

Energy Policies in Brazil and Europe (Germany/Austria): A Comparative Study on Energy Shortage, Renewable Energies, and Hydrogen

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Abstract: Objective: This dissertation, which is in progress, examines the economic, political, and environmental landscapes in Germany, Austria, and Brazil. It advocates for an eco-centric energy policy to ensure national energy security and economic prosperity and explores the potential of hydrogen as a sustainable energy source for future deployment.

Methodology: The study utilizes a comparative analytical approach and reviews scientific and journalistic literature. It addresses technological challenges such as scaling up renewable energy, hydrogen production, policy alignment, and financial resourcing through literature review, data collection, and policy engagement.

Originality: The research identifies a gap in synthesizing energy policies that address environmental integrity and energy security. It highlights the need to transition to renewable energy and integrate hydrogen technology amidst global energy disruptions.

Results: Strategic recommendations will have been formulated to scale renewable energy, establish hydrogen production networks, and harmonize policies. The study will provide insights for policymakers and stakeholders to advance the energy transition.

Methodological Contributions: This study will offer a model for comparative analysis and policy formulation across national energy scenarios. It enhances understanding of sustainable energy transitions in the face of geopolitical and economic challenges.

Social and Environmental Contributions: The dissertation proposes energy policies promoting sustainable development, security, and economic resilience. It advocates for a diversified energy mix, efficiency, and technological innovations for a sustainable future.

Key-words: Climate change; Energy crises; Energy market; Hydrogen; Renewable resources

INTRODUCTION

The objective of this dissertation is to conduct a systematic examination of the current economic, political, and environmental contexts within Germany, Austria, and Brazil.

Germany has demonstrated its commitment to transforming its energy sector through the ambitious policies outlined in the German Coal-fired Power Generation Termination Act (KVBG, 2020) and the revised German Renewable Energy Sources Act (Deutscher Bundestag, 2020). These policies represent a significant change, including the planned discontinuation of nuclear power generation and a partial coal phase-out by 2030 (Wehrle et al., 2021).

In a significant decision in 1978, Austrians used a democratic referendum to prohibit the use of nuclear power. Instead, they favored wind and solar energy for expanding low-carbon power generation (Pelinka, 1983; Wehrle et al., 2021). Moreover, measures introduced in 1998, such as requiring grid operators to accept electricity from renewable sources, set the stage for the nation's enduring commitment to renewable electricity. This commitment gained momentum in 2002 by adopting Austria's climate strategy as a nationwide plan, aligning with international agreements like the Kyoto Protocol. Under this protocol, Austria pledged to reduce greenhouse gas emissions by 13% below 1990 levels by 2008–2012 (Crichton et al., 2023). This pivotal moment led Austria towards a nuclear-free and environmentally sustainable energy future. The Green Electricity Act (Ökostromgesetz, ÖSG) of 2002 underwent an amendment in 2012, which set ambitious installation targets for solar photovoltaic and wind power, demonstrating Austria's dedication to utilizing renewable energy (ÖSG, 2012).

Brazil stands out in the global energy landscape with a unique profile. Despite the predominance of non-renewable energy sources in national consumption, Brazil relies more on renewable sources (e.g., hydropower, and sugarcane derivatives). Approximately 44.8% of Brazil's energy matrix comprises renewable sources, illustrating a significant commitment to sustainable energy practices.

Brazil has an electricity mix that consists predominantly of renewable energies, with a focus on hydropower, which accounts for 53.4% of the total supply. Because almost all imports come from the Itaipu power plant, hydropower accounts for around 57%. Renewable energy sources account for 78.1% of Brazil's domestic electricity supply. This is the result of the sum of domestic production plus imports, which mainly come from renewable sources (Empresa de Pesquisa Energética, 2022).

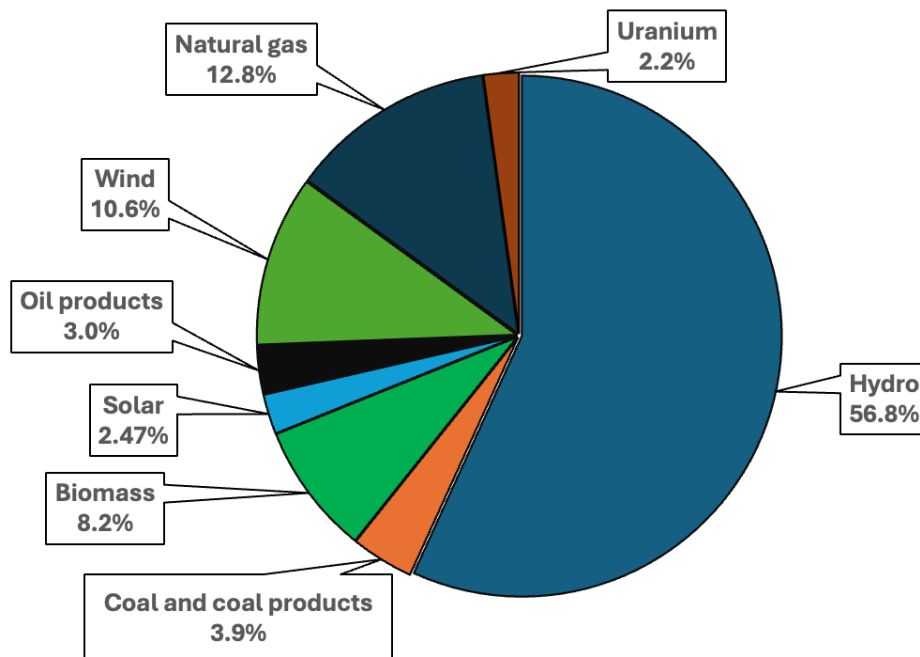


Figure 1: Brazil Total Electricity Supply by Source 2021
Source: Adapted from Empresa de Pesquisa Energética (2022)

This investigation will leverage the accrued data to formulate strategic recommendations for an eco-centric energy policy framework that simultaneously prioritizes national energy security to uphold economic robustness. This research will elucidate the methodologies adopted by the nations above in combating energy deficits, fostering the proliferation of renewable energy sources, and incorporating hydrogen-based energy technologies. Through a comparative analysis of these distinct geopolitical entities, the study aims to distill actionable insights and construct guidelines for establishing optimal energy policies, thereby accentuating the novelty and practical applicability of the research.

The specific aims of the research are outlined as follows:

1. Execute an exhaustive review and analysis of the energy policies and strategic implementations operational within Brazil and the European context.
2. Promote knowledge exchange between Brazil and European nations by pinpointing efficacious policy implementations, identifying best practices, and assimilating the learnings of energy scarcity management.
3. Critically assess the current energy policies of Brazil, Germany, and Austria in terms of their capability to address energy deficits, endorse renewable energy sources, and integrate hydrogen-based technologies.
4. Delineate and appraise the technological, economic, sociopolitical, and environmental impediments Brazil, Germany, and Austria encountered in transitioning towards sustainable energy frameworks.

5. Craft tailored proposals for refined energy policies that consider Brazil's unique situational parameters, drawing upon the empirical experiences of Germany and Austria.

The doctoral research spans multiple facets that bolster sustainable progression in the subject countries. It is poised to enhance the corpus of scientific understanding by presenting a nuanced dissection of energy policies and sustainable energy methodologies. The research's outcomes are anticipated to furnish critical insights for decision-making paradigms, policy construction, and strategies for the transition to sustainable energy. Furthermore, the study is designed to catalyze the transference of knowledge and the circulation of best practices and stimulate capacity building within renewable energy and hydrogen technology. Collectively, this research bears the potential to propel scientific advancement, inform policymaking, encourage inter-regional cooperation, and contribute significantly to the sustainable evolution of the energy sector within the implicated regions and beyond.

MATERIAL AND METHODS

The methodology for the scientific investigation outlined in the research project involves addressing various technological challenges and implementing strategic solutions as follows:

Technological Challenges:

Renewable Energy Scale-up: Initiatives to escalate renewable energy to satisfy demand while reducing fossil fuel reliance involve tackling intermittency, grid integration, and energy storage challenges, as well as balancing supply with demand.

Hydrogen Production and Network Development: Advancing sustainable hydrogen production methods and constructing an extensive distribution network encompasses challenges such as cost-effective production via electrolysis alongside storage and transportation logistics for hydrogen energy.

Policy and Regulatory Alignment: Creating synergy between Brazil's and Europe's (Germany/Austria) energy policies necessitates overcoming standardization, regulatory, and incentive-based discrepancies, demanding coordination and harmonization.

Financial Resourcing: Obtaining sufficient financing for renewable energy and hydrogen initiatives is crucial, necessitating the development of financial frameworks, attraction of private investment, and establishment of favorable conditions for project financing.

Strategies for Overcoming Challenges:

A. **Literature Analysis:** Conducting a comprehensive scientific and technical literature review to understand energy policies, transition strategies, and hydrogen's role as a sustainable energy source.

- B. Data Compilation: Gathering pertinent data from government reports, official documents, and academic research to inform on energy policies and performance indicators.
- C. Policy and Regulatory Engagement: Participating in policy dialogues, aligning regulatory frameworks, fostering international collaboration, and harmonizing standards and regulations through advocacy and policy engagement.
- D. Technology and Knowledge Transfer: Promoting technology exchange and knowledge transfer through collaboration, sharing best practices, and forming partnerships among research entities, industry stakeholders, and policymakers.
- E. Environmental Impact Proposal: Analyzing the environmental implications of various energy policies, assessing renewable potentials, evaluating clean technology feasibility, and suggesting policy measures for a sustainable, low-carbon transition.
- F. Energy Security Proposal: Evaluating the security and reliability of energy supply within diverse policy frameworks, diversifying energy sources, and proposing policies for stable and secure energy provisions with minimized external dependencies.
- G. Integrated Policy Proposal: This approach synthesizes environmental sustainability with energy supply security, combining findings from environmental and security assessments to propose a comprehensive policy that ensures a reliable and resilient energy system balanced with sustainable practices.

The research aims to create proposals that reflect the interplay of environmental integrity and energy security, advocating for a diversified mix of renewable sources, enhanced energy efficiency, technological innovation, and robust infrastructure development.

CONCLUSION

In conclusion, this ongoing dissertation provides a multi-dimensional analysis of the energy sectors in Germany, Austria, and Brazil, focusing on developing a sustainable, secure, and economically viable energy policy. It aims to identify critical technological and policy-related challenges, such as scaling renewable energy, hydrogen production and distribution, and harmonizing policy and regulatory frameworks across different national contexts. Through meticulous literature review, data collection, and policy analysis, the research will formulate strategic recommendations to address these challenges.

The anticipated findings aim to underscore the importance of renewable energy scale-up, the potential of hydrogen as an energy carrier, and the necessity for aligned policy frameworks to facilitate international collaboration and investment. This research seeks to contribute to the academic discourse by highlighting the complexities of transitioning to renewable energy sources and the role of hydrogen technologies in this process. It also intends to provide actionable insights for policymakers and industry stakeholders to advance the energy transition in an environmentally conscious and economically sound manner.

The proposals developed through this research will offer a blueprint for energy policy that integrates environmental considerations with the imperatives of energy security. They will advocate for a diversified energy portfolio, the promotion of energy efficiency, and the support of technological advancements. This holistic approach is poised to guide the regions towards a more resilient and sustainable energy future.

Thus, the dissertation aims to provide evidence of the intricate interplay between environmental stewardship, energy security, and economic sustainability. It paves the way for further research and policy development, aiming to ensure that the pursuit of energy transition mitigates the impact of climate change and secures the socio-economic well-being of nations in an increasingly uncertain global energy landscape.

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