THE SOCIAL AND ECONOMIC IMPACT OF GREEN TECHNOLOGY ON SUSTAINABLE

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ABSTRACT

This study examines the social and economic impacts of green technology in the context of sustainable development in Indonesia. The main objective of the study is to explore the extent to which green technology can contribute to community welfare and environmental preservation, as well as to understand the challenges faced in its implementation. The methodology used is a literature study with a qualitative descriptive approach, which includes an analysis of literature related to green technology, green economy, and sustainable development. This study uses a Systematic Literature Review (SLR) approach to compile and analyse various data sources from scientific journals, research reports, and policy documents. The main findings show that green technology, such as renewable energy and efficient waste management, has great potential to reduce greenhouse gas emissions, improve resource use efficiency, and create new jobs. This study also highlights the importance of sustainable investment and policy support from the government to ensure the implementation of green technology. These findings are in line with other studies that state that innovation in green technology can strengthen economic resilience and provide broad social benefits. The uniqueness of this research lies in its deep focus on the Indonesian context, which has specific geographical, demographic, and economic challenges. By integrating social and economic perspectives, this research provides comprehensive insights into how green technology can be effectively applied to achieve sustainable development goals, as well as identifying strategic steps that need to be taken to overcome obstacles in its implementation.

Keywords: Social, Green Economy Technology, Sustainable Development

BACKGROUND

Sustainable development is a major challenge facing humanity and the earth in the 21st century. Accelerating climate change, environmental degradation and the depletion of natural resources that can be used forever have made the issue of sustainable development increasingly important throughout the world. (Yunanto, 2018). Indonesia faces a major challenge in maintaining a balance between rapid economic growth and environmental preservation. Conventional development models that focus on the exploitation of natural resources often result in environmental damage, social inequality, and the degradation of non-renewable resources (Marfai, 2019). Amidst this situation, the transition to a green economy has become an urgent necessity. A green economy, which prioritizes poverty alleviation through resource efficiency, carbon emission reduction, and improved social welfare, offers a solution to ensure that Indonesia's development remains inclusive and sustainable. The importance of this research lies in the effort to understand the extent to which the concept of a green economy can be adopted and applied in the context of Indonesia's development, which has unique geographical, demographic, and economic characteristics that will ultimately impact the welfare of its people (Ammar et al., 2024). The topic of green economy has become a global concern, especially after the adoption of the Sustainable Development Goals (SDGs) by the United Nations in 2015. This concept integrates three

main pillars, namely economy, environment, and society, to create a more balanced development system. In Indonesia, the implementation of the green economy includes various initiatives, such as the development of renewable energy, energy efficiency, and sustainable waste management. However, this implementation still faces various obstacles, ranging from regulatory limitations to a lack of public awareness (Regif et al., 2023).

The green economy is a way of doing business that aims to improve people's lives by reducing carbon emissions and other environmental problems. This goal is achieved by using natural resources more sparingly, reducing waste and pollution, and developing renewable energy, as explained by UNEP. The concept of a green economy is often understood as an economic system that is environmentally friendly, ecologically sound, and supports social welfare. From the perspective of green economy advocates, this system is an alternative in the effort to create a more sustainable economy (Sheng Fulai, 2011).

Green technology is an environmentally friendly innovation that leads to social and economic sustainability. Clean technology is the same as green technology. Green technology was once referred to as environmental technology. Compared to other technologies, green technology has the potential to significantly improve environmental performance. The use of science to preserve the environment and reduce the negative impacts of human activities is known as "green technology." (Lohar et al., 2022)

Therefore, the green technology economy can be defined as an economic system that integrates green economic principles with the application of environmentally friendly and sustainable science and technology. The goal is to promote economic growth and social welfare while actively protecting, improving, and preserving the environment from the negative impacts of human activities. The research question that is the focus of this study is: How do the social and economic impacts of green technology affect sustainable development?

Research Objectives

This research aims to thoroughly examine the challenges of the social and economic impacts of green technology in order to achieve sustainable environmental development through a literature review. The results of this research are expected to provide insights and recommendations for policy makers and stakeholders in line with efforts to realize sustainable development.

LITERATURE REVIEW

Theoretical Framework

The theoretical framework of sustainable development used in this study refers to the definition from the 1987 Brundtland Commission. According to them, sustainable development is a development process that can meet the needs of today's society without compromising the ability of future generations to meet their own needs. This concept emphasizes the importance of balance between three main aspects, namely

economic, social, and environmental, so that development can continue sustainably in the long term. (Ammar et al., 2024)

The Ecological Modernization Theory proposed by Mol and Spaargaren (2000) is also relevant because it emphasizes that technological innovation, especially green technology, can go hand in hand with environmental regulations to create sustainable development. This theory explains that the development and application of green technology can reduce negative impacts on the environment while promoting economic growth through resource efficiency. (Eka et al., 2025)

In addition, the Green Economy theory presents a framework that integrates the principles of efficient use of natural resources, reduction of carbon emissions, and improvement of social welfare. The green economy system aims to optimize economic growth without damaging the environment, with the support of green technological innovation as the main key. This approach encourages the creation of new jobs and increases the competitiveness of businesses that are oriented towards sustainability. (Purba et al., 2024)

The theoretical basis from a social perspective also highlights the importance of the social impact of green technology in changing social structures and community behavior towards more inclusive and environmentally friendly practices. This is in line with the sustainable development approach, which not only emphasizes economic growth but also pays attention to social equality and the quality of life of the community. (Ardianto et al., n.d.)

Green Engineering

Green engineering is defined as the process of designing, developing, and implementing methods and products that have economic value and are effective, with the aim of reducing negative impacts on human health and the environment (Zimmerman, 2003). The main principles of green engineering include energy efficiency, waste minimization, use of renewable materials, and product design with a long life cycle. In the context of manufacturing, green engineering is applied through innovations in production lines such as the use of renewable energy, heat recovery systems, and process automation that reduces waste (Graedel & Allenby, 2010).

Green Technology Economics

Economics is a field of study that examines how individuals and societies allocate limited resources to meet their needs and desires. In the field of macroeconomics, this study focuses on aspects of economic growth, inflation, unemployment rates, and fiscal and monetary policy (Teddy Chandra, 2016). Green technology cannot be separated from the paradigm of sustainable development, which seeks to balance economic growth, environmental sustainability, and social welfare. The green economy is an important and urgent approach to achieving sustainable development. By focusing on reducing emissions, resource efficiency, and investment in environmentally friendly technologies, the green economy has a significant positive

impact on various aspects, including the environment, economy, and society. Reducing pollution and emissions improves air quality and public health, while technological innovation and the creation of new jobs support economic growth and reduce unemployment. The green economy is an economic system that aims to improve people's welfare by reducing carbon emissions and various negative impacts on the environment. This goal is achieved through the optimal use of natural resources, reduction of waste and pollution, and development of renewable energy, as explained by UNEP. The concept of green economy is often understood as an economic system that is environmentally friendly, ecologically sound, and supports social welfare. From the perspective of green economy advocates, this system is an alternative in the effort to achieve a more sustainable economy (Fulai et al., 2011).

Social

In the social sphere, the green economy plays a role in creating better and more inclusive jobs. Green sectors, such as renewable energy technology, waste management, and organic farming, open up new job opportunities that are often safer and utilize local skills. In addition, the green economy aims to reduce inequality by ensuring that the transition to sustainable practices does not sacrifice disadvantaged groups. Through fair and inclusive policies, the green economy can provide broader access to basic services, resources, and economic opportunities for all (Sloboda et al., 2024). In the social context, the green economy has a positive impact by creating better jobs and providing relevant skills training for the workforce. The transition to a green economy requires jobs in environmental technology, resource management, and other green industries. This job creation not only reduces unemployment but also improves quality of life by offering more stable and sustainable jobs. This is important for creating social balance and reducing economic disparities in various communities (Verma & Kandpal, 2021).

Sustainable Development

Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs. This concept has two important elements: 1) the term ‘needs’, especially basic needs, and 2) the idea that the environment has limits in meeting current and future needs.The root of the problem of sustainable development is concern that our environmental carrying capacity is being exceeded by human production and consumption. This concept combines natural and ecological needs and social and economic preferences, including conservation and protection with development and growth. Sustainable development means that what is built by the current generation must take into account sustainability for future generations (intergenerational equity) and proactively consider economic, social, and environmental aspects of political development. Otto Soemarwoto argues that sustainable development must be ecologically, socially, and economically sustainable. Emil Salim states that sustainable development requires us to manage

natural resources as rationally as possible. For this reason, environmental development cooperation is needed, namely environmental development (Azis et al., 2010). Sustainable development is a way of meeting the needs of the present without compromising the ability of future generations to meet their own needs. (Khan et al., 2024). This concept emphasises the importance of maintaining a balance between economic development, social equality and environmental protection. By promoting the efficient use of natural resources, clean technology, and inclusive community participation, sustainable development aims to create a better quality of life for all (Fu et al., 2023).

Previous Research

In an article (Yusmaneli, 2023) entitled "How Does Green Technology Innovation Respond to Challenges and Determine Its Impact?" The findings show that green technology innovations, such as renewable energy technology, clean water and waste treatment systems, and sustainable agricultural practices, are effective in reducing greenhouse gas emissions, improving air and water quality, and conserving natural resources.

In addition, research findings (Muhammad Ammar Nur Handyka, 2023) show that green technology has made a positive contribution to reducing negative environmental impacts, maximising resource reduction, and supporting sustainable economic growth. Furthermore, this research emphasises the importance of further investment and development in various areas of green technology, such as environmentally friendly transportation, efficient waste management, and sustainable agriculture. This research suggests that green technology should be a primary focus in realising sustainable development in the future.

There is also a study (Yuldashova et al., 2024) entitled "The Role of Green Technology and Innovation in Sustainable Development." It argues that renewable energy technology, waste management innovation, and sustainable agricultural practices are essential in reducing greenhouse gas emissions and preserving natural ecosystems. (Ammar et al., 2024) Overall, the green economy has great potential to promote sustainable development in Indonesia. Its positive impact on the environment, society, and economy are key pillars for achieving the SDGs. By strengthening synergies between the government, the private sector, and the community, as well as overcoming various obstacles, the green economy can be an effective strategy for improving people's welfare without sacrificing environmental sustainability

The report 'Our Common Future' produced by the World Commission on Environment and Development (WCED) in 1987 states that sustainable development is a way of meeting the needs of the present without compromising the ability of future generations to meet their own needs., with a strong emphasis on social dimensions such as poverty reduction and equity. This study highlights social impacts such as increased access to resources and reduced inequality, which form the foundation for the subsequent global agenda. (WCED, 1987). (Commission, n.d.)

RESEARCH METHODS

The method used in this study is library research, with a descriptive qualitative approach to examine concepts and findings from various relevant literature. This approach was chosen because the focus of the research was not on collecting field data, but rather on an in-depth study of various theories, concepts, and previous research results relevant to the topic of study. Through this method, the researcher sought to gain a comprehensive understanding of the social and economic impacts of green technology on sustainable development.

This study uses a Systematic Literature Review (SLR) approach to thoroughly analyze relevant literature on the role of the green economy as a sustainable development strategy in Indonesia. The SLR approach was chosen because it allows researchers to identify, evaluate, and synthesize research, beginning with determining the focus of the research and formulating research questions, which include the implementation, challenges, and opportunities of the green economy in Indonesia.

Data

Research data was collected from various literature sources, including scientific journals, research reports, books, and policy documents. The main data sources were obtained through academic databases such as Scopus, Sinta, MDPI, ScienceDirect, CelPress, and Google Scholar. The keywords used in the literature search included "green economy technology," "sustainable development," and "social impact." (Ammar et al., 2024b).

In the data collection process, the literature used was selected based on the following criteria:

1. Articles and journals discussing the social and economic impacts of green technology and sustainable development.
2. Publications from journals indexed in Sinta, Scopus, and other academic sources
3. The selection of articles was not limited by year of publication, as the focus of this study was to obtain a comprehensive conceptual and empirical understanding of the development and implementation of the concept of green technology in various periods.
4. Open access articles to facilitate source verification in English and Indonesian

Methods

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RESULTS AND DISCUSSION

Table. Data analysis matrix on articles used in the review literature

Author (Year)	Research Title	Main Findings
(Iwan J. Azis & Arianto A. Patunru, 2010)	Green Technology and Sustainable Financial Strategy: A Study of Green Engineering and Green Accounting Implementation in the Manufacturing Industry	The results of the study show that the application of green engineering through innovations such as the use of energy recycling systems, waste treatment, and production process efficiency can improve energy efficiency, reduce operational costs, and reduce the company's carbon footprint.
(Purba et al., 2025)	Kontribusi Ekonomi Hijau terhadap Keberlanjutan Pengelolaan Sumber Daya Alam di Indonesia	The results of this study confirm that the green economy is a strategic investment in realizing the vision of Indonesia Emas 2045, which is competitive, resilient, and ecologically sustainable.
(Kumar, 2024)	Green Technologies and Sustainable Development: Opportunities and Challenges for Technology Transfer	This report also discusses how international cooperation and public-private partnerships can facilitate technology transfer to support sustainable development goals.
(Ammar et al., 2024)	Ekonomi Hijau Sebagai Strategi Pembangunan Berkelanjutan di Indonesia: Literatur Review	This study emphasizes the importance of inclusive incentive policies, strengthening the capacity of human resources, and optimizing the potential of natural resources to accelerate the green economic transition.
(Lohar et al., 2022)	A Review on Green Technology and Sustainability	This study concludes that the application of green technology is an important solution to balance economic growth and environmental preservation.
(Eka et al., 2025)	Dampak Ekonomi Hijau terhadap Pertumbuhan Ekonomi dan Lingkungan di Indonesia	This study concludes that the green economy has a positive impact on the community's economy and preserves the environment.
(Loso Judijanto, 2025)	Penerapan Ekonomi Hijau Dalam Pembangunan Berkelanjutan: Analisis Literatur Teoritis dan Empiris	The results of this study show that the green economy is a very important path to achieving sustainable development, which balances environmental protection and improving community welfare.

(Muhammad Ammar Nur Handyka, 2023)	Peran Teknologi Hijau dalam Mencapai Pembangunan Berkelanjutan Di Masa Depan	The results of this study emphasize that green technology has great potential to accelerate progress towards sustainable development.
(Naufal et al., 2023)	Dinamika Perubahan Sosial dan Dampaknya Terhadap Pembangunan Berkelanjutkan: Perspektif Multidisiplin	A good understanding of the impact of social change is necessary in order to design sustainable development policies and strategies. The aim is to create political stability, improve the quality of life of the community, and ensure the equitable distribution of benefits in the sustainable development process.
(Judijanto et al., 2025)	Green Economy and Environmental Sustainability: A Literature Review Of Challenges and Opportunities	The green economy is not merely an environmental concept, but rather a comprehensive development framework that combines economic efficiency, social welfare, and ecological sustainability. Although the challenges are significant, optimizing opportunities through collaboration, innovation, and inclusive policies can make the green economy a key foundation for global sustainable development..

Results

The results of the literature review of the ten articles above are that the authors argue that Green Technology Economics is an important strategy in supporting sustainable development by balancing social and economic impacts in sustainable development. The application of green engineering here, through the use of waste processing energy recycling systems and production process efficiency, can increase energy efficiency, reduce operational costs, and reduce the company's carbon footprint. The application of green technology is also an important solution for balancing economic growth and environmental preservation. Green economics also has a positive impact on society and preserves the environment. Similarly, the green economy has a positive impact on society and preserves the environment. The impact of social change needs to be taken into account in the design of sustainable development policies and plans, with the aim of achieving political stability, community empowerment and social justice in the sustainable development process. The green economy is not merely an environmental concept, but a comprehensive development framework that combines economic efficiency, social welfare, and ecological sustainability. Although the challenges are significant, optimising opportunities through collaboration, innovation, and inclusive policies can make the green economy a key foundation for global sustainable development.

Discussion

SOCIAL IMPACT ON SUSTAINABLE DEVELOPMENT

The dynamics of social change have a significant impact on sustainable development when viewed from a multidisciplinary perspective. In an economic context, social change can affect economic structures, income distribution, and access to economic resources. The impact can take the form of sustainable economic growth, reduced economic inequality, and improved community welfare. From a social perspective, changes in values, norms, and social behaviour can influence social relationships between individuals and groups and shape new patterns of interaction. This impact can include changes in family structure, gender roles, education levels, and community health. Furthermore, the impact of social change on sustainable development can also be seen from an environmental perspective. Social change can influence consumption patterns, natural resource use, and production patterns in society. Socially, green technology contributes to improving quality of life by mitigating environmental pollution and related health risks. Reducing greenhouse gas emissions and pollutants through clean energy and sustainable practices lowers the incidence of respiratory and chronic diseases, which directly benefits public health. Furthermore, green technology promotes social inclusion by creating diverse job opportunities in growing sectors such as renewable energy installation, maintenance, and research and development, facilitating the participation of workers from various demographics, including marginalised communities. There is also an increase in public awareness and a shift in behaviour towards sustainability, driven by the application of green technology, which encourages community involvement in environmental management and sustainable consumption. The dual role of this technology, both as an environmental and social enabler, supports broader sustainable development goals, namely balancing economic growth, social equity, and ecological preservation. (Febrianda1 & Junita Sari 2, 2024)

The discussion of the research results shows that green technology has a significant impact on sustainable development, both socially and economically. From a social perspective, the social changes triggered by green technology have an impact on economic structures, income distribution, and community access to economic resources, which ultimately encourages sustainable economic growth and reduces social inequality. On the other hand, the transformation of values, norms, and social behaviour that emerges supports new, more inclusive patterns of social interaction, with improved gender roles, education, and public health. In addition, green technology also influences more environmentally friendly consumption and production patterns, which are an important component of sustainable development. From an economic perspective, green technologies, such as renewable energy, efficient waste management, sustainable transport, and sustainable agriculture, have been proven to reduce greenhouse gas emissions and optimise the efficient use of natural resources. Research indicates that green technological innovations drive sustainable economic growth and create new jobs that contribute to social welfare.

However, this success requires continuous investment and policy support from the government so that eco-innovation can continue to develop and be widely adopted. Thus, synergy between technological innovation, public policy, and community participation is a key factor in optimising the social and economic benefits of green technology for sustainable development.

THE ECONOMIC IMPACT OF GREEN TECHNOLOGY ON SUSTAINABLE DEVELOPMENT

The environment and sustainable development have become a global focus due to increasing population growth and industrial activity. In an effort to address these challenges, green technology has emerged as one of the key tools in achieving sustainable development. Green technology refers to innovations designed to reduce negative environmental impacts while supporting sustainable economic growth and social welfare. Green technology covers various aspects, including renewable energy, sustainable transportation, efficient waste management, sustainable agriculture, and many more. Although there has been progress in the adoption of green technology, the challenges that remain in achieving sustainable development make further development and investment in various aspects of green technology very important. A study by Chien (2022) evaluated the effectiveness of green technology in addressing sustainable development challenges. The results of this study show that green technology has made a positive contribution to reducing negative environmental impacts, increasing resource efficiency, and supporting sustainable economic growth. Furthermore, this study emphasises the importance of further investment and improvement in various green technologies, such as sustainable agriculture, sustainable transport, and efficient waste management. This study suggests that in future sustainable development efforts, green technology should be a key focus. A study by Lima et al. (2020) The results of the study show that the application of renewable energy technologies and various green solutions has reduced greenhouse gas emissions, decreased dependence on fossil fuels, and provided benefits for economic growth. The current situation also reflects the progress that has been made, with more and more countries and companies adopting green technologies in their efforts to tackle climate change and maintain environmental sustainability. However, in order to maintain and improve the performance of green technology in the future, there are several aspects that must be taken into account. First, further investment must be made in different green technologies, such as sustainable agriculture, sustainable transport, and efficient waste management. This will demonstrate that green solutions cover various aspects of our lives, from energy production to resource use and agriculture. After that, it is very important to continue to emphasise innovation in green technology. This includes developing more efficient and sustainable technologies and ways to integrate them into society. Strong policy incentives from the government also play an important role in ensuring that green technology is adopted comprehensively and that obstacles such as widespread climate change can be addressed efficiently.

CONCLUSION

This study explores the social and economic impacts of green technology on sustainable development. Key findings indicate that green technology has significant potential to drive sustainable economic growth and improve social welfare. The implementation of green technology, such as renewable energy and efficient waste management, contributes to reducing greenhouse gas emissions and optimising the use of natural resources. This creates new jobs, promotes social inclusion, and improves the quality of life for communities. Furthermore, this study is in line with other research findings that show that innovation in green technology not only reduces negative environmental impacts but also creates new economic opportunities. Research by Chien (2022) and Lima et al. (2020) emphasises the importance of sustainable investment in green technology to achieve sustainable development goals. Both underscore that the application of green technology can strengthen economic and environmental resilience and create broad social benefits. The results of this study emphasise that to achieve effective sustainable development, there needs to be synergy between public policy, technological innovation, and community participation. Through strong collaboration between the government, private sector, and community, green technology can become the main foundation for realising sustainable development goals in Indonesia.

From this study, it is recommended to increase the social and economic impact of green technology on sustainable development. First, increased investment in green technology is needed, especially in the fields of renewable energy and waste management. Second, policies and regulations that encourage the use of green technology must be strengthened so that the community and the private sector participate more actively. In addition, public awareness needs to be raised through educational programmes that explain the benefits of green technology. Collaboration between the government, the private sector and the community must also be enhanced to produce innovative solutions. Finally, monitoring and evaluation mechanisms must be implemented to measure the impact of green technology on social and environmental aspects. With these steps, it is hoped that the role of green technology can be maximised in achieving sustainable development goals in Indonesia.

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