

GREEN INNOVATION AND OPERATIONAL EFFICIENCY: DOES LOWER CARBON EMISSIONS ALWAYS LEAD TO PROFITABILITY?

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ABSTRACT

This study examines the relationship between green innovation, operational efficiency, and corporate profitability, focusing on carbon emission reduction. Using the Resource-Based View (RBV) and Stakeholder Theory approaches, this research explores how investments in green innovation can enhance operational efficiency and provide a competitive advantage for companies. While theoretically, reducing carbon emissions can improve efficiency and lower production costs, its impact on profitability is not always direct. High initial investment costs, regulatory complexities, and varying market demand are key factors influencing the success of this strategy. A review of the literature indicates that while some studies support a positive relationship between green innovation and profitability, others suggest that economic benefits only materialize in the long term. Therefore, adopting sustainability strategies requires a comprehensive approach that considers government incentives, industry pressures, and consumer preferences to ensure success in increasing profitability through green innovation and operational efficiency.

Keywords: Green Innovation, Operational Efficiency, Carbon Emissions, Profitability, Sustainability

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INTRODUCTION

Climate change and environmental sustainability have become critical concerns for businesses, policymakers, and society at large. Companies are increasingly under pressure to adopt green innovation technological advancements and business practices that reduce environmental impact while maintaining or enhancing operational efficiency (Ibishova et al., 2024). Green innovation includes the development of ecofriendly products, the implementation of energy efficient production processes, and the optimization of supply chain logistics to minimize waste and carbon emissions.

Theoretically, reducing carbon emissions can enhance operational efficiency by decreasing energy consumption, minimizing waste, and improving resource utilization. According to the Porter Hypothesis, well-designed environmental regulations and proactive sustainability strategies can drive innovation, leading to long-term competitive advantages and profitability (Zhong et al., 2024). Several studies support this perspective, arguing that firms that invest in

green technologies often experience cost savings, improved market reputation, and increased customer loyalty, all of which contribute to financial success.

However, despite these potential benefits, the financial implications of green innovation are not always straightforward. Implementing environmentally sustainable practices often requires significant upfront investments in research and development, infrastructure, and compliance with regulatory frameworks. Small and medium-sized enterprises, in particular, may struggle with the high costs associated with green initiatives, leading to financial strain rather than immediate gains. Moreover, the effectiveness of green innovation in driving profitability can depend on external factors such as government incentives, industry competition, and consumer demand for sustainable products. Empirical findings on the relationship between carbon emission reduction and financial performance remain mixed. Some studies indicate a positive correlation between sustainability efforts and profitability, particularly in industries where consumers value environmental responsibility. Others suggest that the economic benefits of green innovation materialize only in the long term, and companies may face short-term financial drawbacks due to high implementation costs.

LITERATURE REVIEW

Resource-Based View (RBV)

The RBV theory developed by Barney provides a foundation for understanding how green resources and capabilities can become sources of competitive advantage (Ozdemir et al., 2023). In extending RBV to the Natural-Resource-Based View (NRBV), argues that a firm's capability to manage environmental challenges can become a source of sustainable competitive advantage.

Stakeholder Theory

Freeman (1984) proposed that firms should consider the interests of all stakeholders, including the environment. Apply this theory to show that pressure from external and internal stakeholders drives companies to adopt green practices (Mahajan et al., 2023). By combining stakeholder theory and the balanced scorecard, companies can create a balanced management system that not only focuses on financial profits but also considers the impact on all stakeholder groups (Marzuki, et al., 2020). Stakeholder satisfaction through green initiatives can provide social legitimacy that positively impacts financial performance.

Green Innovation and Operational Efficiency

Green innovation (GI) involves the adoption of environmentally friendly technologies, processes, and practices aimed at reducing resource consumption and minimizing environmental impact (Wang et al., 2025). Studies have consistently shown that GI enhances operational efficiency by optimizing resource use, reducing waste, and lowering production costs. For instance, the implementation of green accounting practices has been found to significantly improve resource management, including energy and raw material consumption, which contributes to better operational performance and cost savings. Moreover, green banking initiatives have demonstrated that operational efficiency measured through indicators like operating expenses relative to income positively impacts profitability metrics such as Return on Assets (ROA).

Carbon Management Strategies

Organizations employ various strategies to reduce carbon emissions (Chu et al., 2024). Carbon management strategies are multifaceted approaches that require a combination of technological innovation, effective policies, corporate responsibility, stakeholder engagement, and rigorous monitoring (Moon et al., 2024). By adopting these strategies, organizations can significantly contribute to global efforts in mitigating climate change while reaping economic benefits.

Profitability Considerations

While lower carbon emissions can lead to cost savings, the relationship with profitability is not always straightforward. Initial investments in green technology can be substantial, and the payback period may be lengthy (Walters, D., et al., 2020). Additionally, firms in sectors with high carbon intensity, such as manufacturing and logistics, may face significant challenges in balancing emission reduction and profitability. Some scholars argue that companies adopting green innovation may gain competitive advantages through enhanced brand reputation and customer loyalty, leading to long-term profitability.

Previous Research

Previous research was collected through a selection process that included indexed journal articles. The literature search was conducted in stages, focusing on accredited journals ranked SINTA 1–4 and international journals from Science Direct and Emerald. These sources were chosen for their high credibility. The following outlines the filtering stages implemented to obtain a dataset that meets the criteria of this research.

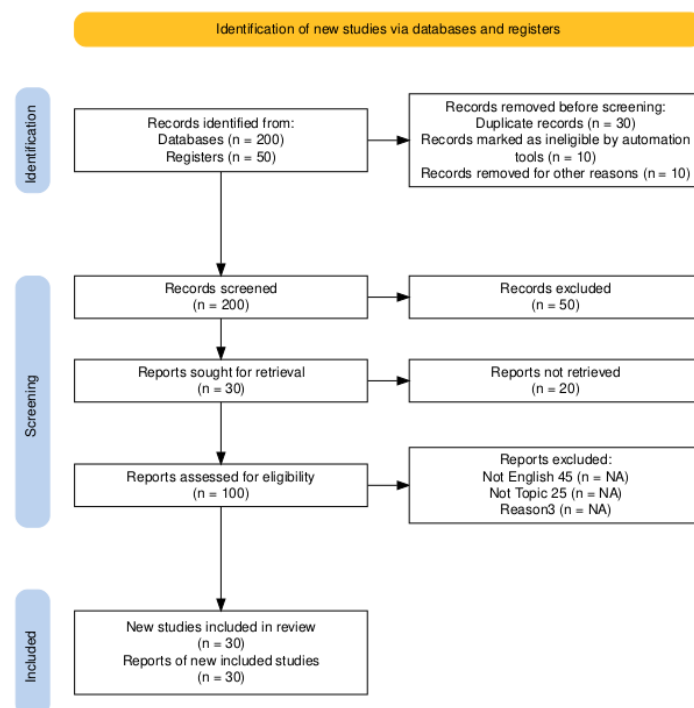


Figure 1. Prism Diagram

Out of 250 articles, 30 relevant articles were produced for the research topic. The majority of these articles, totaling 20, were sourced from Scopus Q1-Q3 journals. Additionally 3 articles came from journals accredited with Sinta 2.

Table 1. Distribution of Articles Based on Journal Names, accreditation Citations

The Journal Article	Number of articles	Country
ScienceDirect	20	United States, United Kingdom, China, Australia, Germany, The Netherlands, Japan, Ecuador, Malaysia, South Korea, Norway, Ghana, Saudi Arabia, South Africa.
Scopus – Q1	4	China, South Africa, Unites States
Scpous – Q2	2	China, South Korea
Scopus – Q3	1	China
Sinta 3	1	Indonesian
Sinta 2	2	Indonesian

Table 2. The Influence of Green Innovation and Operational Efficiency

Variable	Authors	Research Findings
<i>Green Innovation</i>	(Silvia Mega, 2023),(Dewi & Ananda, 2024), (Alshuaibi et al., 2024), (Ruan et al., 2024), (Chang et al., 2024), (Ma & Li, 2025), (Moon et al., 2024), (Zhang, 2024),(Al Amosh & Khatib, 2025), (Vollmuth et al., 2024).	+
	(Y. Wang et al., 2025), (Chu et al., 2024), (Toriyama et al., 2025), (Veenstra & Mulder, 2024), (Hu & Shi, 2025), (Sabando et al., 2025)	-
<i>Operational Efficiency</i>	(Liu & Cui, 2024), (Adu et al., 2023),(Boye et al., 2023), (Appiah et al., 2025), (Li et al., 2024), (R. Wang & Zhao, 2024), (H. Wang et al., 2025), (Osei-Assibey Bonsu et al., 2025), (Xie & Wang, 2025).	+
	(Ngoc Huynh et al., 2024)(P. Wang & Xu, 2025), (Zhong et al., 2024), (Zhan et al., 2025), (Qiao et al., 2025)	-
(+) positive (-) negative		

From a total of 250 journals, 30 relevant journal articles were selected for the research. Among these, 10 articles indicate a positive relationship between Green Innovation and Lower Carbon Emissions, while 6 articles show a negative relationship between Green Innovation and the disclosure of Lower Carbon Emissions. Additionally, there are 9 articles that demonstrate a positive relationship between Operational Efficiency and Lower Carbon Emissions, and 5 articles that indicate a negative relationship between Operational Efficiency and Lower Carbon Emissions.

METHOD

This research uses the systematic literature review (SLR) method to comprehensively analyze findings from previous research related to green innovation, operational efficiency, and

its impact on reducing carbon emissions and company profitability. The main objective of this SLR is to answer the research problem formulation, namely: Does investment in green innovation and increasing operational efficiency always lead to increasing company profitability through reducing carbon emissions?

DISCUSSION

1. Green Innovation: Does Lower Carbon Emissions Always Lead to Profitability?

Based on the Resource-Based View (RBV) theory, green innovation can serve as a competitive advantage if a company effectively manages its environmental resources. Green innovation includes the development of environmentally friendly products, energy efficiency in production processes, and supply chain optimization to reduce waste and carbon emissions (Wang et al., 2025). However, while green innovation theoretically enhances operational efficiency, its implementation requires significant initial investments in research and development of green technologies, as well as adaptation to complex environmental regulations.

From the perspective of Stakeholder Theory, companies that adopt green innovation can gain support from various stakeholders, including customers, investors, governments, and local communities. This support can enhance a company's reputation, strengthen customer loyalty, and create added value that positively impacts profitability (Freeman, 1984). Additionally, supportive regulations and consumer preferences for sustainable products can accelerate the return on investment in green innovation (Zhang, 2024).

Although many studies indicate a positive relationship between green innovation and profitability, some research suggests that the economic benefits of green innovation materialize only in the long term (Sabando et al., 2025). In some cases, companies face financial burdens in the short term due to high implementation costs and regulatory uncertainties. Moreover, the effectiveness of green innovation in boosting profitability depends on external factors such as government incentives, industry competition, and consumer demand for sustainable products (Alshuaibi et al., 2024).

2. Operational Efficiency: Does Lower Carbon Emissions Always Lead to Profitability?

Operational efficiency based on carbon emission reduction can lower production costs, improve productivity, and optimize resource utilization, aligning with the RBV concept. The use of energy-efficient technology, improved waste management systems, and the digitalization of production processes can significantly enhance efficiency and reduce operational costs (Liu & Cui, 2024). Furthermore, efficiency in the supply chain and greener logistics can help companies reduce dependence on raw materials with a high carbon footprint.

According to Stakeholder Theory, companies committed to operational efficiency and sustainability are more likely to gain investor trust and government support in the form of fiscal incentives and regulatory ease. Consumers are also increasingly inclined to choose products from companies that demonstrate environmental responsibility (Ma & Li, 2025). However, the main challenges in adopting carbon emission-based operational efficiency are

high implementation costs and uncertainties related to changing environmental policies and industry competition (Vollmuth et al., 2024).

Several studies suggest that reducing carbon emissions through operational efficiency can lead to significant cost savings in the long run. However, its impact on profitability may vary depending on a company's cost structure, industry sector, and market readiness to adopt sustainable products and services. For instance, manufacturing and logistics sectors with high carbon intensity may face greater challenges in balancing emission reduction with profitability compared to service-based sectors.

CONCLUSION

This study concludes that green innovation and operational efficiency can contribute to reducing carbon emissions and enhancing a company's profitability, but this relationship is not always straightforward and depends on various factors. While theories such as the Resource-Based View (RBV) and Stakeholder Theory support the long-term benefits of sustainable strategies, high initial costs and implementation challenges can hinder short-term profitability. External factors, including government incentives, consumer preferences, and industry competition, also influence the effectiveness of green innovation in driving financial success.

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