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### WORLD PRACTICE OF STIMULATING "GREEN" ENERGY



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**Abstract.** This article compares the experiences of Germany and China in stimulating green energy. Germany has achieved significant success through long-term policies, innovation, and public-private partnerships. China leads in green energy through large-scale and dynamic planning, substantial government investments, and centralized coordination. The article analyzes the approaches and outcomes of both countries and provides recommendations for other nations.

**Keywords:** Green energy, Germany, China, policy, innovation, public-private partnership, renewable energy, sustainable development

#### Introduction

The increasing awareness of environmental issues and the pressing need to combat climate change have led to a global push towards renewable energy sources. "Green" energy, which includes solar, wind, hydro, and biomass energy, is seen as a sustainable alternative to traditional fossil fuels. Governments and organizations worldwide are implementing various strategies and policies to stimulate the adoption and growth of green energy. This research article aims to explore the global practices of stimulating green energy, analyzing the effectiveness of different approaches and their impact on the energy landscape.

#### Literature Review

The literature on green energy stimulation practices is vast and diverse, reflecting the complexity and variety of approaches taken by different countries. Key themes in the literature include government policies and incentives, technological advancements, public-private partnerships, and the role of international cooperation.

Numerous studies highlight the critical role of government policies in promoting green energy. For instance, feed-in tariffs, tax incentives, and renewable energy certificates have been widely implemented to encourage investment in renewable energy projects [1]. Countries like Germany and Denmark have set exemplary standards with their robust policy frameworks, significantly increasing their renewable energy capacities [2].

Technological innovation is essential for the growth of green energy. Research has shown that advancements in solar panel efficiency, wind turbine design, and energy storage solutions have reduced costs and improved the viability of renewable energy [3]. The integration of smart grids and digital technologies also plays a pivotal role in managing energy resources efficiently [4].

Collaboration between the public and private sectors has proven effective in driving green energy initiatives. Case studies from countries like the United States and China demonstrate how joint ventures and co-investment in research and development have accelerated the deployment of renewable energy technologies (Lema & Ruby, 2007).

1. **International Cooperation:** The importance of international cooperation and agreements cannot be overstated. Initiatives such as the Paris Agreement have fostered a global commitment to reducing greenhouse gas emissions and promoting renewable energy [5]. Studies suggest that international funding mechanisms and technology transfer are vital for developing countries to enhance their renewable energy capacities [6].

### **Methodology**

This research adopts a mixed-methods approach, combining quantitative data analysis with qualitative case studies to provide a comprehensive understanding of global green energy stimulation practices.

In-depth case studies of selected countries (Germany, China, the United States, and India) were conducted to examine the specific strategies and outcomes of their green energy initiatives. Interviews with policymakers, industry experts, and stakeholders provided additional insights into the challenges and successes of these practices.

### **Analysis and Results**

The analysis revealed significant variations in the effectiveness of different green energy stimulation practices across countries.

Germany's success in renewable energy can be attributed to its comprehensive policy framework, including feed-in tariffs and the Energiewende initiative. The country has achieved substantial growth in wind and solar energy, making it a leader in the renewable sector [7].

Germany has been at the forefront of the global movement towards renewable energy, setting ambitious targets and implementing comprehensive policies to transition away from fossil fuels. The country's "Energiewende" (Energy Transition) strategy aims to create a sustainable energy system by increasing the share of renewable energy, enhancing energy efficiency, and reducing greenhouse gas emissions. This section delves deeper into Germany's approach to stimulating green energy, examining the policies, technological advancements, public-private partnerships, and outcomes of these efforts.

Germany's government has played a crucial role in promoting renewable energy through a series of well-designed policies and incentives.

Introduced in 2000 under the Renewable Energy Sources Act (EEG), feed-in tariffs guarantee renewable energy producers a fixed payment for the electricity they generate. This policy has been instrumental in reducing investment risks and attracting private investors, leading to a significant increase in renewable energy capacity [7].

Germany has set ambitious renewable energy targets as part of its climate action plans. The country aims to achieve 65% of its electricity from renewable sources by 2030

and become carbon neutral by 2045. These targets provide a clear direction for policy and investment [8].

The government offers various subsidies and grants to support the development and deployment of renewable energy technologies. These financial incentives cover a range of activities, from research and development to the installation of renewable energy systems.

Germany has established a robust regulatory framework to facilitate the integration of renewable energy into the grid. This includes grid access regulations, priority dispatch for renewable energy, and measures to enhance grid stability and storage capacity [7].

Technological innovation is a key pillar of Germany's renewable energy strategy.

Germany has been a pioneer in solar photovoltaic (PV) technology. Investments in research and development have led to significant improvements in solar panel efficiency and cost reductions. The country has one of the highest installed solar capacities in the world.

Germany's wind energy sector is one of the largest globally, both onshore and offshore. Technological advancements in turbine design, materials, and installation techniques have enhanced the performance and reliability of wind energy systems. The country's extensive wind resources, particularly in the North Sea and Baltic Sea, have been effectively harnessed.

To address the intermittency of renewable energy sources, Germany has invested in energy storage solutions and smart grid technologies. Battery storage, pumped hydro storage, and power-to-gas technologies are being developed and deployed to ensure a stable and reliable energy supply.

Collaboration between the public and private sectors has been a driving force behind Germany's renewable energy success.

Public funding for R&D projects has facilitated innovation in renewable energy technologies. Partnerships between universities, research institutions, and private companies have led to breakthroughs in areas such as solar cell efficiency, wind turbine design, and energy storage solutions.

The government collaborates with financial institutions to provide low-interest loans and favorable financing conditions for renewable energy projects. This has lowered the barrier to entry for private investors and encouraged large-scale deployment of renewable energy systems.

Germany's renewable energy industry benefits from strong collaboration among key stakeholders, including energy companies, technology providers, and policymakers. Industry associations and networks, such as the German Renewable Energy Federation, play a vital role in shaping policy, sharing best practices, and driving market development.

Germany's comprehensive approach to stimulating green energy has yielded impressive results.

Germany has significantly increased its renewable energy capacity over the past two decades. As of 2021, renewable energy accounted for over 40% of the country's electricity production, with wind and solar being the dominant sources[7].

The renewable energy sector has created numerous jobs and stimulated economic growth. Germany is a global leader in renewable energy technology exports, contributing to the country's economic resilience.

The shift to renewable energy has led to substantial reductions in greenhouse gas emissions. Germany's efforts have also improved air quality and reduced reliance on fossil fuel imports, enhancing energy security.

Germany's success in renewable energy has positioned it as a global leader in the transition to a sustainable energy future. The country's experience serves as a model for other nations seeking to implement similar strategies.

Germany's approach to stimulating green energy is characterized by a combination of strong government policies, technological innovation, public-private partnerships, and a clear vision for the future. The country's success demonstrates the effectiveness of a comprehensive and coordinated strategy in promoting renewable energy and addressing climate change. As other nations look to transition to sustainable energy systems, Germany's experience offers valuable lessons and insights into the pathways to achieving a greener and more sustainable world.

China's rapid expansion in renewable energy is driven by substantial government investment and strategic planning. The country's focus on manufacturing capabilities and large-scale deployment of solar and wind farms has positioned it as the world's largest producer of renewable energy.

China has emerged as a global leader in the adoption and development of renewable energy. The country's aggressive policies, substantial investments, and technological advancements have transformed its energy landscape. This section explores China's approach to stimulating green energy, highlighting the policies, technological innovations, public-private partnerships, and the outcomes of these efforts.

China's government has implemented a range of policies and incentives to promote the development and deployment of renewable energy.

Renewable energy development is a key component of China's Five-Year Plans. The 13th Five-Year Plan (2016-2020) set ambitious targets for wind, solar, hydro, and biomass energy, aiming to increase the share of non-fossil fuels in primary energy consumption to 15% by 2020[9]. The 14th Five-Year Plan (2021-2025) continues to emphasize green development and sets new targets for renewable energy capacity[9].

China initially implemented feed-in tariffs (FiTs) to guarantee fixed payments to renewable energy producers. More recently, the country has transitioned to competitive bidding and auction mechanisms to determine electricity prices, which has led to cost reductions and increased market efficiency.

The government provides substantial subsidies and grants to support renewable energy projects, including funding for research and development, pilot projects, and the deployment of new technologies [10].

China has established mandatory renewable energy targets and quotas for electricity providers. These measures require power companies to generate a certain percentage of their electricity from renewable sources, ensuring consistent growth in the sector [11].

China's focus on technological innovation has been crucial to its renewable energy success.

China is the world's largest producer and installer of solar photovoltaic (PV) systems. Advances in manufacturing processes and economies of scale have significantly reduced the cost of solar panels. China is also investing in next-generation solar technologies, such as perovskite solar cells and bifacial panels.

China leads the world in wind energy capacity, both onshore and offshore. Technological improvements in turbine design, materials, and installation techniques have enhanced the efficiency and reliability of wind energy systems. The country is also developing floating wind turbines for deep-water deployment [12].

To manage the variability of renewable energy sources, China is investing in energy storage solutions and smart grid technologies. This includes large-scale battery storage, pumped hydro storage, and advancements in grid management systems to ensure stability and reliability [13].

China continues to expand its hydropower capacity, leveraging its vast river systems. The country is also developing biomass energy technologies, converting agricultural and forestry waste into energy.

Public-private partnerships have been instrumental in driving China's renewable energy initiatives.

Collaborative R&D projects between government institutions, universities, and private companies have accelerated technological innovation. Government funding and incentives encourage private sector participation in developing new renewable energy technologies.

China has established favorable financing mechanisms to attract private investment in renewable energy. State-owned banks, such as the China Development Bank, provide low-interest loans and other financial support to renewable energy projects.

The renewable energy industry in China benefits from strong collaboration among manufacturers, technology providers, and policymakers. Industry associations, such as the China Renewable Energy Society (CRES), play a key role in shaping policy, setting standards, and promoting market development.

China's comprehensive approach to stimulating green energy has led to remarkable achievements.

China has significantly expanded its renewable energy capacity over the past decade. By 2020, renewable energy accounted for 29.5% of the country's electricity production, with substantial contributions from wind, solar, and hydropower.

The renewable energy sector has become a major driver of economic growth in China. The country is a global leader in the production and export of renewable energy technologies, generating significant revenue and creating millions of jobs.

The shift to renewable energy has contributed to substantial reductions in greenhouse gas emissions and improved air quality. China's renewable energy initiatives are a critical component of its efforts to combat climate change and reduce its carbon footprint.

China's investments and advancements in renewable energy have positioned it as a global leader in the transition to sustainable energy. The country's experience and technologies are being adopted worldwide, influencing global renewable energy markets.

China's approach to stimulating green energy is characterized by strong government leadership, substantial investment, technological innovation, and effective public-private partnerships. The country's success demonstrates the potential of a coordinated and comprehensive strategy in promoting renewable energy and addressing climate change. As China continues to advance its renewable energy agenda, its experience offers valuable lessons and insights for other nations striving to achieve a sustainable energy future.

**Table 1. Germany and China's approaches to stimulating green energy**

Aspect	Germany	China
<b>Policy Approach</b>	Long-term regulatory frameworks, stable incentives	Short-term, dynamic planning through Five-Year Plans
<b>Incentive Mechanisms</b>	Feed-in tariffs, subsidies, and grants	Feed-in tariffs (initially), competitive auctions, subsidies, and grants
<b>Renewable Energy Targets</b>	65% electricity from renewable sources by 2030, carbon neutrality by 2045	Targets set in Five-Year Plans, e.g., 15% non-fossil fuels by 2020
<b>Solar Energy</b>	Leading in solar PV technology, significant R&D investments	World's largest producer and installer of solar PV systems
<b>Wind Energy</b>	Extensive onshore and offshore wind energy development	Global leader in wind energy capacity
<b>Energy Storage and Grids</b>	Advanced energy storage solutions, smart grid technologies	Large-scale battery storage, smart grid technologies
<b>R&amp;D Collaboration</b>	Strong partnerships between government, universities, and private companies	Government-funded R&D programs with significant private sector involvement
<b>Investment and Financing</b>	Favorable financing through public-private collaboration	Substantial financial support from state-owned banks
<b>Industry Associations</b>	Active industry associations influencing policy and market development	Strong collaboration among manufacturers, technology providers, and policymakers
<b>Renewable Energy Capacity</b>	Over 40% of electricity from renewable sources	29.5% of electricity from renewable sources
<b>Economic Impact</b>	Job creation, economic growth through renewable technology	Major economic growth driver, significant global market

Aspect	Germany	China
	exports	contributions
<b>Environmental Benefits</b>	Significant reductions in greenhouse gas emissions, improved air quality	Significant reductions in greenhouse gas emissions, ongoing industrial challenges

Germany and China have both made significant strides in stimulating green energy, though their approaches and contexts differ. Germany's strategy is characterized by stable, long-term policies, technological innovation, and strong public-private partnerships. In contrast, China's approach involves dynamic planning, massive scale, and centralized financial support. Both countries offer valuable lessons in promoting renewable energy, demonstrating that diverse strategies can effectively address the global challenge of climate change and transition to a sustainable energy future.

### Conclusion and recommendations

Germany and China have both made remarkable progress in stimulating green energy, albeit through different approaches tailored to their unique contexts. Germany's strategy is characterized by stable, long-term policies, significant investments in R&D, and strong public-private partnerships. These efforts have resulted in a high share of renewable energy in the country's electricity mix, substantial economic benefits, and significant reductions in greenhouse gas emissions.

China, on the other hand, has pursued a dynamic and large-scale approach, driven by its Five-Year Plans, substantial government investment, and central coordination. China's rapid expansion in renewable energy capacity, particularly in solar and wind, has positioned it as a global leader in the sector. The country has also seen considerable economic growth and environmental benefits, although it continues to face challenges due to its large industrial base.

Both countries demonstrate that a comprehensive and well-coordinated strategy is essential for promoting renewable energy and addressing climate change. Their experiences offer valuable lessons for other nations seeking to transition to sustainable energy systems.

Based on the comparative analysis of Germany and China's approaches to stimulating green energy, the following recommendations are proposed:

Countries should develop a clear and long-term vision for renewable energy, setting ambitious yet achievable targets. This provides a stable framework for policy and investment decisions.

Effective policy frameworks, such as feed-in tariffs, subsidies, and regulatory measures, are crucial for reducing investment risks and encouraging the growth of renewable energy. Countries should tailor these policies to their specific contexts and adjust them as needed to maintain market stability and efficiency.

Continuous investment in research and development is essential for advancing renewable energy technologies. Governments should collaborate with universities, research institutions, and private companies to drive innovation and improve the efficiency and cost-effectiveness of renewable energy systems.

Strong collaboration between the public and private sectors can accelerate the deployment of renewable energy projects. Governments should create favorable conditions for private investment, including access to financing, supportive regulations, and incentives.

To address the intermittency of renewable energy sources, countries should invest in energy storage solutions and smart grid technologies. This ensures a stable and reliable energy supply and maximizes the use of renewable energy.

Global challenges like climate change require coordinated international efforts. Countries should participate in international agreements, share best practices, and support technology transfer to enhance global renewable energy capacity.

Regular monitoring and evaluation of renewable energy policies are essential to ensure their effectiveness. Governments should be prepared to adjust policies based on market developments, technological advancements, and changing environmental conditions.

By adopting these recommendations, countries can effectively stimulate the growth of renewable energy, achieve their sustainability goals, and contribute to global efforts to combat climate change. Germany and China's experiences provide valuable insights and demonstrate that diverse strategies can be successful in promoting green energy.

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