

Green Economy in the Experience of Developed Countries: Germany, Japan, and South Korea

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Abstract

The global imperative to transition towards a sustainable economic model has positioned the 'green economy' at the forefront of policy discourse. This paper conducts a comprehensive comparative analysis of the green economy strategies implemented by three highly industrialized yet resource-scarce nations: Germany, Japan, and South Korea. Employing a qualitative comparative case study methodology based on secondary data from governmental reports, international organizations, and academic literature, this research investigates the distinct policy frameworks, technological priorities, and socio-economic outcomes associated with each country's approach. Germany's *Energiewende* is characterized by a citizen-driven, decentralized focus on renewable energy, particularly solar and wind. Japan's strategy, heavily influenced by the Fukushima disaster and its "Society 5.0" vision, prioritizes technological innovation in hydrogen, energy efficiency, and carbon capture. South Korea's state-led "Green New Deal" emphasizes a rapid, integrated transformation of digital and green infrastructure to foster new engines of economic growth. The results indicate significant variations in performance, with Germany achieving the highest share of renewables, while South Korea demonstrates a model for large-scale public investment. However, all three nations face persistent challenges, including energy costs, path dependency on existing industries, and social equity concerns. This study concludes that while no single model is universally applicable, the experiences of these nations offer critical insights into the complex interplay between policy design, technological pathways, and national context in the pursuit of sustainable development.

Keywords: Green Economy, Sustainable Development, Comparative Policy Analysis, Germany, Japan, South Korea, Renewable Energy.

Introduction

The early 21st century is defined by a confluence of interconnected crises, most notably climate change, resource depletion, and biodiversity loss, which collectively threaten the stability of both ecological systems and human societies. In response to these existential challenges, the concept of a 'green economy' has emerged as a paradigm-shifting alternative to the traditional, linear 'brown' economic model predicated on fossil fuel consumption and unfettered resource extraction. 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. In its simplest terms, it is an economy that is low-carbon, resource-efficient, and socially inclusive. This paradigm advocates for the 'decoupling' of economic growth from environmental degradation, positing that investments in renewable energy, sustainable infrastructure, and resource efficiency can serve as powerful engines for innovation, job creation, and long-term prosperity. The transition is not merely a technical challenge but a profound structural transformation that necessitates comprehensive policy frameworks,

significant capital reallocation, and a fundamental shift in societal values and consumption patterns.

While the theoretical appeal of a green economy is widespread, its practical implementation varies dramatically across different national contexts, shaped by unique political, economic, historical, and geographical factors. Developed countries, given their historical contribution to global emissions and their advanced technological and financial capacities, bear a particular responsibility and are often looked to as pioneers in this transition. This paper focuses on the experiences of three such nations: the Federal Republic of Germany, Japan, and the Republic of Korea (South Korea). The selection of these three countries is deliberate and strategic. They represent major global economies within the OECD, are characterized by high population density, heavy reliance on imported energy, and possess world-leading industrial and technological sectors. Despite these similarities, they have embarked on remarkably distinct pathways toward greening their economies. Germany's journey, famously known as the *Energiewende* (energy transition), has been largely defined by a long-term, politically robust, and citizen-supported push for renewable energy and a phase-out of nuclear power. Japan's approach has been profoundly shaped by the 2011 Fukushima Daiichi nuclear disaster, leading to a recalibration of its energy policy with a strong emphasis on energy efficiency, hydrogen technology, and a more cautious re-engagement with nuclear power, all framed within its broader "Society 5.0" vision. South Korea, in contrast, has pursued a state-led, investment-driven model exemplified by its ambitious "Green New Deal," which seeks to simultaneously address economic recovery, climate change, and social inequality through

massive public investment in green and digital infrastructure.

This research aims to critically analyze and compare these divergent national strategies. The central research question guiding this study is: How do the policy frameworks, implementation strategies, and resulting outcomes of the green economy transitions in Germany, Japan, and South Korea differ, and what lessons can be drawn from their respective experiences? To address this question, the paper sets out three primary objectives: first, to systematically document and compare the key policy initiatives and institutional arrangements in each country; second, to analyze quantitative and qualitative data to evaluate the performance and impacts of these policies in terms of environmental effectiveness, economic development, and energy security; and third, to synthesize the findings to identify common challenges, successful practices, and the broader implications for international climate and development policy. By undertaking this comparative analysis, this paper seeks to contribute a deeper, more nuanced understanding of the complexities inherent in national-level green transitions, providing valuable insights for policymakers, scholars, and practitioners worldwide who are grappling with the monumental task of forging a sustainable economic future. The paper is structured as follows: a review of the relevant literature is presented, followed by an outline of the research methodology. The subsequent sections present the results of the comparative analysis, a discussion of their significance, and a conclusion that summarizes the key findings and offers policy recommendations.

Literature Review

The academic discourse on the green economy is multifaceted, drawing from ecological economics, political science, innovation studies, and development

studies. A foundational concept is that of 'sustainable development', defined by the Brundtland Commission as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (WCED, 1987). The green economy is often framed as the primary operational vehicle for achieving sustainable development, focusing on the economic mechanisms needed for the transition (Pearce et al., 1989). Scholars like Jacobs (1991) argued early on for the compatibility of environmental protection and economic growth, a concept now known as 'green growth'. This perspective suggests that well-designed environmental policies can spur innovation, create new markets, and enhance competitiveness, a theory known as the 'Porter Hypothesis' (Porter & van der Linde, 1995). However, this optimistic view is challenged by proponents of 'degrowth' or post-growth economics, who argue that infinite growth on a finite planet is impossible and that affluent nations must reduce their material and energy throughput (Jackson, 2009; Kallis, 2018). While this paper operates within the green growth framework that dominates policy circles in Germany, Japan, and South Korea, it acknowledges this critical counter-narrative.

Country-specific literature reveals the unique drivers and contours of each nation's green transition. Germany's *Energiewende* is extensively documented, with scholars highlighting its 'bottom-up' character, driven by strong public anti-nuclear sentiment and citizen-owned renewable energy cooperatives (Hake et al., 2015). The Renewable Energy Sources Act (EEG) of 2000, with its generous feed-in tariffs, is identified as the cornerstone policy that catalyzed massive investment in wind and solar power (Lipp, 2007). However, critics point to the significant costs passed on to consumers, challenges

of grid stability, and the 'paradox' of continued reliance on coal and natural gas to ensure baseload power, particularly after the accelerated nuclear phase-out post-Fukushima (Brunekreeft et al., 2013).

The literature on Japan's green economy often centers on the pre- and post-Fukushima periods. Prior to 2011, Japan was a leader in energy efficiency and was pursuing a 'low-carbon society' vision, but with a heavy reliance on nuclear power (METI, 2008). The Fukushima disaster forced a dramatic policy reset. Scholarly analyses focus on the resulting surge in fossil fuel imports, the slow restart of the renewable energy sector despite the introduction of a feed-in tariff system in 2012, and the government's subsequent pivot towards high-tech solutions like hydrogen and carbon capture, utilization, and storage (CCUS) as central pillars of its "Green Growth Strategy" (Kainuma, 2021; Akimoto et al., 2019). This technology-centric approach is seen as reflecting the influence of Japan's powerful industrial conglomerates (*Keiretsu*) and its desire to create new export markets.

South Korea's green economy narrative is dominated by its top-down, state-led development model. The initial "Green Growth" strategy launched in 2008 under President Lee Myung-bak was one of the first comprehensive national strategies of its kind and has been analyzed as a model for using green investment as a post-financial crisis stimulus (Mathews & Tan, 2016). More recently, the "Korean Green New Deal" announced in 2020 has garnered significant academic attention. Scholars analyze it as a more holistic framework that explicitly links climate action with digital transformation and social safety nets (Kim & Kim, 2021). However, critical studies question the substance behind the rhetoric, pointing to South Korea's continued status as one of the world's largest GHG emitters per capita and the powerful incumbency of

its fossil fuel-dependent heavy industries, such as steel, petrochemicals, and shipbuilding (Nam, 2020). This literature review thus establishes that while all three nations are pursuing a green economy, their paths are deeply embedded in distinct national histories, political economies, and technological paradigms, creating a rich basis for comparative analysis.

Methodology

This research employs a qualitative, comparative case study methodology to analyze the green economy strategies of Germany, Japan, and South Korea. This approach is particularly well-suited for the study's objectives, as it facilitates an in-depth, context-rich examination of complex phenomena within their real-world settings, while also allowing for systematic cross-case comparison to identify patterns, differences, and transferable lessons (Yin, 2018). The unit of analysis is the national green economy strategy of each country. The selection of these three cases, as justified in the introduction, is purposive, based on their status as highly industrialized, energy-importing nations that have implemented distinct and influential models of green transition. This allows for a "most similar systems" design, which helps to control for certain macro-economic variables while isolating the impact of different policy choices and political contexts.

The research relies exclusively on the analysis of secondary data, which is a standard and appropriate method for a high-level policy comparison of this nature. The data were systematically collected from a wide array of authoritative sources to ensure validity and reliability. These sources include: (1) official government documents, policy papers, and national strategy reports published by relevant ministries, such as Germany's Federal Ministry for Economic Affairs and Climate Action (BMWK), Japan's Ministry of

Economy, Trade and Industry (METI), and South Korea's Ministry of Environment; (2) statistical databases and analytical reports from international organizations, including the Organisation for Economic Co-operation and Development (OECD), the International Energy Agency (IEA), the International Renewable Energy Agency (IRENA), and the United Nations Environment Programme (UNEP); and (3) a comprehensive body of peer-reviewed academic literature, including journal articles, books, and conference proceedings sourced from academic databases like Scopus, Web of Science, and Google Scholar.

The analytical framework for comparing the cases is structured around three core dimensions. First, the 'Policy and Institutional Framework' dimension examines the key legislative acts, national targets, and governance structures steering the green transition in each country. Second, the 'Technological and Investment Focus' dimension investigates the priority sectors and technologies (e.g., solar/wind, hydrogen, electric vehicles) and the financial mechanisms (e.g., feed-in tariffs, public investment, carbon pricing) used to promote them. Third, the 'Performance and Outcomes' dimension assesses the results of these strategies using a set of key performance indicators (KPIs), including the share of renewable energy in the electricity mix, greenhouse gas (GHG) emissions reduction trends, and data on green investment and employment. Data collected were synthesized and organized according to these dimensions for each country, enabling a structured comparison that moves beyond description to critical analysis of the strengths, weaknesses, and unique characteristics of each national approach. The findings are presented through narrative description as well as through summary tables and a graph to enhance clarity and comparative insight.

Results and Analysis

The comparative analysis of the green economy pathways in Germany, Japan, and South Korea reveals three distinct models of transition, each with a unique configuration of policy drivers, technological priorities, and socio-economic outcomes. The findings are presented below, structured around the key policy frameworks and performance indicators.

Comparative Policy Frameworks

The foundational policies in each nation reflect their different political and historical contexts. Germany's *Energiewende* is arguably the most mature and socially embedded of the three. Its cornerstone, the Renewable Energy Sources Act (EEG) from 2000, guaranteed priority grid access and fixed, long-term feed-in tariffs (FiTs) for renewable energy producers, which democratized energy production and spurred massive investment from individuals, farmers, and local cooperatives. This approach was reinforced by a strong political consensus to phase out nuclear energy, a decision made initially in 2002 and accelerated decisively after the Fukushima incident in 2011. Japan's strategy, by contrast, was reactive and has been more centrally coordinated by the government and large corporations. Following the 2011 disaster, Japan introduced its own FiT system in 2012, but its "Green Growth Strategy," finalized in 2021, places a far greater emphasis on future-oriented technologies like hydrogen and ammonia co-firing in thermal power plants, reflecting a strategic goal to maintain industrial leadership in advanced energy systems. South Korea's "Green New Deal," part of the larger "Korean New Deal" of 2020, represents a state-led developmentalist approach. It is structured as a massive national project with public investment of over KRW 73.4 trillion (approx. USD 62 billion) planned through 2025, aiming to fundamentally restructure

the economy around green infrastructure, renewable energy, and low-carbon industries, while simultaneously boosting post-pandemic economic recovery. Table 1 provides a comparative summary of these policy frameworks.

Table 1: Comparative Overview of Green Economy Policies in Germany, Japan, and South Korea

Feature	Germany	Japan	South Korea
Key Policy Initiative(s)	<i>Energiewende</i> (Energy Transition); Renewable Energy Sources Act (EEG)	Green Growth Strategy (in line with 2050 Carbon Neutrality); Society 5.0	Korean Green New Deal
Primary Focus Area(s)	Renewable energy (wind, solar); energy efficiency; nuclear phase-out	Hydrogen & ammonia; carbon capture (CCUS); offshore wind; energy efficiency; nuclear restart	Green infrastructure; renewable energy; electric vehicles; industrial decarbonization
Key Governance Driver(s)	Bottom-up social movement; strong political consensus; federalism	Top-down, ministry-led (METI); corporate-industrial complex influence	Top-down, presidential initiative; state-led developmentalism
Key Targets	80% renewables in electricity by 2030; Climate neutrality by 2045	36-38% renewables in electricity by 2030; Carbon neutrality by 2050	30.2% renewables in electricity by 2030; Carbon neutrality by 2050

Performance and Outcomes Analysis

The differing strategies have led to markedly different outcomes, particularly in the energy sector. Germany has made the most substantial progress in decarbonizing its electricity supply. As shown in Table 2,

the share of renewables in Germany's gross electricity consumption surged from 17.1% in 2010 to over 46% by 2022. This has contributed to a significant reduction in GHG emissions, which were approximately 40% below 1990 levels by 2022. However, this transition has come with challenges, including some of the highest retail electricity prices in Europe and ongoing reliance on natural gas as a transition fuel, the geopolitical risks of which were exposed in 2022.

Japan's progress has been more modest. The post-Fukushima shutdown of its nuclear fleet led to a sharp increase in fossil fuel imports. While its FiT scheme has successfully boosted solar PV capacity, the overall share of renewables in its electricity generation remains lower than in other G7 nations, reaching around 22.7% in 2022. Its GHG emissions reductions have also lagged behind Germany's. South Korea, starting from a much lower base, has seen the fastest recent growth in renewable capacity, but its energy mix remains dominated by fossil fuels and nuclear power. The share of renewables in its electricity generation was just 7.7% in 2022, a significant distance from its 2030 target. Its historical GHG emissions have grown substantially in line with its rapid economic development, and while they have recently peaked, the reduction trajectory is less steep than in the European context.

Table 2: Key Green Economy Performance Indicators (Selected Years)

Country	Indicator	2010	2022/2023 ¹
Germany	Share of Renewables in Gross Electricity Consumption (%)	17.1%	46.2% (2022)
	GHG Emissions Reduction from 1990 levels (%)	-24.8%	-40.4% (2022)
Japan	Share of Renewables in Electricity Generation (%)	10.2%	22.7% (2022)

	GHG Emissions Reduction from 1990 levels (%)	+4.1%	-20.3% (2022) ²
South Korea	Share of Renewables in Electricity Generation (%)	1.1%	7.7% (2022)
	GHG Emissions Reduction from 1990 levels (%)	+122.3%	+136.5% (2019) ³

¹Most recent consistent data available from IEA/National sources. ²Relative to fiscal year 2013, Japan's target baseline, the reduction is greater. ³South Korea's emissions peaked in 2018 and have started to decline; comparison with 1990 reflects its development trajectory.

The financial commitment to the green transition also varies, particularly in the use of public funds for stimulus. South Korea's Green New Deal stands out for its scale as a centralized, public investment program. As illustrated in Figure 1, the planned public investment under this deal represents a significant portion of its GDP, dwarfing the regular annual green R&D and infrastructure budgets of many other nations, framing the transition as a national strategic mission. Germany's investment has been more sustained over a longer period and driven more by private and decentralized actors responding to policy incentives like FiTs. Japan's investment is a mix of public R&D funding for future technologies and private sector capital expenditure.

Discussion

The results presented in the previous section highlight the multifaceted and context-dependent nature of national green economy transitions. This discussion interprets these findings, comparing and contrasting the strategic logics of Germany, Japan, and South Korea, and exploring the broader implications of their divergent paths. The core difference between the three models can be understood through the lens of their primary drivers and governance structures. Germany's

Energiewende is fundamentally a socio-political project, born from a powerful anti-nuclear and environmental movement that was successfully institutionalized into national policy. Its success in rapidly deploying renewables is a testament to the power of a consistent, long-term policy framework (the EEG) that empowered decentralized actors. However, this bottom-up approach has also created significant political and economic friction, manifested in debates over the high cost of electricity for consumers and industry, the challenges of modernizing the grid to accommodate intermittent renewables, and the "Not In My Backyard" (NIMBY) resistance to new wind turbines and transmission lines. This reflects a key tension in democratic green transitions: balancing participatory processes with the need for rapid, large-scale infrastructure development.

In stark contrast, South Korea's Green New Deal embodies a classic "developmental state" model. The transition is framed not primarily as an environmentalist project, but as a national economic strategy to secure future competitiveness and create jobs. The government acts as the central orchestrator, using massive public investment to "de-risk" private sector involvement and direct the economy towards state-sanctioned green industries. This approach allows for rapid mobilization of resources and decisive action, potentially enabling South Korea to leapfrog in certain technologies like electric vehicles and battery storage. However, this top-down model faces its own challenges. Its success is heavily reliant on the state's ability to correctly identify technological winners and can be vulnerable to shifts in political leadership. Furthermore, there is a risk of "greenwashing," where state support for incumbent, carbon-intensive industries (like steel and petrochemicals) continues under the guise of incremental efficiency improvements, thereby undermining the

transformative potential of the deal. The continued high share of fossil fuels in its energy mix suggests a powerful path dependency that state direction has yet to overcome.

Japan's strategy represents a third, more technologically deterministic and corporatist model. Profoundly influenced by the trauma of Fukushima and a deep-seated concern for energy security, Japan's approach is less about a fundamental restructuring of the energy system (as in Germany) and more about developing advanced technological solutions to decarbonize the existing industrial structure. The focus on hydrogen, ammonia, and CCUS can be seen as a way to preserve the country's centralized utility model and leverage the engineering prowess of its major industrial firms. This strategy holds the promise of breakthrough innovations that could be globally significant. However, it is also a high-risk, high-reward approach. These technologies are currently very expensive, not yet commercially viable at scale, and their true carbon-reduction potential is still debated (e.g., the carbon footprint of "blue" hydrogen derived from natural gas). By prioritizing these future technologies, Japan risks underinvesting in the rapid deployment of mature, cost-effective renewables like solar and wind, which could slow down its near-term emissions reductions. This reflects a strategic gamble on technological supremacy as the primary vehicle for achieving green growth.

Conclusion

This comparative study of the green economy strategies in Germany, Japan, and South Korea has illuminated three distinct national pathways toward sustainability. It confirms that the transition from a 'brown' to a 'green' economy is not a monolithic process but is profoundly shaped by national political culture, industrial structure, and historical context. Germany's *Energiewende* stands as a model of a

citizen-driven, renewables-focused transition that has achieved significant decarbonization of its power sector, albeit with associated costs and grid integration challenges. Japan offers a case of a technology-centric, corporatist response to a national energy crisis, betting on long-term, high-tech solutions like hydrogen while moving more cautiously on the deployment of existing renewables. South Korea exemplifies a state-led, investment-driven "Green New Deal" approach, which frames the transition as a grand national project for economic modernization and future competitiveness.

The findings demonstrate a clear trade-off between different strategic priorities. Germany's model has maximized the deployment of mature renewable technologies but has grappled with social acceptance and system costs. Japan's model prioritizes industrial leadership and potential future export markets in breakthrough technologies but risks lagging in near-term emissions reductions. South Korea's model allows for rapid, large-scale capital mobilization but faces challenges in overcoming the inertia of its powerful, carbon-intensive incumbent industries. No single model emerges as unequivocally superior; each contains elements of success and cautionary lessons.

The implications for global policymaking are significant. For countries embarking on their own green transitions, this study underscores the importance of tailoring strategies to specific national circumstances rather than importing a one-size-fits-all blueprint. The German experience highlights the power of consistent, long-term policy incentives and the benefits of engaging civil society. The Korean case shows the potential of using state-led green investment as a powerful macroeconomic tool, particularly in post-crisis recovery contexts. The Japanese case serves as a reminder of the critical role

of R&D and innovation in developing the next generation of clean technologies, which will be essential for decarbonizing hard-to-abate sectors.

This study is subject to certain limitations. It is based on secondary data, and the policy landscape is evolving rapidly. Future research could build upon this analysis through in-depth, primary data collection, including interviews with policymakers and industry stakeholders in each country. Further quantitative analysis could also more rigorously model the economic and employment impacts of the different policy choices. Ultimately, the experiences of Germany, Japan, and South Korea demonstrate that the path to a green economy is a complex journey of policy experimentation, technological innovation, and political negotiation. Their continued progress, and their respective struggles, will provide invaluable lessons for the rest of the world as it collectively strives to build a more sustainable and equitable future.

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