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Optimising Green Industry Development to Strengthen the National Economy

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Abstract

Purpose: The study analyses the current status of green industry development in Indonesia, investigates the factors influencing its progress, and proposes optimisation strategies to support a sustainable national economy.

Study Design/Methodology/Approach: A descriptive research method is applied using the PESTLE (Political, Economic, Social, Technological, Legal, and Environmental) framework. Data sources include comprehensive literature reviews, national policy documents, and industry performance reports.

Findings: The study reveals that green industry development in Indonesia faces substantial obstacles, such as regulatory inconsistencies, limited access to local technological innovation, inadequate fiscal incentives, and a shortage of skilled human resources in green sectors. Despite these challenges, there are significant opportunities for improvement through enhanced technological innovation, strengthened cross-sector collaboration, expanded government incentives, and increased investment in green industries.

Originality/Value: The study provides a novel contribution by presenting actionable strategies for optimising green industry development through regulatory harmonisation and multi-stakeholder collaboration. The insights offer policy recommendations designed to foster sustainable, inclusive, and competitive economic growth in alignment with national and international sustainability commitments.

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INTRODUCTION

Indonesia's economic development is guided by Pancasila and Article 33, Paragraph 4 of the 1945 Constitution of the Republic of Indonesia (UUD NRI 1945), which emphasises the principles of justice, independence, efficiency, and sustainability. These principles align with the concept of a green economy, which promotes harmony between economic, social, and environmental objectives. In the face of increasingly complex challenges related to sustainable development, the industrial sector plays a pivotal role as the primary driver of the economy. In 2024, the manufacturing industry accounted for 18.67 per cent of the Gross Domestic Product (GDP) and provided employment to 19.34 million workers (Santika, 2024). However, industries in Indonesia remain predominantly characterised by conventional practices that overlook environmental sustainability (Imansyah and Putranti, 2024).

High carbon emissions from these brown industries pose serious threats to the sustainability of the national economy. According to the Climate Transparency Report, the industrial sector accounts for approximately 23% of total carbon emissions in Indonesia (Santika, 2024). This situation contradicts global commitments, including the Paris Agreement, which Indonesia ratified through Law No. 16 of 2016 on Greenhouse Gas Emission Reduction. The agreement requires signatory countries to support sustainable development agendas. Achieving net zero emissions (NZE) in Indonesia requires a comprehensive framework that aligns sustainable development principles with technological advancement and strategic accounting practices. Challenges include gaps in policy coordination, inconsistent reporting standards, and limited adoption of NZE technologies, which necessitate increased public awareness and cross-sector collaboration (Fitri et al., 2024). With increasing awareness of sustainability, demand for environmentally friendly products continues to grow. Consequently, fossil-based industries face the risk of losing competitiveness in the international market.

Despite the government's efforts to prioritise green industry development in strategic planning documents such as the Medium-Term National Development Plan (RPJMN) for 2020 to 2024 and the National Industrial Development Master Plan (RIPIN) for 2015 to 2035, actual implementation has lagged behind established targets. Regulatory frameworks, including Government Regulation No. 14 of 2015 and Ministry of Industry Regulation No. 55 of 2020 on green standards for shopping bags and bioplastic industries, have been enacted to support this initiative. However, as of 2023, data from the Ministry of Industry indicate that only 183 industries have obtained green certification, representing less than one per cent of all medium and large industries nationwide. The number of certified industries increased by only thirty-nine between 2021 and 2023, compared to the target of eighty-three (Ministry of Industry, 2023). This discrepancy highlights ongoing challenges in regulatory alignment, technological capacity, human resource availability, financing, and institutional coordination.

Research indicates that green industry development can significantly reduce energy and water consumption while lowering greenhouse gas emissions by as much as thirty-seven per cent. However, this transformation requires more robust policy support, including the enforcement of comprehensive regulations that mandate the adoption of

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green industry standards. Furthermore, the provision of fiscal and non-fiscal incentives is essential to encourage greater industrial participation in sustainable practices.

This study aims to analyse optimisation strategies for green industry development to strengthen the national economy. It addresses three core research questions: What is the current state of green industry development in Indonesia? What factors influence this development? How can optimisation strategies be applied to support the national economy? The findings are expected to deliver comprehensive and actionable recommendations for policymakers and stakeholders, facilitating a transition to sustainable industrial growth that is both inclusive and environmentally responsible in alignment with global sustainability commitments.

Literature Review

The green industry (GI) is a core strategy for achieving sustainable and environmentally friendly national economic development. According to the United Nations Environment Programme (UNEP), a green economy emphasises resource efficiency, carbon emission reduction, and social equity in economic activities. In industry, this concept involves prudent resource management and environmentally sound waste processing to maintain ecosystem balance. The Green Growth framework identifies key indicators such as ecosystem productivity, socio-economic resilience, and sustainable reductions in greenhouse gas emissions. The circular economy, explained by the Ellen MacArthur Foundation, promotes resource reuse by reducing waste through extended material lifecycles and ecosystem regeneration, in contrast to the linear economy, which leads to excessive waste. Implementing circular economy principles enhances energy efficiency and reduces environmental impact, thereby improving long-term industrial competitiveness. Salim (2010) argues that sustainable development balances economic growth, environmental protection (Firmansyah, 2022), and social welfare through efficient resource use and pollution control, which are essential in facing climate change challenges.

Optimising GI development requires effective resource management to maximise results. Siringo Ringo (2005) identifies three key elements of optimisation: defining clear goals, making strategic decisions, and ensuring stakeholder commitment. Operational optimisation is crucial in reducing production costs, energy consumption, and carbon emissions. The PESTLE framework provides a structured approach to understanding external factors affecting GI development, encompassing political, economic, social, technological, legal, and environmental dimensions (Fathi S.M. Abdullah, 2009). This framework enables industries to identify strategic opportunities and threats while fostering innovation in production processes. The government serves as a catalyst by establishing regulatory frameworks, facilitating collaboration among stakeholders, and promoting active participation (Firdaus, 2020; Rasyid, 2000). Through policies such as Law No. 3 of 2014 on Industry, the government reinforces its role by offering incentives and strengthening access to technological resources to support GI development.

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Current State of Green Industry Development

Globally, the development of green industries shows a growing trend towards environmentally friendly technological innovation and the implementation of stricter regulations. Developed countries, such as Germany, through the Energiewende initiative, have successfully integrated renewable energy technologies into their industrial sectors. This integration has significantly enhanced resource efficiency and reduced carbon emissions (Benediktus Krisna Yogatama, 2022). In Indonesia, priority sectors such as renewable energy, green manufacturing, and sustainable agro-industry are emerging, although they continue to face challenges including uneven infrastructure, voluntary regulations, and limited awareness and preparedness among industry players (Kemenperin, 2023). The government has introduced various policies to accelerate the transformation towards a GI, including Law No. 3 of 2014 on Industry, which mandates green standards for certain industrial sectors.

Despite these efforts, the implementation of GI policies still encounters obstacles related to financing and access to technology. Currently, only 183 medium and large industries meet GI standards out of over 30,000 industries nationwide (Ministry of Industry, 2023). To address these challenges, the government is promoting investment through fiscal incentives and green public procurement initiatives aimed at supporting the procurement of environmentally friendly goods and services in the public sector (Anis Fitria, 2024). As global awareness of environmentally friendly products continues to rise, Indonesia's GI holds significant potential to expand its market share by fostering technological innovation and enhancing international collaboration.

Factors Influencing Green Industry Development

The development of green industries is influenced by various external and internal factors. Globally, climate change and commitments to reduce carbon emissions, as outlined in agreements such as the Paris Agreement, are driving industries to adopt sustainable production practices (Ministry of Environment and Forestry, 2016). Additionally, international trade dynamics are increasingly prioritising green product standards, exemplified by the European Union's implementation of a carbon border tax (Damiana Cut Emeria, 2023). Within the ASEAN region, multilateral cooperation through the Green Economic Initiative encourages member countries to develop environmentally friendly industries in pursuit of carbon neutrality by 2050 (ASEAN, 2023).

Internally, the development of green industries in Indonesia is shaped by regulatory frameworks, government incentives, and the readiness of local technology. While some policies have been implemented, limited human resource capacity and inadequate financial support from banking institutions remain significant challenges (Martha Herlinawati Simanjuntak, 2023). Public support for creating a market for green products also needs to be strengthened, although recent surveys indicate that Indonesian consumers are becoming more concerned about environmentally friendly products (Sekar Langit Nariswari, 2022). Optimising strategies through collaboration among government,

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industry, and academia, using a Triple Helix approach, presents a viable solution to accelerate the transformation of green industries in Indonesia.

Impact of Green Industry Development on the National Economy

The development of green industries significantly impacts the economy by creating new economic opportunities, particularly through the generation of green jobs. Sustainable development initiatives in sectors such as renewable energy and green manufacturing increase the demand for workers with specialised skills in green technology and sustainable resource management. This development contributes to more inclusive and environmentally friendly national economic growth, as evidenced by the rise in Indonesia's Green Growth Index to 58.36 in 2022 (Global Green Growth Institute).

Moreover, GI development fosters innovation that enhances the competitiveness of national industries in international markets. A relevant example is Germany's success in integrating green innovation policies with economic development strategies through the Energiewende initiative, which has strengthened its position as a leading exporter of green technology products (Makmur Keliat et al., 2022). In Indonesia, the growth of the GI sector also creates a multiplier effect by stimulating green investment and expanding market access for environmentally friendly products (Ministry of Industry, 2023). However, this potential is hindered by challenges such as inadequate infrastructure and the absence of mandatory GI certifications. Addressing these challenges requires policy reforms and stronger cross-sectoral support to accelerate sustainable industrial transformation.

Strategies for Optimising Green Industry Development

Optimising the development of green industries requires comprehensive strategies involving cross-sectoral collaboration and the adoption of innovative technologies. A key strategy is the implementation of technological innovation, such as improving energy efficiency and utilising renewable energy in production processes (Gennitsaris et al., 2023; Southernwood et al., 2021). The government should also provide tax incentives for green technologies to attract investment (Widodo, 2021; Suprianto, 2024).

Strengthening human resources is a crucial component of this optimisation. Technical and managerial training for workers in green industries can enhance the capacity for sustainable production (LAB 45, 2022). Additionally, the development of multilateral and bilateral cooperation, particularly through initiatives like the ASEAN Green Economic Initiative, can accelerate the green transformation by facilitating technology transfer and investment.

Previous Studies and Research Gap

Previous studies have demonstrated that the GI positively influences economic growth, particularly by generating new employment opportunities and enhancing industrial competitiveness (Coordinating Ministry for Economic Affairs of the Republic of Indonesia, 2024; Purba et al., 2024). Research conducted in developed countries highlights the successful implementation of green standards across industrial supply

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chains. However, studies focusing on developing countries indicate challenges such as limited funding and low adoption of environmentally friendly technologies (Duarte et al., 2023; Green et al., 2012; Hejazi et al., 2023; Tirpak & Parry, 2009).

This study aims to address the research gap regarding the integration of GI strategies into national economic policies. The study also seeks to explore the role of local stakeholders and assess the effectiveness of incentive policies by applying a more comprehensive and practical approach (Coordinating Ministry for Economic Affairs of the Republic of Indonesia, 2024; Aminah & Yusriyadi, 2018; Mutingi & Mutingi, 2013).

Policy Perspective and Recommendations

From a national policy perspective, optimising GI development requires strengthening regulations that support the sustainable development agenda. Policy integration should be reflected in medium- and long-term development plans (RPJMN and RPJP) with the establishment of measurable key performance indicators (KPIs). The government must also promote cross-sectoral coordination among ministries, regional governments, and the private sector to ensure effective implementation.

Moreover, incentive mechanisms such as tax relief and dedicated funding should be expanded to accelerate the adoption of green technologies in the industrial sector. Industries must be encouraged to integrate sustainability standards throughout their entire production value chain. Additionally, public education and awareness campaigns need to be enhanced to foster greater acceptance of environmentally friendly products among consumers. The recommendations of this study emphasise the importance of developing a comprehensive roadmap for implementing green industries, which includes strategic phases and clearly defined targets. By adopting this approach, the transformation towards a GI is expected to make a significant contribution to strengthening the national economy in a sustainable manner.

METHODS

This study utilises a descriptive analysis methodology to examine the conditions, challenges, and opportunities in developing green industries as a means of strengthening the national economy. The research prioritises secondary data analysis, drawing from national policy documents, industry reports, and relevant academic publications. Data were obtained from the Ministry of Industry (Kemenperin), focusing on industrial companies in Indonesia that have either achieved or are in the process of obtaining green certification. These companies represent key sectors, including manufacturing, industrial agriculture, and renewable energy. Purposive sampling was employed, with criteria based on active participation in green industry development programmes led by Kemenperin.

The study applies the PESTLE framework, which analyses six strategic environmental factors: political, economic, social, technological, legal, and environmental. The political analysis investigates government policies and regulations supporting green industry initiatives, including their alignment with international agreements such as the Paris Agreement. Economic factors are examined through an

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evaluation of production costs, access to financing, and the availability of fiscal incentives to promote industrial transformation. The social analysis focuses on public awareness and acceptance of green industry practices, while the technological analysis assesses both the level of technological innovation and the capacity for its integration into production processes. The legal analysis explores the coherence and enforcement of national regulations related to green industries, and the environmental analysis evaluates industrial impacts on carbon emissions and natural resource conservation.

By synthesising insights from these six dimensions, the study aims to formulate practical and evidence-based strategies to optimise the development of green industries. This approach is intended to support sustainable growth and enhance the long-term competitiveness of Indonesia's industrial sector within both national and global contexts.

RESULT AND DISCUSSION

Development of Green Industry in Indonesia: Conditions, Policies, and Challenges

The development of green industries in Indonesia represents a strategic initiative aimed at bolstering the national economy, with the industrial sector contributing 18.67% to the GDP in 2023. Despite this contribution, the sector continues to grapple with significant challenges such as high carbon emissions and environmental degradation, both of which necessitate the urgent adoption of sustainability standards. According to the OECD (2019), industrialised economies face similar pressures to integrate green industry standards as part of efforts to mitigate environmental harm. Comparative analyses indicate that developed nations like Germany and Sweden have achieved greater success by enforcing mandatory, cross-sector regulations, whereas in Indonesia, the application of Green Industry (GI) standards remains predominantly voluntary.

External pressures, such as the European Union Deforestation Regulation (EUDR), have intensified the urgency for industrial transformation in Indonesia to comply with international market requirements. Zeng et al. (2020) underscore that regulatory demands can undermine the competitiveness of developing nations unless these countries implement adaptive domestic policies. In Indonesia, additional barriers to GI development include excessive resource exploitation and inefficiencies in supply chains. Consequently, there is a pressing need for the government to formulate a comprehensive GI roadmap, prioritising clear policy measures and providing both fiscal and non-fiscal incentives to expedite the adoption of sustainable practices.

The government’s commitment to GI development has been reflected in the establishment of 37 Green Industry Standards (GIS), encompassing areas such as resource management and occupational safety. However, the uptake of these standards across industries remains minimal. Prasad et al. (2021) highlight that the successful implementation of such standards relies heavily on rigorous monitoring and enforcement, including penalties for non-compliance. Increasing the number of certified green auditing and regulatory bodies is also crucial to expand compliance among medium and large manufacturers.

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Data from the Global Carbon Project (2022) indicate that Indonesia ranks as the seventh-largest contributor to global carbon emissions, emphasising the critical need for accelerated sustainable transformation in the industrial sector. To address this challenge, strategic initiatives should focus on reinforcing regulatory frameworks, enhancing the availability of green incentives, and fostering cross-sector collaborations to promote the development and integration of local technology. These efforts are anticipated to boost national competitiveness and support Indonesia's sustainable economic growth in an increasingly competitive global landscape.

Performance Achievements in Green Industry Development in Indonesia

The progress of green industry (GI) development in Indonesia can be evaluated through several key indicators, although in many cases, initiatives are confined to corporate social responsibility (CSR) activities (Soebandrija, 2011). One of the main indicators is the number of Green Industry Standards (GIS) established by the government. As of April 2024, a total of 37 standards had been developed, encompassing various industrial sectors, including Portland cement, fertilisers, and food products such as bottled water and crystal sugar. This represents an increase from 28 standards recorded in 2020. However, implementation remains voluntary. To address this, the government intends to enforce these standards gradually, through mandatory compliance and the imposition of penalties for non-conformity.

Despite these measures, the adoption of green standards by industries remains limited. In 2023, only 183 industries had implemented GIS, up from 177 the previous year. This figure accounts for less than 1% of the 32,193 medium and large-scale manufacturing industries in the country. The Ministry of Industry reported that, by April 2024, 118 GI certifications had been issued, with 95 certifications still active and 23 expired. To expand the implementation of green standards, the government has set ambitious targets to certify 1,000 industries by 2025 and 10,000 industries by 2030.

Decarbonisation has emerged as a core component of GI development, with efforts directed towards reducing carbon emissions through energy efficiency, increased use of renewable energy, and the adoption of low-carbon technologies. As part of these efforts, 387 multinational companies operating in Indonesia have committed to the Renewable Energy 100 (RE100) initiative, which aims for 60% renewable energy usage by 2030, 90% by 2040, and 100% by 2050.

The promotion of energy and water efficiency constitutes another key objective of GI practices. In 2022, the industrial sector achieved energy savings valued at Rp9.8 trillion, while water efficiency measures contributed Rp20 trillion to the national economy. Additionally, the recycling of 913,000 tonnes of plastic waste generated an economic value of Rp10 trillion. These resource efficiency initiatives are expected to improve Indonesia's water resource resilience, especially given the projected clean water crisis by 2040. Furthermore, improving energy efficiency is anticipated to reduce Indonesia’s reliance on fossil fuels, which currently account for 67.21% of the nation’s energy supply.

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Despite these advancements, the development of green industries in Indonesia remains suboptimal. The number of industries adopting green standards remains disproportionately small in comparison to the total number of industrial entities. The pace of GIS expansion is sluggish, with an average increase of only 4-5 new standards annually. Furthermore, many government targets for green industry transformation have not been fully achieved, highlighting ongoing challenges in policy enforcement and strategic implementation. A more comprehensive analysis of the factors influencing GI development is necessary. Identifying these opportunities and constraints will serve as a critical foundation for developing more effective strategies to support sustainable economic growth by reinforcing green industries in Indonesia.

Factors Influencing Green Industry Development to Support the National Economy

Green industry (GI) development in Indonesia is shaped by a combination of external and internal factors, which can either facilitate or impede progress. External factors are evaluated using the PESTLE framework (Political, Economic, Social, Technological, Legal, and Environmental), offering a comprehensive understanding of the strategic dynamics affecting GI development.

Political factors involve both national and international commitments, including the 2015 Paris Agreement, the target for net-zero emissions by 2050 for the industrial sector, and Indonesia's national commitment to achieving carbon neutrality by 2060. The government has introduced policies to simplify business processes, such as the Job Creation Law and the Online Single Submission (OSS) system. However, conflicting policies, such as the relaxation of Environmental Impact Assessment (AMDAL) requirements for several business sectors, undermine environmental sustainability efforts and complicate GI implementation (Yogatama, 2024).

Economic factors play a pivotal role in accelerating the transition to GI. Increased investment and the adoption of green economic principles have been encouraged through regulations, such as Presidential Regulation No. 16 on the General Investment Plan (2012) and Law No. 25 on Investment (2007) (Aisah et al., 2023). In 2023, green investments in Indonesia reached Rp1.59 billion, with banks gradually adopting green banking principles (Ahdiat, 2024). Despite these advancements, obstacles such as greenflation—a rise in product prices due to high transition costs—remain significant. This phenomenon, also experienced in France, has contributed to increased operational costs for green industries.

Social factors present challenges related to the availability of human resources (HR) with green competencies. While the government targets the creation of millions of green jobs by 2030 and 2045, the current preparedness of the workforce is insufficient. There is a clear gap between industry demand for green-skilled labour and the qualifications of university graduates. Nevertheless, the demographic bonus expected between 2020 and 2035 offers a unique opportunity to enhance HR capacity if properly managed.

Technological factors are addressed through initiatives like the Making Indonesia 4.0 programme, which aims to integrate technologies such as the Internet of Things (IoT), Big Data, and Artificial Intelligence into industrial processes. However, Indonesia's

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technological capacity remains constrained by a reliance on imported green technologies. This dependency elevates implementation costs, which in turn reduces the price competitiveness of green products in the domestic market and limits industrial competitiveness.

Legal factors highlight the inefficiencies in environmental law enforcement, despite the presence of regulations under Law No. 32 on Environmental Protection and Management (2009). Weak deterrent measures for violators, inadequate compensation for environmental damage, and the absence of mechanisms prioritising the restoration of victims' rights hinder the sustainability of GI efforts.

Environmental factors pose ongoing risks despite recent improvements. For instance, Indonesia's Environmental Quality Index rose to 72.54 points in 2023. However, projections of a clean water crisis by 2040 and high carbon emissions from the industrial sector underscore the urgency of accelerating the transition to sustainable industries. Continued dependence on fossil fuels, which meet 67.21% of the country's energy needs, presents significant risks to future energy security. The renewable energy target of 23% by 2025 is still far from being achieved, with current levels reaching only 12.8% as of 2023. This gap underscores the need for faster progress in energy transition.

In conclusion, these external factors reveal that GI development in Indonesia is hampered by challenges in policy coherence, economic transitions, social readiness, technological adaptation, legal enforcement, and environmental management. Accelerated and coordinated efforts across these domains are essential to improve the contribution of green industries in supporting the country's sustainable economic growth.

Internal Factors Influencing GI Development to Support the National Economy

Several internal factors shape the development of green industries (GI) in Indonesia, significantly affecting their progress. These factors include policies, institutional frameworks, resources, research and innovation, and supporting programmes. Regulatory policies play a crucial role in driving the shift towards sustainable industries. The government has introduced 114 regulations to demonstrate its commitment to a green economy. However, regulatory inefficiencies persist due to overlapping mandates between key institutions such as the Ministry of Industry and the Ministry of Environment. Both the PROPER initiative and the Green Industry Standard (GIS) regulations share similar performance indicators, leading to redundant reporting requirements for industries. These overlapping policies fail to fully address socio-technological aspects, including the need for more comprehensive research development and workforce capacity building.

Institutional frameworks involve coordination among multiple stakeholders. The Ministry of Industry leads the effort, supported by other entities such as Bappenas (the National Development Planning Agency), the Ministry of Finance, the Ministry of Environment, the National Research and Innovation Agency (BRIN), and financial institutions. However, weak collaboration among these agencies hinders progress. For example, the Ministry of Industry and BRIN have not yet established effective cooperation in advancing innovation research. Additionally, policy inconsistencies

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remain an obstacle, as exemplified by plans to develop coal-fired power plants in the Green Industrial Zone in North Kalimantan. These plans contradict the goal of integrating clean energy solutions into GI initiatives.

Human resources and financial incentives are also critical challenges. Non-fiscal incentives such as GI certification support and industry recognition have been introduced (Saepudin et al., 2020). However, the number of certification bodies and green auditors is insufficient compared to the large number of manufacturing industries. Industrial transformation requires considerable funding, but limited access to low-interest credit from financial institutions slows adoption. Strengthening financial support mechanisms is essential to facilitate the transition to green industries.

In terms of research and innovation, Indonesia continues to rely on imported technologies for GI implementation. The domestic machinery sector has not yet developed the capability to produce advanced green technologies, thereby hampering progress in innovation. By contrast, countries like the United Kingdom, Sweden, and Singapore have established innovation hubs that accelerate industrial sustainability (Badruzzuhad & Firmansyah, 2023). The absence of similar green innovation zones in Indonesia highlights the need for greater investment and collaboration in research to support technological development.

Supporting programmes such as PROPER, eco-labelling, and the National Industrial Information System (SIINas) play a significant role in implementing GI standards, although overlapping indicators between these programmes often create confusion for industries. The SIMPEL (Environmental Reporting Information System) programme facilitates digital reporting, but its effectiveness is hindered by limited integration with other institutional information systems. Internal factors, including fragmented regulations, weak inter-agency coordination, and inadequate technological capacity, continue to obstruct the development of green industries. Strengthening institutional collaboration, expanding research and innovation initiatives, and implementing effective incentive mechanisms are crucial for accelerating the transformation to green industries (Fitri et al., 2024). These measures are essential to support sustainable national economic growth and enhance Indonesia's competitiveness in the global green economy.

Supporting and Inhibiting Factors in GI Development in Indonesia

Table 1 provides an overview of the internal and external factors influencing the development of green industries in Indonesia, categorising them into enablers and constraints. Supporting factors are denoted by the symbol (+), while inhibiting factors are identified with (-). Strategic improvements are recommended to enhance institutional collaboration, harmonise regulations, and foster local technological advancements.

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Table 1: Mapping of Supporting & Inhibiting Factors for GI Development

Category	Supporting Factors (+)	Inhibiting Factors (-)
External		
Political	Government commitment to climate change and SDGs.	Contradictory policies (ease of doing business disregarding environmental sustainability)
	Policies supporting business facilitation	Import policies conflicting with green industry standards (e.g., textile imports hindering GIS implementation)
Economic	Promotion of circular and green economy	Credit interest rates comparable to those for brown industries
	Growth in green investment and banking	Risk of greenflation during the economic transition
	Increase in GDP per capita	
Social	Demographic bonus providing a potential workforce	Limited availability of green-skilled human resources
	Growing consumer interest in eco-friendly products	Lack of awareness among industries about green practices
Technological	Making Indonesia 4.0 programme supporting smart and green technologies	Low technological capacity, increasing the cost of green products
Legal	Policies on environmental protection	Weak enforcement of environmental laws
Environmental	Increasing awareness of sustainability	Threat of clean water crises
		High consumption of fossil fuels contributing significantly to carbon emissions
Internal		
Regulations	Supportive regulations for green industries	Overlapping and incomplete regulations
Institutions	Ministry of Industry (Kemenperin) as the leading sector with support from various agencies	Inconsistent policies and weak institutional collaboration
Resources	Provision of non-fiscal incentives	Absence of fiscal incentives
		Limited number of GI Certification Bodies (LSIH) and auditors
Research & Innovation	Potential for green research and technology development	Dependence on foreign technology
		Limited domestic green innovation
Supporting Programmes	Programmes such as PROPER, eco-labelling, SIINas, and SIMPEL	Lack of alignment between programme indicators

Source: Processed by the Author, 2024.

Strategies for Developing Green Industries to Support National Economic Growth

A comprehensive strategy is essential for developing green industries in Indonesia to overcome challenges and harness opportunities that enhance national economic growth. This strategy prioritises improving the quality, coherence, and implementation of government policies to accelerate the shift from conventional to green industries, which remains suboptimal (Balai Standarisasi dan Pelayanan Jasa Industri Banjar Baru, 2023).

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It involves optimising the government's roles as a regulator, facilitator, catalyst, and coordinator, as outlined in Government Regulation No. 41 of 2015. Regulatory reforms are essential to address overlapping and inconsistent regulations, thereby fostering a cohesive framework that integrates sustainable development, environmental protection, and green investment. This approach provides industries with the legal certainty required to adopt and implement sustainable production practices. As a dynamic coordinator, the government must strengthen collaboration among stakeholders through enhanced inter-agency coordination and awareness initiatives. Empowering local governments to develop green master plans and ecosystems will also support the effective production and distribution of eco-friendly products.

The government, as a facilitator, aims to alleviate financial constraints on industries undergoing transformation by enhancing access to fiscal and non-fiscal incentives, including green financing initiatives such as green banking and low-interest credit schemes. Developing human resources aligned with green industry needs through Green Human Resource Management (GHRM) and a sustainable development roadmap is also prioritised (Anis Fitria et al., 2024). In its catalytic role, the government must expedite research, innovation, and technology transfer by fostering collaboration between the Ministry of Industry and the National Research and Innovation Agency (BRIN) to ensure practical application of research findings. Furthermore, integrating programmes like PROPER, eco-labelling, SIINas, and SIMPEL will streamline administrative processes, improve coordination, and reduce bureaucratic burdens on industries.

The implementation of this strategy is anticipated to deliver substantial economic benefits, as mandated by Presidential Regulation No. 98 of 2020 on the Implementation of Carbon Economic Value to achieve Nationally Determined Contribution (NDC) targets. By 2030, Indonesia aims to reduce greenhouse gas emissions by 31.89% through national efforts and 43.20% with international support, contributing to global climate change mitigation, safeguarding ecosystems, and reducing the costs of environmental disaster management. Additionally, the adoption of green industries is expected to foster healthier and more productive ecosystems through the utilisation of eco-friendly raw materials, clean energy, and sustainable waste management practices. These initiatives will promote inclusive economic growth by generating new job opportunities and enhancing the Human Development Index (HDI), as outlined in Government Regulation No. 41 of 2015, while the strategic development of green human resources will empower local communities and alleviate poverty.

This approach aligns with sustainable development goals and enhances resilience across social, economic, and environmental dimensions (Fitri et al., 2024), with improvements in both the green economy and environmental quality indices reflecting this strengthened resilience. In the face of resource, water, and energy crises, green industries are positioned to optimise resource utilisation and efficiency, thereby supporting long-term economic sustainability. Ultimately, the strategy aims to bolster national competitiveness, elevate Indonesia's global standing, and promote national prosperity and well-being, as mandated by Law No. 3 of 2014 on Industry. Through the

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full implementation of this strategy, the transformation towards a resilient, sustainable, and globally competitive green industry is expected to materialise in the near future.

CONCLUSION

The development of green industries in Indonesia is a strategic effort to mitigate environmental degradation caused by conventional industrial activities while supporting sustainable economic growth. Although various policies have been introduced, including efforts to facilitate industrial transformation, enhance institutional support, establish standards, provide incentives, and develop a roadmap, performance outcomes remain suboptimal. Key challenges include the slow adoption of Green Industry Standards (SIH), limited industry participation, and difficulties in meeting transformation targets. External obstacles such as conflicting policies, technological constraints, and environmental crises, along with internal issues like overlapping regulations, weak inter-agency coordination, and inadequate fiscal incentives, continue to hinder progress. This study contributes to the academic discourse by offering a comprehensive analysis of the factors influencing green industry development and by proposing strategic solutions to enhance regulatory frameworks, stakeholder collaboration, and technology-driven transformation. Future research should explore the long-term impacts of green industry policies on economic, social, and environmental outcomes, with comparative studies across industries and regions providing insights into best practices.

As a recommendation, regulatory reforms should be accelerated to harmonise policies and create a supportive framework for green industry transformation. The Ministry of Industry must enhance stakeholder coordination by establishing structured communication forums and improving auditor training and certification programmes. The Ministry of Finance should strengthen fiscal policies by introducing green industry incentives and applying lower credit interest rates. Furthermore, the Ministry of Environment should integrate the PROPER programme with GIS to streamline administrative procedures. Active involvement from universities, industries, and communities is also crucial to advance research, innovation, and human resource development in eco-friendly practices. Through strengthened multi-stakeholder collaboration, institutional capacity, and policy integration, Indonesia's green industries can become a cornerstone of inclusive, resilient, and sustainable national development.

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