



The Impact of Green Economy Policies Carbon Emission Reduction: Analysis Transportation Sector (Case Study of South Sulawesi)

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Abstract. This study examines the impact of green economy policies on carbon emission reduction in the transportation sector of South Sulawesi, Indonesia. Using a qualitative case study approach, the research explores the implementation and perceived effects of key policies introduced since 2015, including the Public Transportation Enhancement Program, Green Vehicle Incentive Scheme, and Sustainable Urban Mobility Plan. Data was collected through document analysis, semi-structured interviews with 18 key stakeholders, three focus group discussions, and field observations in major cities of South Sulawesi. The findings suggest that these policies have contributed to a perceived reduction in carbon emissions, with stakeholders estimating a 15-20% decrease in transport-related emissions since implementation. Key success factors identified include strong political leadership, policy integration across sectors, and public-private partnerships. However, significant challenges remain, including financial constraints, limited technical capacity, and inadequate infrastructure for supporting green transportation. The study reveals mixed community perceptions, with appreciation for improved air quality and public transportation services, alongside concerns about the affordability of green vehicles. Emerging themes highlight the need for better policy coordination, long-term planning, and public awareness campaigns. While the perceived impact is positive, the research underscores the importance of developing robust mechanisms for quantifying emission reductions. The study concludes by recommending increased funding for green infrastructure, enhanced capacity building programs, and stronger public-private partnerships to accelerate the transition to sustainable transportation in South Sulawesi.

Keywords: green economy, carbon emission reduction, transportation sector

1 Introduction

Climate change has become one of the greatest global challenges facing the world today. The continually increasing carbon emissions are the primary cause of global warming and climate change. According to the Intergovernmental Panel on Climate Change (IPCC), "Human-induced greenhouse gas emissions have been the dominant driver of observed global warming since the mid-20th century" [1]

The transportation sector is a significant contributor to global carbon emissions. As reported by the International Energy Agency (IEA), "The transport sector accounted for about 24% of total CO₂ emissions from fuel combustion in 2020" [2]. This figure underscores the importance of emission reduction efforts in the transportation sector to mitigate climate change.

In an effort to address this issue, many countries, including Indonesia, have begun to adopt green economy policies. The United Nations Environment Programme (UNEP) defines a green economy as "one that results in improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities" [3]

South Sulawesi, as one of Indonesia's provinces, also faces challenges in reducing carbon emissions from its transportation sector. According to data from the Central Bureau of Statistics (BPS) of South Sulawesi, "The number of motor vehicles in the province increased by 7.8% annually between 2015 and 2020" [4]. This growth contributes to the increase in carbon emissions in the transportation sector.

Although several green economy policies have been implemented in various regions, their impact on carbon emission reduction, particularly in the transportation sector, has not been comprehensively studied. As stated by Tiwari et al. [5] in their journal, "Despite increasing interest in green economy policies, evaluation of their impact on carbon emission reduction in the transportation sector remains limited, especially in developing countries."

Therefore, this research aims to analyze the impact of green economy policies on carbon emission reduction in the transportation sector, taking South Sulawesi as a case study. As expressed by Hardoy et al. [6], "Local case studies are crucial for understanding how green economy policies can be effectively implemented in specific contexts and produce tangible impacts on emission reduction."

The results of this study are expected to provide valuable insights for policymakers and other stakeholders in designing and implementing more effective strategies to reduce carbon emissions in the transportation sector. As emphasized by Zhang et al. [7], "Evidence-based policy evaluation is essential for improving the effectiveness of climate change mitigation efforts at both local and national levels."

2 Literature Review

2.1 Green Economy Concept and Policies

The concept of a green economy has gained significant attention in recent years as a potential solution to environmental challenges while promoting economic growth. UNEP [3] defines a green economy as one that results in "improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities." In the context of the transportation sector, green economy policies often focus on promoting sustainable transport systems, encouraging the use of low-emission vehicles, and improving energy efficiency.

Barbier and Markandya [8] argue that transitioning to a green economy requires a combination of policy instruments, including regulatory measures, economic

incentives, and public investments. They emphasize the importance of tailoring these policies to local contexts and economic structures.

2.2 Carbon Emissions in the Transportation Sector

The transportation sector is a major contributor to global carbon emissions. According to the International Energy Agency [2], transport accounted for about 24% of global CO₂ emissions from fuel combustion in 2020. Sims et al. [9] highlight that road vehicles are responsible for the majority of transport-related emissions, with passenger cars and heavy-duty vehicles being the largest contributors.

In developing countries, rapid urbanization and economic growth have led to increased motorization rates, exacerbating the challenge of reducing emissions from the transport sector. Pojani and Stead [10] discuss how this trend is particularly evident in Southeast Asian countries, including Indonesia.

2.3 Green Economy Policies in the Transportation Sector

Various green economy policies have been implemented globally to address carbon emissions in the transportation sector. These policies can be broadly categorized into three groups:

Technological Measures. Taptich et al. [11] review the impact of fuel efficiency standards and the promotion of alternative fuel vehicles on reducing transport emissions. They find that while these measures can be effective, their impact depends on the broader energy mix and supporting infrastructure

Modal Shift Strategies. Shifting to more sustainable modes of transport is another key strategy. Santos et al. [12] analyze the effectiveness of policies promoting public transportation, cycling, and walking in urban areas. They conclude that such policies can significantly reduce emissions, especially when combined with urban planning measures.

Demand Management. Policies aimed at reducing the overall demand for transportation, such as congestion pricing and parking management, have also shown promise. Yang et al. [13] demonstrate how these measures can lead to both reduced emissions and improved urban mobility.

2.4 Case Studies of Green Economy Policies in Transportation

Several case studies have examined the implementation and impact of green economy policies in the transportation sector: Hou et al. [14] analyzed the effects of electric vehicle promotion policies in China, finding significant potential for emission reduction but highlighting challenges in grid integration and battery recycling. Cats et al. [15] studied the impact of free public transport in Tallinn, Estonia, observing a

modal shift from private cars to public transport but noting the importance of complementary measures to maximize emission reductions. Hirte and Tscharaktschiew [16] investigated the effects of urban congestion pricing schemes in European cities, demonstrating their potential to reduce emissions while improving urban livability.

2.5 Challenges in Implementing Green Economy Policies

Despite the potential benefits, implementing green economy policies in the transportation sector faces several challenges: Financial constraints: Timilsina and Dulal [17]) discuss how the high upfront costs of sustainable transport infrastructure can be a barrier, especially for developing countries. Behavioral factors: Sommer and Lambrecht [18] explore the role of consumer behavior and preferences in the adoption of sustainable transport options, emphasizing the need for policies that address both infrastructure and behavior change. Policy coordination: May et al. [19] highlight the importance of integrating transport policies with broader urban and economic development strategies to achieve optimal outcomes.

2.6 Evaluation of Policy Effectiveness

Evaluating the effectiveness of green economy policies in reducing carbon emissions is crucial for policy refinement and resource allocation. However, this evaluation presents methodological challenges: Data limitations: Schwanen [21] discusses the difficulties in obtaining accurate and comprehensive data on transport emissions, particularly in developing countries. Complex interactions: Creutzig et al. [21] emphasize the need to consider the interactions between different policy measures and their potential synergies or conflicts. Long-term impacts: Brand et al. [22] argue for the importance of considering the long-term effects of policies, including potential rebound effects and systemic changes.

2.7 Research GAP

While existing literature provides valuable insights into the potential of green economy policies to reduce carbon emissions in the transportation sector, there are still significant knowledge gaps, particularly in the context of developing countries and at the sub-national level. The case study of South Sulawesi presents an opportunity to contribute to this body of knowledge by examining the implementation and impact of green economy policies in a specific local context.

3 Methodology

This study employs a qualitative research design, specifically utilizing a case study approach focused on South Sulawesi, to explore the impact of green economy policies on carbon emission reduction in the transportation sector. The research design allows for an in-depth examination of the local context and the nuanced effects of policy

implementation. Data collection methods include document analysis, semi-structured interviews, focus group discussions, and field observations. Policy documents, government reports, and local environmental assessments are analyzed to understand the framework and objectives of green economy initiatives in the region's transportation sector. Semi-structured interviews are conducted with 15-20 key stakeholders, including local government officials, transportation planners, environmental experts, public transportation operators, and representatives from relevant NGOs. These interviews aim to gather diverse perspectives on policy implementation, challenges, and perceived impacts. Field observations of transportation infrastructure and practices in South Sulawesi complement these methods, providing firsthand insights into the practical implementation of green economy policies.

The sampling method employs purposive sampling to ensure representation of diverse perspectives and expertise. Data analysis involves thematic analysis of interview and focus group transcripts, content analysis of policy documents, and comparative analysis of different stakeholder perspectives. Narrative analysis is also used to develop rich descriptions of stakeholder experiences. To enhance the trustworthiness and validity of the findings, the study employs triangulation of data sources and collection methods, member checking with key informants, and maintenance of a reflexive journal to address potential researcher biases. Ethical considerations are prioritized, including obtaining informed consent, ensuring confidentiality and anonymity of respondents, and securing necessary permissions from local authorities. The research acknowledges limitations such as potential challenges in accessing certain stakeholders or sensitive information, and the inherent limitations of generalizability in case study research. This comprehensive qualitative approach aims to provide a nuanced understanding of the impact of green economy policies on carbon emission reduction in South Sulawesi's transportation sector, offering valuable insights for policy refinement and future research directions.

4 Result and Discussion

The implementation of green economy policies in South Sulawesi's transportation sector has shown promising results in terms of carbon emission reduction, according to qualitative analysis. Through extensive document review, three key policies implemented since 2015 were identified: the Public Transportation Enhancement Program (PTEP), the Green Vehicle Incentive Scheme (GVIS), and the Sustainable Urban Mobility Plan (SUMP). These policies represent a concerted effort by local authorities to address the growing environmental concerns in the region's rapidly developing urban areas.

Interviews with 18 key stakeholders revealed a generally positive perception of these policies' impact. Government officials reported a 30% increase in bus ridership following the implementation of PTEP, suggesting a significant shift from private to public transportation. This shift was corroborated by transportation planners, who noted a marked reduction in traffic congestion during peak hours in major cities like Makassar. Environmental experts, while cautious about providing exact figures, estimated a 15-20% reduction in transport-related carbon emissions since the policies

were enacted. This estimation was based on their analysis of air quality data and vehicle usage patterns over the past five years.

The GVIS has been particularly successful in promoting the adoption of electric motorcycles, with sales increasing by 45% in the two years following its introduction. However, as pointed out by several interviewees, the lack of adequate charging infrastructure remains a significant barrier to wider adoption. Public transportation operators reported improved service quality due to fleet modernization under PTEP, with 70% of the bus fleet now consisting of low-emission or electric vehicles. This improvement in service quality was reflected in our focus group discussions, where participants expressed increased satisfaction with public transportation, citing reduced travel times and improved air quality in urban centers.

Despite these positive outcomes, research uncovered several challenges in policy implementation. Financial constraints were consistently mentioned as a major hurdle, with 80% of government officials and transportation planners citing limited budgets as a primary obstacle to full policy implementation. The SUMP, while comprehensive in its approach, has seen only partial implementation due to these financial limitations. Technical capacity was another significant challenge, with 65% of stakeholders expressing concerns about the local workforce's ability to maintain and operate new green technologies.

Community perceptions, While there was widespread appreciation for improved air quality and public transportation services, concerns were raised about the affordability of green vehicles for the average citizen. Of the 24 focus group participants, 18 expressed worries about the potential economic burden of transitioning to greener transportation options. This highlights the need for more comprehensive economic support systems to facilitate broader community participation in green initiatives.

field observations in major cities of South Sulawesi corroborated many of these findings. noted a visible increase in the number of electric vehicles on the roads, particularly in urban centers. Public transportation hubs showed signs of recent upgrades, with digital information systems and cleaner, more modern vehicles in operation. However, we also observed that many of these improvements were concentrated in wealthier urban areas, suggesting potential issues of equity in policy implementation.

Emerging themes from analysis include the need for better policy coordination across government departments, the importance of long-term planning and consistent implementation, and the critical role of public awareness and education in policy success. Interestingly, 75% of interviewees highlighted the potential for green transportation policies to drive economic innovation, suggesting a possible avenue for future policy development.

5 Conclusion

In conclusion, while the perceived impact of green economy policies on carbon emission reduction in South Sulawesi's transportation sector is largely positive, significant challenges remain in terms of full implementation, equitable distribution of benefits, and accurate quantification of impacts. this research underscores the

importance of stakeholder engagement, adequate funding, and infrastructure development in the success of these policies. Moving forward, writer recommend the development of more robust mechanisms for measuring and monitoring carbon emissions, increased funding allocation for green transportation infrastructure, enhanced capacity building programs, strengthened public awareness campaigns, and fostering of more public-private partnerships to accelerate the transition

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