GREEN ECONOMY AND INNOVATION: INTEGRATING ENVIRONMENTAL ACCOUNTING WITH TECHNOLOGICAL ADVANCES IN HEALTHCARE AND INDUSTRY

Ety Meikhati[1*], Erna Chotidjah Suhatmi [2], Nor Aishah Mohd Ali[3]
[1,2]Accounting Study Program, Faculty of Law and Business, Universitas Duta Bangsa Surakarta, Indonesia
[3]Faculty of Accountacy, Universiti Teknologi MARA, Malacca branch, Malaysia
*Correspondence Email: ety_meikhati@udb.ac.id

ABSTRACT

The Shift toward a green economy has emerged as a global priority in tackling climate change, resource scarcity, and the growing demand for sustainable development. Alongside this transition, rapid progress in healthcare and industrial technologies offers opportunities to boot efficiency, lower emissions, and generate added value. This study explores how green economy principles, environmental accounting, and technological innovation can be integrated within the healthcare and industrial sectors. A qualitative descriptive approach is applied, utilizing literature reviews and document analysis from scientific articles, sustainability reports, and policy documents published in the past five years. The results suggest that combining environmental accounting with technological innovation enhances the realization of a green economy by improving resource efficiency, increasing transparency in sustainability reporting, and supporting the achievement of the Sustainable Development Goals (SDGs). The findings also emphasize the essential function of environmental accounting in measuring the economic impact of technological innovations, particularly in healthcare and industry, which are among the largest contributors to energy use and carbon emissions.

KEYWORDS

Green Economy, Environmental Accounting, Technological Innovation, Healthcare, Industry

INTRODUCTION

The paradigm shift in global economic development toward the concept of a green economy is gaining increasing attention in response to the growing challenges of climate

change, ecosystem degradation, and societal demands for sustainable services, including in the health sector. The green economy is not merely understood as environmentally friendly practices such as the use of renewable energy, pollution control, and recycling activities, but also encompasses broader social and economic dimensions. This concept emphasizes the importance of creating environmentally conscious employment opportunities, alleviating poverty, and developing sustainable infrastructure that holistically supports community well-being. This aligns with the study by Rahmawati and Bayangkara (2024), which asserts that the green economy plays a strategic role in enhancing social welfare through the strengthening of access to green economic opportunities, job creation, and improvements in quality of life. Therefore, today's development trajectory is required to be more inclusive, equitable, and consistent with the principles of sustainability (UNEP, 2025).

The advancement of a green economy in Indonesia is institutionalized through strategic planning instruments, most notably the National Medium-Term Development Plan (RPJMN) 2020–2024. This policy framework places strong emphasis on transitioning toward a low-carbon development paradigm while simultaneously enhancing green competitiveness as an integral component of the nation's sustainable development agenda. According to the report by Bappenas (2021), this strategy has the potential to attract investment opportunities while simultaneously fostering the creation of employment in environmentally friendly sectors. Nevertheless, the practical implementation of this concept continues to encounter several challenges, including limited availability of reliable data, the absence of comprehensive ecological accounting instruments, and the relatively low level of industry awareness—factors that collectively hinder the effective adoption of Environmental Management Accounting (EMA) within the manufacturing sector of emerging economies (Mukwarami et al., 2023).

Recent advances in digital technology over the past five years have created significant opportunities to accelerate the transition toward a green economy. Innovations driven by artificial intelligence, big data analytics, and the Internet of Things (IoT) have demonstrated their capacity to enhance service efficiency while simultaneously reducing energy consumption and carbon emissions. This is consistent with the findings of Fragao-Marques & Ozben (2023), who highlight that digital transformation within the healthcare and clinical laboratory sectors not only enhances service quality but also fosters the development of more sustainable systems. The integration of digital technologies enables more effective resource management, minimizes waste generation, and improves operational efficiency, thereby contributing to the advancement of the green economy agenda in the health sector.

In the healthcare sector, the application of IoT-based smart service systems has proven effective in improving both the quality of medical services and the efficiency of resource utilization. Beyond enhancing service processes and data accuracy, this technology also contributes to reducing energy consumption, lowering carbon emissions, and minimizing operational inefficiencies. These outcomes underscore the strong interconnection between digital transformation and the principles of the green economy, where technological innovation serves as a catalyst for developing more environmentally friendly and sustainable healthcare systems. Accordingly, the integration of IoT into healthcare services can be regarded as a strategic approach to advancing inclusive, efficient, and globally aligned sustainable development (Karamina & Ilham, 2025).

In the industrial sector, green innovation through both process innovation and recycling innovation has been shown to enhance energy efficiency while simultaneously reducing production waste (Liu et al., 2023). Nevertheless, numerous studies indicate that the economic and environmental impacts of sustainable technology adoption are often not

systematically measured, which poses challenges for developing accountable strategies. The application of innovation-driven green economy principles in both healthcare and industry has become increasingly relevant in light of global commitments to the Sustainable Development Goals (SDGs), particularly Goal 3 (Good Health and Well-being), Goal 9 (Industry, Innovation, and Infrastructure), and Goal 13 (Climate Action). By integrating environmental accounting into the innovation framework, organizations can produce more comprehensive sustainability reports, strengthen transparency, and promote sustainability-oriented decision-making (Kementerian Keuangan RI, 2023). Thus, advancing a green economy requires not only technical and operational improvements but also a systematic approach that combines technological innovation with environmental accountability as the foundation of sustainable development strategies.

To address these needs, environmental accounting has emerged as an instrument that bridges the economic, environmental, and sustainability dimensions. Through green and environmental accounting practices, organizations are able to identify, measure, and report the environmental costs and impacts of their economic activities. This approach has been shown to enhance transparency and accountability in resource management, while also fostering innovation and strengthening corporate reputation through sustainable practices (Putri Ir & Sisdianto, 2024). Previous studies demonstrate that the implementation of environmental accounting is positively associated with corporate sustainability performance (Agyemang et al., 2023), and increases investor confidence by ensuring greater transparency in reporting (Moussa & Elmarzouky, 2024). In the Indonesian context, Salavia et al., (2024) found that environmental accounting practices not only influence operational performance and regulatory compliance but also reinforce organizational reputation in the public sphere.

A closer review of the literature reveals that most existing studies continue to examine the green economy and technological innovation largely in isolation from the lens of environmental accounting. Prior research has predominantly emphasized either the economic benefits or the technological contributions to energy efficiency, with limited attention given to an integrative perspective that connects these three interrelated dimensions: the green economy, technological innovation, and environmental accounting. This gap is particularly evident in the contexts of the healthcare and industrial sectors, both of which possess distinct characteristics. The healthcare sector faces the dual imperative of delivering high-quality services while ensuring environmental sustainability, whereas the industrial sector plays a crucial role in mitigating emissions and advancing the broader low-carbon development agenda. In response to the existing gap, the research is directed toward an in-depth examination of how the green economy, technological innovation, and environmental accounting can be integrated to enhance sustainability in the healthcare and industrial domains. The findings aim to contribute both theoretically, by filling a gap in the literature, and practically, by informing policies and business practices aligned with long-term sustainable development.

RESEARCH METHOD

This research employs a qualitative descriptive method with a literature review approach. The data were drawn from international scholarly journals, sustainability reports in the healthcare and industrial sectors, as well as policy documents related to the green economy and environmental accounting published between 2019–2024.

Data analysis was conducted using content analysis, which comprised three stages: coding to identify relevant concepts and indicators, categorization to organize the findings into core themes, and interpretation to formulate patterns of interrelationships among these

themes. These stages were applied to explain the integration of the green economy, technological innovation, and environmental accounting.

Table 1. Research Method Flow

Stage	Description	Expected Outcomes
Data Collection	International scientific journals, sustainability reports from the healthcare and industrial sectors, and policy documents (2019–2024).	Secondary data relevant to the research topic.
Coding	Identification of keywords, concepts, and indicators related to the green economy, technological innovation, and environmental accounting.	List of key concepts and indicators
Categorization	Grouping the coding results into major themes	More structured research themes
Interpretation	Analysis of interrelationships among themes to explain the integration of concepts	Patterns of interconnection between the green economy, technological innovation, and environmental accounting

Source: processed data, 2025

RESULT AND DISCUSSION

The findings highlight a synergistic relationship among the green economy, technological innovation, and environmental accounting, positioning them as foundational pillars for sustainable development strategies in the healthcare and industrial sectors..

Digitalization as a Catalyst for the Green Economy

Digital innovations such as artificial intelligence (AI), the Internet of Things (IoT), and big data play a pivotal role in improving operational efficiency while simultaneously supporting emission reductions. Evidence from Sultana et al. (2025) demonstrates that AI and the digital economy have contributed to lowering CO_2 emissions in the United States. Within this context, the concept of the *twin transition* underscores the mutually reinforcing interplay between digital transformation and environmental sustainability. The twin transition refers to the integration of digital transformation and ecological sustainability, which together foster ecological efficiency and long-term competitiveness. The adoption of digital technologies including AI, IoT, digital twins, and big data enables resource optimization, carbon footprint reduction, and enhanced environmental reporting, thereby strengthening competitive advantage through adaptive and sustainability-oriented organizational practices (Tabares et al., 2025).

Environmental Accounting Enhancing Performance and Transparency

The implementation of green accounting has been shown to significantly improve corporate environmental performance, as evidenced in Indonesia's mining, energy, and consumer goods sectors (Wahyuni et al., 2019), It has also been found to positively influence corporate sustainability through energy efficiency practices under Environmental Management Accounting (EMA) (Pratiwi et al., 2020). In the consumer goods sector, green accounting contributes to long-term sustainability (Pertiwi et al., 2023), while in the manufacturing sector, such practices have demonstrated a positive impact on firm value, particularly in relation to the Price-to-Book ratio (Kartini et al., 2024). Overall, the adoption of environmental accounting not only supports corporate sustainability but also enhances firm value by fostering transparency and energy efficiency.

The Role of the Digital Economy in Green Innovation

The digital economy plays a significant role in promoting green innovation within firms, as evidenced in China (Chen et al., 2025). It positively influences sustainable development by facilitating industrial structural transformation and serving as a driver for technological innovation aimed at enhancing environmental performance. Digital tools and platforms enable firms to adopt eco-friendly processes, optimize resource utilization, and accelerate the development of green products and services. Consequently, the integration of digital technologies with corporate strategies acts as a key mechanism for achieving high-quality green development, reinforcing both economic competitiveness and environmental sustainability (Ma & Zhu, 2022).

Analyzing and Interpreting Patterns of Interconnection

The coding analysis identified key variables, including energy efficiency, reporting transparency, and waste reduction. Environmental accounting emerges as a critical instrument for measuring and reporting environmental impacts, thereby enhancing accountability and stakeholder trust. Concurrently, digital transformation fosters operational efficiency and innovation, creating a positive feedback loop in which technological innovation reinforces the green economy, while environmental accounting provides a transparent framework that ensures these innovations develop responsibly. The interpretation of interconnection patterns indicates that the integration of the green economy, technological innovation, and environmental accounting produces mutually reinforcing synergies. The three core variables energy efficiency, reporting transparency, and waste reduction play pivotal roles in strengthening sustainability strategies, particularly within the healthcare and industrial sectors. This integrated approach highlights how technological and accounting mechanisms can jointly support long-term ecological, operational, and economic sustainability.

Table 2. Interpretation of Interconnection Patterns among Green Economy, Technological Innovation, and Environmental Accounting

Key Variables	Scientific Findings	Strategic Implications	References
Energy Efficiency	Digital innovation (AI, IoT, and big data) reduces energy consumption while enhancing productivity in the industrial and healthcare sectors.	Enhances green competitiveness and supports low-carbon development.	Fragao-Marques & Ozben, (2023); Liu et al., (2023)
Reporting Transparency	Environmental accounting strengthens accountability, corporate reputation, and investor confidence through sustainability reporting.	Serves as an external control mechanism to ensure that green strategies adhere to sustainability principles.	Putri Ir & Sisdianto, (2024); Moussa & Elmarzouky, (2024)
Waste Reduction	Firms implementing environmental accounting consistently report waste management practices; IoT facilitates smart manufacturing processes.	Reduces operational waste and enhances the efficiency of resource management.	Salavia et al., (2024); Karamina & Ilham, (2025)
Interconnection Pattern (Loop)	Digital innovation drives energy efficiency and waste reduction; environmental accounting provides a framework for accountability and transparency.	The synergy among the three dimensions creates a positive feedback loop that supports the achievement of SDGs 3, 9, and 13.	UNEP (2025); Kementerian Keuangan RI, (2023)

Source: processed data, 2025

Explanation of table 2 **First**, energy efficiency emerges as a dominant factor in strengthening the green economy through digital innovation and environmentally friendly production processes. Technologies such as the Internet of Things (IoT), artificial intelligence (AI), and big data have been shown to reduce energy consumption while simultaneously enhancing productivity (Fragao-Marques & Ozben, 2023). Liu et al., (2023) further emphasize that green innovation, in the form of process and recycling innovations, can decrease carbon emissions while improving industrial competitiveness. These findings indicate that technology serves as a key catalyst in supporting the achievement of low-carbon development goals.

Second, reporting transparency, driven by the implementation of environmental accounting, plays a significant role in enhancing organizational accountability. The application of green accounting enables firms to systematically identify, measure, and report the environmental impacts of their business activities (Putri Ir & Sisdianto, 2024). Such transparency not only strengthens corporate reputation and investor confidence (Moussa & Elmarzouky, 2024), but also fosters accountable governance. Ultimately, this transparency functions as an external control mechanism, ensuring that digital innovations and green strategies are executed in alignment with sustainability principles.

Third, waste reduction emerges as a tangible outcome of integrating technology with environmental accounting principles. Salavia et al., (2024) found that companies in Indonesia implementing environmental accounting consistently report their waste management practices, providing a stronger foundation for evaluating the effectiveness of eco-friendly innovations. Simultaneously, digital innovations, such as IoT-based smart manufacturing, facilitate production waste control by minimizing operational inefficiencies (Karamina & Ilham, 2025)

The interaction among these three variables creates a positive feedback loop: technological innovation enhances energy efficiency and waste reduction, while environmental accounting provides an accountability framework that ensures these innovations are implemented transparently and in alignment with sustainability principles. Consequently, the integration of the green economy, digital innovation, and environmental accounting not only strengthens organizational competitiveness but also serves as a long-term strategy to advance the Sustainable Development Goals (SDGs), particularly Goal 3 (Good Health and Well-being), Goal 9 (Industry, Innovation, and Infrastructure), and Goal 13 (Climate Action) (UNEP, 2025; Kementerian Keuangan RI, 2023).

CONCLUSION

The integration of the green economy, technological innovation, and environmental accounting constitutes a fundamental foundation for strengthening sustainability in the healthcare and industrial sectors. The findings indicate that digital innovation drives energy efficiency and waste reduction, while environmental accounting functions as a key instrument for accountability and transparency. The synergy between these elements generates a positive feedback loop that enhances green competitiveness and supports the achievement of the Sustainable Development Goals (SDGs), particularly Goal 3 (Good Health and Well-being), Goal 9 (Industry, Innovation, and Infrastructure), and Goal 13 (Climate Action).

This conclusion addresses the research objectives, demonstrating that the integration of these three dimensions not only enriches academic literature but also provides a practical framework for formulating sustainable development strategies that are measurable, accountable, and oriented toward long-term impact.

Suggestions for Future Research

Future studies may focus on developing more actionable implementation models at the organizational level, as well as conducting quantitative assessments of the impact of integrating these three dimensions on sustainability performance. Comparative studies across sectors and countries are also recommended to broaden understanding and enhance sustainable development practices in diverse contexts.

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