

Comparative Analysis of Renewable Energy Transition and Its Impact on Green Economy Growth in Developed and Emerging Economies

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ABSTRACT

This research examines the impact of renewable energy transition on green economy growth by comparing practices in developed and emerging economies. The urgency of this transition is underscored by the global climate crisis and the need to achieve long-term sustainability goals. Using a comparative qualitative approach supported by secondary data analysis, the study investigates policy frameworks, technological advancements, and socio-economic outcomes across multiple case studies. The results indicate that developed economies have advanced rapidly due to strong institutional frameworks, financial capacity, and technological innovation, while emerging economies demonstrate unique strengths through localized solutions, community participation, and adaptive strategies tailored to resource availability. The findings further highlight the value of mutual learning, where developed nations contribute regulatory and technological expertise, while emerging nations provide lessons in resilience and inclusivity. Despite these opportunities, challenges such as financial barriers, policy inconsistency, and infrastructural limitations persist. Policy implications point to the need for stronger international cooperation, inclusive financing models, and capacity building to support an equitable global energy transition. Overall, this research emphasizes that renewable energy transition is not only a driver of environmental sustainability but also a foundation for inclusive and resilient green economic growth.

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1. INTRODUCTION

The urgency to transition from fossil fuels to renewable energy has become one of the most pressing global challenges of the 21st century. For decades, the heavy dependence on fossil fuels such as coal, oil, and natural gas has fueled industrialization and economic growth, but at the same time, it has contributed significantly to greenhouse gas emissions, environmental degradation, and the acceleration of climate change. Rising global temperatures, extreme weather events, melting ice caps, and loss of biodiversity are only some of the alarming consequences that highlight the unsustainable nature of fossil fuel-based development (Loucks, 2021). These environmental crises not only threaten ecosystems but also pose serious risks to food security, public health, economic stability, and global security.

In response, the international community has increasingly recognized the need for a rapid shift toward renewable energy sources as a cornerstone of climate change mitigation and sustainable development (Elum & Momodu, 2017). Renewable energy technologies such as solar, wind, hydro, and geothermal power provide clean, abundant, and increasingly cost-competitive alternatives to

fossil fuels. Their adoption reduces carbon emissions, enhances energy security, and creates new opportunities for innovation and green job creation. The transition aligns directly with global sustainability agendas, particularly the Paris Agreement, which calls for limiting global warming to well below 2°C, and the Sustainable Development Goals (SDGs), which emphasize affordable and clean energy (SDG 7), climate action (SDG 13), and sustainable economic growth (SDG 8).

The global economy is undergoing a fundamental transformation driven by the urgent need to address climate change, energy security, and sustainable development (Grubb et al., 2014). The continued reliance on fossil fuels has contributed to rising greenhouse gas emissions, environmental degradation, and volatile energy markets. In response, countries worldwide are accelerating the transition to renewable energy sources such as solar, wind, hydro, biomass, and geothermal power. This shift is not only an environmental necessity but also a strategic pathway to foster green economy growth, which emphasizes low-carbon development, sustainable investment, resource efficiency, and inclusive job creation.

The concept of the green economy has gained prominence as a framework for achieving sustainable growth that balances economic, social, and environmental objectives (Bina, 2013). The renewable energy transition plays a central role in this framework by reducing carbon footprints, diversifying energy sources, enhancing energy security, and creating new opportunities in technology, manufacturing, and services. Beyond mitigating climate risks, renewable energy has the potential to drive innovation, improve public health, and promote long-term economic resilience.

However, the pathways and impacts of renewable energy transition differ significantly between emerging and developed countries. Developed countries typically possess advanced technologies, strong institutional frameworks, and greater financial resources that enable them to scale up renewable energy initiatives more effectively (Suzuki, 2015). In contrast, emerging economies face challenges such as limited access to finance, dependency on fossil fuel-based industries, infrastructural gaps, and regulatory uncertainties. Yet, emerging countries also hold unique opportunities, including abundant renewable resources, rapidly growing markets, and the ability to leapfrog traditional development models by adopting clean technologies.

Given these disparities, a comparative analysis of renewable energy transition in emerging and developed countries is crucial to understand how the shift influences green economy growth in different contexts (Mundaca et al., 2016). Such an analysis can reveal best practices, highlight challenges, and identify policy interventions that are most effective under varying economic and institutional conditions. Moreover, it contributes to the global discourse on achieving the Sustainable Development Goals (SDGs) and fulfilling the commitments of the Paris Agreement, both of which emphasize the importance of renewable energy and sustainable economic transformation.

The transition from fossil fuels to renewable energy has been a major focus of academic and policy-oriented research over the past two decades. Stern (2006), in his influential Stern Review on the Economics of Climate Change, argued that the costs of inaction on climate change far outweigh the investments required to shift toward low-carbon energy systems. This foundational work framed renewable energy transition as both an environmental and an economic imperative, setting the stage for subsequent studies that examined the contribution of renewable energy adoption to sustainable development and economic growth.

Empirical analyses have consistently demonstrated that renewable energy plays a critical role in promoting green economy growth. Bhattacharya, Paramati, Ozturk, and Bhattacharya (2016), for example, found that renewable energy consumption has a positive long-term effect on economic growth in a panel of the world's top renewable energy-consuming countries. Similarly, Apergis and Payne (2010) provided evidence across OECD and non-OECD countries showing that renewable energy consumption contributes to economic expansion while simultaneously reducing carbon emissions. These findings suggest that renewable energy is not only a tool for climate mitigation but also a driver of broader economic transformation.

At the technical level, Jacobson et al. (2017) proposed comprehensive roadmaps for 100% renewable energy transitions across different regions, demonstrating that such a shift is technically feasible and economically viable if supported by proper infrastructure investments and policy frameworks. Their analysis highlighted the potential for job creation, improved public health, and long-term energy security, reinforcing the argument that renewable energy can serve as a catalyst for green growth. Complementary research in systems integration and grid reliability further supports the feasibility of large-scale renewable deployment, though it acknowledges the need for innovations in storage, smart grids, and demand management.

In the context of emerging versus developed countries, existing research highlights important differences. Developed countries often lead in renewable energy deployment due to stronger institutions, advanced technological capacity, and well-developed financing systems (REN21, 2021). In contrast, emerging economies face structural barriers such as weak regulatory environments, limited access to capital, and infrastructure deficits (Bhattacharyya, 2013). However, emerging countries also possess unique opportunities, particularly in harnessing abundant renewable resources and utilizing decentralized solutions such as off-grid solar and micro-hydro systems to accelerate electrification and inclusive green growth. Comparative studies (Paramati et al., 2017; IRENA, 2020) emphasize that while developed economies have advantages in scaling renewable technologies, emerging economies have the potential to leapfrog traditional fossil-fuel-based development pathways.

A growing body of literature also stresses the importance of policy, finance, and social equity in shaping the outcomes of renewable energy transitions. Sovacool and Dworkin (2015) highlighted the concept of energy justice, arguing that equitable distribution of costs and benefits, participatory decision-making, and recognition of marginalized communities are essential to ensuring a just transition. Reports from IRENA and the International Labour Organization (ILO) further show that renewable energy can generate millions of green jobs, provided that adequate training, social protection, and supportive institutions are in place. These studies collectively underline that renewable energy transition is not merely a technological shift but a socio-economic transformation with far-reaching implications.

Therefore, this research seeks to explore and compare the role of renewable energy transition in driving green economy growth across emerging and developed countries. By doing so, it aims to provide deeper insights into the synergies between energy transition and sustainable economic development, as well as generate practical policy recommendations that support inclusive and resilient green growth worldwide.

2. RESEARCH METHOD

This research adopts a comparative qualitative–quantitative approach to examine the role of renewable energy transition in driving green economy growth in both emerging and developed countries (Andreas et al., 2017). A mixed-methods design is employed to capture both statistical relationships and contextual differences, enabling a more comprehensive understanding of the phenomenon under study.

The study begins with the selection of countries representing both categories. For developed countries, members of the OECD such as Germany, the United States, and Denmark are considered due to their advanced renewable energy policies and established green economy frameworks (Melnyk et al., 2020). For emerging economies, countries such as India, Brazil, and Indonesia are included, as they illustrate both the challenges and opportunities of transitioning to renewable energy within developing contexts (Koutoudjian et al., 2021). The selection criteria are based on renewable energy consumption trends, policy adoption levels, and data availability.

Quantitatively, the research uses secondary data analysis from reliable international databases, including the International Renewable Energy Agency (IRENA), World Bank, International Energy Agency (IEA), and United Nations Sustainable Development Goal (SDG) indicators (Koutoudjian et al., 2021). Key variables include renewable energy consumption (% of total final energy use), carbon emissions per capita, green investment flows, employment in renewable sectors, and indicators of economic growth such as GDP per capita and green economy indexes. Data from 2000–2023 is analyzed to identify trends and correlations between renewable energy transition and green economy growth across the two groups of countries. Panel data regression models are applied to assess causal relationships and differences between developed and emerging economies.

Content analysis of policy documents, reports, and academic literature is conducted to evaluate the institutional, regulatory, and financial mechanisms supporting the energy transition. This analysis allows the study to contextualize quantitative findings within broader socio-political and economic realities, highlighting best practices and barriers.

In addition, a comparative framework is applied to contrast outcomes between developed and emerging countries (Kern & Howlett, 2009). The framework evaluates five dimensions: (1) institutional and regulatory structures, (2) financing and investment patterns, (3) technological capacity and innovation, (4) socio-economic impacts, including employment and inclusivity, and (5)

environmental outcomes, particularly emissions reduction. This enables the identification of commonalities, divergences, and lessons that can inform policy recommendations.

Finally, to ensure robustness, the research adopts triangulation by cross-validating data from different sources and combining statistical results with qualitative policy insights. Limitations such as data availability and contextual differences are acknowledged, while ethical considerations are maintained through proper citation of all data sources.

3. RESULTS AND DISCUSSIONS

Result

The findings of this study reveal that the renewable energy transition plays a significant role in promoting green economy growth, although the scale and impact vary notably between developed and emerging countries. The quantitative analysis of panel data from 2000–2023 indicates a strong positive correlation between renewable energy consumption and green economy indicators, such as GDP growth from sustainable industries, increased investment in clean technologies, and reductions in carbon emissions. However, the degree of effectiveness is influenced by institutional capacity, financial resources, and policy frameworks in each group of countries.

In developed countries, the results show that renewable energy adoption has contributed substantially to both economic and environmental outcomes. Countries such as Germany and Denmark, which have invested heavily in wind and solar energy, demonstrate consistent declines in greenhouse gas emissions alongside measurable growth in green industries (Lyeonov et al., 2019). Furthermore, developed economies exhibit higher levels of innovation, with patent registrations in renewable energy technologies and strong support for research and development. Employment data also reflects a steady increase in green jobs, particularly in manufacturing, installation, and maintenance of renewable energy infrastructure. These outcomes are reinforced by supportive policies, such as feed-in tariffs, carbon pricing mechanisms, and subsidies that encourage large-scale renewable deployment.

In contrast, emerging countries present a more complex picture. Nations such as India and Brazil display considerable progress in expanding renewable energy capacity, particularly in solar, hydro, and bioenergy. The results indicate that renewable energy transition in these countries has positively influenced electrification, improved energy security, and created employment opportunities, especially in rural areas through decentralized energy solutions like solar mini-grids. However, the contribution of renewables to overall GDP growth remains relatively smaller compared to developed countries due to financial constraints, policy inconsistencies, and infrastructural challenges. Moreover, emerging economies face difficulties in attracting sustainable investments and often rely on international funding and technology transfer to sustain their energy transitions.

A comparative analysis across the two groups highlights important differences. Developed countries tend to achieve higher efficiency and greater economic returns from renewable energy investments, largely due to advanced technology, stable institutions, and strong policy incentives (Romano et al., 2017). Emerging economies, while making rapid strides, often prioritize energy access and affordability over environmental outcomes, which sometimes leads to slower reductions in emissions despite renewable deployment. Nonetheless, the study finds that emerging countries hold significant potential to leapfrog fossil fuel dependency by adopting decentralized renewable solutions, provided that supportive policies and international collaborations are strengthened.

Overall, the results suggest that renewable energy transition is a key driver of green economy growth, but its success is conditional on the presence of enabling environments, including stable policy frameworks, sufficient financial support, and technological innovation. Developed countries showcase the benefits of long-term investments and strong governance, while emerging countries demonstrate that renewable energy can serve as a catalyst for inclusive development and energy equity, though greater global cooperation is required to maximize these outcomes.

Best Practices and Lessons for Mutual Learning

The comparative analysis of renewable energy transitions in developed and emerging countries reveals several best practices and lessons that can foster mutual learning and strengthen global progress toward green economy growth. Developed economies, with their mature institutions and technological capacity, provide valuable insights into the importance of long-term policy commitment and consistent regulatory frameworks (George & Prabhu, 2003). Countries such as Germany and Denmark exemplify how stable feed-in tariffs, targeted subsidies, and carbon

pricing can stimulate private investment, accelerate renewable deployment, and create green jobs. The lesson emerging countries can draw from this experience is that a predictable and transparent policy environment is crucial to building investor confidence and ensuring the sustainability of renewable energy projects.

Emerging economies, on the other hand, offer important lessons in innovation, inclusivity, and adaptability (Altenburg, 2009). Nations like India and Brazil have demonstrated the effectiveness of decentralized renewable solutions such as solar home systems, mini-grids, and bioenergy initiatives that expand energy access in rural and underserved areas. These practices highlight that renewable energy transition can be designed not only to reduce emissions but also to address social equity by providing affordable energy to marginalized communities. Developed countries, particularly those grappling with issues of energy poverty in remote regions, can learn from these models of decentralized, community-based energy solutions that combine affordability, participation, and sustainability.

Another best practice identified is the role of international cooperation and financing mechanisms. Emerging countries have benefitted from green climate funds, technology transfer, and capacity-building initiatives supported by multilateral organizations and partnerships with developed nations. The lesson here is that the global energy transition requires collective action, where knowledge sharing, joint investments, and collaborative research reduce barriers to adoption and spread technological advancements more evenly (Jaegersberg & Ure, 2011). At the same time, developed countries benefit from the rapid scaling of renewable energy in emerging markets, which opens new trade and investment opportunities while contributing to global emissions reduction.

Finally, both groups of countries emphasize the importance of public engagement and social acceptance. Research shows that public awareness campaigns, community participation in decision-making, and fair distribution of costs and benefits are decisive factors in sustaining renewable energy transitions. While developed countries have advanced in embedding energy justice principles, emerging countries illustrate how grassroots movements and local ownership can accelerate acceptance and ensure long-term success.

Taken together, these best practices underscore the need for mutual learning between developed and emerging economies. Developed nations provide models of policy stability, technological leadership, and institutional support, while emerging countries offer examples of inclusivity, decentralized innovation, and adaptability under resource constraints. The synergy of these lessons can inform global strategies for renewable energy transition, enabling countries at all stages of development to align their efforts more effectively with the goals of sustainable growth and climate resilience.

Policy Implications

The findings of this study highlight the central role of renewable energy transition in driving green economy growth, offering important implications for policymakers in both emerging and developed countries. The most significant implication is the necessity of creating stable and predictable policy frameworks (Hughes, 2013). Evidence from developed countries shows that long-term commitments, such as feed-in tariffs, carbon pricing, and renewable portfolio standards, build investor confidence and encourage innovation. Emerging economies, therefore, need to prioritize regulatory consistency and minimize policy uncertainty to attract private and foreign investments in renewable energy projects.

Another key implication is the importance of tailored financial mechanisms to support the energy transition. For developed countries, policies should focus on scaling up investments in advanced renewable technologies, energy storage, and grid modernization. These efforts will help integrate higher shares of renewable energy into existing systems while maintaining stability. In emerging economies, financial strategies should emphasize blended finance, concessional loans, and targeted subsidies to overcome barriers related to high upfront costs. Strengthening access to international funds such as the Green Climate Fund and promoting public-private partnerships are essential steps to mobilize the resources needed for sustainable energy projects.

This research also underscores the need to integrate social equity and inclusivity into renewable energy policies. Both developed and emerging countries must ensure that the transition is not only technologically and economically viable but also socially just (Swilling et al., 2016). In developed countries, this means addressing job losses in fossil fuel-dependent regions through retraining programs and just transition policies. In emerging economies, renewable energy projects should be designed to expand energy access, particularly in rural areas, thereby reducing inequality and improving quality of life.

Furthermore, the comparative findings point to the value of international cooperation and knowledge exchange. Developed nations can play a critical role in transferring technology, sharing best practices, and providing capacity-building initiatives to support emerging countries (Chrysostome, 2019). Conversely, emerging economies offer innovative models of decentralized renewable solutions and community-based projects that can inform energy justice initiatives in developed contexts. Policymakers on both sides should foster platforms for dialogue and cooperation that strengthen global collective action on renewable energy and climate change.

Lastly, the results emphasize the importance of embedding renewable energy strategies within broader sustainable development agendas. Aligning energy policies with the United Nations Sustainable Development Goals (SDGs) and the Paris Agreement ensures that the energy transition contributes not only to emissions reduction but also to economic resilience, job creation, and environmental sustainability. This holistic approach ensures that renewable energy serves as a catalyst for systemic transformation toward a green and inclusive global economy.

Comparison of the results of the current study with previous studies

The results of the current study align with, yet also expand upon, findings from previous research on the relationship between renewable energy transition and green economy growth. Earlier studies, such as Sovacool (2017), emphasized the role of renewable energy in reducing carbon emissions while fostering sustainable economic development. Similarly, Lee and Min (2019) highlighted that renewable energy adoption drives innovation and investment opportunities, particularly in developed economies with strong institutional support. The present study confirms these outcomes, showing that developed countries indeed benefit from robust policies, technological leadership, and financial stability, which accelerate the renewable energy transition and directly contribute to green growth.

In contrast, the current study also provides additional insights into the experiences of emerging economies, complementing findings from Ozturk and Acaravci (2013), who identified challenges related to energy infrastructure and financial constraints in developing countries. While previous studies tended to emphasize barriers, the present research demonstrates that emerging economies are not only overcoming some of these limitations but also experimenting with innovative financing models, regional cooperation, and community-based renewable energy projects. These findings suggest that while structural barriers remain, emerging countries are developing unique pathways that contribute to the global green economy in ways not fully captured by earlier work.

Moreover, the comparative approach of this study provides a nuanced understanding absent in many earlier analyses. Unlike studies that primarily focused on either developed or developing contexts, this research illustrates the mutual learning potential between the two groups. For example, while developed countries can share technological expertise and policy frameworks, emerging economies offer valuable lessons in localized, cost-effective solutions and community engagement. In this sense, the findings extend the scope of works like Stern (2007) and IRENA (2021), reinforcing the notion that renewable energy transition is not a uniform process but rather a diverse and context-dependent driver of green economic growth.

Challenges and Barriers

One of the primary challenges is data availability and comparability. While developed countries often maintain comprehensive, reliable, and up-to-date datasets on renewable energy consumption, investment flows, and environmental impacts, emerging countries frequently face gaps in reporting and inconsistencies in measurement. This makes cross-country comparisons more difficult and may limit the precision of the statistical analysis (Kaminska & Lynn, 2017). In some cases, secondary data sources use varying methodologies, which creates additional challenges in ensuring validity and reliability of results.

Another significant barrier lies in the variability of institutional and policy frameworks between developed and emerging economies. Developed countries typically possess strong governance structures and regulatory mechanisms that support renewable energy adoption, whereas emerging countries often struggle with political instability, regulatory uncertainty, and policy inconsistency. This disparity complicates comparative analysis, as the factors influencing renewable energy transition differ not only in scale but also in nature.

Financial constraints represent an additional barrier, particularly in emerging economies. The high initial investment costs for renewable energy infrastructure limit the ability of developing countries to expand renewable capacity at the same pace as developed nations. Dependence on international funding and technology transfer also introduces external vulnerabilities, such as

exposure to global market fluctuations and geopolitical tensions (Ibrahim et al., 2021). From a research perspective, this financial disparity means that evaluating the “role” of renewable energy in economic growth cannot be generalized without accounting for structural differences in access to capital.

Technological and infrastructural challenges further complicate the transition. Developed countries generally have advanced grid systems, strong research and development ecosystems, and greater capacity to integrate renewables (Blaabjerg & Ionel, 2015). Emerging economies, by contrast, face limited technical expertise, weaker grid reliability, and inadequate transmission infrastructure. These disparities act as barriers not only to effective renewable energy deployment but also to direct comparison within this study, as the technological baseline differs significantly across countries.

Finally, social and cultural dimensions present additional challenges. Public acceptance of renewable energy varies, with some communities resisting wind or solar projects due to land use conflicts, aesthetic concerns, or lack of involvement in decision-making (Wolsink, 2007). In emerging economies, issues of affordability and access often take precedence over environmental concerns, creating tensions between economic development priorities and climate goals. For this research, these social differences pose barriers to framing renewable energy transition as a universally comparable process, since societal values and priorities influence both adoption and outcomes.

4. CONCLUSION

The findings of this research highlight the pivotal role of renewable energy transition in fostering green economy growth across both developed and emerging economies. The study demonstrates that while developed countries benefit from strong institutional frameworks, advanced technologies, and substantial financial capacity, emerging economies are increasingly contributing through innovative, community-driven, and context-specific strategies. These diverse approaches illustrate that there is no singular pathway to achieving green economic transformation; rather, success depends on adapting strategies to national priorities, institutional capacities, and socio-economic contexts. Furthermore, the research underscores the importance of mutual learning between developed and developing nations. Developed economies can provide technological expertise and regulatory frameworks, while emerging economies offer lessons in resilience, localized solutions, and inclusive participation. This interplay creates opportunities for building a globally sustainable and equitable energy transition that supports both economic growth and environmental protection. However, the study also identifies significant challenges and barriers, including policy inconsistency, financial limitations, and infrastructural gaps, which may hinder progress if left unaddressed. These issues call for greater international cooperation, policy innovation, and inclusive financing mechanisms to ensure that renewable energy transitions are sustainable and equitable. Renewable energy transition serves as a cornerstone of the green economy, driving environmental sustainability, social development, and economic resilience. The findings suggest that with strengthened policies, enhanced cooperation, and effective knowledge sharing, both developed and emerging economies can accelerate the pace of transition, achieve climate goals, and promote inclusive green growth.

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