

Green Innovation Practices and Their Impact on Business Performance and Environmental Responsibility

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Abstract

Green innovation has emerged as an important strategic response to rising environmental pressure, resource constraints, climate-related risk, changing stakeholder expectations, and the need for more resilient business models. It includes the development and adoption of products, processes, technologies, organisational routines, and business-model changes that reduce resource use, pollution, waste, carbon intensity, and ecological harm while maintaining or improving economic value. For business firms, green innovation is not limited to compliance with environmental rules; it can influence cost structures, market positioning, operational reliability, investor confidence, brand legitimacy, employee engagement, and long-term competitiveness. Its outcomes, however, depend on the quality of implementation, the availability of finance and capabilities, the sector in which the firm operates, and the extent to which environmental goals are integrated into core strategic decisions.

This review-based study examines green innovation practices and their relationship with business performance and environmental responsibility. It brings together perspectives from strategic management, innovation studies, sustainable operations, environmental management, circular economy, and responsible corporate governance. The paper considers green product innovation, cleaner production, energy and material efficiency, renewable-energy adoption, waste prevention, eco-design, environmental management systems, digital monitoring, sustainable procurement, and circular business models. It also evaluates how these practices influence financial and operational outcomes, market and reputational benefits, regulatory readiness, risk management, stakeholder trust, and the capacity of firms to contribute to environmental improvement.

The analysis indicates that green innovation produces the strongest and most credible results when it is embedded in business strategy rather than treated as an isolated sustainability initiative. Key requirements include leadership commitment, measurable environmental targets, investment in research and skills, collaboration with suppliers and customers, credible data systems, life-cycle thinking, employee participation, and transparent reporting of progress and limitations. Firms that align environmental responsibility with product design, process improvement, capital allocation, and performance evaluation are better positioned to create durable value. Green innovation can therefore support profitability and resilience while helping businesses reduce environmental impacts, respond to stakeholder expectations, and contribute to more responsible patterns of production and consumption.

Keywords: Green innovation; Business performance; Environmental responsibility; Eco-innovation; Sustainable operations; Circular economy; Green product development; Environmental management; Corporate sustainability

1. Introduction

Businesses increasingly operate in an environment where economic performance is closely connected to resource availability, ecological quality, regulatory change, technological transition, and stakeholder trust. Energy costs, supply interruptions, water scarcity, pollution controls, carbon-related expectations, waste-management obligations, and consumer concern about sustainability can all affect business decisions. Green innovation has therefore become a significant route through which firms seek to improve environmental performance while strengthening competitiveness. The term refers to innovations that reduce negative environmental impacts, improve the efficient use of materials and energy, enable cleaner production, extend product life, support recovery and reuse, or create new forms of value with lower ecological intensity.

The relevance of green innovation is visible across manufacturing, services, agriculture, construction, transport, information technology, retail, finance, and public infrastructure. In manufacturing, firms may redesign products, substitute hazardous inputs, upgrade equipment, reduce material loss, improve energy systems, or adopt closed-loop production methods. In service industries, innovation may involve digital delivery, low-carbon logistics, smart energy management, paperless operations, sustainable purchasing, or circular service models. Although the practical form differs by sector, the underlying objective is similar: to improve business activity without transferring excessive environmental costs to communities, ecosystems, or future generations.

Green innovation also changes the way business performance is understood. Traditional performance measures such as revenue, profit, productivity, market share, and return on investment remain important, but they are increasingly assessed alongside indicators of energy intensity, emissions, water use, waste generation, environmental compliance, resource productivity, product stewardship, and stakeholder confidence. These dimensions are interdependent. A reduction in material waste may lower production costs; cleaner technology may reduce regulatory and reputational risk; eco-designed products may open new market segments; and credible environmental practices may strengthen relationships with investors, suppliers, employees, customers, and regulators. At the same time, green innovation can require significant investment, organisational change, and new technical capabilities, so positive outcomes cannot be assumed automatically.

The purpose of this paper is to examine the major forms of green innovation practices and assess their influence on business performance and environmental responsibility. The discussion emphasises that green innovation should be interpreted as a strategic and organisational process rather than a narrow technology purchase or a communication exercise. Effective practices require leadership support, cross-functional coordination, reliable measurement, responsible supply-chain relationships, and a willingness to redesign established routines. By examining the benefits, mechanisms, limitations, and improvement pathways associated with green innovation, the study aims to clarify how firms can pursue economic value while contributing to environmental protection and more sustainable development.

2. Literature Review

The literature on green innovation has developed from early debates about whether environmental protection creates costs for firms or stimulates productivity and competitiveness. A central perspective argues that appropriately designed environmental action can encourage innovation by revealing inefficiencies, reducing waste, improving processes, and creating demand for cleaner products and services. Subsequent research has broadened the discussion to include green product development, cleaner production, renewable-energy adoption, environmental management systems, sustainable supply chains, eco-design, circular economy models, and sustainability-oriented business model innovation. Across these areas, scholars generally recognise that green innovation is shaped by a combination of regulation, market demand, organisational capabilities, access to finance, stakeholder pressure, technology availability, and management commitment.

A second body of research considers the conditions under which green innovation produces measurable business value. Environmental improvements may generate direct savings through lower energy, water, material, disposal, and compliance costs. They may also generate indirect benefits through stronger differentiation, improved reputation, new customer relationships, risk reduction, learning effects, and access to green finance or procurement opportunities. However, innovation outcomes vary across firms. Small and medium enterprises may face financial, technical, and informational constraints, while larger firms may struggle with organisational complexity, legacy systems, or fragmented supply chains. The literature therefore suggests that green innovation is most effective when environmental goals are connected to core business processes, investment decisions, and performance systems.

2.1 Green Innovation and Business Performance

Green innovation can be classified into product, process, organisational, marketing, and business-model forms. Green product innovation involves designing goods or services that use fewer resources, contain safer materials, generate less waste, last longer, are easier to repair or recycle, or provide environmental benefits during use. Green process innovation focuses on cleaner production, energy efficiency, pollution prevention, water management, material recovery, and improvements in logistics or maintenance. Organisational innovation includes environmental management systems, employee training, cross-functional sustainability teams, supplier standards, target-setting, and incentive mechanisms. Business-model innovation may involve leasing, sharing, product-service systems, take-back schemes, remanufacturing, repair services, and other approaches that decouple value creation from the continuous use of virgin resources.

The relationship between green innovation and business performance is often explained through efficiency, differentiation, capability development, and risk management. Efficiency gains arise when firms reduce input use, energy consumption, process losses, emissions, and disposal costs. Differentiation benefits arise when customers, business partners, and public procurers recognise the environmental value of a product or service. Capability development occurs when firms improve their technical knowledge, environmental data, design competence, supplier coordination, and problem-solving capacity. Risk management benefits arise when firms are better prepared for regulatory changes, resource volatility, environmental incidents, or public criticism. These pathways can reinforce one

another, but they require managers to translate environmental ambitions into disciplined operational and commercial choices.

Green innovation should not be assessed only through short-term financial outcomes. Some practices generate immediate cost savings, while others deliver value over a longer period through learning, market access, brand reputation, regulatory readiness, or the ability to anticipate changing customer needs. For example, investments in cleaner equipment may require capital expenditure before savings become visible, and eco-design may require new supplier relationships or product testing before a market advantage is realised. A balanced assessment therefore combines financial indicators with operational, market, environmental, and strategic measures. It also considers whether the innovation improves a firm's ability to adapt to future resource, technology, and policy conditions.

The literature also warns against treating green innovation as a purely promotional activity. Environmental claims that are not supported by credible product design, verified data, responsible sourcing, or transparent disclosure can damage trust and create legal and reputational risk. Business performance gains are more durable when firms can demonstrate that environmental improvements are integrated into the design, production, delivery, and end-of-life stages of products and services. This requires clear governance, accurate data, internal accountability, and an understanding of the full life-cycle impacts that may occur beyond the firm's immediate operations.

2.2 Environmental Responsibility and Stakeholder Value

Environmental responsibility refers to the obligation of businesses to identify, prevent, reduce, and address the environmental impacts associated with their operations, products, services, investments, and supply-chain relationships. It includes compliance with applicable law, but it also extends to proactive action on energy use, greenhouse-gas emissions, water stewardship, pollution prevention, biodiversity, chemical safety, waste, resource efficiency, and product recovery. Green innovation provides practical mechanisms through which environmental responsibility can be translated into everyday decisions. It helps firms move from broad commitments to specific changes in technology, process design, procurement, product portfolios, and stakeholder engagement.

A credible environmental responsibility strategy uses life-cycle thinking. Environmental impacts do not occur only inside a factory or office; they may arise during raw-material extraction, supplier production, transportation, product use, maintenance, repair, disposal, recycling, or recovery. Firms therefore need to understand where their most significant impacts occur and how their decisions influence them. For some businesses, the main opportunity may lie in renewable energy or production efficiency; for others, it may be in sustainable materials, supplier engagement, packaging reduction, circular design, or lower-impact services. A life-cycle perspective helps prevent the shifting of impacts from one stage, geography, or stakeholder group to another.

Stakeholder relationships are central to the effectiveness of green innovation. Customers may reward credible environmental quality, but they may also expect clarity about product claims and performance. Investors increasingly evaluate how environmental risk and opportunity are governed, while lenders and insurers may consider exposure to climate, resource, and compliance risk. Employees can contribute ideas for efficiency, safety, and operational improvement, particularly when they receive training and are encouraged to report problems. Suppliers and business partners are important because many environmental impacts are embedded in purchased materials, components, logistics, and

outsourced processes. Collaborative relationships can therefore improve both innovation quality and the reliability of environmental outcomes.

Environmental responsibility also involves accountability for results. Firms should set relevant objectives, measure progress, disclose material information, and explain both achievements and limitations. Reporting should be based on data that are sufficiently reliable for internal decision making and stakeholder communication. It should not rely only on high-level commitments or isolated success stories. Transparent reporting helps identify gaps, supports board and management oversight, and enables stakeholders to assess whether green innovation is producing genuine environmental improvement. In this way, disclosure is not merely a communication practice; it is a governance mechanism that can strengthen discipline, learning, and trust.

3. Object of Study

The primary object of this study is to examine how green innovation practices influence business performance and environmental responsibility. The paper analyses the relationships among innovation choices, operational efficiency, product and process redesign, environmental management, stakeholder engagement, governance, and long-term business value. It considers how firms use green innovation to reduce environmental pressure while strengthening competitiveness, resilience, and organisational capability.

The study focuses on green innovation dimensions that are relevant across a wide range of sectors, including eco-design, cleaner production, energy and material efficiency, renewable energy, water stewardship, waste prevention, circular economy practices, sustainable procurement, environmental management systems, digital environmental monitoring, and sustainability-oriented business models. These dimensions are examined in relation to their effects on financial, operational, market, reputational, risk-management, and environmental outcomes.

A further objective is to identify the pathways through which green innovation creates or fails to create value. These pathways may include lower operating costs, reduced resource dependence, improved product quality, increased market access, stronger brand credibility, better regulatory preparedness, supplier collaboration, employee learning, and reduced exposure to environmental incidents. The study also recognises possible constraints such as high initial investment, uncertain demand, insufficient capabilities, weak data, fragmented supply chains, greenwashing risk, and misalignment between sustainability commitments and commercial incentives.

Finally, the study considers practical approaches for strengthening green innovation in a way that supports both corporate performance and public environmental value. The objective is not only to describe environmentally oriented practices but also to clarify how firms can embed them into strategy, management systems, investment planning, product development, procurement, operations, and transparent accountability.

3.1 Types of Green Innovation Practices

This subsection identifies the main forms of green innovation that businesses can use to improve environmental and economic outcomes.

- Green product innovation through eco-design, safer materials, durable products, repairability, energy-efficient use, reduced packaging, and improved recyclability.

- Green process innovation through cleaner production, energy-efficiency improvements, water conservation, pollution prevention, waste reduction, and material recovery.
- Renewable-energy adoption, electrification, smart energy management, low-carbon logistics, and operational measures that reduce dependence on fossil-fuel-intensive processes.
- Sustainable procurement and supplier engagement that incorporate environmental criteria, traceability, responsible material choices, and capability development across value chains.
- Environmental management systems, digital monitoring, life-cycle assessment, target setting, environmental accounting, and employee training that support continuous improvement.
- Circular business-model innovation through repair, reuse, remanufacturing, leasing, sharing, take-back systems, recycling partnerships, and product-service approaches.

The purpose is to understand whether green innovation is treated as a set of isolated initiatives or as a coordinated portfolio of practices linked to strategy, investment, operations, and stakeholder value.

3.2 Business Performance Outcomes

This subsection evaluates the business outcomes associated with the adoption and effective management of green innovation practices.

- Operating-cost reduction through lower energy, material, water, disposal, maintenance, and compliance-related expenditure.
- Productivity and quality improvement through cleaner processes, reduced process loss, better equipment performance, and more efficient resource use.
- Market differentiation, customer trust, access to environmentally sensitive market segments, and improved eligibility for sustainable procurement opportunities.
- Risk management through better preparedness for regulatory change, environmental incidents, supply disruption, resource price volatility, and reputational pressure.
- Innovation capability through employee learning, research and development, technology partnerships, supplier collaboration, and cross-functional problem solving.
- Long-term resilience through more adaptive products, processes, supply chains, investment decisions, and relationships with customers, investors, regulators, and communities.

These dimensions are used to assess whether green innovation contributes to durable value creation rather than only short-term cost reduction or symbolic environmental communication.

3.3 Environmental Responsibility and Governance

This subsection considers the governance and accountability measures that help green innovation produce credible environmental benefits.

- Clear board and senior-management oversight of environmental risk, opportunity, targets, investment priorities, and innovation performance.
- Measurable environmental objectives covering energy, emissions, water, waste, materials, pollution prevention, product stewardship, and resource efficiency where relevant.
- Life-cycle assessment and environmental data systems that identify significant impacts across operations, products, services, supply chains, and end-of-life stages.
- Supplier standards, sustainable sourcing criteria, technical support, and collaboration that extend environmental responsibility beyond direct operations.
- Transparent reporting of relevant policies, targets, indicators, progress, limitations, corrective action, and assurance or verification where appropriate.

- Stakeholder engagement with employees, customers, suppliers, investors, communities, regulators, researchers, and civil-society organisations.

4. Research Methodology

The present study adopts a review-based, descriptive, analytical, and comparative methodology to examine green innovation practices and their effects on business performance and environmental responsibility. The approach combines ideas from strategic management, innovation studies, sustainable operations, environmental economics, corporate governance, circular economy, and stakeholder theory. It is designed to identify the links among green innovation choices, operational change, environmental impact reduction, commercial performance, organisational capability, and accountable governance.

The study relies on secondary evidence from peer-reviewed research articles, academic books, international standards, policy reports, environmental-management guidance, sustainability frameworks, and selected industry assessments. The evidence is interpreted through a thematic framework that considers innovation type, organisational capability, operational efficiency, market effects, environmental outcomes, stakeholder relationships, transparency, and long-term resilience. No original survey or experimental data are claimed; instead, the paper synthesises established concepts and findings to provide a structured analysis of the topic.

4.1 Research Design

The research follows a descriptive and comparative design to synthesise evidence on green innovation and sustainable business performance.

Component	Description
Research Type	Review-based, descriptive, analytical, comparative
Approach	Green innovation and sustainable business performance analysis
Data Source	Research articles, standards, policy documents, sustainability reports, and selected industry assessments
Analysis Method	Thematic synthesis and comparative assessment of economic, environmental, operational, and governance outcomes
Focus Area	Product, process, organisational, and business-model innovation; business performance; environmental responsibility; stakeholder value

4.2 Sources and Analytical Categories

The study considers the following evidence categories for evaluation:

- Research on eco-innovation, strategic management, cleaner production, environmental management, circular economy, and sustainable business models.

- International standards and guidance on environmental management, sustainability reporting, innovation measurement, climate action, and responsible business conduct.
- Policy documents and industry reports on resource efficiency, renewable energy, sustainable production, environmental regulation, and green transition pathways.
- Corporate and stakeholder assessments concerning environmental targets, product stewardship, supply-chain responsibility, disclosure, and governance.

Each evidence source is analysed based on:

- Type of green innovation practice, environmental issue, operational process, product or service, or business-model pathway addressed.
- Business-performance mechanisms, including efficiency, cost, quality, market differentiation, resilience, risk management, and capability development.
- Evidence of environmental improvement, including reduced resource use, lower pollution, waste prevention, cleaner energy, circularity, or improved stewardship.
- Role of leadership, finance, employee participation, supply-chain relationships, data systems, policy conditions, and stakeholder expectations.
- Potential contribution to long-term value creation, environmental responsibility, transparency, accountability, and sustainable development.

5. Data Analysis

The data analysis synthesises evidence on how green innovation affects business performance and environmental responsibility through linked strategic and operational mechanisms. A firm identifies environmental pressures or opportunities; it then introduces changes in product design, process technology, energy systems, material use, supplier relationships, organisational routines, or business models; these changes influence resource productivity, costs, quality, risk, stakeholder perception, and environmental outcomes. The sequence shows that green innovation is not a single activity but an integrated process through which business decisions shape both economic and ecological performance.

Efficiency is one of the most visible mechanisms. Firms often discover opportunities for savings when they map energy use, material loss, water consumption, emissions, waste streams, equipment performance, and maintenance requirements. Cleaner production and resource-efficiency measures can reduce input costs and improve operational control, particularly when projects are based on reliable baseline data and clear targets. However, cost savings should not be treated as the only indicator of success. Some innovations generate broader benefits, such as reduced exposure to supply disruption, improved product reliability, safer operating conditions, and the development of internal capabilities that support future improvement.

Product and service innovation can support market performance when environmental value is relevant to customers, business buyers, public procurers, or distribution partners. Eco-design may improve energy efficiency, durability, repairability, recyclability, material safety, packaging, or end-of-life options. These features can strengthen product differentiation and help firms enter markets with environmental requirements. Yet the business value of green products depends on credibility, quality, affordability, performance, and communication. A product that carries a broad environmental claim but lacks evidence, transparency, or practical customer benefit may create scepticism rather than competitive

advantage. Effective innovation therefore connects environmental improvement with functional value and clear verification.

Organisational practices determine whether green innovation becomes sustained or remains temporary. Leadership commitment, environmental targets, investment criteria, managerial accountability, employee training, and performance incentives influence whether ideas are implemented at scale. Cross-functional coordination is especially important because environmental improvements often require cooperation among research and development, production, procurement, finance, marketing, logistics, human resources, and compliance teams.

6. Discussion

The findings indicate that green innovation is most effective when it is integrated into business strategy and operating models. Firms may begin with environmental compliance or a targeted efficiency project, but the strongest results appear when innovation is linked to product development, investment planning, procurement, operations, risk management, and performance evaluation. This integration helps managers identify trade-offs and opportunities across departments instead of treating environmental responsibility as an add-on. It also increases the likelihood that cost savings, market benefits, and environmental improvements are measured together and supported by formal decision processes.

One important observation is that environmental performance and business performance are not automatically aligned. Some improvements may require upfront capital, new skills, supplier changes, redesign work, or longer payback periods. In some cases, a firm may face a choice between a lower short-term cost and a higher long-term environmental and strategic benefit. Managers therefore need to use investment criteria that recognise risk reduction, resource security, regulatory readiness, learning, and reputation in addition to immediate financial returns. Public policy, green finance, technical support, and market incentives can also influence whether firms are able to make these investments, particularly in sectors with tight margins or in smaller enterprises with limited resources.

The discussion also highlights the importance of credibility. Stakeholders increasingly distinguish between businesses that make general sustainability statements and businesses that can demonstrate specific, measurable, and verifiable improvements. Credibility depends on accurate data, transparent targets, clear governance, and honest communication about limitations. It is strengthened when environmental claims are connected to product design, operational practices, supplier requirements, and public reporting. It is weakened when companies use vague language, omit material impacts, shift burdens to suppliers or consumers, or report achievements without explaining the basis for measurement. Green innovation should therefore be accompanied by systems that protect against greenwashing and encourage accountability.

Employee participation is an underused source of green innovation. Workers, technicians, engineers, managers, and frontline staff often understand where energy, materials, time, and quality are lost in everyday processes. Their involvement can generate practical ideas for waste reduction, preventive maintenance, safer handling of inputs, improved logistics, and more efficient resource use. Participation also improves implementation because employees are more likely to support changes when they understand their purpose and can contribute to problem solving. Firms should provide training,

feedback channels, recognition, and access to relevant performance information so that environmental responsibility becomes part of organisational learning rather than a distant management objective.

Environmental responsibility should also be interpreted through a just and inclusive transition. Cleaner technology, automation, new materials, renewable energy, and circular systems can create opportunities, but they may also change job roles, supplier requirements, investment needs, and local economic conditions. Businesses should assess how transitions affect workers, smaller suppliers, communities, and customers. Support for training, responsible procurement, fair contracting, accessible product design, and collaboration can help ensure that environmental gains do not depend on transferring costs or risks to less powerful stakeholders. A responsible approach aligns ecological improvement with fairness, capability development, and long-term social value.

Finally, governance and collaboration remain essential. Boards and senior leaders should oversee material environmental risks and opportunities, while management systems should translate commitments into responsibilities, data, targets, budgets, and review processes. Businesses also need collaboration with suppliers, customers, researchers, technology providers, regulators, investors, and communities because many environmental challenges cannot be solved by a single organisation. Such collaboration can improve standards, share learning, support infrastructure, and reduce the uncertainty associated with new practices. The long-term objective is to build business systems in which innovation, profitability, resilience, and environmental responsibility reinforce rather than contradict one another.

7. Conclusion

This study concludes that green innovation is a significant pathway through which businesses can strengthen performance while reducing environmental pressure. It includes changes in products, processes, organisational systems, procurement, energy use, materials, logistics, and business models that improve resource productivity, prevent pollution, reduce waste, support circularity, and respond to changing stakeholder expectations. The value of green innovation lies not only in individual technologies or projects but in its capacity to reshape the way firms create, deliver, and preserve value.

The analysis shows that business-performance benefits can arise through lower operating costs, improved productivity, product differentiation, market access, stronger reputation, risk management, regulatory readiness, and organisational learning. These benefits are more likely to be sustained when environmental responsibility is embedded in strategy, capital allocation, product development, supply-chain relationships, employee participation, and performance management. Firms should therefore evaluate green innovation through both short-term indicators and longer-term measures of capability, resilience, stakeholder trust, and environmental impact.

A credible green innovation framework should combine life-cycle thinking with measurable targets, reliable data, transparent disclosure, responsible sourcing, and inclusive stakeholder engagement. It should recognise that many impacts occur beyond direct operations and that environmental improvement must not be achieved by shifting costs or risks to suppliers, workers, communities, or consumers. Businesses should invest in the technical, financial, organisational, and collaborative conditions that allow environmental responsibility to become practical, measurable, and economically viable.

Future progress will depend on leadership commitment, supportive policy environments, green finance, research and development, workforce capability, supplier collaboration, and meaningful accountability.

8. References

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