

Green industry implementation in Vietnam: Current situation and some policy implications

Dinh Hoang Tuong Vi^{1,2,*}, Pham Nhat Quang^{1,2}



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ABSTRACT

Vietnam has committed to achieving net-zero carbon emissions by 2050, rendering the transition toward a green industry (GI) a strategic imperative. In this context, the transformation of the industrial sector toward greener production models is not only an environmental necessity but also a critical condition for maintaining competitiveness and deeper integration into global value chains. Despite this commitment, the practical implementation of GI in Vietnam continues to face significant constraints, including fragmented policy frameworks, limited access to finance, weak innovation capacity, and a shortage of skilled labor. Against this backdrop, this study aims to assess the current status of green industry development in Vietnam by identifying key achievements, persistent challenges, and emerging opportunities. The findings indicate that although Vietnam has made initial progress through initiatives such as eco-industrial parks and the promotion of green finance, these efforts remain uneven and insufficient in scale and effectiveness. Most enterprises, particularly small and medium-sized firms (SMEs), encounter substantial barriers related to high compliance costs and restricted access to green credit, while foreign direct investment has largely concentrated in environmentally intensive industries. Moreover, pronounced regional disparities and low labor productivity further impede a balanced and inclusive green transition. Based on these insights, the study proposes a set of comprehensive policy measures, including strengthening the institutional and regulatory framework, promoting innovation and technological upgrading, enhancing human capital for the GI transition, and improving resource and environmental management within green industrial zones. These policy implications are expected to accelerate Vietnam's GI transformation, enhance its competitiveness in global markets, and support sustainable and inclusive economic growth.

Key words: green industry, legal framework, green industrial policy

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History

- Received: 14-08-2025
- Revised: 02-03-2026
- Accepted: 28-08-2026
- Published Online: 28-09-2026

DOI : <https://doi.org/10.32508/vnuhcmj-ebl.v10i3.1711>



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INTRODUCTION

The concept of “green industry” emerged alongside the industrial revolutions, when local enterprises were recognized as contributing negatively to environmental quality¹. In response, the United Nations Industrial Development Organization (UNIDO) introduced the term with the aim of aligning industrial development with global sustainable development goals. GI refers to the transformation of industries toward environmentally friendly practices by integrating climate and social considerations into production processes and promoting sustainable models of production and consumption¹. Unlike traditional pollution control approaches that focus on end-of-pipe treatment, GI emphasizes pollution prevention across the entire production cycle. This includes input-saving measures, cleaner production processes, output recycling, and the adoption of industrial ecology models that mimic natural ecosystems². Compared to conventional or “brown” industry, GI offers superior production efficiency, cost reduction, and

fosters sustainable growth^{3,4}. Only when enterprises can produce more with fewer resources, can they truly become sustainable¹. Achieving this requires the promotion of green practices throughout several stages: from technological upgrades to pollution reduction, the adoption of resource-efficient production models, and ultimately a full-scale transition to GI.

In Vietnam, GI plays a pivotal role in the national roadmap to reduce greenhouse gas emissions and achieve the net-zero emissions target. Transitioning toward GI not only alleviates environmental pressures but also fosters technological innovation, enhances production efficiency, and ensures long-term economic sustainability. However, the implementation of GI in Vietnam faces multiple institutional and operational challenges: (1) fragmented and insufficiently detailed institutional and policy frameworks to guide stakeholders' actions; (2) limited financial resources, particularly for small and medium-sized enterprises in accessing green credit; (3) a lack of data, information, and adequate assessment tools for green

Cite this article : Tuong Vi D H, Quang P N. **Green industry implementation in Vietnam: Current situation and some policy implications.** *VNUHCM J. Econ. Bus. Law.* 2026; 10(3):7075-7086.

technologies; and (4) a workforce whose skills and qualifications are currently inadequate to meet the technological and scientific demands of a green economy.

This paper seeks to analyze both theoretical and practical issues associated with GI implementation in Vietnam. It provides an overview of the current state of GI development and offers policy implications based on the analysis to support a sustainable and efficient industrial transition.

LITERATURE REVIEW

Studies on regulatory systems and economic incentives

Studies on regulatory systems and economic incentives emphasize the complementary roles of GI policies and market mechanisms in establishing the foundation for, and driving the implementation of GI. Such policies also address market failures by advancing green finance, facilitating green credit access, issuing emission permits, and implementing broader market reforms⁴. Green finance and green credit have emerged as important tools, acting as capital reallocation channels from polluting industries toward cleaner production sectors⁵. Furthermore, emissions trading schemes have proven effective in reducing SO₂ emissions, improving green innovation efficiency, and driving industrial restructuring^{6,7}. In Vietnam, current macro-level policies have yet to sufficiently prioritize green credit, necessitating adjustments to support investments in green assets, stabilize the financial system, and strengthen foreign exchange markets in the face of climate-induced shocks⁸. Regulatory frameworks also influence the capacity of non-bank financial institutions to offer green credit, thereby indirectly reducing pollution, redirecting investment capital, and fostering sustainable development⁹. Price-based policy instruments, such as environmental taxes, and incentive mechanisms, including public spending, have likewise proven effective in promoting the adoption of low-emission renewable energy sources^{10,11}.

Markets also stimulate green initiatives by offering subsidies, tax exemptions, or preferential credit terms for environmentally friendly projects. Consumer demand for eco-friendly products further motivates firms to adopt sustainable production models in pursuit of profitability. Green initiatives introduced in one market may also spill over into others¹². The relationship between green bonds and financial markets is dynamic: while short-term effects may be negative, long-term impacts tend to be positive¹³. In

the case of Vietnam, green investments influence CO₂ emissions, though this impact varies depending on financial market conditions and the pace of economic growth^{14,15}. In Asia-Pacific countries, green finance has been found to enhance energy efficiency. Accordingly, there is a pressing need to develop legal frameworks and supportive policies to promote environmental technologies and attract foreign direct investment^{15,16}.

Studies on production efficiency and model transformation

Innovation - particularly green innovation - serves as a key driver of GI, focusing on green technologies, green productivity, and the circular economy. The case of China illustrates this point: its shift from a highly polluting economy toward green and sustainable growth has been largely attributed to advancements in green technology¹⁷. Both regulatory frameworks and market competition have been shown to redirect capital from traditional investments toward green assets, thereby fostering green innovation¹⁸. In addition, provincial and local governments have played a vital role in developing large-scale infrastructure that facilitates the production of renewable energy at optimized costs¹⁹. Technological innovation has also been found to significantly improve green productivity²⁰. Moreover, innovation within the circular economy promotes industrial restructuring in pursuit of sustainable development. Corporate governance exerts a positive influence on green innovation, especially in countries with well-functioning institutional environments²¹. In Vietnam, assessments of circular economy development suggest that although still in its early stages, models such as recycling, renewable energy, and the sharing economy have already delivered positive outcomes across economic, social, and environmental dimensions. To further promote the circular economy, clear policy design and an enabling institutional environment are essential²².

Studies on human resource development and equity

Human capital is not only a critical issue for Vietnam's overall development but also a decisive factor in the process of green industrialization. Moreover, inclusiveness ensures that all stakeholders can participate in, benefit from, and are not left behind during this transition. Human capital fosters green innovation, reduces pollution, and creates green jobs. Higher education has been shown to have a positive

impact on green total factor productivity²³⁻²⁵. High levels of human capital reduce dependence on non-renewable energy sources, enhance the efficiency of green energy consumption, and promote the use of renewable energy²⁶⁻²⁹. In the context of enterprises, green human resource management (green HRM) improves environmental awareness and performance, while green training equips workers with the necessary skills and attitudes to promote corporate sustainability^{30,31}. However, green skills training needs to be aligned with labor demand in the renewable energy sector, particularly in areas such as design, financial management, urban planning, and communications³². In Vietnam, income inequality exists between workers in green and non-green jobs, although economic growth has been found to positively influence the creation of green employment^{33,34}. Additionally, individual factors such as age and education level influence access to green jobs, while regional characteristics and economic structures create disparities in green employment opportunities³⁵.

Studies on resource management and environmental impact

Natural resources exert a significant influence on the development of GI. Economies that rely heavily on resource extraction tend to become less competitive and slower to innovate⁴. In the case of China, resource dependence hinders green growth by eroding both human and technological capital³⁶. For instance, regions with abundant renewable energy sources such as Qinghai experience lower pollution levels compared to more fossil fuel-dependent provinces like Shaanxi and Xinjiang³⁷. As resources become depleted, investments in green infrastructure and technologies help accelerate the green transition³⁸. China is actively promoting technological innovation to mitigate the risks of “stranded assets” in carbon-intensive sectors³⁹. Although coal-fired electricity generation is still subsidized, the country is also developing carbon markets and increasing carbon pricing to expedite decarbonization⁴⁰. In contrast, coal and oil sectors in regions such as the Middle East and Latin America face growing risks of stranded assets⁴¹. In emerging Southeast Asian markets, the trade-off between economic growth and climate change mitigation is becoming more pronounced, underscoring the urgent need for cleaner production processes⁴².

GI aims to delink economic expansion from unsustainable resource exploitation through two primary forms of decoupling: relative and absolute. Relative decoupling occurs when environmental pressures

grow more slowly than GDP, thanks to improved pollution control and resource efficiency. Absolute decoupling, by contrast, refers to a scenario in which emissions and pollution decline even as the economy continues to grow¹. Advanced economies have come close to achieving absolute decoupling primarily through technological progress, while developing countries have relied more on industrial restructuring⁴³. One of the most effective strategies to improve decoupling is increased investment in R&D⁴⁴. However, decoupling gains are not always permanent. Without sustained and coordinated efforts, countries may revert to higher emissions levels. In Vietnam, GDP growth has been associated with negative environmental effects in the short term but contributes to emission reductions in the long term. Consequently, the government should promote foreign direct investment (FDI) in renewable energy to ensure a green and sustainable growth trajectory⁴⁵.

METHODOLOGY

This article employs a qualitative approach, specifically as follows: First, a systematic literature review is conducted to analyze and evaluate materials related to green industry, thereby providing valuable insights into the concept and identifying key pillars for a detailed analysis of the current situation in Vietnam. Second, statistical analysis is used to examine the status of green industry through various human, energy, and socio-economic indicators. Third, a comparative method is applied to contrast Vietnam's practices with those of other nations (including China, Germany, and Japan), highlighting the international context. Finally, a case study approach is utilized to analyze the successes and limitations of specific prominent green industry policies and strategies implemented in Vietnam in recent times.

RESULTS AND DISCUSSION

Regulatory systems and economic incentives

Vietnam has yet to adopt a comprehensive and specialized policy framework dedicated to GI. GI-related content is primarily integrated into broader national strategies such as the National Green Growth Strategy, the Circular Economy Development Scheme. Despite these efforts, Vietnam's policymaking process continues to face several critical shortcomings. Major obstacles include institutional fragmentation, legal and regulatory gaps, underdeveloped policy frameworks, and insufficient investment resources^{46,47}. In practice, GI implementation remains limited due to

uneven awareness of green growth and GI across provinces and sectors. In many localities, these concepts have yet to be operationalized as concrete and prioritized policy agendas, leading to inconsistent implementation⁴⁸. An example is the instability in renewable energy policies. As illustrated in Figure 1, the share of renewable energy in total energy supply increased significantly up to 2017 but declined sharply from 2018 to 2020, largely due to abrupt changes in policy - particularly revisions to feed-in-tariff (FIT) pricing for solar power⁴⁹. Although this trend showed signs of recovery in 2021 following policy adjustments, the share has yet to return to its previous peak.

One of the most essential components for promoting GI is the establishment of green finance mechanisms. In recent years, the Vietnamese government has made initial efforts to lay the groundwork for green finance, including the National Green Growth Strategy, a circular guiding environmental risk management in credit activities, and a pilot roadmap for developing green banking in Vietnam. Nevertheless, current support mechanisms remain underdeveloped, and access to green financial resources is limited. Although the State Bank of Vietnam has issued circulars to encourage green credit, borrowing conditions remain stringent and interest rates are high, deterring firms from financing green projects effectively. Vietnam is also witnessing a growing interest in GI from the market, as reflected in the rise of sustainable consumption and the growth of green credit. However, several barriers remain, including high product prices, underdeveloped distribution systems, lack of transparency in information, and unsatisfactory product quality. These challenges hinder the expansion of the green product market and create obstacles for enterprises in improving supply chains and enhancing product value to attract consumers⁵⁰. Parallel to the shift in consumer preferences, green credit has expanded significantly from 2017 to 2024, indicating growing financial market interest in green projects (Figure 2). However, the growth trajectory remains volatile due to the lack of a clear legal framework and standardization in green finance deployment. Additionally, financial institutions often lack the capacity to assess risks associated with green projects, resulting in bottlenecks in credit allocation⁵¹. From the business side, most enterprises are not yet fully aware of the long-term benefits of transitioning to green production models. Amid ongoing economic challenges, many firms are reluctant to invest in green production due to concerns over high costs, thus weakening the motivation to pursue green finance.

In addition to domestic factors, foreign direct investment (FDI) also plays a vital role in shaping Vietnam's GI landscape. However, empirical evidence indicates that the majority of FDI projects are concentrated in high-emission, low-value-added, and environmentally unfriendly industries. The quality of FDI remains relatively low, as many projects are limited to assembly or light industrial processing, with small or medium scale and minimal contribution to the green value chain⁵².

Production efficiency and the transformation of industrial production models

In Vietnam, innovation is increasingly emerging as a key driver of economic development in general and industrial advancement in particular, with both the public and private sectors actively participating. The government has made efforts to foster innovation by establishing research centers, promoting the development of eco-industrial parks, and raising environmental standards. However, despite these initiatives, the effectiveness of green innovation remains below expectations. According to the World Intellectual Property Organization (WIPO), Vietnam ranked 44th in the Global Innovation Index (GII) and held the second position among lower-middle-income economies, after India⁵³. This suggests that Vietnam still faces a considerable gap in innovation capacity compared to more advanced economies. Beside that, according to the Global Green Economy Index report updated in 2024, Vietnam ranked 79th out of 160 countries in terms of Green Economy Index, behind Timor-Leste⁵⁴. Despite many efforts, this ranking shows that Vietnam's green economy is still modest.

Several key challenges contribute to this gap: **First**, the cost of investment in green technologies remains high. Enterprises aiming to transition toward sustainable production must bear substantial expenses for modern equipment, process upgrades, and workforce retraining. However, the majority of Vietnamese firms are small and medium-sized enterprises (SMEs), which already encounter difficulties in accessing finance, thus making it harder for them to adapt to the green production trend. **Second**, the domestic capacity for R&D is relatively weak. Vietnam's R&D expenditure has remained modest, at only 0.11% to 0.16% of GDP - significantly lower than that of developed countries. This underinvestment has resulted in heavy reliance on imported technologies, limiting the country's ability to generate endogenous

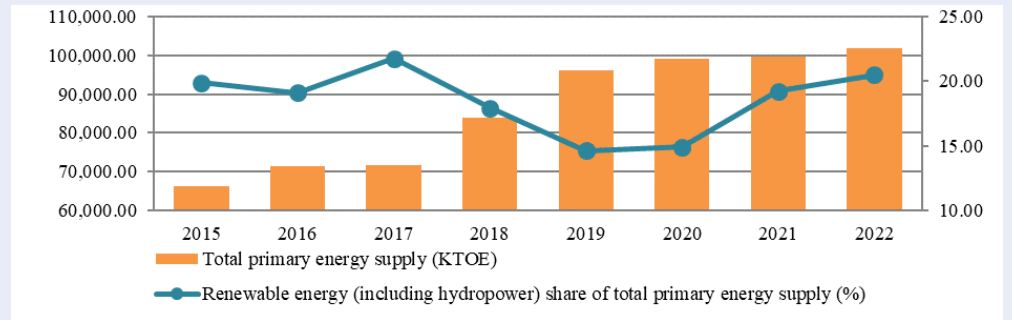


Figure 1: Renewable energy production situation, period 2015 - 2022 Source: General Statistics Office (2025)

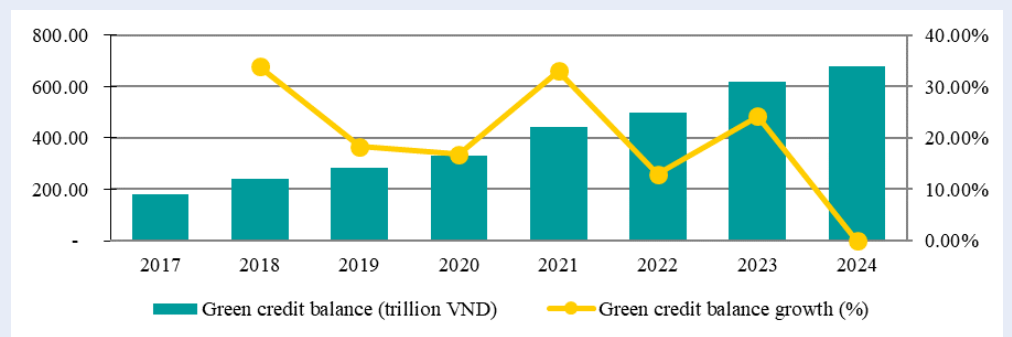


Figure 2: Green credit balance, period 2017 - 2024 Source: State Bank of Vietnam, BIDV Research Institute (2024)

innovations tailored to its development context. **Finally**, there is still a lack of comprehensive awareness among businesses regarding the long-term benefits of green technologies. Many firms remain hesitant to innovate, as the associated benefits are mostly realized in the long run and do not yield immediate profits. For instance, converting a textile manufacturing facility to run on renewable energy and to meet international standards for wastewater treatment can require an investment of several million USD, while the financial benefits may take five to ten years to materialize. Without sufficient technical guidance or institutional support, firms are often left uncertain about how to implement green innovations effectively and meet evolving environmental expectations in the global market.

The government has taken many steps to promote green transformation, including encouraging the development of eco-industrial parks, supporting businesses to apply clean technology, and issuing stricter environmental standards. Decree 82/2018/ND-CP has created a legal framework for converting traditional industrial parks into eco-industrial parks. Some industrial parks such as Deep C and Nam Cau

Kien (Hai Phong) have pioneered the circular economy model. However, most of the remaining industrial parks are still operating under the traditional model, causing serious environmental pollution. According to statistics from the Ministry of Planning and Investment, in 2024, Viet Nam had 431 industrial parks and export processing zones, of which 301 industrial parks had come into operation⁵⁵. FDI capital in industrial parks and economic zones also accounts for about 35% - 40% of the total registered FDI capital of the whole country. Interestingly, if we only count the processing and manufacturing sector, these capital accounts for 70% - 80% of the total registered capital of the whole country⁵⁵. However, the rapid development of industrial parks has put great pressure on the environment when 13% of operating industrial parks have not built wastewater treatment plants, threatening the health and lives of people around the industrial parks. Water pollution, air pollution, and increased hazardous waste threaten the health of surrounding communities⁵⁵.

Barriers to green transformation in Vietnam include high investment costs and long payback periods. For example, to convert a textile factory to use renewable

energy and an internationally standardized wastewater treatment system, businesses may have to invest millions of dollars, while financial benefits may take 5 to 10 years. In addition, many businesses still lack knowledge of international environmental standards, leading to a passive state in the conversion process.

Human resource development and equity

Vietnam currently possesses one of the strongest human capital foundations in Southeast Asia, with an average of 10.2 years of schooling - ranking second in the region - and a Human Capital Index of 0.69, the highest among lower-middle-income economies⁵⁶. This provides a favorable basis for developing a green workforce. However, the practical implementation of green human capital strategies still faces numerous challenges. Foremost among these is the quality of education and workforce skills, which remain insufficient to meet the demands of a transitioning economy. According to ManpowerGroup, during the 2023 - 2024 period, the highest demand for green jobs in Vietnam is in manufacturing (33%), followed by life sciences, healthcare, technology, energy, transportation, logistics, and agriculture. However, the supply of labor with suitable green skills is severely limited. In addition, Vietnam's labor productivity remains low compared to regional peers (Figure 3), which undermines national competitiveness. The main reasons are the limited skill levels of the workforce, the lack of a strong culture of innovation, and the ineffective application of technology in production processes. Furthermore, the number of specialists and engineers with expertise in strategic fields such as renewable energy, green economy, and circular economy remains inadequate. This shortage is primarily due to unattractive talent retention and recruitment policies, raising the risk of dependence on foreign labor or stagnation. The development of GI in Vietnam is also marked by significant regional disparities. Major cities such as Hanoi, Ho Chi Minh City, and Da Nang - as well as key economic zones - are leading the transition, benefiting from abundant investment capital, well-developed infrastructure, and a highly skilled labor force. In contrast, underdeveloped regions such as the Northwest, Central Highlands, and the Mekong Delta face considerable constraints in advancing GI⁵⁷. Regional inequalities not only impede the green transition but also risk deepening socioeconomic divides between more and less developed areas. Furthermore, the growing income gap between different labor groups is a pressing concern. While workers in green industries often enjoy higher wages and better working conditions, those in conventional sectors

are increasingly vulnerable to unemployment and declining incomes.

Figure 4 illustrates the complex relationship between inequality, industrial employment, poverty, and carbon intensity in Vietnam from 2000 to 2025. Although poverty rates have decreased significantly, income inequality has fluctuated - most notably around 2010 - highlighting the uneven distribution of economic growth benefits. The share of labor in the industrial sector increased sharply up to 2020 but has since plateaued, raising concerns about the long-term sustainability of employment in the green transition. Meanwhile, carbon intensity relative to GDP has shown an upward trend, particularly after 2010, reflecting continued reliance on carbon-intensive production models. While Vietnam has made substantial progress in poverty reduction and industrialization, inclusive and equitable development remains a critical challenge that requires renewed focus in the context of green economic transformation.

Resource management and environmental impact

Vietnam's industrial sectors continue to exhibit low production efficiency, remaining heavily reliant on energy and natural resources, resulting in significant waste and inefficiencies⁵⁸. Despite the rapid growth of solar power projects, the country still lacks effective solutions for managing photovoltaic panel waste. Moreover, the risk of "stranded assets" in the fossil fuel industry poses a major challenge to the GI transition. Coal-fired power plants continue to play a crucial role in Vietnam's energy supply. However, with the nation's commitment to achieving carbon neutrality by 2050, the risk of asset obsolescence in the coal sector is inevitable.

According to Vietnam Electricity (EVN), the country ranks third in Southeast Asia in terms of installed solar and wind capacity. Nevertheless, fossil fuels - particularly coal - remain dominant, accounting for more than 45% of total electricity generation. As shown in Figure 5, Vietnam continues to rely heavily on fossil fuels, while renewable energy sources represent only a small fraction (7%) of total energy consumption. This underscores the urgent need for a well-calibrated transition pathway that balances economic growth with emission reductions. Currently, Vietnam's industrial development has not yet achieved decoupling; carbon emissions continue to rise in parallel with per capita income growth. Although there is an observable shift in industrial structure from extractive industries and basic manufacturing toward processing, advanced manufacturing, and services, heavy

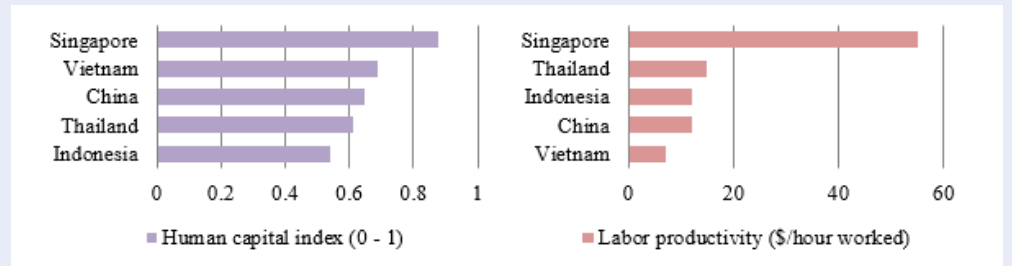


Figure 3: Human capital index (2020) and labor productivity (2019) of some Asian countries Source: World Bank (2025), Penn World Table (2021)

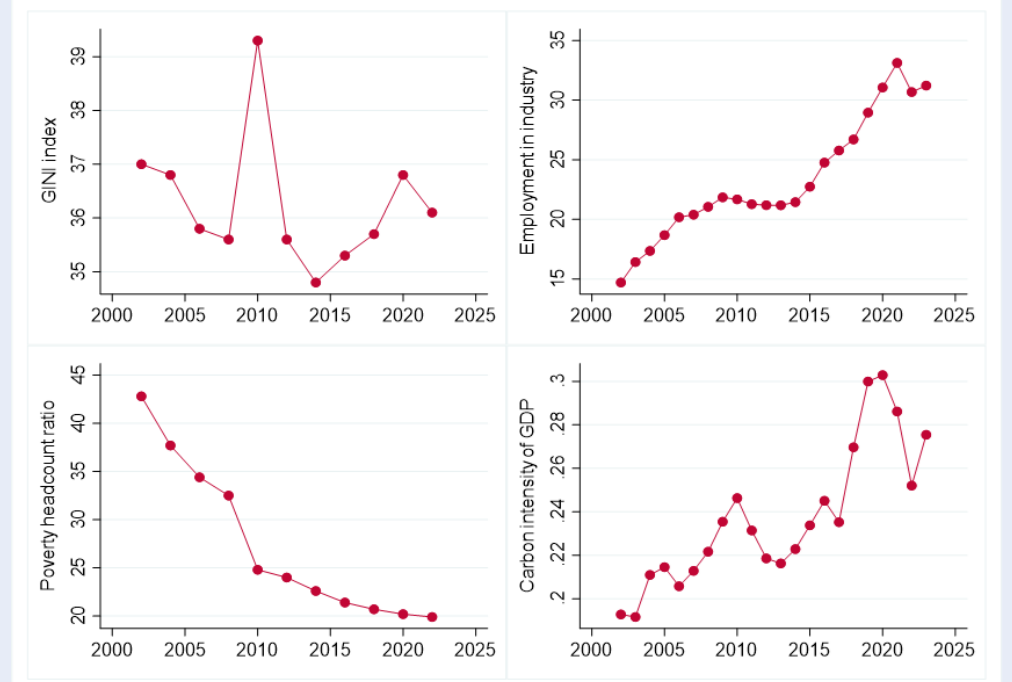


Figure 4: Inequality, industrial employment, poverty and carbon intensity in Vietnam, 2000 - 2025 Source: World Bank (2025)

industry still constitutes a significant portion of GDP and remains the main driver of emissions. Additionally, many FDI enterprises in sectors such as textiles, footwear, and electronics continue to consume large quantities of resources and contribute substantial emissions. The phenomenon of developed countries “outsourcing” emissions to developing nations by relocating polluting industries is not new. Without strong regulatory mechanisms, Vietnam risks becoming a pollution hotspot rather than achieving meaningful decoupling between economic growth and environmental degradation.

Figure 6 illustrates the relationship between per capita CO₂ emissions (vertical axis) and gross national income per capita (horizontal axis) in four countries. In Vietnam and China, per capita emissions rise in tandem with income, reflecting ongoing industrialization and increased fossil fuel consumption. This indicates that both countries remain in a phase of emissions-intensive growth and have yet to reach decoupling. In contrast, Germany and Japan show a decline in CO₂ emissions as income rises, exemplifying absolute decoupling - where economic growth is achieved independently of environmental harm.

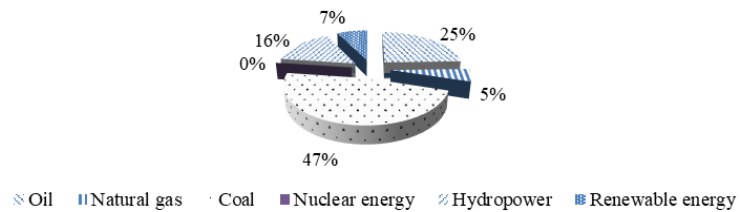


Figure 5: Primary energy consumption by fuel type, 2023 Source: Energy Institute (2024)

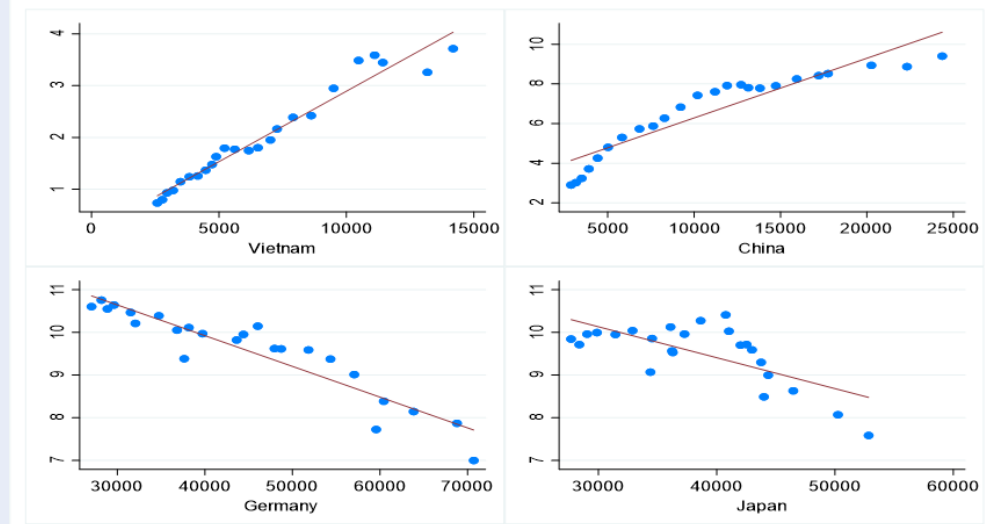


Figure 6: Correlation between CO2 emissions and economic growth of some countries, period 2000 - 2023 Source: World Bank (2025)

CONCLUSION AND SOME POLICY IMPLICATIONS FOR ADVANCING GREEN INDUSTRY IMPLEMENTATION IN VIETNAM

Conclusion

In conclusion, the implementation of GI in Vietnam remains at an early stage despite the country's strong commitment to achieving net-zero emissions by 2050. While initial progress has been made through eco-industrial initiatives and the promotion of green finance, constraints related to policy coherence, financing capacity, innovation, and human capital continue to limit the scale and effectiveness of these efforts. Addressing these challenges through a comprehensive national strategy and coordinated policy interventions is essential to accelerate the GI transition and ensure sustainable and inclusive development in Vietnam.

Some policy implications for advancing green industry implementation in Vietnam

Vietnam urgently needs a comprehensive institutional and policy framework for GI. The government should develop a National Green Industry Strategy to address current policy gaps and ensure alignment with broader socio-economic development plans. In parallel, the establishment of a Green Credit Guarantee Fund can facilitate access to capital - particularly for SMEs - by reducing collateral requirements. Although Vietnam issued a temporary green activity classification system in 2022, an official Green Taxonomy remains necessary. Effective implementation will also require communication strategies and capacity building for both enterprises and financial institutions. Additionally, Vietnam should develop a national standard for "green industrial zones," incorporating carbon credit systems, green finance mechanisms, and eco-certification.

Public financial support mechanisms should be designed to encourage enterprise-level R&D in green technologies. Vietnam should establish dedicated green innovation funds to ease access to capital and provide technical assistance during the piloting and application of new technologies. Strengthening public-private partnerships (PPPs) can also leverage resources and innovation capacities across sectors. Vietnam could further learn from the PPP models of the EU, which have expanded collaboration into lesser-addressed sectors such as circular economy, waste management, and recycling⁵⁹. Expanding the scope of PPPs requires transparent risk-sharing mechanisms and greater participation from commercial banks through preferential lending schemes.

A major challenge facing Vietnam's GI transition is the shortage of skilled labor. A long-term, systematic human capital development strategy is essential - particularly one that strengthens partnerships between vocational education institutions and enterprises. Vietnam can adopt the successful "dual education" model from Germany, where students combine theoretical training with practical experience at partner firms⁶⁰. Beside that, to facilitate labor mobility from high-pollution sectors to green industries, the government should introduce targeted financial support for workers, including retraining subsidies, job transition allowances, and income support during the adjustment period. In addition, Vietnam should develop and adopt occupational skill standards for green jobs to inform curricula, competency assessments, and certification systems in areas such as renewable energy, wastewater treatment, and circular manufacturing.

Effective GI development requires strict resource management and environmental control. A Carbon Intensity Index (CII) should be established for each industrial zone to monitor, assess, and rank greenhouse gas emissions. Therefore, a national environmental database for industrial zones should be developed, with mandatory disclosure of emissions, energy, water, and resource usage. Artificial intelligence technologies should be employed to analyze environmental data across regions and enterprises violating environmental regulations should be publicly listed on national data portals to foster accountability and social pressure. Finally, Vietnam should also pilot regional eco-industrial symbiosis models, where firms within a cluster share resources (energy, water, materials), reuse by-products, and support each other's operations. This model should be implemented both in newly developed parks and in the conversion of traditional industrial zones into eco-smart zones. International experiences demonstrate that such models reduce input costs, lower emissions, and foster resilient

green value chains^{1,61}.

ABBREVIATIONS

Green industry: GI

Small and medium-sized enterprises: SMEs

Research and development: R&D

CONFLICT OF INTEREST STATEMENT

The authors declare that they have no conflicts of interest

AUTHOR CONTRIBUTIONS

Both Dinh Hoang Tuong Vi and Pham Nhat Quang are responsible for concept, methodology, analysis, and drafting the manuscript.

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Triển khai công nghiệp xanh tại Việt Nam: Thực trạng hiện nay và một số hàm ý chính sách

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TÓM TẮT

Việt Nam đã cam kết đạt mục tiêu phát thải carbon ròng bằng 0 vào năm 2050, biến quá trình chuyển đổi sang nền công nghiệp xanh (GI) trở thành một nhiệm vụ chiến lược cấp thiết. Trong bối cảnh này, việc chuyển đổi ngành công nghiệp sang các mô hình sản xuất xanh hơn không chỉ là một yêu cầu về môi trường mà còn là điều kiện then chốt để duy trì khả năng cạnh tranh và hội nhập sâu hơn vào chuỗi giá trị toàn cầu. Mặc dù có cam kết này, việc thực hiện GI trên thực tế tại Việt Nam vẫn tiếp tục đối mặt với những hạn chế đáng kể, bao gồm khung chính sách rời rạc, hạn chế tiếp cận nguồn tài chính, năng lực đổi mới yếu và thiếu lao động có tay nghề. Trên cơ sở đó, nghiên cứu này nhằm đánh giá hiện trạng phát triển công nghiệp xanh tại Việt Nam bằng cách xác định những thành tựu chính, những thách thức dai dẳng và những cơ hội mới. Kết quả cho thấy, mặc dù Việt Nam đã đạt được những tiến bộ ban đầu thông qua các sáng kiến như khu công nghiệp sinh thái và thúc đẩy tài chính xanh, nhưng những nỗ lực này vẫn chưa đồng đều và chưa đủ về quy mô và hiệu quả. Hầu hết các doanh nghiệp, đặc biệt là các doanh nghiệp vừa và nhỏ (SMEs), gặp phải những rào cản đáng kể liên quan đến chi phí tuân thủ cao và hạn chế tiếp cận tín dụng xanh, trong khi đầu tư trực tiếp nước ngoài chủ yếu tập trung vào các ngành công nghiệp thâm dụng tài nguyên. Hơn nữa, sự chênh lệch vùng miền rõ rệt và năng suất lao động thấp càng cản trở quá trình chuyển đổi xanh cân bằng và toàn diện. Dựa trên những hiểu biết này, nghiên cứu đề xuất một loạt các biện pháp chính sách toàn diện, bao gồm tăng cường khung pháp lý và thể chế, thúc đẩy đổi mới và nâng cấp công nghệ, nâng cao nguồn nhân lực cho quá trình chuyển đổi sang nền kinh tế xanh, và cải thiện quản lý tài nguyên và môi trường trong các khu công nghiệp xanh. Những tác động chính sách này được kỳ vọng sẽ đẩy nhanh quá trình chuyển đổi công nghiệp xanh của Việt Nam, nâng cao khả năng cạnh tranh trên thị trường toàn cầu và hỗ trợ tăng trưởng kinh tế bền vững và toàn diện.

Từ khóa: công nghiệp xanh, khung pháp lý, chính sách công nghiệp xanh

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Lịch sử

- Ngày nhận: 14-08-2025
- Ngày sửa đổi: 23-03-2026
- Ngày chấp nhận: 28-08-2026
- Ngày đăng: 28-09-2026

DOI : <https://doi.org/10.32508/vnuhcmj-ebl.v10i3.1711>



Bản quyền

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Trích dẫn bài báo này: Tường Vi D H, Nhật Quang P. **Triển khai công nghiệp xanh tại Việt Nam: Thực trạng hiện nay và một số hàm ý chính sách.** VNUHCM J. Econ. Bus. Law. 2026; 10(3):7075-7086.