International Journal of Progressive Sciences and Technologies (IJPSAT)
ISSN: 2509-0119.

Vol. 45 No. 1 June 2024, pp. 646-662

Green Industry Analysis Of Green House Gas (GHG) Emissions With PASTEL & SWOT In Indonesia's Energy Resilience

Fajar Bayu Nugroho, Purnomo Yusgiantoro, Sri Murtiana, Imam Supriyadi, Arananda Dwi Putri

Faculty of Defense Management, Energy Security
Republic of Indonesia Defense University
Jakarta, Indonesia
E-mail: nugroho.fbn@gmail.com

Abstract—A lot of nations are focusing on environmental sustainability. One of them in industrial development, which is important for domestic energy resilience and economic growth. This is unconditionally related to the issues facing the whole global society, since increasing environmental degredation with followed an increase frequency of different natural disaster. Since the middle of the 20th century, human activity has increased GHG concentrations, which has been the primary factor in the rise in average world temperatures. Energy security is "a condition of guaranteed energy availability, community access to energy at affordable prices in the long term while still paying attention to environmental protection". Energy Resilience can be realized by referring to the concept of energy security, Availabitity, Affordability, Accessibility, Acceptability, and Sustainability. Study of analysis Geen Industry to Green House Gas with PASTEL & SWOT very suitable and appropriate in the current era. This is expected to be the basis to help formulate appropriate policies related to Indonesia's agreement to reduce global emissions and provide sustainable national energy. Green Industry concept can be one of many solution for the problem. With integrating the right approach, an Industry that adopts the Green concept can reduce carbon emissions and other negative impacts on the environment. It not only helps in mitigating climate change but also enhances energy security by ensuring the sustainability of natural resources for future generations and makes a significant contribution to ensuring a stable, sustainable and environmentally friendly energy supply.

Keywords— Energy Resilience, Green Industry, Green House Gas, SWOT & PESTEL

I. INTRODUCTION

A lot of nations are focusing on environmental sustainability. One of them in industrial development, which is important for domestic energy resilience and economic growth. This is unconditionally related to the issues facing the whole global society, since increasing environmental degredation with followed an increase frequency of different natural disaster. Some of these impacts are the result of industrial development that does not care about the environmental impacts.

In this time, the term global warming is familiar to all people. It is often used as the cause of temperature changes, erratic weather, floods, landslides, and other natural disasters. The emergence of the term global warming is not for no reason. Exploitation and use of natural resources without proper regulations, one of which is in industrial sector, an additional role for the presence of this term. Global warming is a phenomenon of increasing global temperatures from year to year due to the greenhouse effect caused by increasing emissions of gases such as carbon dioxide (CO2), methane (CH4), nitrous oxide (N2O), and chlorofluorocarbons (CFCs) (hereafter referred to as greenhouse gas (GHG) emissions) so that solar energy is trapped in the Earth's atmosphere (Riebeek 2010). According to the Intergovermental Panel on Climate Change (IPCC), the increase in GHG concentrations due to human activities is the main cause of the rise in global average temperatures since the mid-20th century.

Corresponding Author: Fajar Bayu Nugroho

Climate models used as a reference by the IPCC show that global surface temperatures will increase by 1.1 to 6.4 degrees Celsius between 1990 and 2100.

Industrial development by prioritizing environmental aspects in the production and operational processes is the concept of Green Industry. The Green Industry concept is one of the solutions to overcome this problem. This concept has been applied in several countries, including Indonesia.

Green industry is industrial development that produces products from processes that do not have an impact environmental sustainability or detrimental to human health (UNIDO, 2011) which aims to strength consideration of environmental, climate and social aspects in the company's business activities (Widyantoro, 2017). This concept was first introduced 1989 in Canada in the development of 12 industrial areas that were able to create sustainable socio-economic conditions with apply Green Industry concept (Zhang, 2016).

Energy security is the ability to respond the dynamics of global energy changes (external) and to ensure the availability of energy at reasonable prices (internal) (Yusgiantoro, 2014). Government Regulation No. 79/2014 on "National Energy Policy", energy security is "a condition of guaranteed energy availability, community access to energy at affordable prices in the long term while still paying attention to environmental protection". Effort to realize energy security can refer to the concept of energy security from the Indonesian Defense University in 2023 with the principles of Availability, Affordability, Accessibility, Acceptability and Sustainability.

Study of analysis Geen Industry to Green House Gas with PASTEL & SWOT very suitable and appropriate in the current era. This is expected to be the basis to help formulate appropriate policies related to Indonesia's agreement to reduce global emissions and provide sustainable national energy. Some previous studies are relevant to this research because some of the variables used are the same in this study which can be used as comparisons and references:

Table 1. Previous Studies

No	Name	Title	Method	Results
1	Asni Mustika Rani, Tia Yuliawati, Dheka Dwi Agustiningsih Journal Advances in Social Science, Education and Humanities Research, Volume 307 2018	How to Change MSME's Paradigm in Applying Green Industry Principles?	Narrative Literature Review	Factors to apply of Green Industry principles in MSMEs are external factors, internal factors and connecting factors. External factors are (1) government regulations, (2) certification, (3) financing, (4) incentives, (5) awards, (6) competitors in the industry, (7) public buying interest, (8) public opinion, (9) social organizations. The internal factors are (1) production process, (2) waste treatment technology, (3) changes in production standards, (4) suppliers, (5) corporate awareness, (6) environmental mitigation. The two factors are related to the connecting factors, namely (1) environment, and (2) education and training.
2	Swapnil V. Ghinmine, Dilip I. Sangotra IJRET:	Implementation of Green manufacturing Industry A Case Study	Quantitative	With the advance of achievements in the manufacture system, the environment began to problem of pollution cause degradation. The main challenge for the government was to protect the environment from this

	International Journal of Research in Engineering and Technology 2015			pollution. So, in 20th century the concept of Green Manufacture evolved. The term "green manufacturing" can be seen in two ways: manufacturing "green" products, specifically those used in renewable energy systems any kind of green technology equipment, and "greening" the manufacturing sector reducing pollution and waste with minimizing the use of natural resources, recycling and reusing what is considered waste, and reducing emissions.
3	Dora Kusumastuti, Wibowo Murti, Samadi Sutiyo, Supriyanta International Journal of Business, Economics and Law 2022	Green Industry Policy In Indonesia	Juridical Normative	Effort to reduce the potential impact on natural resources and the environment, the government has adopted a policy of implementing the concept of sustainable development in every national economic development activity. The concept of sustainable development has been described in Article 1 paragraph (3) of Law Number 32 of 2009 concerning environmental protection and management. Regulation of the Minister of Industry No. 50 of 2020 states that the Green Industry is an industry that in its production process prioritizes efficiency and effectiveness in the use of sustainable resources so that it is able to harmonize industrial development with the preservation of environmental functions and can provide benefits to the community. The Ministry of Industry (Kemenperin) continues to strive to spur the development of green industries to prioritize efforts for efficiency and effectiveness in using resources in a sustainable manner. This is so that industrial development is in line with the preservation of environmental functions and can provide benefits to the community.
4	Phurita Noranarttakun dan Chanathip Pharin Environment Asia	Strategic Implementation to Enhance Green Industry Practices in SMEs: Lesson Learned from	SWOT Analysis, Strenght, Weakness, Opportunity, Threat	Although, SMEs' capability in internal resource especially budget, green technology knowledge remains major weakness as well as absence of appropriate regulatory incentive. The key opportunity is arising from the

	Journal 2021	Thailand		global SDGs and the 20-year national strategy focusing on green economy and sustainable development. The future strategy recommendation for policy makers is to promote the implementation of economic based incentives including sustainable procurement, voluntary green product certifi cation scheme, together with pragmatic regulation mechanism i.e. green product law, product tax to close the gap of green industry practices implementation and sustainable growth for SMEs.
5	Mujammil Asdhiyoga Rahmanta dan Agus Salim Samsudin Offshore Journal: Oil, Production Facilities and Renewable Energy 2022	Pastel & Swot Analysis of Pumped Storage Hydropower Technology Utilization to Increase Renewable Energy Penetration in Indonesia	PESTEL Analysis (political, economic, sociocultural, technological, legal, and environmental) & SWOT (Strenght, Weakness, Opportunity, Threat)	The usage of fossil fuel power plants that harm the environment CO^2 emissions can be decreased by generating power using renewable energy (RE). The performance of solar power plants (PLTS) and wind power plants (PLTB) is characterized by intermittent features that are heavily impacted by external factors such variations in solar radiation and wind speed. By removing these plants' erratic behavior from the electrical grid, PSH technology can facilitate the adoption of renewable energy sources (RE) in Indonesia, particularly wind and solar power plants. PSH is also a proven energy storage technology that can be used in large-scale, intricate electrical systems since it is both affordable and mature.

II. Research Methodology

The following study is qualitative in nature as it elucidates the application of PESTEL and SWOT analysis as the foundation for formulation. Qualitative research produces findings that do not rely on statistical procedures or other quantitative means, where data are presented more in descriptive forms rather than numerical ones.

PESTEL analysis is an acronym for political, economic, sociocultural, technological, environmental, and legal factors. PESTEL analysis serves as a tool to examine the factors within a country and assess how these factors influence success (Investopedia, 2022). SWOT analysis is a structured planning method used to evaluate Strengths, Weaknesses, Opportunities, and Threats within a project (Asmaranto, et al., 2021). SWOT analysis is conducted to assess the potential for developing the Green Industry in Indonesia and to determine appropriate development strategies.

Figure 1. Pestel Analyses Aspect

The data utilized in this research were gathered using the literature review method. As a research method, literature review should be conducted with proper steps and actions to ensure thorough, accurate, and reliable scrutiny. This method is one suitable for research aimed at providing an overview of a specific issue or research problem (Snyder, 2019).

1. Prepare Your Paper Before Styling

A. PESTEL Analyis (Politic, Economic, Social, Technology, Environmental, Legal) to Green Industry

The PASTEL Analysis (Political, Economic, Social, Technological, Environmental, Legal) is employed to evaluate external factors influencing the green industry and greenhouse gas emissions in Indonesia.

• Political

Indonesia's government policies regarding green energy and greenhouse gas emissions demonstrate a strong commitment to the Paris Agreement. Programs such as the General Plan for National Energy (RUEN) and various regulations concerning renewable energy indicate a clear direction towards emission reduction. However, consistent implementation and transparency in policies remain significant challenges.

• Economic

Indonesia's rapid economic growth necessitates increased energy consumption. Diversification of energy sources and investment in green technology are required to reduce reliance on fossil fuels. Economic incentives and green financing schemes also play a crucial role in promoting the adoption of environmentally friendly technologies.

• Social

Public awareness of the importance of reducing greenhouse gas emissions and adopting renewable energy is growing. However, there is a need to enhance education and public participation in supporting green initiatives. Behavioral changes and support from local communities are essential for the success of these programs.

• Technological

Advancements in renewable energy technologies, such as solar, wind, and bioenergy, present significant opportunities for reducing greenhouse gas emissions. However, technology transfer and enhancing local capacity remain obstacles that must be overcome to achieve broader adoption.

• Environmental

Indonesia possesses high biodiversity and ecosystems vulnerable to climate change. Therefore, reducing greenhouse gas emissions is not only essential for energy resilience but also for environmental conservation. Implementation of green industry practices can help mitigate negative impacts on the environment.

• Legal

Stringent regulations and standards are necessary to monitor and control greenhouse gas emissions. Effective law enforcement and a regulatory framework supportive of green innovation are crucial in ensuring industry compliance with emission targets.

2. The Political and Social Aspects

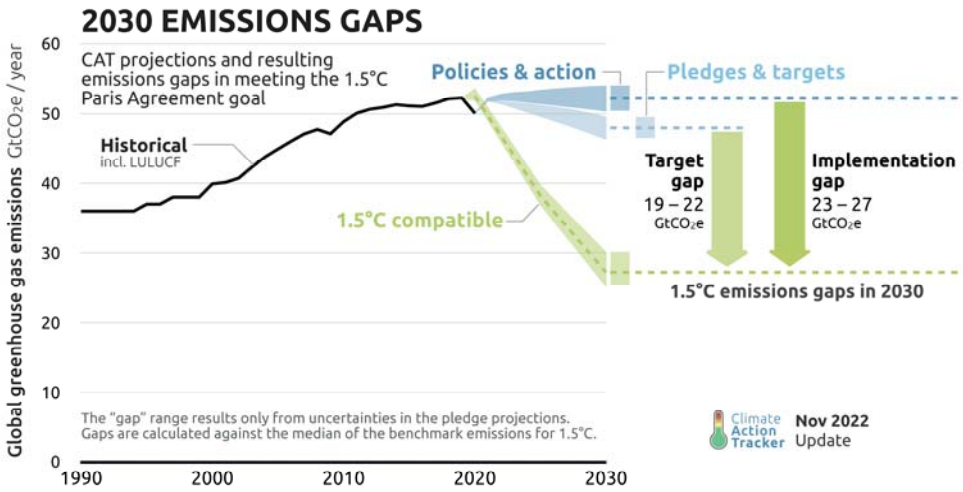


Figure 2. Emissions Gaps 2030

Source: hijauku.com

The Climate Action Tracker analysis indicates a shortfall in emission reduction implementation by 2030, reaching 23-27 gigatons of CO2 equivalent emissions. To achieve the target of limiting global warming to below 1.5 degrees Celsius, countries that have ratified the Paris Agreement must enhance their ambitions to reduce greenhouse gas (GHG) emissions. Thus, there is still an opportunity for the world to achieve this, but time is running short.

This graph illustrates the projections of global greenhouse gas emissions and the gap in meeting the Paris Agreement targets to limit global warming to 1.5°C. Politically, there is a disparity between government policies and actions (Policies and Action) and the pledges and targets set by various countries (Pledges & Targets). Governments of various countries bear the responsibility to establish and implement policies that can reduce greenhouse gas emissions. The gap between current policies and the pledges made indicates that many countries have not fulfilled their commitments.

The implementation gap (23-27 GtCO2e) suggests that despite ambitious pledges by countries, on-the-ground implementation still significantly lags. This reflects the need for stricter monitoring and evaluation of environmental policies.

To achieve emission reduction targets, strong international cooperation is necessary. Countries must collaborate in sharing technology, funding, and capabilities to accelerate the transition to a low-carbon economy. The Paris Agreement is a prime example of international cooperation efforts, but this graph indicates that these efforts are still inadequate without broader concrete actions.

Reviewing the social aspects, the continued increase in greenhouse gas emissions directly impacts climate change, which can lead to more frequent and severe natural disasters such as floods, droughts, and storms. This can affect millions of people, especially

those living in vulnerable areas. Climate change also has the potential to affect food security, access to clean water, and global public health. Increased public awareness of the impacts of climate change can drive grassroots actions and increase pressure on governments and industries to act. Communities can play an active role through behavioral changes, such as reducing personal carbon footprints, supporting environmentally friendly products, and participating in environmental movements.

Furthermore, this also indicates the importance of climate justice. Developing countries, which generally contribute less to global emissions, often suffer the most from the impacts of climate change. Therefore, it is crucial to ensure that the transition to a low-carbon economy does not exacerbate global injustice. International assistance and fair financing mechanisms are essential to help developing countries mitigate and adapt to climate change. This highlights the urgency to bridge the gap between current policies and the necessary targets to achieve global climate goals. Political and social aspects play a crucial role in addressing these challenges. Strong international cooperation, effective policy implementation, and public participation and awareness are essential to achieve emission targets in line with the Paris Agreement and ensure a safer and more sustainable future for all.

3. The Economical Aspect

The primary national priority of the Medium-Term National Development Plan, concerning the development of the national industrial sector, is to strengthen economic resilience for quality growth and enhance quality, competitive human resources. The instructions from the elected President of the Republic of Indonesia for the period 2019-2024, reinforced by the Letter from the Minister of National Development Planning/Head of the National Development Planning Agency Number B.899/M.PPN/SES/PP.03.02/12/2019 dated December 20, 2019, regarding the Alignment of the President and Vice President's Vision and Mission in the Strategic Plan Document of Ministries/Institutions 2020-2024, stipulate that Ministers/Leaders of Institutions must adhere to the President and Vice President's vision and mission in carrying out their duties and functions. Indonesia will become an advanced, sovereign, and independent country by becoming an advanced industrial nation with a competitive industrial sector.

Competitiveness here refers to the Indonesian industrial sector's ability to rely on its capabilities and strengths, manage available resources for value-added enhancement, job creation through the establishment of new employment opportunities, and increase investment and export in the industrial sector through technology utilization. Resource management includes human resource management, innovative technology utilization, and the implementation of Industry 4.0 (Ministry of Industry Strategic Plan 2021-2024). The role of the Green industry is one of the sectors that contribute to fostering the economy, which is greatly needed with positive impacts on equitable and fair societal welfare.

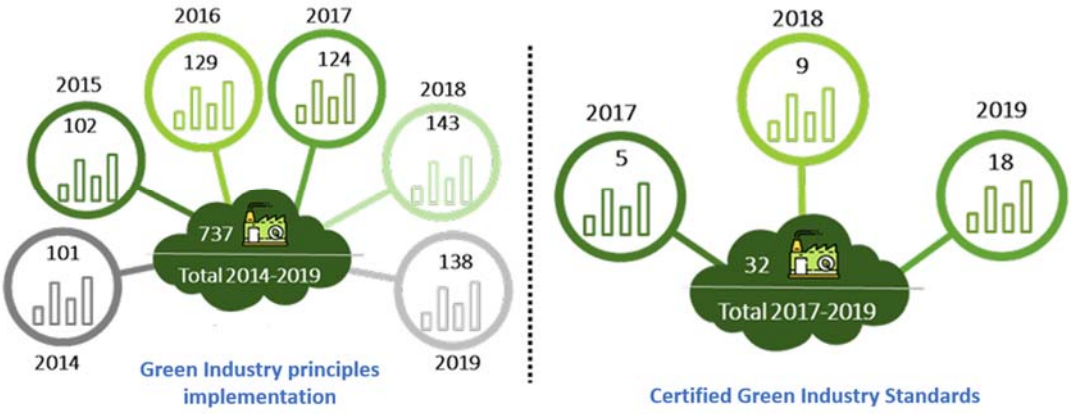


Figure 3. The number of industries implementing Green Industry principles and industries certified with Green Industry standards.

Source: Ministry of Industry Strategic Plan 2021-2024

Industrial companies that apply green industry principles are those that have successfully achieved level 4 and 5 in green industry awards, totaling 737 companies over the past five years. Until 2019, 32 companies have been certified according to 13 existing green industry standards. The implementation of green industry provides direct benefits to the industry, especially in

terms of energy and raw material efficiency. In 2018, out of 143 companies receiving green industry awards, energy efficiency amounted to Rp. 2.8 trillion and water raw material efficiency amounted to Rp. 96 billion.

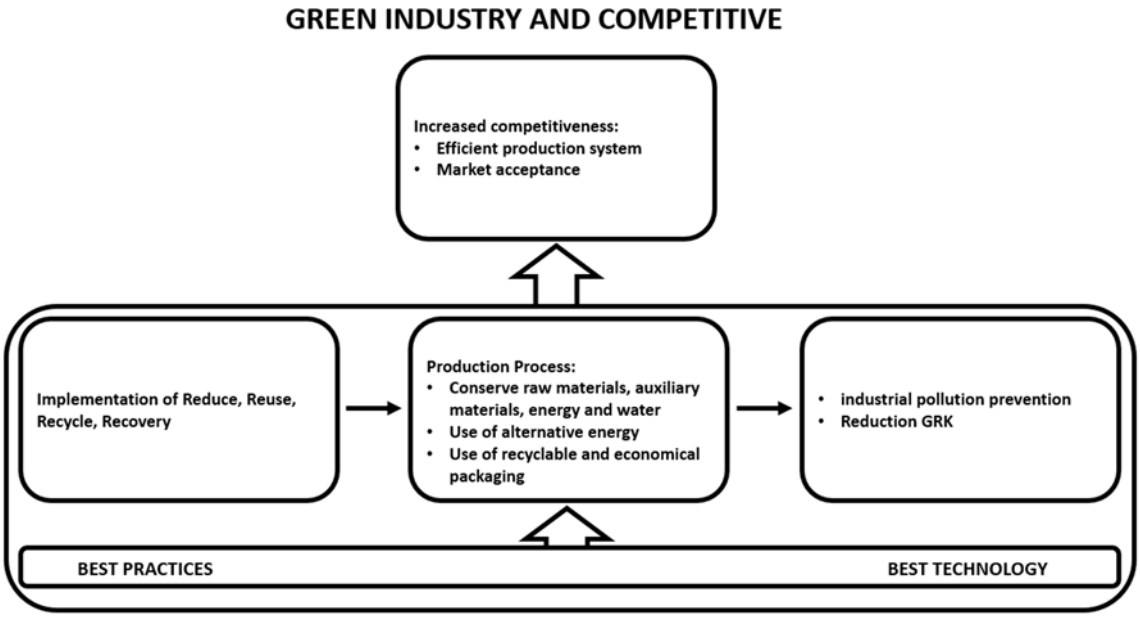


Figure 4. The Relationship between Green Industry and Product Competitiveness

Source: Widyantoro 2017

From another perspective, the green industry approach will also drive the creation of new job opportunities, new business opportunities, and stimulate the development and innovation of technology, particularly related to environmentally friendly technology. Both the private and government sectors are seeking the latest innovations to create a sustainable environment and energy sources that produce minimal pollution to transform our polluted world (Center for Green Industries and Sustainable Business Growth of Duquesne University, 2014).

4. The Technology of Green Industry Aspect

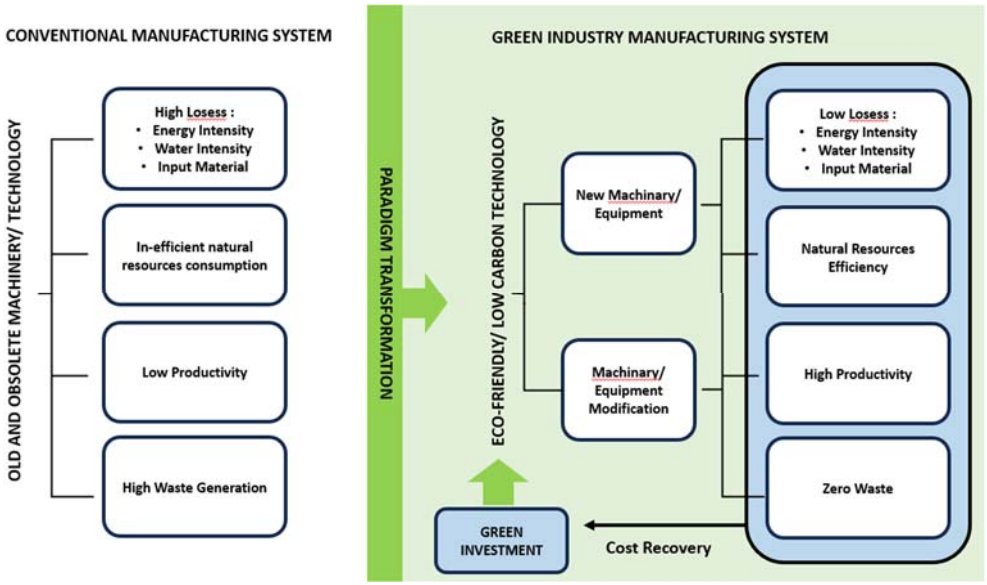


Figure 5. Development Modelling of Green Industry

Source: Hutahean (2016)

The implementation of green industry utilizing best practices and technologies not only aims to preserve natural resources through effective and efficient usage but also enhances product competitiveness. Best practice implementation follows the principles of reduce, reuse, recycle, recovery (4R), thereby improving efficiency in both raw materials and resources. Coupled with the use of recyclable and more economical packaging, this prevents and reduces pollution in the industrial sector, ultimately decreasing greenhouse gas emissions and contributing to environmental sustainability (Hutahaean, 2017).

Technologies applied in green industry development, such as the utilization of renewable energy sources like solar, wind, water, and biomass, aim to reduce reliance on fossil fuels. Green Industry technologies develop ways to utilize industrial waste as an energy source, such as generating electricity from biogas produced from organic waste. This reduces the need for energy from primary sources and enhances energy resilience through the utilization of previously untapped resources.

5. The Environmental Aspect

The industrial management processes in certain regions often overlook the environmental damage, ultimately resulting in disasters for those areas, which, of course, adversely affect the local community. The intention behind the establishment of industries in a region is to support a better and prosperous life, but by disregarding the fact that human life inherently coexists with nature, the local community becomes victims of excessive exploitation of the surrounding areas by the industry. Green Industry must observe sustainable changes in the surrounding environment and strive to minimize its impact on the environment.

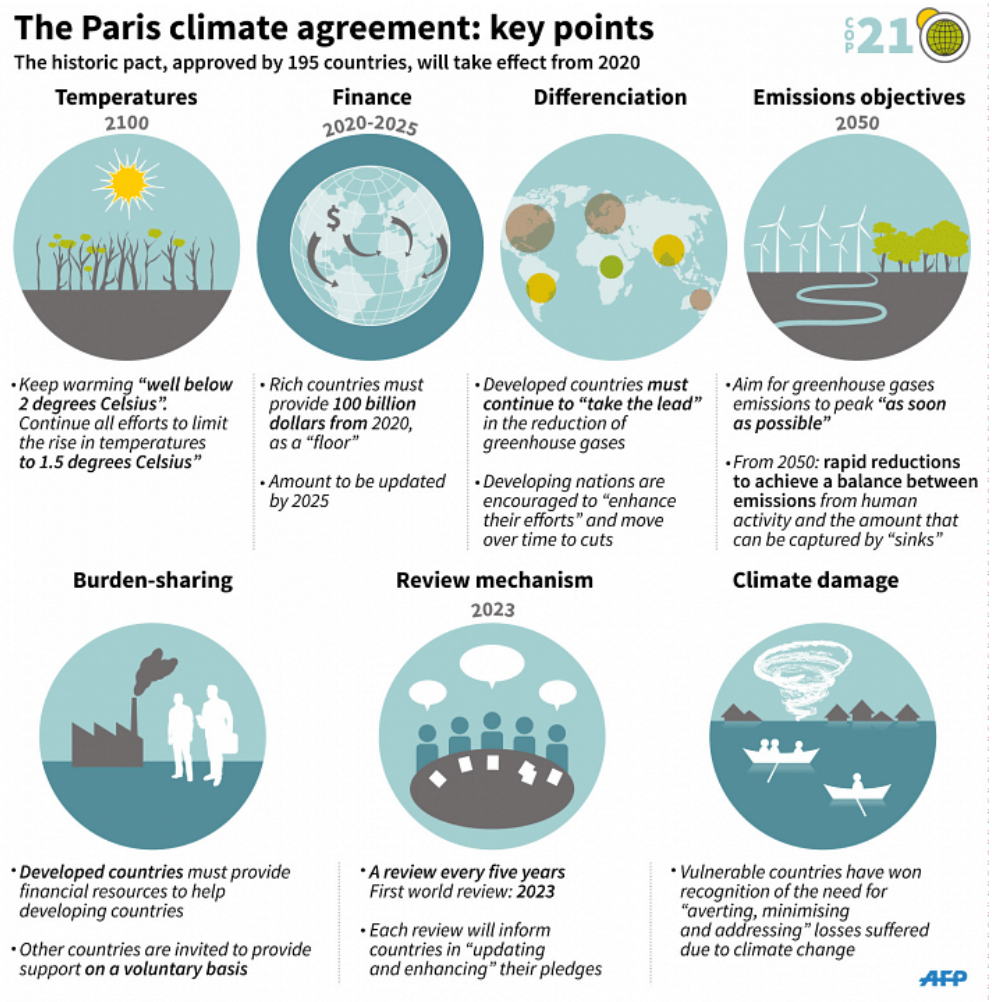
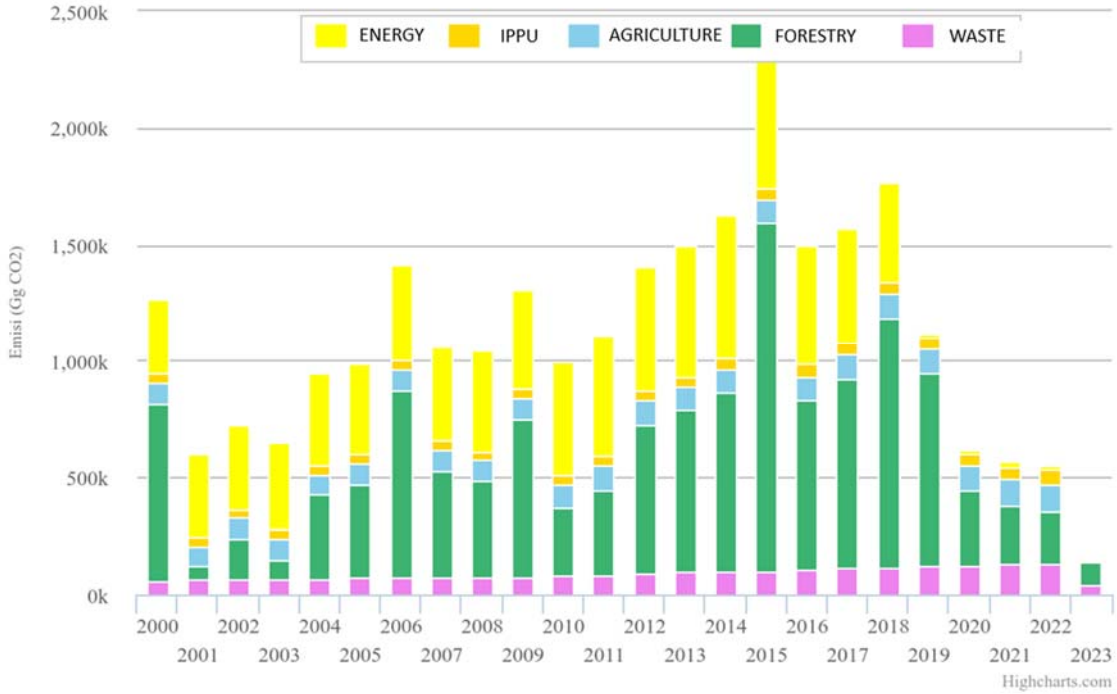


Figure 6. The Paris Climate Agreement:KeyPoint, 1987, hijauku.com

Source: Institute for Essential Services Reform (IESR), trasisienergi.id

The reduction of GHG emissions in industrial sectors implementing the Green Industry concept, based on the strategic plan data of Green Industry Center for 2022-2024, indicates that in 2019, the target reduction of GHG emissions in the industrial sector from energy use and Industrial Processes and Product Use (IPPU) sources by 6 percent was achieved by 6 percent. This figure is obtained by comparing the reduction in GHG emissions in the industrial sector from energy use and as IPPU sources to the baseline of the year 2010.



Graphic 1. The Total National Emissions for 2000-2023

Source: signsmart.menlhk.go.id

Table 1. Total National Emissions for 2000-2023

NO	CATEGORY	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
1	ENERGY	319.265,81	349.253,74	361.881,08	370.783,32	391.539,66	390.443,51	417.888,15	410.427,75	437.724,42	429.804,28
2	IPPU	41.265,27	46.796,68	40.094,80	39.776,59	41.634,76	40.594,18	37.006,66	34.570,27	35.118,30	36.032,13
3	AGRICULTURE	84.537,46	82.786,49	83.269,07	86.166,19	85.948,98	87.410,58	88.693,14	91.755,87	90.616,37	93.956,48
4	FORESTRY	756.503,90	56.724,18	176.512,77	82.630,24	356.823,01	398.695,97	799.650,60	452.510,29	409.141,82	668.412,27
5	WASTE	60.929,38	63.340,66	65.676,28	68.265,03	69.114,83	70.728,64	75.219,09	75.130,88	75.657,76	78.070,78
	TOTAL	**1.262.501,82**	**598.901,75**	**727.434,00**	**647.621,37**	**945.061,24**	**987.872,88**	**1.418.457,64**	**1.064.395,06**	**1.048.258,67**	**1.306.275,94**

NO	CATEGORY	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
1	ENERGY	483.997,72	513.887,30	533.490,56	563.563,33	614.215,45	553.971,79	513.255,44	495.185,46	430.068,68	20.682,03
2	IPPU	41.378,04	42.492,47	47.929,20	47.241,58	53.677,79	49.286,30	55.232,07	48.593,55	51.179,98	50.878,11
3	AGRICULTURE	96.955,06	102.978,69	101.693,21	96.905,53	99.984,01	100.591,34	102.574,85	105.307,25	104.053,45	105.300,85
4	FORESTRY	289.153,38	361.166,82	636.749,90	692.763,41	762.167,99	1.492.308,31	723.514,27	810.894,16	1.067.962,86	821.201,67
5	WASTE	83.374,37	86.098,51	88.852,83	94.616,14	97.564,59	99.696,01	103.461,72	111.106,63	117.464,20	123.017,79
	TOTAL	**994.858,57**	**1.106.623,79**	**1.408.715,70**	**1.495.089,99**	**1.627.609,83**	**2.295.853,75**	**1.498.038,35**	**1.571.087,05**	**1.770.729,17**	**1.121.080,45**

NO	CATEGORY	2020	2021	2022	2023
1	ENERGY	17.790,05	17.749,87	17.197,77	0
2	IPPU	49.890,83	52.068,74	59.451,89	0
3	AGRICULTURE	107.849,59	111.824,25	119.840,97	66,98
4	FORESTRY	317.235,91	253.347,85	221.367,88	96.039,31
5	WASTE	125.748,50	128.714,28	130.419,22	39.702,69
	TOTAL	**618.514,88**	**563.704,99**	**548.277,73**	**135.808,98**

Notes :
Industrial Processes and Product Use (IPPU

Source: signsmart.menlhk.go.id

In **Table 1,** it presents Indonesia's national emissions data from 2000 to 2023, divided into five main sectors: Energy, Industrial Processes and Product Use (IPPU), Agriculture, Forestry, and Waste. From the data provided, it is evident that the energy sector consistently remains the largest contributor to greenhouse gas (GHG) emissions throughout the period. Emissions from the energy sector fluctuate, peaking in 2014 at 614,215.45, but then experiencing a significant decline in the following years to reach 17,197.77 in 2023. This decrease reflects efforts and emission reduction policies that may have been implemented in the energy sector.

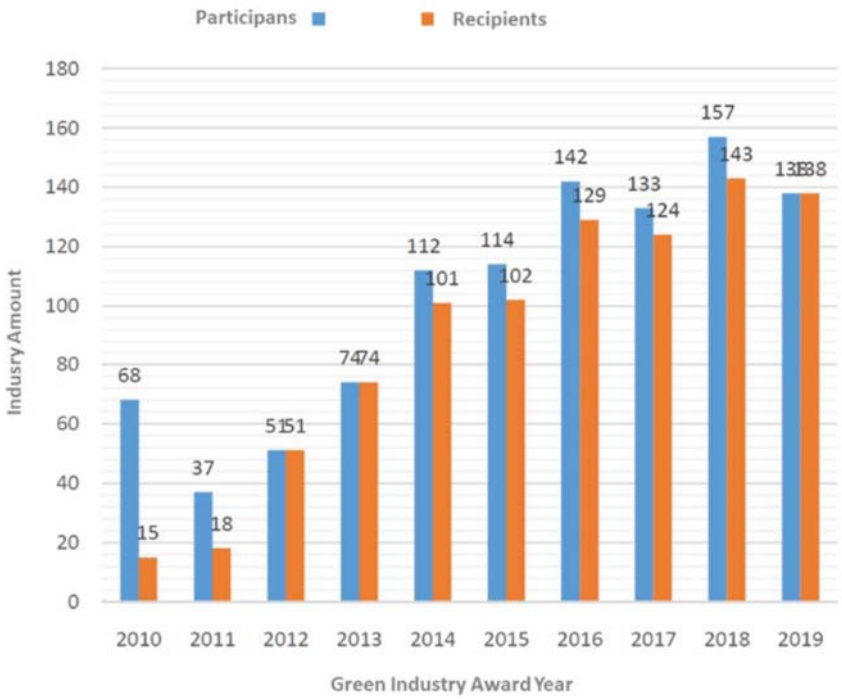
The forestry sector also shows significant dynamics, particularly from 2012 to 2018, where emissions from this sector experienced a sharp increase, reaching its peak in 2015 at 1,492,308.31. This is likely due to intensive deforestation and forest degradation during that period. However, emissions from the forestry sector drastically decreased after 2018, indicating effective measures to control deforestation and land restoration. In 2023, emissions from the forestry sector were recorded at only 8,290.37, a drastic decrease compared to previous years.

Other sectors such as IPPU, agriculture, and waste also exhibit diverse patterns. Emissions from the IPPU and waste sectors are relatively stable but have consistently decreased since 2018. Agriculture also shows a significant decline in emissions starting in 2021. The reduction in emissions across sectors in recent years, especially in 2023, indicates positive outcomes from various climate change mitigation policies implemented by the Indonesian government. These efforts include the adoption of green technologies, better waste management, and more sustainable farming practices.

6. The Legal Aspects

The implementation of green industry concepts in Indonesia has been ongoing for quite some time, starting with the enactment of Law Number 5 of 1984 concerning Industry. One of the articles in this law states that industrial development must be based on the principle of environmental sustainability. In 2009, the Manila Declaration on Green Industry in Asia established a non-binding legal agreement for the development of industry as an adaptation and mitigation measure to climate change. This declaration created a shared agreement among Asian countries to be realized through the development of green industries. Therefore, in 2010, Indonesia began implementing the agreed agenda in the Manila Declaration by instituting the Green Industry Awards (PIH). This award is given to companies that have implemented green industry principles in their production processes. As of now, the PIH is still ongoing, with a total of 895 companies receiving this award during the period 2010-2019. Green Industry Center assessment covers three main components: production processes (70%), waste/emission management (20%), and company management (10%). Participation in this award is not limited to large-scale industries only but is also open to small and medium-sized industries.

Law Number 3 of 2014 concerning Industry regulates the implementation of green industry in Indonesia through policies, institutional capacity strengthening, standardization, and provision of facilities. As a follow-up to this implementation, in 2017, the first green industry certification was held, with five industries declared to meet the standards by certification bodies. The second certification took place in 2018, with nine industries meeting green industry standards. In the same year, Government Regulation Number 29 of 2018 concerning Industry Empowerment was issued, detailing standards and certification for green industries. The third certification was held in 2019, with 17 industries funded by the government and two industries self-funded meeting green industry standards. In 2020, five Green Industry Standards were established, bringing the total number of Green Industry Standard's to 18, and this number will continue to increase to cover other industries.



Graphic 2. The Number of Industrial Participants and Recipients of the Green Industry Award Program from 2010-2019

Source: Green Industry Center, the Ministry of Industry Outlook 2020

The government established the Green Industry Center as a concrete step reflecting the political will of the government to realize green industry in Indonesia. The Green Industry Center, as a task force under the Agency of Standardization and Industrial Policy Services, implements the Value Added and Industrial Competitiveness Program through Green Industry Development activities. These activities are an elaboration of national priorities, strategic objectives, indicators, and targets in the National Medium-Term Development Plan (RPJMN) 2020-2024, as well as the National Industrial Policy 2020-2024.

Table 2. The Regulatory Framework

NO	Direction of Regulatory Framework and/or Regulatory Needs	Urgency of Establishment Based on Evaluation of Existing Regulations, Studies and Research	Responsible Unit	Unit/ Institution	Deadline
1	Draft Minister of Industry Regulation on Water management in the Industrial Sector	Mandate of Law No. 3 of 2014 on Industry Article 35 paragraph 1 and 2; Water Resources Bill and RPP JAKNAS (Water Security Policy)	Green Industry Center	1. Ministry of Public Works and Housing (PUPR) (Surface Water); 2. Ministry of Environment and Forestry (KLHK); 3. Ministry of Energy and Mineral Resources(ESDM) (Groundwater); 4. Water Resources Council	2021
2	Draft Minister of Industry Regulation on energy management in the Industrial Sector	Mandate of Law number 3 of 2014 on Industry article 34 paragraph 1 and 2 RPP revision of Government Regulation 70 on Energy Conversion	Green Industry Center	1. Ministry of Energy and Mineral Resources(ESDM) (Groundwater); 2. National Energy Council	2021
3	Draft Minister of Industry Regulation on establishment of Green Industry Standards	Mandate of Law Number 33 of 2014 concerning Industry Article 79 paragraph (1)	Green Industry Center	1. Ministry of Environment and Forestry (KLHK);	2020-2024

Source: signsmart.menlhk.go.id

In order to implement the policy direction and development strategy for the period of 2020-2024, the Green Industry Center has developed a regulatory framework as a legal umbrella for the implementation of programs and activities aimed at promoting green industry. Based on Regulation No. 7 of 2021 regarding the Organization and Work Procedures of the Ministry of Industry, it is stated that the Green Industry Center is tasked with formulating technical policies, plans, programs, implementation, monitoring, evaluation, reporting on the implementation of research, assessment, development, and promotion in the field of green industry. Government policies in the development of green industry are carried out through:

1. Development of green industry standards;
2. Strengthening green industry infrastructure;
3. Facilitation of fiscal and non-fiscal incentives for green industry;
4. Enhancement of the competence of human resources in the green industry;
5. Improvement of industrial resource efficiency (raw materials, energy, and water) and control of environmental impacts of industrial activities; and
6. Promotion of industrial competitiveness through the application of green industry.

To implement the above policies, the strategies and operational steps to be taken by the Green Industry Center are:

1. Implementation of activities to reduce industrial sector GHG emissions, including increasing the application of energy management and the utilization of renewable energy in the industrial sector, developing carbon trading markets in the industrial sector, drafting guidelines for reducing GHG emissions in the IPPU and waste sectors, compiling information on the provision of energy utilization of new and alternative energy and energy efficiency in the industrial sector.

2. Development of Green Industry Standards and Institutions, including assessment and supervision of Green Industry Certification Bodies, strengthening the capacity of Green Industry Certification Bodies, and developing Green Industry Standards.
3. Development of International Recognition of Green Industry Standards, including a study on the application of green industry standards in Indonesia related to international recognition efforts, and a study on the mandatory implementation of green industry standards.
4. Strengthening the application of green industry principles in the industrial system, including green industry awards, green industry certification, drafting fiscal incentives, and implementing non-fiscal incentives for green industry, as well as policies and monitoring of industrial sector process water management.
5. Handling of hazardous waste issues in the industrial sector and application of circular economy principles in sustainable industrial development, including the implementation of action plans for the reduction and elimination of mercury in the industrial sector, preparation of policy studies on the application of circular economy in the industrial sector, control and supervision of compliance with green industry implementation, and control of industrial waste in river basin areas.
6. Strengthening industrial infrastructure in the management of hazardous materials and hazardous waste (B3) in the industrial sector through capacity building for environmental testing in the industrial sector.

B. The SWOT Analysis (Strenght, Weakness, Opportunity, Threat) to Green Industry

The SWOT analysis provides a comprehensive framework for evaluating the strengths, weaknesses, opportunities, and threats facing the green industry. Examining these factors offers valuable insights into the industry's current position and future prospects. Strengths of the green industry lie in its ability to deliver environmentally friendly products and processes, aligning with the growing concern for sustainability among consumers and companies. Meeting stringent environmental standards not only enhances the industry's reputation but also mitigates legal risks associated with regulatory compliance. Additionally, the adoption of energy-efficient technologies drives cost savings and fosters innovation, boosting competitiveness. Companies prioritizing sustainability enjoy positive public perception and stakeholder support, further enhancing their standing in the market.

However, the green industry faces several weaknesses, including higher production costs compared to conventional products. Limited consumer and corporate awareness of the benefits of green products poses a challenge, as does the scarcity of environmentally friendly raw materials and requisite technologies. Scaling up production to meet rising demand and penetrating new markets with varying regulations and consumer preferences present additional hurdles.

Despite these challenges, numerous opportunities abound for the green industry. Increasing consumer awareness of environmental issues drives the demand for eco-friendly products, providing a significant growth avenue. Governments worldwide offer incentives such as subsidies and tax breaks to companies adopting green practices, stimulating industry expansion. Investor interest in sustainable portfolios and collaboration prospects with international organizations and research institutions further bolster the industry's growth potential. Moreover, access to international markets with stringent environmental regulations presents lucrative opportunities for expansion.

Nevertheless, threats loom over the green industry, including the high initial investments required for implementing green technologies. Competition from non-green companies offering cheaper alternatives poses a significant challenge, as does the uncertainty surrounding environmental regulations. Continuous innovation and adaptation to evolving technological landscapes are imperative to navigate these threats successfully. Additionally, global economic fluctuations may impact demand and access to funding, necessitating proactive risk management strategies.

The SWOT analysis underscores the green industry's inherent strengths, weaknesses, opportunities, and threats, providing a roadmap for strategic decision-making. By leveraging its strengths, addressing weaknesses, capitalizing on opportunities, and mitigating threats, the green industry can achieve sustainable growth and contribute meaningfully to environmental conservation efforts.

a. Strengths of the Green Industry

- Environmentally friendly products and processes provide added value, as more consumers and companies are concerned about the environment.
- Green industries meet strict environmental standards, reducing legal risks and costs associated with regulations.
- The use of energy-efficient technologies and practices can reduce operational costs.
- Innovative green technologies can improve production efficiency and competitiveness.
- Companies focusing on sustainability have a positive image in the eyes of the public and stakeholders.

b. Weaknesses of the Green Industry

- Production costs of green products are often higher compared to conventional or regular products.
- Not all consumers and companies understand the benefits and importance of green products.
- Limited availability of environmentally friendly raw materials and required technologies can be obstacles.
- Scaling up production to meet larger demand.
- Entering new markets may be challenging due to differences in regulations, consumer preferences, and local competition.

c. Opportunities for the Green Industry

- Demand for environmentally friendly products continues to rise as consumer awareness of environmental issues increases.
- Many governments provide incentives such as subsidies, tax reductions, and grants for companies implementing green practices.
- Increased interest from investors seeking sustainable portfolios.
- Opportunities to collaborate with international organizations, NGOs, and research institutions to develop innovative solutions.
- Potential to access international markets with strict environmental regulations and appreciation for green products.

d. Threats to the Green Industry

- Implementation of green technologies often requires high initial investments.
- Competition from companies not implementing green practices but offering products at lower prices.
- Uncertainty and changes in environmental regulations affecting company operations and costs.
- Green industries must continue to innovate and keep up with the latest technological developments to remain competitive.
- Global economic fluctuations can affect demand for green products and access to funding.

C. The Role of Green Industry in Enhancing Indonesia's Energy Resilience

Energy resilience refers to the ability to respond to the dynamics of global energy changes (external) and the ability to ensure energy availability at reasonable prices (internal) (Yusgiantoro, 2014). Based on Government Regulation Number 79 of 2014 concerning "National Energy Policy," energy resilience is defined as "a condition where energy availability is guaranteed, public access to energy at affordable prices is ensured in the long term while still considering environmental protection." The concept of energy resilience is in line with the scope of green industry, which prioritizes the environment for the continuous supply of raw materials. Efforts to achieve energy resilience can refer to the concept of energy resilience from the Defense University in 2023 with the principles of availability, affordability, accessibility, acceptability, and sustainability.

These five basic aspects can be explained as follows:

a. Availability refers to the availability of energy, both from fossil sources and renewable energy.

b. Affordability pertains to the affordability of prices for consumers, the ability of consumers to obtain or pay for energy.

c. Accessibility denotes the ease of energy users in obtaining final energy, starting from the exploration and processing processes to reaching the user's location using transmission and distribution lines.

d. Acceptability refers to the acceptance of energy that will be used to meet energy needs.

e. Sustainability entails the continuous availability of energy over the long term to meet the needs of society without sacrificing future generations.

Green industry promotes the creation of national energy resilience by using renewable energy sources such as solar, wind, water, and biomass. This diversification reduces dependence on fossil fuels and enhances energy security by providing various more sustainable and stable energy sources. The use of resources preserved through the Green Industry concept will maintain the availability of energy sources in the environment that will not quickly deplete. Green industry also supports decentralized energy generation through the installation of renewable energy in locations close to consumption points. Systems like microgrids and small-scale power plants increase energy resilience by reducing the risk of failure due to dependence on centralized sources.

III. Conclusion

The analysis presented highlights the pressing need for global collaboration to combat climate change and transition towards a low-carbon economy. Despite commitments made under the Paris Agreement, a substantial gap persists in implementing emission reduction targets, posing challenges to limiting global warming. This gap underscores the disparity between government pledges and practical actions, necessitating stricter monitoring of environmental policies and closer evaluation of their implementation.

Efforts to address this gap demand robust international cooperation, with countries sharing technology, funding, and capabilities to expedite the transition to a sustainable future. While initiatives like the Paris Agreement mark progress, concrete actions are essential to align policies with necessary targets. Additionally, the social ramifications of climate change underscore the necessity for increased public awareness and grassroots actions, emphasizing the role of communities in reducing carbon footprints and endorsing environmentally friendly initiatives while ensuring climate justice remains a core principle.

From an economic standpoint, the green industry emerges as a key driver of sustainable growth and energy resilience. Through promoting eco-friendly practices and leveraging innovative technologies, the green industry not only mitigates environmental degradation but also enhances economic competitiveness and job creation. The SWOT analysis offers valuable insights into the industry's strengths, weaknesses, opportunities, and threats, guiding strategic decision-making to ensure sustainable growth and meaningful contributions to environmental conservation efforts. In Indonesia, initiatives like the Green Industry Awards exemplify the country's commitment to sustainable development and energy resilience, demonstrating the importance of concerted efforts from governments, industries, and communities worldwide to pave the way for a safer, more sustainable future.

IV. Acknowledgment

The authors really appreciated and would like to thank all those who have helped and supported this research. Special thanks to the Republic of Indonesia Defense University and the entire academic community.

References

[1] Buku Pedoman Pembiayaan Efisiensi Energi di Industri untuk Lembaga Jasa Keuangan 2015

[2] Christiani, A., Kristina, H. J., Hadi, L., & Rahayu, P. C. (2017). Pengukuran Kinerja Lingkungan Industri di Indonesia Berdasarkan Standar Industri Hijau. Jurnal Rekayasa Sistem Industri, 6(1), 39–48.

[3] Energy.gov. What Are Energy- and Emissions-Intensive Industries?. Diakses pada 30 Januari 2024. https://www.energy.gov/eere/iedo/energy-and-emissions-intensive-industries

[4] Hutahean, L., S. (2016). Green Industry Scheme Implementation in Indonesia. https://www.unido.org/sites/default/files/files/201809/Lintong%20Sopandi%20Hutahaean_presentation_Plenary%204%20GIC%202016.pdf

[5] Kusumastuti, D., Samadi, W., M., Sutiyo, Supriyanta. (2022). Green Industry Policy in Indonesia. International Journal of Business, Economics and Law, Vol. 26, Issue 2 (April) 2022

[6] Laporan Kinerja Pusat Industri Hijau 2022. Badan Standardisasi Dan Kebijakan Jasa Industri Kementerian Perindustrian. Analisis Swot Potensi Pengembangan Teknologi Energi Generator Magnetik Di Industri Baja (Studi Kasus Pt Xyz). Jurnal Cafetaria, Vol.3, No.1

[7] Locmelis, K., dkk. (2017). Energy policy for energy intensive manufacturing companies and its impact on energy efficiency improvements. System dynamics approach. International Scientific Conference "Environmental and Climate Technologies". Energy Procedia.

[8] Peraturan Menteri Perindustrian Republik Indonesia Tentang Program Penganugerahan Penghargaan Industri Hijau

[9] Peraturan Pemerintah Republik Indonesia Nomor 70 Tahun 2009 Tentang Konservasi Energi

[10] Rencana Kinerja Tahun 2023 Pusat Industri Hijau. Badan Penelitian dan Pengembangan Industri.

[11] Reviu Rencana Strategis Pusat Industri Hijau Tahun 2022-2024. Badan Standardisasi Dan Kebijakan Jasa Industri.

[12] Skakelja, Neda., Derek McGlynn. (2018). Resource Efficiency. European Network for Rural Development No.25.

[13] Undang-Undang No. 32 Tahun 2004 Tentang Pemerintah Daerah

[14] Widyantoro, Sigid. (2017). Implementasi Kerjasama Indonesia dan Jepang dalam Kebijakan Green Industry. Jurnal Bisnis dan Manajemen. Vol. 5, No. 1, Maret 2017.

[15] Yakin, Addinul, (1997). Ekonomi Sumberdaya dan Lingkungan. Teori dan Kebijaksanaan Pembangunan Berkelanjutan. Cet. 1. Akademika Pressindo, Jakarta.