




The Integration of Digital and Green Economies: A Pathway to Sustainable Growth in Vietnam

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ABSTRACT

This paper explores the intersection of the digital and green economies, crucial for sustainable development. With rapid advancements in information and communication technologies, the digital economy has become a significant driver of economic growth and societal transformation. However, this growth comes with increased energy consumption, electronic waste, and carbon emissions. Conversely, the green economy aims to mitigate these impacts through efficient resource use and sustainable practices. Through a comprehensive analysis of secondary data and literature reviews, this study elucidates the synergistic potential of integrating digital and green initiatives to promote sustainable economic practices, enhance energy efficiency, and reduce environmental footprint. This paper provides policymakers and business leaders with insights into aligning digital innovations with ecological sustainability goals.

Keywords: carbon market, international experiences, lessons, Vietnam

1. Introduction

Vietnam has placed green economic development at the core of its national strategy (National Assembly, 2020; Government, 2022), emphasizing sustainable growth, resource efficiency, and environmental protection. The 13th National Party Congress introduced a comprehensive vision for the country's 10-year Socio-Economic Development Strategy (2021–2030), highlighting the need to integrate low-carbon economic models, promote a circular economy, and enhance climate resilience. Additionally, Resolution No. 29-NQ/TW (November 17, 2022) reaffirmed the government's commitment to accelerating industrialization and modernization by incorporating digital transformation and green initiatives across various sectors. These strategic directions underscore Vietnam's ambition to align economic growth with environmental sustainability.

A green economy prioritizes the sustainable management of natural resources, environmental protection, and climate adaptation to ensure long-term economic resilience. Both the public and private sectors in Vietnam have increasingly allocated investments toward eco-friendly infrastructure, resource-efficient projects, and clean technologies. These efforts aim to reduce pollution, enhance energy efficiency, and mitigate biodiversity loss, contributing to a more sustainable economic framework. Meanwhile, digital transformation, a key driver of the Fourth Industrial Revolution (Industry 4.0), has been rapidly evolving and reshaping production and consumption patterns. Technologies such as artificial intelligence (AI), blockchain, and the Internet of Things (IoT) (Rumana Bukit & Heeks, 2017) play an essential role in optimizing resource use and reducing environmental footprints, thereby reinforcing the connection between the digital and green economies.

Despite the increasing recognition of the importance of both digitalization and sustainability, there remains a gap in research and policy integration regarding how these two paradigms interact in the Vietnamese context. While some studies explore digital advancements in environmental monitoring or the role of green finance in economic policies, few comprehensively assess the interplay between digital transformation and green economic development (Thi Thanh Tu & Hoi Hoang Yen, 2015; Volz, 2018). This study aims to bridge that gap by examining how digital technologies contribute to or present challenges for green economic strategies in Vietnam. Specifically, the research will evaluate how technological advancements impact sustainable business practices, energy efficiency, and environmental policy implementation. By analyzing these dynamics, the study seeks to provide insights for policymakers, businesses, and stakeholders on fostering a harmonized digital-green transition for sustainable economic growth.

2. Research method

This study employs a mixed-methods approach, integrating both secondary data analysis and theoretical framework review to explore the convergence of the digital and green economies, with a specific focus on Vietnam. This section outlines the data sources, selection criteria, and analysis techniques used to ensure robust and comprehensive findings.

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K. Keni et al. (eds.), *Proceedings of the International Conference on Economics, Business, Social, and Humanities 2025 (ICEBSH 2025)*, Advances in Social Science, Education and Humanities Research 967,

https://doi.org/10.2991/978-2-38476-495-2_19

2.1 Research Framework and Hypothesis

This study formulates the following key hypotheses to guide the analysis:

- **H1:** Digital transformation positively correlates with improved energy efficiency and resource optimization in Vietnam's green economy.
- **H2:** Government policies on digital transformation significantly influence the adoption of sustainable business practices.
- **H3:** The application of digital technologies (IoT, AI, blockchain) in Vietnam leads to measurable reductions in carbon emissions.
- **H4:** Vietnam can enhance its sustainable development goals by adopting international best practices in digital-green economy integration.

2.2 Data Sources

The primary data for this research were derived from:

Secondary Data: Comprehensive review and analysis of existing literature sourced from peer-reviewed journals, industry reports, government publications, and white papers relevant to digital and green economies (World Bank, 2013; World Bank Group, 2022). Major databases such as JSTOR, Scopus, and Web of Science were utilized, with supplementary information gathered from reputable news outlets and organizational reports.

Government and Industry Reports: Specific data on Vietnam's digital and green economic policies were collected from the Vietnamese Ministry of Industry and Trade, the Ministry of Natural Resources and Environment, and reports from international bodies like the United Nations and the World Bank.

2.3 Data Analysis

This research employs a mixed-method approach, utilizing:

Secondary Data Analysis: Reviewing government reports, academic studies, and industry data from sources like the Ministry of Industry and Trade, UNDP, and the World Bank.

Comparative Case Studies: Analyzing experiences from the EU, China, and Singapore in integrating digital and green economic policies (Nguyen, 2022).

Policy Review: Evaluating Vietnam's existing regulatory framework to identify gaps and propose improvements.

3. Results and Discussions

3.1 The relationship between the digital economy and the green economy.

The digital economy and the green economy have emerged as two crucial drivers of sustainable development in the 21st century. While the concept of a green economy is a more recent development compared to the digital economy, both now coexist and are expected to play increasingly interconnected roles in the coming decades. The digital economy is characterized by economic activities and production models that rely on digital technologies, data-driven decision-making, and information networks. Meanwhile, the green economy emphasizes environmental sustainability, resource efficiency, and reduced ecological footprints. Their intersection presents both opportunities and challenges in balancing economic growth with environmental responsibility (UNFCCC, n.d.).

A key aspect of the digital economy's expansion is its impact on environmental sustainability. Since the 1990s, researchers have examined the environmental consequences of digitalization, categorizing them into four primary areas: the footprint of the ICT sector, the role of digital applications, the environmental effects of e-commerce, and broader socio-economic impacts. Policies aimed at mitigating the negative consequences of digital expansion, such as energy consumption from data centers and electronic waste (e-waste), have gained increasing attention. In parallel, digital technologies provide powerful tools for environmental monitoring, emissions tracking, and resource optimization, forming the foundation of a sustainable digital economy.

The interplay between digitalization and green transformation manifests in several ways. Across different stages of economic development, technology adoption has shown both positive and negative effects on sustainability, impacting energy use, carbon footprints, and industrial efficiency. Digital transformation is reshaping business models, supply chains, and social interactions, accelerating the shift toward resource-efficient, low-emission economic structures. The ICT sector plays a central role in modern economies, yet its environmental impact remains complex. The COVID-19 pandemic and global economic crises have influenced digital adoption

trends, simultaneously accelerating digital applications while exposing vulnerabilities in ICT infrastructure and global supply chains. At the macro level, studies suggest that internet development positively correlates with improvements in green productivity. Empirical research has demonstrated that digital innovation contributes to reducing carbon emissions, enhancing industrial efficiency, and fostering sustainable production and services. Digital tools such as artificial intelligence (AI), the Internet of Things (IoT), and blockchain have shown promise in optimizing energy consumption and reducing environmental waste. For example, AI-driven analytics can predict energy demands, IoT sensors can improve industrial resource management, and blockchain can provide transparent carbon credit trading mechanisms (Volz, 2018; Thi Thanh Tu & Hoi Hoang Yen, 2015).

Digital transformation supports green innovation through four primary mechanisms (Nguyen, Chuc, & Dang, 2019). Advances in ICT have enabled improved energy efficiency, sustainable materials usage, and waste reduction in digital infrastructure, including eco-friendly data centers and green cloud computing. Digital tools streamline the production, distribution, and consumption of goods and services, reducing inefficiencies and enhancing circular economy models. Digital platforms replace physical processes, such as e-books replacing paper books, online banking reducing paper transactions, and virtual conferencing lowering business travel emissions. Digital solutions influence consumer awareness, corporate sustainability commitments, and policy implementation, driving a cultural shift toward eco-conscious decision-making.

At the enterprise level, digitalization contributes significantly to green innovation. Digital adoption helps businesses increase efficiency, reduce waste, and lower production costs. The growth of e-commerce, digital payments, and smart logistics enables firms to decrease transaction costs and enhance supply chain transparency. Businesses leveraging big data analytics and real-time monitoring can track energy usage, manage waste disposal, and optimize logistics, contributing to a measurable reduction in environmental footprints. Implementing AI-powered automation, blockchain for supply chain tracking, and digital inventory management reduces financial and administrative burdens associated with regulatory compliance and sustainability reporting. As digital transformation advances, businesses shift toward eco-efficient value chains, investing in green technologies, renewable energy adoption, and sustainable procurement strategies.

The integration of digital and green economies offers transformative potential for achieving long-term sustainable development. While digital transformation can streamline production, reduce waste, and optimize resource management, it also presents environmental challenges, including e-waste management, energy-intensive computing, and supply chain disruptions. Addressing these challenges requires a harmonized policy approach, investments in green ICT, and collaborative innovation. Future research should continue to explore sector-specific impacts, policy frameworks, and adaptive strategies to ensure that digitalization reinforces—not undermines—environmental sustainability goals.

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3.2 International Comparative Analysis

- European Union (EU): Pioneering the Digital-Green Twin Transition

The European Union (EU) has emerged as a leader in integrating digital transformation with sustainability efforts through strategic initiatives like the European Green Deal and the twin transition agenda. These frameworks are not only policy declarations but also serve as blueprints guiding economic restructuring, technological advancements, and regulatory alignment across its member states.

Introduced in 2019, the European Green Deal outlines a vision for achieving climate neutrality by 2050. A core component of this initiative is the recognition that digital technologies can be leveraged to drive environmental objectives. Rather than treating digital and green economies as separate domains, the EU approaches them as complementary forces. For example, innovations such as smart meters, automated energy management systems, and IoT-driven precision agriculture are actively utilized to optimize resource efficiency and lower emissions.

To facilitate this dual transformation, the EU has implemented key legislative measures, including the Digital Services Act (DSA) and the Digital Markets Act (DMA). These laws regulate large digital platforms while simultaneously incentivizing the adoption of technological solutions that contribute to sustainability goals. By promoting transparency and fair competition, the EU ensures that environmental objectives remain integral to technological growth. The DSA, for instance, encourages digital service providers to take greater responsibility for their environmental impact, particularly in sectors involving cloud computing and e-commerce logistics.

Additionally, the EU Taxonomy for Sustainable Activities provides a standardized classification system that defines what constitutes an environmentally responsible economic activity. This framework enables businesses and investors to align their digital projects—such as AI-enhanced logistics, green fintech solutions, and blockchain-enabled supply chains—with sustainability benchmarks. By directing digital investments toward green initiatives, the taxonomy supports broader goals related to carbon reduction, biodiversity conservation, and pollution mitigation.

The EU also promotes a circular digital economy by integrating data-driven waste reduction strategies and fostering product life cycle management. Digital passports for consumer goods, for example, enable better tracking of materials, improving recycling efficiency and reducing overall resource depletion. These approaches illustrate how digitalization can enhance sustainability not only through operational efficiencies but also by increasing accountability in environmental management.

For Vietnam, the EU model presents valuable insights into policy integration and governance. Firstly, it demonstrates the importance of embedding sustainability principles into digital transformation strategies rather than treating them as separate efforts. Secondly, it highlights how regulatory and financial instruments—such as green taxonomies and digital regulations—can incentivize businesses to prioritize sustainable innovation. Thirdly, the EU’s experience emphasizes the role of cohesive governance at both national and international levels in managing the transition effectively.

Vietnam could benefit from adopting a similar approach by developing a “Vietnamese Green Digital Taxonomy” to guide investments in green digital infrastructure. Additionally, adapting regulatory mechanisms from the DSA and DMA could help Vietnam establish governance structures that support both digital economic growth and environmental protection. Ultimately, the EU’s experience highlights that a well-coordinated digital-green transition is both necessary and achievable through long-term vision, policy coherence, and institutional commitment.

- China: Driving Green Transformation through Digital Technology

China has positioned itself as a global leader in leveraging digital technologies to drive sustainability, reflecting a strategic shift toward green and innovation-driven growth. Faced with significant environmental challenges stemming from rapid industrialization, China has prioritized integrating digital solutions into its green development policies.

Through initiatives such as the Digital China Strategy, Smart City projects, and the 14th Five-Year Plan (2021–2025), China has made digital transformation a cornerstone of its sustainability agenda. The government has set ambitious targets for reducing carbon intensity and achieving carbon neutrality by 2060, alongside substantial investments in AI, big data, cloud computing, blockchain, and the Internet of Things (IoT). These technologies are not deployed in isolation but are integrated across industries—including energy, manufacturing, transportation, and agriculture—to enhance efficiency, transparency, and sustainability.

One of China’s most significant applications of digital technology in environmental management is its use of AI-powered platforms for real-time monitoring of emissions and predictive analytics. Smart sensors installed in industrial zones collect extensive environmental data, which AI algorithms analyze to detect potential violations and forecast pollution levels. This system has greatly improved regulatory enforcement, reducing dependence on manual inspections and enabling more effective environmental governance.

Another major advancement is China’s use of blockchain technology in carbon trading. The national carbon market, launched in 2021, is underpinned by digital systems that ensure the accurate and secure recording of emissions data and trading transactions. This level of transparency helps build trust among market participants and facilitates the expansion of market-driven mechanisms for reducing greenhouse gas emissions. Blockchain technology is also being applied in supply chain tracking, allowing businesses and consumers to verify the environmental impact of products throughout their life cycles.

China has also made strides in the development of smart energy management systems. Digital platforms are integrated into power grids to optimize energy distribution, monitor renewable energy inputs, and minimize transmission losses. AI-driven forecasting tools and smart meters empower utilities and consumers to manage energy consumption more efficiently, supporting a shift toward low-carbon energy solutions. In urban settings, Smart City initiatives incorporate data-driven urban planning, intelligent traffic systems, and waste management technologies to enhance sustainability.

For Vietnam, China’s experience offers several strategic takeaways. First, it underscores the importance of state-led investments in digital infrastructure, which are essential for enabling large-scale deployment of green technologies. Vietnam can prioritize similar smart infrastructure projects, particularly in urban development, renewable energy expansion, and sustainable logistics.

Second, China’s approach illustrates how effective data governance and digital integration can improve environmental compliance and accountability. Vietnam could benefit from establishing national digital platforms

for environmental monitoring, linking real-time data from businesses, local authorities, and regulators. This would not only enhance enforcement but also promote greater public engagement in environmental oversight.

Third, China's model highlights the value of aligning green finance mechanisms with digital innovation. Vietnam could explore the development of digital-based carbon markets, enhance tracking of green bonds, and expand financial technology (fintech) solutions that facilitate sustainable investment.

While China and Vietnam differ in terms of governance structures and economic scale, the core principle remains relevant: digital transformation is not merely an enabler of economic development but a critical pillar of 21st-century environmental governance. By adopting a similar integrative approach, Vietnam can leverage digitalization as a strategic tool to support its climate commitments and long-term green growth objectives.

- Singapore: A Smart Nation Model for Green and Digital Synergy – Implications for Vietnam

Singapore provides a compelling example of how a small, resource-limited country can harness digital innovation to promote environmental sustainability, positioning itself as a leader in the integration of digital and green economies. Due to its constrained natural resources and limited land area, Singapore has prioritized technological advancement to achieve sustainable growth, a strategy formalized through its Smart Nation Initiative launched in 2014.

A fundamental aspect of Singapore's approach is the seamless integration of digital infrastructure across key sectors such as transportation, energy, waste management, water resources, and housing. These advancements are closely aligned with environmental goals, creating an interconnected, resilient, and adaptive urban ecosystem. Through the strategic use of data-driven governance, state-of-the-art digital infrastructure, and multi-sector collaboration, Singapore has successfully built a model for sustainable urban management.

One of the country's most notable innovations is its smart water and waste management systems. The NEWater initiative, for instance, employs cutting-edge membrane technology and IoT-based monitoring to recycle wastewater into potable water, reducing dependence on external sources and minimizing environmental impact. In the waste management sector, sensor-enabled trash bins facilitate optimized collection routes, minimizing fuel consumption and lowering emissions.

Singapore's Urban Redevelopment Authority (URA) leverages big data analytics and geographic information systems (GIS) to create compact, energy-efficient, and livable urban spaces. Additionally, the city-state has pioneered the use of digital twins—virtual simulations of real-world environments—to enable precise urban planning, optimize energy consumption, enhance green spaces, and improve traffic flow. A key component of these sustainability efforts is the implementation of e-governance and open data platforms, allowing citizens to access real-time environmental data, report violations such as illegal dumping, and actively participate in policy discussions through digital applications. This high level of civic engagement fosters transparency, strengthens environmental awareness, and promotes a collective commitment to sustainable urban living.

From an economic perspective, Singapore has positioned itself as a hub for green fintech and sustainable finance. The Project Greenprint initiative, spearheaded by the Monetary Authority of Singapore (MAS), employs artificial intelligence and blockchain technology to establish a trusted data ecosystem for environmental, social, and governance (ESG) disclosures and green finance. These digital tools enhance efficiency in capital allocation for sustainability projects while streamlining compliance and verification processes. Moreover, Singapore's extensive use of digital payment systems contributes to the dematerialization of economic activities by reducing reliance on physical cash, minimizing logistics costs, and limiting the need for paper-based transactions. The adoption of e-invoicing, digital banking, and consumer-facing carbon footprint calculators exemplifies how financial technology can promote sustainable consumption and low-carbon lifestyles.

For Vietnam, Singapore's digital-green strategy presents valuable lessons in long-term policy planning, public-private collaboration, and digital governance. Cities like Hanoi, Ho Chi Minh City, and Da Nang are actively developing smart city frameworks, and aligning these projects with clear sustainability objectives can prevent the risk of digital expansion that lacks environmental consideration. Furthermore, Singapore's emphasis on capacity-building and digital literacy programs is particularly relevant for Vietnam, ensuring that technological adoption is inclusive and benefits all segments of society. Vietnam can also strengthen bilateral cooperation with Singapore by establishing joint knowledge-sharing initiatives, digital innovation hubs, and co-investment opportunities in green technology startups. By leveraging Singapore's expertise in urban intelligence and data-driven sustainability management, Vietnamese local governments can enhance service efficiency, reduce ecological footprints, and foster greater community engagement in environmental efforts.

3.3 The development of digital economy and green economy in Vietnam

The integration of the digital economy and green economy has become a pivotal strategy for Vietnam, ensuring both rapid and sustainable growth in the first half of the 21st century. In the context of the Fourth Industrial

Revolution, digital transformation and green growth have emerged as the most viable approaches, given that digital expansion is advancing at an unprecedented pace while requiring fewer physical resources. The information and communication technology (ICT) sector, along with telecommunications, plays a crucial role in making environmental impacts more transparent and creating opportunities to mitigate them. Policymakers recognize the necessity of prioritizing digital economic policies as a means of achieving green growth, aligning national efforts with global climate change mitigation strategies rather than focusing solely on localized economic objectives.

As Vietnam progresses in its post-pandemic economic recovery, the digital economy is gaining a more significant role within the traditional economic structure. The expansion of ICT-driven markets and digital infrastructure is expected to serve as a catalyst for new growth models, providing innovative solutions to address environmental challenges and economic uncertainties. Vietnam's national development strategy has increasingly emphasized the importance of harmonizing digital and green economic objectives. The country's 10-year Socio-Economic Development Strategy (2021–2030) and the 5-year Socio-Economic Development Plan (2021–2025) both stress the implementation of the Green Growth Strategy as a key priority. These efforts present a significant opportunity for Vietnam to position itself as a regional leader in green growth, green recovery, and sustainable development. Moving forward, the challenge lies in overcoming economic recovery constraints while maintaining innovation-driven, high-quality, and efficient economic models.

The development of Vietnam's digital economy dates back to the late 1990s, with the rise of the internet and the rapid adoption of digital technologies. By the late 2000s, internet usage had surged, with smartphone penetration exceeding 50%. This trend accelerated further with the advent of the Fourth Industrial Revolution in the late 2010s. Recognizing the transformative potential of digitalization, the government has consistently emphasized national digital transformation, aiming to enhance productivity, efficiency, and competitiveness. Digital economic growth has been recognized as a central pillar in Vietnam's long-term economic development strategy. To facilitate this transformation, the Politburo issued Resolution No. 52-NQ/TW on September 27, 2019, outlining key policies and proactive measures for Vietnam's participation in the Fourth Industrial Revolution. This resolution sets forth eight guiding principles and several ambitious targets for the period 2025–2045, including an objective for the digital economy to contribute approximately 20% of GDP by 2025 and over 30% by 2030. The 13th National Party Congress (2021) reaffirmed this commitment by advocating for continued innovation, institutional modernization, and the advancement of digital economic and social transformation. These directives emphasize restructuring the economy, promoting industrialization, and fostering a knowledge-based society centered around innovation and creativity.

Looking ahead, the digital economy is expected to remain a primary driver of Vietnam's economic expansion. Government policies prioritize digital economic growth as a fundamental strategy for restructuring the economy, transitioning to higher-value industries, and escaping the middle-income trap, with a long-term vision of becoming a developed industrialized nation by 2045. To support this transition, the Vietnamese government has actively developed regulatory frameworks and issued numerous policies, including decrees and circulars, to establish a structured and well-managed digital economy. A key milestone in this journey was the issuance of Decision No. 749/QĐ-TTg on June 3, 2020, which launched the National Digital Transformation Program aimed at guiding digital development until 2025 and beyond to 2030. The program outlines dual objectives: fostering the growth of a digital government, digital economy, and digital society, while simultaneously encouraging the formation of Vietnamese digital technology enterprises capable of competing on a global scale. The program sets ambitious benchmarks, including ensuring that the digital economy accounts for at least 20% of GDP by 2025, increasing the digital sector's contribution in each economic field to a minimum of 10%, and achieving an annual labor productivity increase of at least 7%. By 2025, Vietnam also aims to significantly enhance its digital infrastructure, with targets such as ensuring over 80% of households have access to fiber-optic broadband, achieving 100% nationwide 4G/5G coverage, and surpassing a 50% penetration rate for electronic payment systems. Additionally, Vietnam seeks to strengthen its position in global digital competitiveness rankings, with aspirations to rank among the top 50 in the Information Technology Index (IDI) and Global Competitiveness Index (GCI), the top 35 in the Global Innovation Index (GII), and the top 40 in the Global Cybersecurity Index (GCI).

Vietnam's digital transformation and green economic development are deeply interconnected. While the digital economy presents significant opportunities for enhancing efficiency, productivity, and economic resilience, it also plays a crucial role in supporting environmental sustainability by reducing resource consumption, optimizing energy use, and promoting circular economic models. The successful realization of Vietnam's digital and green economic goals will depend on the country's ability to implement cohesive policies, invest in digital infrastructure, and foster innovation across multiple sectors.

3.4 Challenges in Vietnam's digital-green transition

Although digital transformation and green growth present significant opportunities for Vietnam, the integration of these two priorities remains complex. Several structural, institutional, and financial obstacles hinder the

country's ability to fully harness the benefits of the digital-green economy. The key challenges can be categorized into three main areas: regulatory gaps, infrastructure constraints, and financial barriers for small and medium-sized enterprises (SMEs).

Regulatory Gaps

Vietnam's policy framework for digital transformation and environmental sustainability remains fragmented, with limited cross-sectoral coordination. Different ministries oversee separate aspects of digitalization and green growth, leading to inconsistencies in policy implementation. For instance, while the Ministry of Information and Communications drives national digitalization efforts, these initiatives are not always aligned with environmental sustainability targets set by the Ministry of Natural Resources and Environment. The lack of harmonized regulations makes it difficult to integrate sustainability principles into digital policies and vice versa. Additionally, there are insufficient legal guidelines governing the environmental impact of digital technologies, including data center energy consumption, electronic waste management, and the carbon footprint of ICT infrastructure. The absence of standardized policies and incentives creates uncertainty for businesses looking to invest in green digital solutions, such as carbon tracking platforms, digital product passports, and sustainable fintech applications. Addressing these regulatory gaps will require a more coordinated approach among government agencies to establish clear and enforceable policies that support the digital-green transition.

Infrastructure Limitations

Vietnam has made significant progress in expanding its digital infrastructure, yet disparities between urban and rural areas remain a major barrier to widespread digital adoption. Many regions still face challenges related to limited high-speed internet access, inadequate cloud computing services, and the absence of advanced data management systems—factors that are essential for implementing smart and sustainable technologies. The lack of robust ICT infrastructure disproportionately affects sectors such as agriculture, energy efficiency, and waste management, where IoT-based solutions could enhance sustainability efforts. Beyond digital infrastructure, environmental infrastructure—including smart grids, green-certified buildings, and integrated waste management systems—remains underdeveloped. The successful deployment of digital sustainability solutions depends on the availability of supporting physical infrastructure, which is still in the early stages of development in Vietnam. Closing this infrastructure gap is critical to ensuring that digital innovations can effectively contribute to environmental and economic goals.

Financial Barriers for SMEs

As the backbone of Vietnam's economy, small and medium-sized enterprises (SMEs) play a crucial role in driving digital and green transformation (Bao Tram, 2022). However, limited access to financing poses a significant obstacle to their adoption of sustainable cloud and digital technologies. Many SMEs struggle with the high initial costs associated with investing in automation, energy-efficient equipment, and digital platforms, while the return on investment is often uncertain or long-term. Vietnam's green finance ecosystem remains underdeveloped (Nguyen, D., 2022; Nguyen, Chuc, & Dang, 2019), with few tailored financial instruments such as green bonds, concessional loans, or sustainability-linked credit facilities specifically designed to support digital-green initiatives. The lack of risk-sharing mechanisms and credit guarantees further discourages commercial banks from financing projects related to digital sustainability, particularly in sectors with lower profit margins such as agriculture and waste management.

Without targeted policy interventions and financial incentives, SMEs are unlikely to be early adopters of green digital technologies, slowing down the country's overall transition. To overcome these challenges, Vietnam must establish a more comprehensive support system encompassing regulatory reforms, infrastructure investments, and accessible financing mechanisms to enable businesses of all sizes to participate in the digital-green economy.

4. Conclusions and Suggestions

This paper examines the potential for Vietnam to align its digital transformation with green economic initiatives to foster sustainable development. By leveraging digital technologies in sustainability efforts, Vietnam can stimulate economic growth while minimizing environmental impacts. The findings underscore the interconnected nature of these two paradigms, which are essential for addressing both economic and ecological challenges in the era of the Fourth Industrial Revolution and climate change.

The analysis highlights that digital technologies play a crucial role in enhancing resource efficiency across various green economy sectors. For instance, IoT applications in agriculture optimize water and fertilizer use, leading to increased productivity and sustainability. However, the rapid expansion of the digital economy has also introduced new environmental concerns, such as rising electronic waste and escalating energy consumption. These challenges emphasize the need for robust e-waste management systems and the adoption of energy-

efficient digital solutions to mitigate negative environmental impacts. Given these complexities, policymakers must address both the opportunities and obstacles in integrating digital and green economic policies. Regulatory frameworks should not only incentivize the adoption of sustainable digital technologies but also establish comprehensive guidelines covering their full lifecycle, from production to disposal. Additionally, workforce training programs must prioritize digital literacy alongside environmental sustainability to equip individuals with the skills needed to drive and benefit from this transition.

Future research should focus on technological advancements that support circular economy principles, particularly in recycling electronic waste and improving energy efficiency in the ICT sector. Furthermore, Vietnam must work toward embedding green growth principles into its national development strategies to ensure coherence between digitalization and sustainability objectives. Strengthening institutional collaboration, aligning public and private investments with sustainability goals, and refining fiscal policies to encourage environmentally responsible digital innovation are all critical steps.

- Policy Suggestions:

Vietnam should develop a national digital-green roadmap that outlines a comprehensive strategy for integrating digital transformation with green growth. This roadmap should set long-term objectives, define performance indicators, and establish clear inter-ministerial roles to ensure a cohesive national approach.

To encourage private sector investment in sustainable digital solutions, the government should introduce tax incentives such as deductions, accelerated depreciation, and R&D subsidies. These measures should target industries that invest in energy-efficient data centers, eco-friendly digital production, blockchain-based sustainability applications, and platforms that promote carbon footprint tracking and resource optimization.

Public-private partnerships should be strengthened to drive the development and deployment of green digital innovations. Collaboration between government agencies, businesses, and research institutions can facilitate the creation of AI-powered smart grids, digital twin applications for urban planning, and IoT-based waste management systems. Such initiatives should be supported through regulatory frameworks that encourage shared data ecosystems, co-investment mechanisms, and innovation testbeds.

Expanding digital infrastructure and improving digital literacy are fundamental to ensuring inclusive green transformation. Investments in broadband connectivity, cloud services, and mobile network expansion should prioritize underserved rural and remote areas. Additionally, national digital skills programs should integrate environmental awareness training to help workers in traditional industries, farmers, and SMEs leverage digital tools for sustainability.

Vietnam should actively learn from international best practices by studying successful digital-green integration models from regions such as the EU, China, and Singapore (UNFCCC, n.d.; World Bank, 2013). This can be achieved through participation in global sustainability forums, forming bilateral partnerships, and establishing joint research initiatives. However, it is crucial to tailor international approaches to Vietnam's specific economic conditions, regulatory framework, and technological infrastructure to ensure practical and effective implementation.

Embedding green growth metrics into digital development strategies is essential for monitoring progress and ensuring accountability. Key environmental performance indicators—such as carbon intensity, resource efficiency, and e-waste recycling rates—should be incorporated into national and provincial planning documents to align digital investment with sustainability objectives.

Enhancing inter-ministerial coordination and institutional capacity is critical for ensuring a synchronized digital-green transition (World Bank Group, 2022). Establishing an inter-agency task force or steering committee dedicated to overseeing the integration of digital and green policies can help prevent regulatory fragmentation and improve implementation efficiency.

Supporting SMEs through targeted funding and innovation programs is essential for fostering inclusive participation in the digital-green transition. SMEs, which represent the majority of Vietnam's business landscape, often struggle to access capital and expertise for green digital solutions. The government should develop specialized funding mechanisms, incubation programs, and financial incentives to support SMEs in adopting technologies such as green e-commerce, digital logistics platforms, and energy management solutions.

This paper contributes to the existing body of knowledge by detailing the interactions between digital and green economic initiatives and offering actionable policy recommendations. Moving forward, continuous research, adaptive policy frameworks, and strong stakeholder collaboration will be key to navigating the complexities of Vietnam's digital-green transition and maximizing its long-term benefits. By strategically integrating digital

innovation with environmental objectives, Vietnam can accelerate sustainable development while enhancing its global economic competitiveness (Journal of Economics and Forecasting, 2022).

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