and an acquired patent may reflect a transaction rather than the firm's own research. Appropriate indicators depend on the question and the innovation strategy.

The third interface connects an output to implementation. A patented low-carbon process may never leave a pilot facility; a non-patented operational adjustment may be deployed across a supply chain. The fourth interface connects implementation to an environmental outcome. A reduction in emissions intensity may result from greater output, electricity-grid changes, divestment, or changes in the accounting boundary rather than the new process alone. The chain thus requires a counterfactual question: what would plausibly have occurred without the intervention, under a comparable boundary and time frame?

These interfaces also distinguish a measurement discrepancy from greenwashing. A weak or unavailable measure is not proof of misconduct, and a gap between a target and outcome is not necessarily intentional. A credible inquiry compares the wording, timing, scope, and materiality of a claim with relevant implementation and outcome evidence. It also examines whether the organization disclosed uncertainty and adverse information. Lyon and Maxwell (2011) model selective disclosure under the possibility of external audit; Marquis et al. (2016) examine selective disclosure across institutional contexts. Both point to communication and scrutiny as important, while neither eliminates the need for case-specific evidence.

3. Review Method

3.1 Design and scope

This article uses a structured narrative review. The approach is suitable for the present conceptual question because it integrates heterogeneous research designs, including theoretical work, reviews, firm-level studies, and technical reporting guidance. Snyder (2019) distinguishes review designs according to their purpose and emphasizes transparency about how evidence is selected and synthesized. The present review is not a PRISMA systematic review, does not claim a complete search of subscription databases, and does not report a number of screened records or a flow diagram. No quantitative meta-analysis was conducted.

The review covers research that addresses at least one of four topics: corporate environmental governance; green or environmental innovation; measures of environmental performance; and disclosure, assurance, or greenwashing. The organizational focus is the business firm, including its relationships with facilities, suppliers, lenders, customers, and regulators. Foundational work provides conceptual context, whereas more recent studies illustrate measurement and institutional developments. Corporate climate and emissions research receives substantial attention because it provides relatively explicit metrics, but the analytical framework also applies to water, waste, materials, and other environmental pressures when suitable evidence is available.

3.2 Discovery, selection, and synthesis

The review draws on a targeted search of publisher websites, research repositories, institutional sources, and reference lists. Three query families addressed governance and innovation; innovation, deployment and environmental outcomes; and disclosure, verification and greenwashing. The searches were executed separately so that a relevant environmental-outcome study was not excluded merely because its title did not mention corporate governance. Representative query strings and source types are displayed in Table 2. Publisher records

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included Wiley, ScienceDirect, Springer Nature, MDPI, PLOS, and Emerald; organizational material included the Greenhouse Gas Protocol, the International Organization for Standardization, and the IFRS Foundation.

The query examples in Table 2 document searches actually used during discovery; they are not a complete export of every query or ranked result. Index coverage, search ranking, publication access, and online records may change. Searches of Web of Science or Scopus are not claimed. The review does not have a recoverable comprehensive record of all hits or exclusions, and it therefore does not estimate study frequencies or report a screening flow diagram. Relevant foundational studies were retained regardless of publication year; more recent empirical material was sought to cover governance, adoption, and environmental measurement.

Table 2. Representative Web-assisted Search Queries and Source Types

Search family	Example query used	Purpose and limitations
Governance and innovation	board environmental sustainability committee green innovation environmental performance corporate firm panel study governance 2023 2024 doi	Identified governance studies and prior syntheses; free-text ranking and coverage may change.
Innovation and outcomes	"green patents" "emissions" innovation manufacturing plants 2023 2024 evidence empirical journal	Identified innovation and pollution studies without requiring governance in the title.
Disclosure and verification	"greenwashing" "environmental performance" selective disclosure patent innovation empirical 2021 2024 DOI journal	Identified disclosure and greenwashing research; did not constitute an exhaustive database search.
Standards and references	site:ifrs.org IFRS S2 scope 1 scope 2 scope 3 greenhouse gas disclosure December 2025 amendments effective	Located official standards and guidance; citations and reference lists supplied supplementary leads.

Note: The examples are actual discovery queries, not a complete search export. Publisher, repository and institutional sources are described in Section 3.2.

Sources were included when they directly informed at least one stage or interface, possessed identifiable authorship and publication details, and offered an accessible publisher or institutional record. Empirical reports with an identifiable setting, method, and outcome measure received priority. The synthesis also included foundational theory, previous reviews for comparison, and technical standards; these sources serve different functions and are not counted as independent empirical tests. Material without a traceable source, a relevant measure, or a discernible relationship to the research questions was not used to support a substantive claim. The selection was purposive rather than exhaustive.

Where full text was available, the outcome definition and reported design were checked against the article; where only an abstract or institutional summary was available, interpretation remained within that record. Tables 3 and 5 identify representative studies rather than an exhaustive set or a statistically representative sample. No claim is made that selection was conducted independently

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by multiple reviewers. Selective source availability, English-language emphasis, and judgment during selection affect the balance of evidence.

The synthesis followed three steps. First, the selected sources were assigned to one or more stages of the evidence chain, without treating a source's principal outcome as evidence for every stage. Second, the studies were compared by governance mechanism, innovation measure, environmental boundary, and research design. Third, the resulting distinctions informed an assessment matrix and practical verification questions. Differences in sample, geography, measurement, and methods precluded a meaningful pooled estimate. The framework is a conceptual synthesis and should be evaluated with subsequent case and quantitative research.

3.3 Limitations of the review process

The search is selective and may underrepresent research outside English-language indexed sources, paywalled publications, small firms, and non-corporate organizations. Publicly listed firms receive disproportionate attention because their governance, patents, and emissions are easier to observe. A publication's absence from this review does not imply that it lacks merit or that the issue has not been studied. Search results and online publication information may also change after the search date.

The review reports associations and authors' interpretations within their respective contexts; it does not independently reproduce the underlying studies. Differences in regulatory environments, industry composition, technology maturity, and reporting rules limit direct comparison. The evidence chain is intended as a framework for organizing claims and developing future tests. Its proposed interfaces are analytical distinctions, not statistically estimated mediators, and no causal or predictive performance is attributed to the framework.

4. Synthesis: From Governance to Environmental Outcomes

4.1 Board structures, expertise, and decision rights

A board's environmental role may include review of material risks, approval of investment priorities, oversight of management, and evaluation of disclosure. However, the existence of a sustainability committee is an incomplete indicator of those activities. Committees differ in their mandates, frequency of meetings, access to technical specialists, relationship with audit and risk committees, and power to influence capital allocation. A board-level structure may concentrate attention, but its effectiveness depends on what information it receives and whether its recommendations alter decisions.

Dwekat et al. (2025) report associations between several board attributes and environmental innovation in a European sample. Zaman et al. (2024) examine demographic and structural diversity across an international sample. These studies suggest that governance attributes merit investigation, but they do not imply that a single attribute is sufficient across firms. Independence may strengthen scrutiny, yet an independent board without relevant technical knowledge may struggle to assess a complex industrial investment. Diversity may bring different knowledge and experiences, but its contribution depends on participation, access to information, and organizational context. Demographic characteristics should not be treated as substitutes for individual expertise or as evidence of a uniform behavioral preference.

Wu and Wang (2026) examine the staggered establishment of sustainability committees among Chinese listed firms and report a positive association with granted green patents under several

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empirical specifications. Their outcome is informative about patent output, while the timing of applications and grants, voluntary committee adoption, and subsequent technology deployment remain relevant interpretive issues. The study notes that patent grants observed after a committee was established may reflect inventive activity initiated earlier. Committee adoption is voluntary in the setting studied, so residual selection and timing uncertainty remain relevant even with the reported design checks. A stronger connection between committee activity and innovation requires information about the decisions, funding, and project timelines through which the committee exercised influence.

Amore and Bennedsen (2016) use changes in US antitakeover legislation to investigate corporate governance and green patents. Their research provides a different design from a cross-sectional comparison of committee membership. It also illustrates that a governance variable may influence a firm's broader allocation of innovative effort rather than a single environmental project. The institutional mechanism and outcome in each study should be read together. Table 3 compares selected governance studies by the link they illuminate and by the inference that their principal measure cannot establish alone.

Table 3. Representative Evidence on Governance and Related Innovation or Disclosure Measures

Study and setting	Design or principal observation	Inference limit
Amore & Bennedsen (2016); US listed firms	Changes in antitakeover legislation; share of patents classified as green.	Patent share does not identify project deployment or physical pollution outcomes.
Dwekat et al. (2025); 24 European countries	13,278 firm-year observations; board attributes and a vendor environmental-innovation indicator.	The score combines provider-defined information and is not a direct measure of tonnes emitted.
Wu & Wang (2026); Chinese listed firms	Staggered committee establishment; 41,189 firm-year observations and green patent grants.	Grant dates may follow earlier inventions; committee adoption and residual confounding matter.
Driss et al. (2024); firms from 35 countries	Committee presence and greenhouse-gas disclosure quality, 2010–2017.	Disclosure quality is not the same outcome as an observed emissions reduction.
Flammer et al. (2019); corporate governance	Responsibility-related executive compensation and firm outcomes.	A compensation criterion does not by itself establish a project-level environmental effect.
Zaman et al. (2024); international listed firms	Board demographic and structural diversity and eco-innovation indicators.	Associations depend on governance, measurement and institutional context.
Calel & Dechezleprêtre (2016); European carbon market	Variation in emissions-trading exposure and low-carbon patent activity.	A policy–patent result does not establish the environmental impact of each invention.

Note: These studies are purposive examples, not a complete or statistically representative sample of the literature.

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Driss et al. (2024) report that sustainability committees are associated with higher-quality greenhouse-gas disclosure in a sample of firms from 35 countries. Their principal outcome concerns the scope and quality of disclosure, so the observation should not be recoded as evidence of lower physical emissions. Flammer et al. (2019) study the incorporation of responsibility criteria into executive pay and its relationship to corporate outcomes. Taken together, these studies identify distinct governance channels—oversight and incentives—but the strength of either channel depends on the outcome and design examined. Tables 3 and 5 deliberately retain those distinctions.

An assessment of board expertise should distinguish education, professional experience, technical access, and actual participation. An engineer serving on a board may contribute differently from an external environmental scientist consulted for a specific project. Likewise, a director with climate finance experience may strengthen investment oversight without possessing detailed process-engineering knowledge. Firms should disclose the nature of the expertise relevant to material decisions rather than rely on an undifferentiated environmental expertise label. Researchers should also distinguish the initial appointment of a director from the activities that occur after appointment.

4.2 Incentives, finance, and allocation of resources

Executive incentives are a proposed channel between environmental governance and action. A pay measure tied to a broad ESG rating may encourage attention to issues captured by the rating, but a composite score may combine material environmental outcomes with unrelated indicators. Rating divergence further complicates interpretation because providers measure different attributes and apply different weights (Berg et al., 2022). A project-specific incentive should identify the environmental variable, baseline, assessment period, responsible manager, and treatment of changes in organizational boundaries. Boards should also examine whether targets encourage short-term metric improvement at the expense of longer-term investment.

Financial decisions are an observable bridge between strategy and innovation, although expenditure alone does not prove environmental value. A research budget may be canceled, a new asset may never reach full capacity, and funds labeled green may replace expenditure that would have occurred anyway. Analysis should distinguish proposed budgets, approved commitments, actual expenditure, and project completion. It should also identify opportunity costs and implementation time. Financial materiality helps determine which sustainability issues may affect business prospects, but financial materiality is not identical to the physical magnitude or social distribution of environmental impacts (Khan et al., 2016).

Green financing offers a useful example. Flammer (2021) studies corporate green bonds and their relationship to environmental commitments and market responses. A labeled bond provides information about the stated use of proceeds, while the credibility of an environmental claim depends on project eligibility, allocation of proceeds, additionality, the scope of external review, and subsequent outcomes. A second-party opinion or certification may improve the quality of information, but it does not by itself establish that every funded project caused an emissions reduction. The financing instrument and the environmental result occupy different points in the chain.

Allocation also has an organizational dimension. Technical expertise, procurement capacity, operating time, and access to supplier data are often required before an innovation can be

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adopted. A board-approved objective without engineering support may remain a reporting exercise even when finance is nominally available. Smaller firms face a different constraint: they may adopt an environmental improvement through a supplier or shared service without creating a formal sustainability department. Comparable research should not assume that sophisticated governance documents are necessary for every form of environmental innovation.

4.3 Regulation and market context

Environmental policy shapes both the incentives for innovation and the visibility of environmental results. Calel and Dechezleprêtre (2016) analyze low-carbon patent activity around the European carbon market and find evidence consistent with a change in the direction of technical innovation among regulated firms. This result supports attention to policy context, but the regulatory effect on patenting should not be conflated with a direct estimate of the effect of a particular patent on global emissions. The latter requires additional information on deployment, substitution, and environmental consequences.

Policy design also influences which activities are recorded. Patent subsidies may increase applications, while performance standards may favor process adoption that does not result in a patent. An empirical study that uses only patent counts could therefore identify a policy effect on formal invention without observing other environmental responses. Horbach (2008) shows the relevance of both market and regulatory determinants of environmental innovation in German panel data. Such evidence cautions against attributing firm behavior solely to an internal board decision when external rules or customer requirements change at the same time.

Industry conditions are particularly important. A cement manufacturer, a software provider, and a food retailer face different sources of environmental impact and different opportunities for innovation. For energy-intensive production, facility-level fuel use and process emissions may be material. For a retailer, supplier production and transport may be more important than direct fuel use. For a digital service, data-center energy use, hardware manufacture, and the scale of computational demand may require attention. An indicator must correspond to the material environmental pressure and the decision under review rather than appear in a standard reporting template alone.

Institutional context may also shape the relationship between disclosure and innovation. Essajide et al. (2026) identify the role of institutional conditions and caution that research based heavily on disclosure and patent proxies may overlook material environmental outcomes. The present evidence chain develops this concern by separating the output, deployment, and outcome claims and by specifying checks at their interfaces. Neither a disclosure mandate nor voluntary transparency should be assumed to produce an environmental benefit without evidence about implementation and results.

4.4 Measures of green innovation

Innovation has multiple dimensions. Research inputs include expenditure, personnel, collaborations, and access to technical knowledge. Intermediate outputs include prototypes, patent applications, patent grants, trademarks, design registrations, and documented process changes. Commercial or operational adoption may be measured by installed capacity, the share of production covered by a new process, supplier uptake, or the proportion of revenue from a product. Each measure answers a different question; a composite measure may obscure these distinctions unless its components remain visible.

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Green patent counts offer comparability and a documented record of formal technical invention. They also permit analysis of application dates, grant dates, technology classes, patent families, and citations. Nevertheless, patents are affected by the propensity to patent, examination rules, strategic filing, and industry practices. Patent applications and grants occur at different times, and an invention may be commercially valuable without being environmentally beneficial in its ultimate use. Citation counts may provide information about subsequent use of technical knowledge, but they are not direct measurements of emissions avoided.

Block et al. (2025) compare patent and trademark indicators with survey evidence for German and Italian firms. Their findings show that intellectual property indicators omit many firms engaged in environmental innovation and that the predictive properties of patents and trademarks vary with firm characteristics and innovation type. Trademarks may capture market-facing product activity that patent data miss, while their environmental labels still require independent substantiation. Survey measures can include organizational or service innovation, but definitions, recall, and self-reporting affect comparability. Table 4 summarizes the principal measures and the inferences they support.

Table 4. Innovation and Environmental Measures across the Evidence Chain

Indicator	What it records	Key limitations and checks
R&D and green capital expenditure	Planned or actual financial and organizational inputs.	Distinguish approval from expenditure, additional from relabeled funds, and development from adoption.
Patent applications and grants	Formal intellectual-property outputs in a green technology class.	Check classification, ownership, family duplicates, application–grant lag, quality and actual use.
Green trademarks	Market-facing identifiers related to environmental positioning.	A trademark does not establish that a product claim is valid or that an impact has declined.
Survey or vendor innovation score	Reported practice or a score produced from selected indicators.	Check self-reporting, weights, construct overlap, missing data and whether the score contains emissions data.
Commissioning and uptake records	Operational use by facilities, suppliers or customers.	Document dates, capacity and coverage; use does not alone identify a net environmental effect.
Absolute emissions or resource use	A physical inventory within a defined period and boundary.	State units, scopes, factors, methods, supplier estimates and uncertainty.
Emissions intensity	Emissions divided by a specified output or activity denominator.	A lower ratio may coexist with higher absolute emissions; disclose both values.

Note: The indicators are complementary and should not be treated as equivalent measures of innovation or environmental impact.

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Composite environmental innovation scores introduce another challenge. Their components may include a mixture of declared policies, product claims, operational data, and external estimates. A score may therefore overlap with the disclosure variable used to predict it, creating an apparent relationship partly because the same information enters both measures. Researchers should identify score construction, separate inputs from outcomes where possible, and examine robustness across measures. When vendor methodology is proprietary or revised over time, uncertainty about construct validity should be explicit.

An additional distinction is the difference between a survey-reported improvement and an independently measured environmental result. Yadegaridehkordi et al. (2023) analyze survey data from 209 Malaysian manufacturing SMEs using a structural equation and neural-network approach. Their study links leadership commitment and green innovation with reported sustainability performance. Fang et al. (2022) investigate employee-reported green human-resource practices, innovation, and environmental performance in Malaysian manufacturing. These studies enlarge the organizational and geographical scope of the literature, but survey-based constructs should not be equated automatically with audited tonnes of emissions or liters of water saved.

The unit of analysis also matters. A firm-level patent count may be matched with a facility-level pollution outcome, but the research design must show whether the facility used the patented technology. Assigning every patent to every site creates a potentially misleading exposure measure. A better design links patent ownership, project records, facility adoption, and dates, while recognizing that patents may be licensed to another organization. Where such linkage is unavailable, the study should describe the association at the level actually observed and avoid attribution to an unobserved installation.

4.5 Implementation and diffusion

Implementation is the stage most likely to disappear when a governance study moves directly from a board variable to a patent count or an emissions score. A prototype may fail a safety test, an approved capital project may be delayed, and an available process may be adopted only at a small subset of facilities. The research question should therefore identify whether the object of interest is invention, investment, use, diffusion, or impact. Each step requires different data and may involve different organizations.

Operational records provide potential measures of use: commissioning dates, capacity utilization, purchases of replacement equipment, and the share of relevant production covered by the new process. Supplier or customer adoption may be assessed through contracts, sales volumes, installation records, or verifiable service data. These indicators are not automatically public, and confidentiality may restrict access. A research design should describe the units, missing observations, verification process, and reasons why the observed sample might differ from the complete population of projects.

Ha et al. (2022) examine Vietnamese SMEs using survey data and analyze research expenditure, networks, leadership, and an environmental-standard registration measure. This study is useful for examining organizational adoption in smaller firms, but registration is a proxy for environmental practice rather than a direct measure of a particular technology’s installation or net environmental result. A firm that licenses a cleaner production method without formal patent

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ownership may be missed by patent-only samples. Table 5 includes this study alongside facility and disclosure measures to show why the unit of observation matters.

Diffusion beyond the original firm requires particular care. A technology may lower pollution at the user's facility while its production creates upstream impacts. A product that appears more efficient per unit of use may also be used more frequently. These possibilities do not make innovation undesirable; they make the system boundary and the comparison explicit. Sorrell (2009) explains why rebound effects require empirical investigation rather than an assumption that every efficiency gain produces the same net energy saving. For example, an illustrative packaging redesign might reduce material per package while increasing total packages sold or shifting environmental pressure to transport. A valid evaluation must state whether its claim concerns the package, a sales unit, the firm's annual operations, or the wider life cycle. The principles of ISO 14040 and the requirements and guidance of ISO 14044 provide a basis for specifying goals, boundaries, inventory analysis, impact assessment, and interpretation (International Organization for Standardization [ISO], 2006a, 2006b).

Implementation also depends on workforce skills, supplier capability, and the availability of complementary assets. A governance decision to purchase cleaner equipment will not produce its intended effect if operators lack training or the electricity supply remains highly carbon intensive. Conversely, operational staff may identify an effective improvement that later receives formal board approval. Such feedback means the stages in Figure 1 should not be read as a one-way theory of organizational change. The framework is a guide to the location of evidence, including evidence that contradicts the expected path.

4.6 Environmental results and attribution

Environmental outcomes may be reported in absolute terms or relative to an activity unit. Absolute emissions measure total within a stated boundary. Emissions intensity divides emissions by output, revenue, energy, or other denominators. Both serve different purposes. Intensity may decline while absolute emissions rise if production expands sufficiently. Revenue-based denominators are affected by prices and product mix, while physical-output denominators are hard to compare across heterogeneous products. A credible claim must specify the numerator, denominator, units, organizational boundary, baseline year, and relevant adjustments.

The Greenhouse Gas Protocol distinguishes direct emissions from indirect emissions associated with purchased energy and the wider value chain (Greenhouse Gas Protocol, n.d.). Scope 1 concerns direct sources controlled or owned by the reporting organization; Scope 2 concerns the generation of purchased energy; Scope 3 covers other relevant upstream and downstream value-chain emissions. A firm-level assessment should identify which scopes and categories are included, the quality of supplier data, and whether estimates or primary measurements were used. Comparisons across firms are uncertain when inventories use different boundaries or data sources.

The Scope 2 Guidance distinguishes location-based and market-based figures, with the latter applying when contractual-instrument quality criteria are met (Greenhouse Gas Protocol, 2015). These figures are alternatives, not additive. Scope 3 requires identifying relevant upstream and downstream categories and differentiating primary supplier data from estimates. The same value-chain emissions may be reported by different firms, so corporate totals should not be summed

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without accounting for double counting. Project-based avoided emissions are reported separately from inventory totals and rely on a specified baseline.

Xiang and Geng (2024) examine green patents and industrial waste-gas and wastewater intensity in Chinese firms using matching and difference-in-differences methods. They report lower pollution intensity and also discuss productivity trade-offs. Their results pertain to the pollutants, sample, measurement, and design studied; they do not by themselves establish lower absolute emissions across the entire value chain. Albitar, Borgi, et al. (2023) examine environmental innovation, governance, and carbon emissions in a different setting. Zaid and Issa (2024) examine Australian listed companies and report associations among eco-innovation, board committees, and carbon performance. Their observational results warrant attention to endogeneity and the particular performance measures used.

Truong (2025) illustrates why the original variable definition matters even when an article title refers to emissions. The study uses a provider's emissions-management rating, in which a higher score reflects a more favorable assessment, rather than a direct observation of tonnes emitted. It reports a statistically significant association for green process patents but not for product patents in the stated specification. A nonsignificant coefficient is not proof of no effect. The rating-based result should not be converted into a quantified pollution reduction, nor should it be treated as directly comparable to the pollution-intensity measures of Xiang and Geng (2024). Table 5 summarizes selected adoption, disclosure, and outcome studies.

Table 5. Representative Evidence on Adoption, Disclosure and Environmental Outcomes

Study and setting	Outcome, data and selected finding	Inference limit
Block et al. (2025); German and Italian firms	Compares green patents and trademarks with firm-reported innovation.	Intellectual-property indicators omit some non-patented or service and process innovations.
Ha et al. (2022); Vietnamese SMEs	Survey data on R&D, networks and environmental-standard registration.	Registration is not direct evidence of equipment deployment or net impact.
Fang et al. (2022); Malaysian manufacturing	Employee survey links green HR practices, innovation and reported environmental performance.	Survey constructs and a shared source limit inference on physical outcomes.
Yadegaridehkordi et al. (2023); Malaysian SMEs	209 manufacturing firms; survey-based sustainability constructs and SEM–ANN analysis.	Reported performance is not automatically an externally verified pollution inventory.
Xiang & Geng (2024); Chinese industrial firms	Matching and difference-in-differences; waste-gas and wastewater intensity and green patents.	Intensity is not absolute value-chain emissions; estimates depend on design assumptions.
Truong (2025); manufacturing firms	Green process patents associate with a more favorable MSCI emissions-management score; product-patent coefficient is not significant in one specification.	The dependent variable is a rating, not measured tonnes; a null coefficient does not prove no effect.

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Study and setting	Outcome, data and selected finding	Inference limit
Zaid & Issa (2024); Australian listed firms	Examines eco-innovation, board committees and carbon performance in panel data.	Interpret the carbon measure and potential endogeneity within the study's design.
Coen et al. (2022); corporate reports	Textual climate communication compared with greenhouse-gas measures.	Different types of communication have different associations; causality is not established by text alone.

Note: The table reports selected evidence and measurement limits; it does not count effects or rank the full field.

Attribution demands a credible comparison. A before-and-after change may reflect energy prices, weather, product mix, shutdowns, mergers, electricity-grid changes, or concurrent regulation. A cross-sectional comparison may reflect pre-existing differences between firms that select into green projects and firms that do not. Where feasible, researchers should use a comparison group, examine pre-intervention trends, report alternative specifications, and explain residual confounding. Operational evaluations should also assess measurement uncertainty and the expected delay between installation and observed results.

4.7 Disclosure, assurance, and greenwashing risk

Disclosure provides a channel through which an organization communicates its governance and environmental activity. It may also supply information that supports monitoring by investors, regulators, employees, and affected communities. IFRS S2 establishes climate-related disclosure requirements for entities applying the standard, including information on governance, strategy, risk management, and metrics and targets (International Sustainability Standards Board [ISSB], 2023). The ISSB issued targeted amendments to greenhouse-gas disclosure requirements in December 2025; those amendments apply to annual reporting periods beginning on or after 1 January 2027, with early application permitted (International Sustainability Standards Board, 2025). Jurisdictional adoption and relief provisions vary, so the review does not assume that one standard is mandatory for every firm.

The credibility of a specific claim depends on its wording and supporting evidence. A claim that a company approved a target is a governance claim and does not establish the target has been met. A claim that a facility installed new equipment is an implementation claim and alone does not establish net environmental improvement. A claim of avoided emissions requires a defined baseline, calculation method, time period, and transparent comparison with the counterfactual scenario. These distinctions prevent evidence from an earlier stage from being presented as proof of a later result.

Coen et al. (2022) examine the relationship between corporate climate communication and emissions performance and report mixed results across types of communication. This study supports closer examination of claims and outcomes, not an assumption that all corporate targets are misleading. Lublóy et al. (2025) review measures of firm-level greenwashing and show the diversity of ways in which communication and performance are represented. In a Chinese listed-firm sample, Ma et al. (2025) examine disclosure, green innovation, and greenwashing together; their findings should be interpreted within that sample and the measures selected. Different measures may identify different firms or behaviors.

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Greenwashing covers related practices and definitions. De Freitas Netto et al. (2020) review corporate and product-level misleading environmental communication, while Walker and Wan (2012) analyze gaps between symbolic and substantive actions. This review defines four assessment states: missing evidence; missed targets with or without explained performance gaps; potentially misleading representations; and evidence sufficient to support deliberate deception allegations. Table 6 summarizes these analytical categories, which are not legal findings. Misleading claims may be investigated without presuming intent, while intent findings require appropriate evidence for the allegation.

Table 6. Four Analytical States for Assessing an Environmental Claim

State	Description	Appropriate response
Evidence unavailable	Data or boundary information is insufficient to assess the claim.	Record the claim as unverified; request relevant records without assuming failure or misconduct.
Target or performance gap	A target was missed or an outcome diverges from an expectation.	Examine timing, conditions, calculations and explanations; a gap does not alone establish deception.
Potentially misleading representation	Available evidence suggests that a claim omits material scope, uncertainty or adverse information.	Compare the precise wording with the relevant boundary and seek independent clarification.
Evidence of deliberate deception	Evidence supports an allegation that information was intentionally misrepresented.	Apply appropriate investigative and legal standards; the framework alone cannot establish intent.

Note: These are analytical categories, not legal findings. Definitions and standards vary across jurisdictions.

External assurance is useful only when its scope matches the claim under review. Simnett et al. (2009) examine sustainability report assurance across countries, illustrating variation in the demand for and provision of assurance. An assurance report may address a selected indicator, a data-collection process, or a broader report, with different levels of assurance. The presence of a third-party statement does not necessarily validate all statements in a sustainability report or the causal effect of a particular technology. The assessor's competence, independence, evidence access, and treatment of exclusions should be disclosed. Parguel et al. (2011) show that external sustainability ratings may influence how audiences interpret corporate communication, while Berg et al. (2022) show why ratings themselves should not be treated as interchangeable measures.

4.8 Answers to the research questions

The preceding sections provide qualified answers rather than a pooled estimate. Governance research associates particular board characteristics, committees, or incentives with patenting, innovation scores, and disclosure, but those outcomes should remain distinct. Patent, trademark, survey, and environmental data measure different stages and do not identify the same set of firms. Research that connects innovation with environmental measures provides important evidence in specific contexts, yet some studies use vendor scores or intensity rather than directly observed absolute emissions. Disclosure and assurance require claim-specific boundaries and do not

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automatically establish a project's environmental effect. Table 7 links each question to its evidence and remaining uncertainty.

Table 7. Qualified Answers to the Review Questions

Question	Synthesis from selected evidence	Remaining uncertainty
RQ1: Governance mechanisms	Board attributes, committees, incentives and regulation are associated with different innovation or disclosure outcomes.	Effects depend on authority, context, measures and design; a committee label alone is insufficient.
RQ2: Innovation measures	R&D, patents, trademarks, surveys and adoption records represent different stages.	No single indicator covers all innovation types or proves environmental benefit.
RQ3: Environmental results	Some studies examine pollution intensity, emissions measures or provider scores alongside innovation.	Boundary changes, adoption, lag and confounding constrain attribution and cross-study comparison.
RQ4: Disclosure and verification	Claims become more assessable when boundaries, evidence and assurance scope are explicit.	A report, target, assurance statement or missed target does not alone establish impact or intent.

Note: These answers summarize selected studies and conceptual analysis; they are not pooled estimates.

5. Discussion and Research Agenda

5.1 An evidence-assessment matrix

The evidence chain provides a way to assess the strength of a particular environmental claim without assigning an overall quality score to the firm. Table 8 pairs an example claim at each interface with relevant evidence and checks. An assessor should also consider alternative explanations and observations that would weaken the claim. This matrix is intended for structured assessment rather than automatic classification. Evidence at an earlier stage may be necessary to explain a later result, but it is rarely sufficient on its own.

Table 8. Claim-specific Assessment at the Interfaces of the Evidence Chain

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Interface and claim	Evidence to request	Comparison and alternative explanations
Governance → resources: the target changed investment priorities.	Decision record, prior capital plan, approved budget and actual expenditure with dates.	Compare with an existing plan and concurrent regulation or price changes; approval alone does not establish change.
Resources → innovation: investment produced an innovation.	Project files, personnel, prototypes, patent applications or documented process change.	Establish chronology and project ownership; consider purchased technology and earlier work.
Innovation → implementation: the innovation was used.	Commissioning, procurement, usage, production and supplier or licensing records.	Link the output to the actual installation and time period; a patent grant alone does not establish use.
Implementation → outcome: use improved an environmental result.	Consistent baseline and follow-up measures, operational data, boundaries and uncertainty.	Assess counterfactual output, grid changes, other interventions and shifted impacts before attribution.

Note: Each row specifies a narrower claim and does not establish the next link in the chain.

The first principle is claim specificity. If a company states that a board approved a capital plan, the central evidence is the approved plan and its decision date. If it asserts that the plan caused a reduction in facility emissions, the relevant evidence extends to installation, operation, emissions measurement, and a credible counterfactual. A project file, therefore, should retain the exact claim and the boundary to which it applies. General evidence of an environmental policy should not be used to establish a facility-level reduction.

The second principle is temporal consistency. A board decision in one year cannot explain a patent application filed several years earlier without additional evidence of prior decisions or ongoing projects. A patent granted after a governance change may also reflect work completed before that change. Likewise, emissions reductions observed immediately after commissioning may not represent stable performance. Researchers should align the dates of governance action, financial commitment, invention, deployment, and outcome measurement. Where these dates are uncertain, alternative lag structures should be reported rather than selected after the results are known.

The third principle is boundary consistency. A headquarters-level target, a factory-level investment, and a supplier-level emissions estimate refer to different entities. A project may improve a single facility while overall corporate emissions increase because of expansion elsewhere. Both statements could be accurate, but a communication that presents the facility result as a company-wide reduction would require further evidence. The same problem arises when a product claim concerns emissions per unit while investors interpret it as a reduction in total life-cycle emissions.

The fourth principle is evidence independence and provenance. A claim and its assessment should not depend entirely on the same self-reported source. An independent environmental

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inventory, equipment record, patent register, or assurance report may corroborate part of an account, but each source has a defined scope and potential error. Data provenance should include the original source, collection method, version, reporting year, and any transformation. Independence improves the opportunity for scrutiny; it does not eliminate the need to assess competence or possible conflicts of interest.

5.2 A five-step verification protocol for practice

Step one is to define a material environmental claim before selecting indicators. An effective claim identifies the relevant activity, location, environmental pressure, comparison, and time period. For example, a claim about lower electricity demand per unit of output at a factory differs from a claim about a reduction in company-wide greenhouse-gas emissions. Management should specify whether the claim concerns an intended design feature, actual operations, or a projected future result. A claim that changes over time should retain its prior wording so that subsequent comparison remains possible.

Step two is to document the decision and the resources assigned. A project record should identify the responsible decision maker, approval date, budget, expected operational changes, and the assumptions underlying the forecast. Where material, it should document the comparison with feasible alternatives, including continued use of the existing process. The record should show whether funds were incremental or represented a reclassification of an existing investment. The purpose is not to require every firm to publish commercially sensitive detail, but to ensure that a verifiable record exists for competent internal and external reviewers.

Step three is to link the innovation output to actual use. A patent or a product specification should be matched to an installation, procurement record, service contract, production process, or other evidence of deployment. The expected scope of use should be compared with the realized scope. If a technology was tested but not adopted, a report may describe the pilot and its lessons without presenting an assumed benefit as an achieved result. If a firm uses a third-party technology, the absence of its own patent should not obscure the actual operational improvement.

Step four is to assess environmental outcomes against an explicit reference. The assessment should specify the relevant emissions scopes or other environmental categories, the baseline and follow-up periods, units, calculation methods, and sources of uncertainty. It should record changes in output, organizational boundaries, fuel mix, and other conditions that affect comparison. If attribution is not credible, the company may report the observed change with appropriate context rather than claim that one project caused the full difference. A credible disclosure explains what has and has not been measured.

Step five is to review the claim and its evidence independently and update the decision. Internal audit may examine data controls and the integrity of project records. An external verifier may evaluate selected metrics or methods within a defined engagement. The reviewer should identify gaps, exclusions, and the level of assurance rather than provide an unqualified endorsement of all environmental activity. Results should return to the board and management for investment and disclosure decisions. A target that is not achieved should be reported with the reasons, revised assumptions, and an explanation of whether the original objective remains appropriate.

5.3 An illustrative application

Consider a hypothetical food-processing company that announces a plan to reduce the greenhouse-gas emissions associated with production. Its board approves a project to replace a

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gas-fired boiler with an electrically powered heat system at one facility. The announcement is a governance statement. Evidence of the approved investment and purchase contract supports the resource-allocation claim, while a commissioning record and operating logs support the implementation claim. None of these records alone establishes the size of the environmental benefit.

A meaningful evaluation would compare fuel and electricity use before and after commissioning, adjust for production volume and operating conditions, and state the relevant emissions factors. The evaluation should consider whether electricity demand rises when gas consumption falls, whether the purchased electricity calculation reflects the chosen accounting method, and whether production has shifted between facilities. If the company uses a per-unit measure, it should also report the change in absolute emissions for the defined boundary. Any supply-chain or equipment-manufacture impact requires additional data and should not be included without a defensible method.

Table 9 gives hypothetical values to make the distinction explicit. Before the project, the facility produces 1,000 units and reports 200 tonnes of CO2 equivalent (tCO2e), an intensity of 0.20 tCO2e per unit. After the project, it produces 1,500 units and reports 240 tCO2e, an intensity of 0.16 tCO2e per unit. Intensity therefore falls by 20%, while absolute emissions rise by 20%. Both calculations are correct because they answer different questions.

Table 9. Hypothetical Illustration of Emissions Intensity and Absolute Emissions

Measure	Before project	After project
Annual output	1,000 units	1,500 units
Annual emissions within stated boundary	200 tCO2e	240 tCO2e
Emissions intensity	0.20 tCO2e per unit	0.16 tCO2e per unit
Change from the earlier period	Baseline	Absolute emissions +20%; intensity −20%

Note: All values are hypothetical. A 300-tCO2e constant-intensity reference and a 60-tCO2e difference are assumptions, not measured causal effects.

If, solely for illustration, the pre-project intensity of 0.20 tCO2e per unit is assumed to apply to the later output, the reference scenario is 1,500 × 0.20 = 300 tCO2e and the difference from the observed 240 tCO2e is 60 tCO2e. This is a hypothetical counterfactual difference, not a measured causal effect. Product mix, weather, operating hours, grid factors, boundary changes, and other interventions may alter the comparison. A project-based estimate should be reported separately from the 240-tCO2e inventory result, with its assumptions and uncertainty. The numbers are constructed for explanation and are not observations from an actual company.

Now consider an alternative in which the firm publishes an ambitious target but delays the investment because of technical or financial difficulties. The target may still represent a genuine intention, but the expected environmental outcome has not yet been demonstrated. Management should disclose the delay and its implications. If the firm continues to describe the project as

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already operational despite contrary records, the evidence supports a concern about the accuracy of that specific statement. Evaluation depends on the content of the claim and the available records, not solely on the presence of a favorable target.

5.4 Implications for corporate leaders and investors

For directors, the main implication is that oversight should follow the decision and evidence trail. Board papers should distinguish targets from approved projects, project milestones, operational outcomes, and independently reviewed indicators. The board should receive a clear account of material trade-offs, including implementation cost, the risk of shifting impacts, and the consequences of delays. Technical advisers may be necessary where the board lacks expertise; the use of an adviser should be accompanied by clear terms of reference and access to relevant data.

Management systems should connect environmental objectives with ordinary investment and operational processes. A project gate may require a baseline, an environmental hypothesis, a financial assessment, and a post-implementation review. Procurement should specify the evidence expected from suppliers, but requirements should be proportionate to supplier size and access to information. A small supplier may need a phased approach to data collection, and a lack of a formal report should not automatically be interpreted as poor environmental practice. What matters is whether the material claim is supported by evidence appropriate to its significance.

For investors and lenders, the framework encourages the separation of a signal from the outcome that the signal is expected to predict. A green bond, a sustainability committee, or an external score may provide useful information about attention, access to capital, or formal oversight. It should be interpreted with the corresponding project allocation, technology deployment, and environmental data where those are material. Investors should also distinguish uncertainty about data from evidence of misconduct. A documented range with transparent assumptions may be more decision-useful than a precise figure without an auditable basis.

Business performance and environmental performance should be considered jointly but not collapsed into a single conclusion. Green innovation may reduce energy or input costs, support market access, or avoid regulatory exposure. It may also involve large upfront costs and uncertain returns. Friede et al. (2015) synthesize evidence on ESG and financial performance, but broad financial associations do not establish the environmental impact of a particular innovation. The board's task is to understand the trade-offs for the specific investment and to report environmental outcomes in their own right.

5.5 Implications for policy and assurance

Policymakers influence incentives through disclosure requirements, performance standards, procurement rules, research support, and financial regulation. A policy that rewards patent counts may stimulate formal patent applications without necessarily producing adoption or measurable environmental improvement. A policy that rewards measured outcomes may create stronger performance incentives but also impose monitoring costs or disadvantage firms with limited measurement capacity. Evaluation should consider the behavior induced by the metric and the administrative burden of obtaining credible evidence.

Transparency rules should support comparability while retaining room for sector-specific materiality. A common definition of organizational boundaries and emission scopes improves consistency, yet a single metric cannot describe all relevant environmental pressures. Firms in

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water-stressed locations, for example, may face material water risks that a carbon-only measure misses. A policy framework should distinguish universal reporting principles from sector-specific indicators and should explain how information gaps, supplier estimates, and subsequent restatements are handled.

Independent assurance should be proportional to the claim and the risks associated with error. A high-level statement about the existence of a board committee requires a different procedure from verification of a company-wide emissions inventory or a project-level avoided-emissions calculation. Assurance statements should identify the responsible entity, applicable criteria, evidence reviewed, level of assurance, exclusions, and limitations. Verification of a reported number should not be described as validation of an entire business model or as proof of the causal contribution of a project.

5.6 Testable propositions and boundary conditions

The following propositions state questions for future research. They are not empirical results of this review, do not imply that the stages form a universal causal chain, and require operational definitions and suitable comparison designs.

Proposition 1: The association between environmental expertise and environmentally relevant resource allocation will be stronger when governance bodies have clear decision authority, regular access to project information, and responsibility for follow-up. A committee title alone is an incomplete measure of these conditions.

Proposition 2: The association between green resource commitments and operational deployment will depend on technical capability, staff skills, suppliers, and financing continuity. A budget approval should be distinguished from expenditures actually incurred and from the commissioning of equipment.

Proposition 3: An association between innovation outputs and an environmental outcome will depend on deployment, the functional unit, the outcome boundary, and the time available for the intervention to operate. A patent count or product label cannot, by itself, identify the direction or size of a facility-level effect.

Proposition 4: Specific disclosure claims accompanied by relevant independent evidence and transparent boundaries will be more assessable than claims without those features. Whether assurance reduces inaccurate communication, however, depends on the scope, competence, and independence of the engagement and must be tested rather than presumed.

A research test should state the unit of observation, pre-intervention conditions, competing mechanisms, and whether the outcome is a governance practice, patent, adoption event, physical measure, or rating. Stronger evidence for one link does not remove uncertainty at another. A comparison across countries should also specify regulatory exposure, firm ownership, technology availability, and reporting rules rather than assume a common mechanism.

5.7 Research designs and the interpretation of evidence

Different designs illuminate different sections of the chain. A qualitative study of board minutes and project files may show how a committee changed a proposal, why a project was rejected, or how managers interpreted conflicting targets. Its strength is detailed process evidence; its limitation is that an observed sequence in a small number of firms does not establish how often

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the same mechanism operates elsewhere. A survey of a larger group may identify patterns in reported governance and innovation practices, but common respondents and simultaneous measurement create risks of common-method bias and uncertain temporal order. Mixed methods are valuable when each method addresses a distinct inference rather than merely repeats the same self-reported claim.

Linkage among board decisions, investment records, patents or process changes, facility adoption, and environmental outcomes remains a priority; a design should disclose missing links and confidentiality restrictions. Suitable designs include staggered policy changes with estimators appropriate to heterogeneous treatment timing, matched comparisons, event studies, or longitudinal case studies. No design eliminates confounding by assumption alone.

A longitudinal panel links governance changes to later innovation measures and permits the analyst to account for some stable firm characteristics. Nevertheless, a firm may create an environmental committee because its leadership already planned a transition, or because a new regulation affects both the committee and the outcome. Fixed effects alone do not remove these time-varying influences. A more credible design specifies the source and timing of the change, compares appropriate firms, checks pre-intervention patterns, and explains how policy and market changes were handled. Where a change is staggered, estimation should reflect possible differences in treatment effects and adoption dates.

A facility-level engineering evaluation may provide detailed evidence on energy or pollution changes around equipment adoption. Yet its result does not automatically establish that a corporate board caused the project, that other facilities experienced the same effect, or that total value-chain impacts declined. Its contribution is strongest when engineers and governance researchers retain a common project identifier, record the implementation date, and align operating data with the decision history. Credible inference across the full chain is a cumulative task: separate studies may support individual links, while uncertainty remains about the connections among them.

For comparative synthesis, null or adverse results deserve the same visibility as positive findings. A failed pilot may reveal a technology constraint; a costly implementation may demonstrate a trade-off; and a patent without deployment may identify a financing or market barrier. A review that counts only statistically significant positive associations would conceal these possibilities and could mislead decision makers. Future reviews should make search and inclusion criteria explicit, assess publication bias where methods permit, and distinguish absence of evidence from evidence of no effect.

5.8 Implications of incomplete or conflicting evidence

A practical assessment often begins with incomplete records. When a company reports a sustainability committee and an environmental target but does not disclose project expenditure, the correct inference is that resource allocation is unobserved. It is not legitimate to infer either that no investment occurred or that the target was fully funded. Similarly, when environmental performance improves without evidence of a particular technology’s adoption, the observed outcome may be real even though the proposed mechanism is unverified. Explicit use of an “unknown” category protects analysis from turning missing data into an unwarranted accusation or an unearned claim of success.

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Conflicting indicators also require investigation rather than mechanical averaging. A firm may report a higher green patent count and a lower environmental innovation score because the measures cover different activities, time periods, or information sources. Emissions may decline at an owned facility while estimated value-chain emissions rise. These differences are analytically useful when the units and boundaries are clear. An aggregate score would risk hiding a meaningful change in the location of environmental pressure. Analysts should retain component measures and explain whether a discrepancy reflects a real trade-off, a change in measurement, or insufficient information.

Research on corporate climate commitments adds a related caution. Albitar, Al-Shaer, et al. (2023) examine eco-innovation and climate governance in relation to corporate commitment, whereas Albitar, Borgi, et al. (2023) examine an environmental innovation measure in relation to carbon emissions. The two questions are related but distinct. A commitment-oriented result informs analysis of strategic intent and governance; an emissions-oriented result concerns a reported environmental measure under the study's definitions. Neither should be cited as if it resolves every link between corporate governance, innovation, deployment, and net environmental impact.

The proposed protocol therefore treats evidence as cumulative and claim-specific. Strong evidence for one interface does not repair a missing observation at another interface, but it may still inform a narrower claim. The practical value of this approach lies in identifying the next question: whether a decision was funded, whether an output was used, whether the observed outcome is attributable, or whether a disclosure fairly represents the outcome. Those questions offer a basis for a more transparent dialogue among managers, researchers, assurance providers, and stakeholders.

6. Conclusion

This review examines the relationship between corporate green governance, innovation, and environmental results through a five-stage evidence chain. Corporate governance influences the distribution of attention, authority, and resources, while green innovation may take technological, organizational, product, or process forms. Existing research provides evidence of associations between governance arrangements and innovation outcomes in particular contexts. It also shows why patents, trademarks, disclosure measures, and environmental indicators should not be interpreted as equivalent representations of corporate performance.

The central implication is that a credible environmental claim requires evidence appropriate to its content and boundary. Governance approval, resource commitment, invention, implementation, and environmental outcomes each need distinct observations. The proposed assessment matrix and verification protocol organize those observations and make missing links visible, but they do not establish causality or identify misconduct by themselves. More robust research requires linked data, transparent measures, credible comparisons, and attention to time and value-chain boundaries. For business practice, the same discipline permits a clearer distinction between what a company intends, what it has implemented, and what its available evidence demonstrates.

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Acknowledgement

I sincerely thank three anonymous reviewers for their constructive and meticulous comments, which greatly improved the analytical rigor and clarity of this article. I also appreciate the journal editorial team's efficient management of the review process and valuable guidance during revision. My thanks go to colleagues and fellow researchers in corporate governance and environmental sustainability, whose published work and insightful discussions over the years inspired the framework proposed here. Finally, I am deeply grateful to my family and friends for their constant encouragement and understanding throughout the lengthy process of conceiving, drafting, and revising this review. All remaining shortcomings are my own.

Author Contributions

Y.L. is the sole author of this review.

Conflicts of Interest

The author declares no conflicts of interest.

Generative AI Statement

ChatGPT was used to assist with literature discovery, synthesis, manuscript drafting, and document preparation.

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References

Albitar, K., Al-Shaer, H., & Liu, Y. S. (2023). Corporate commitment to climate change: The effect of eco-innovation and climate governance. Research Policy, 52(2), 104697. https://doi.org/10.1016/j.respol.2022.104697

Albitar, K., Borgi, H., Khan, M., & Zahra, A. (2023). Business environmental innovation and CO2 emissions: The moderating role of environmental governance. Business Strategy and the Environment, 32(4), 1996–2007. https://doi.org/10.1002/bse.3232

Amore, M. D., & Bennedsen, M. (2016). Corporate governance and green innovation. Journal of Environmental Economics and Management, 75, 54–72. https://doi.org/10.1016/j.jeem.2015.11.003

Berg, F., Kölbel, J. F., & Rigobon, R. (2022). Aggregate confusion: The divergence of ESG ratings. Review of Finance, 26(6), 1315–1344. https://doi.org/10.1093/rof/rfac033

Block, J., Lambrecht, D., Willeke, T., Cucculelli, M., & Meloni, D. (2025). Green patents and green trademarks as indicators of green innovation. Research Policy, 54(1), 105138. https://doi.org/10.1016/j.respol.2024.105138

Calel, R., & Dechezleprêtre, A. (2016). Environmental policy and directed technological change: Evidence from the European carbon market. Review of Economics and Statistics, 98(1), 173–191. https://doi.org/10.1162/REST_a_00470

Coen, D., Herman, K., & Pegram, T. (2022). Are corporate climate efforts genuine? An empirical analysis of the climate 'talk–walk' hypothesis. Business Strategy and the Environment, 31(7), 3040–3059. https://doi.org/10.1002/bse.3063

de Freitas Netto, S. V., Sobral, M. F. F., Ribeiro, A. R. B., & Soares, G. R. L. (2020). Concepts and forms of greenwashing: A systematic review. Environmental Sciences Europe, 32, 19. https://doi.org/10.1186/s12302-020-0300-3

Delmas, M. A., & Burbano, V. C. (2011). The drivers of greenwashing. California Management Review, 54(1), 64–87. https://doi.org/10.1525/cmr.2011.54.1.64

DiMaggio, P. J., & Powell, W. W. (1983). The iron cage revisited: Institutional isomorphism and collective rationality in organizational fields. American Sociological Review, 48(2), 147–160. https://doi.org/10.2307/2095101

Driss, H., Drobetz, W., El Ghoul, S., & Guedhami, O. (2024). The sustainability committee and environmental disclosure: International evidence. Journal of Economic Behavior & Organization, 221, 602–625. https://doi.org/10.1016/j.jebo.2024.02.019

Dwekat, A., Abu Alia, M., Abdeljawad, I., & Meqbel, R. (2025). Governing for the green: How European board attributes are driving environmental innovation. Corporate Social Responsibility and Environmental Management, 32(2), 2128–2146. https://doi.org/10.1002/csr.3043

Essajide, L., Ed-Dafali, S., Sbai, H., & Hussainey, K. (2026). From transparency to transformation: A critical systematic review of the ESG disclosure–green innovation nexus. Business Strategy and the Environment. Advance online publication. https://doi.org/10.1002/bse.71122

Fang, L., Shi, S., Gao, J., & Li, X. (2022). The mediating role of green innovation and green culture in the relationship between green human resource management and environmental performance. PLOS ONE, 17(9), e0274820. https://doi.org/10.1371/journal.pone.0274820

Flammer, C. (2021). Corporate green bonds. Journal of Financial Economics, 142(2), 499–516. https://doi.org/10.1016/j.jfineco.2021.01.010

Flammer, C., Hong, B., & Minor, D. (2019). Corporate governance and the rise of integrating corporate social responsibility criteria in executive compensation: Effectiveness and implications for firm outcomes. Strategic Management Journal, 40(7), 1097–1122. https://doi.org/10.1002/smj.3018

ISSN: 3067-7491 © 2026 INATGI (Institute of Advanced Technology and Green Innovation)
See: https://inatgi.in/index.php/jbgi/index for more information. https://doi.org/10.63646/RHOT3911

Friede, G., Busch, T., & Bassen, A. (2015). ESG and financial performance: Aggregated evidence from more than 2000 empirical studies. Journal of Sustainable Finance & Investment, 5(4), 210–233. https://doi.org/10.1080/20430795.2015.1118917

Greenhouse Gas Protocol. (2015). GHG Protocol scope 2 guidance. World Resources Institute. https://ghgprotocol.org/scope-2-guidance

Greenhouse Gas Protocol. (n.d.). Standards. https://ghgprotocol.org/standards

Ha, L. T., Thang, D. N., & Thanh, T. T. (2022). Effects of R&D, networking and leadership roles on environmental innovation adoption in Vietnam's SMEs. Economic Research-Ekonomska Istraživanja, 35(1), 1211–1242. https://doi.org/10.1080/1331677X.2021.1962381

Hart, S. L. (1995). A natural-resource-based view of the firm. Academy of Management Review, 20(4), 986–1014. https://doi.org/10.5465/amr.1995.9512280033

Hojnik, J., & Ruzzier, M. (2016). What drives eco-innovation? A review of an emerging literature. Environmental Innovation and Societal Transitions, 19, 31–41. https://doi.org/10.1016/j.eist.2015.09.006

Horbach, J. (2008). Determinants of environmental innovation: New evidence from German panel data sources. Research Policy, 37(1), 163–173. https://doi.org/10.1016/j.respol.2007.08.006

International Organization for Standardization. (2006a). Environmental management—Life cycle assessment—Principles and framework (ISO Standard No. 14040:2006). https://www.iso.org/standard/37456.html

International Organization for Standardization. (2006b). Environmental management—Life cycle assessment—Requirements and guidelines (ISO Standard No. 14044:2006). https://www.iso.org/standard/38498.html

International Sustainability Standards Board. (2023). IFRS S2 climate-related disclosures. IFRS Foundation. https://www.ifrs.org/issued-standards/ifrs-sustainability-standards-navigator/ifrs-s2-climate-related-disclosures/

International Sustainability Standards Board. (2025). Amendments to greenhouse gas emissions disclosures: Amendments to IFRS S2. IFRS Foundation. https://www.ifrs.org/projects/completed-projects/2025/amendments-to-disclosure-of-greenhouse-gas-emissions-s2/

Jensen, M. C., & Meckling, W. H. (1976). Theory of the firm: Managerial behavior, agency costs and ownership structure. Journal of Financial Economics, 3(4), 305–360. https://doi.org/10.1016/0304-405X(76)90026-X

Khan, M., Serafeim, G., & Yoon, A. (2016). Corporate sustainability: First evidence on materiality. The Accounting Review, 91(6), 1697–1724. https://doi.org/10.2308/accr-51383

Li, X., & Loang, O. K. (2026). Corporate social responsibility innovation in SMEs: Institutional pressures, resource constraints, stakeholder demands, and contextualized pathways. Journal of Business and Green Innovation, 4(7), 16–42. https://doi.org/10.63646/RJYJ3474

Lublóy, Á., Keresztúri, J. L., & Berlinger, E. (2025). Quantifying firm-level greenwashing: A systematic literature review. Journal of Environmental Management, 373, 123399. https://doi.org/10.1016/j.jenvman.2024.123399

Lyon, T. P., & Maxwell, J. W. (2011). Greenwash: Corporate environmental disclosure under threat of audit. Journal of Economics & Management Strategy, 20(1), 3–41. https://doi.org/10.1111/j.1530-9134.2010.00282.x

Ma, Y., Feng, G.-F., Yin, Z.-J., & Chang, C.-P. (2025). ESG disclosures, green innovation, and greenwashing: All for sustainable development? Sustainable Development, 33(2), 1797–1815. https://doi.org/10.1002/sd.3210

ISSN: 3067-7491 © 2026 INATGI (Institute of Advanced Technology and Green Innovation)
See: https://inatgi.in/index.php/jbgi/index for more information. https://doi.org/10.63646/RHOT3911

Marquis, C., Toffel, M. W., & Zhou, Y. (2016). Scrutiny, norms, and selective disclosure: A global study of greenwashing. Organization Science, 27(2), 483–504. https://doi.org/10.1287/orsc.2015.1039

Mishra, N. K., Mishra, N., & Sharma, P. P. (2025). Unraveling the relationship between corporate governance and green innovation: A systematic literature review. Management Research Review, 48(5), 825–845. https://doi.org/10.1108/MRR-09-2023-0645

Parguel, B., Benoît-Moreau, F., & Larceneux, F. (2011). How sustainability ratings might deter 'greenwashing': A closer look at ethical corporate communication. Journal of Business Ethics, 102(1), 15–28. https://doi.org/10.1007/s10551-011-0901-2

Porter, M. E., & van der Linde, C. (1995). Toward a new conception of the environment-competitiveness relationship. Journal of Economic Perspectives, 9(4), 97–118. https://doi.org/10.1257/jep.9.4.97

Rennings, K. (2000). Redefining innovation—Eco-innovation research and the contribution from ecological economics. Ecological Economics, 32(2), 319–332. https://doi.org/10.1016/S0921-8009(99)00112-3

Simnett, R., Vanstraelen, A., & Chua, W. F. (2009). Assurance on sustainability reports: An international comparison. The Accounting Review, 84(3), 937–967. https://doi.org/10.2308/accr.2009.84.3.937

Snyder, H. (2019). Literature review as a research methodology: An overview and guidelines. Journal of Business Research, 104, 333–339. https://doi.org/10.1016/j.jbusres.2019.07.039

Sorrell, S. (2009). Jevons' paradox revisited: The evidence for backfire from improved energy efficiency. Energy Policy, 37(4), 1456–1469. https://doi.org/10.1016/j.enpol.2008.12.003

Truong, Y. (2025). Green innovations and toxic emissions of manufacturing firms: Do green innovative firms pollute less? Corporate Social Responsibility and Environmental Management, 32(5), 6831–6842. https://doi.org/10.1002/csr.70065

Walker, K., & Wan, F. (2012). The harm of symbolic actions and green-washing: Corporate actions and communications on environmental performance and their financial implications. Journal of Business Ethics, 109(2), 227–242. https://doi.org/10.1007/s10551-011-1122-4

Wu, D., & Wang, C. (2026). Sustainability committees and corporate green innovation: Evidence from Chinese A-share listed firms. Sustainability, 18(17), 8829. https://doi.org/10.3390/su18178829

Xiang, X., & Geng, Y. (2024). Assessing the impact of green patents on pollution reduction: A micro-level study of Chinese industrial firms. Journal of Environmental Management, 368, 122193. https://doi.org/10.1016/j.jenvman.2024.122193

Yadegaridehkordi, E., Foroughi, B., Iranmanesh, M., Nilashi, M., & Ghobakhloo, M. (2023). Determinants of environmental, financial, and social sustainable performance of manufacturing SMEs in Malaysia. Sustainable Production and Consumption, 35, 129–140. https://doi.org/10.1016/j.spc.2022.10.026

Zaid, M. A. A., & Issa, A. (2024). Board committees as catalysts: Divulging the impact of nomination and risk management on corporate eco-innovation and carbon performance. Business Strategy and the Environment, 33(7), 6187–6206. https://doi.org/10.1002/bse.3803

Zaman, R., Asiaei, K., Nadeem, M., Malik, I., & Arif, M. (2024). Board demographic, structural diversity, and eco-innovation: International evidence. Corporate Governance: An International Review, 32(3), 374–390. https://doi.org/10.1111/corg.12545

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