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Renewable Energy Adoption in Emerging Economies

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ABSTRACT:**We investigate the effects of both conventional and renewable energy production, globalization, and indigenous gross fixed capital creation on sustainable development in 14 emerging nations from 1992 to 2021. Our findings demonstrate evidence of both casual and absolute convergence in the sustainable development indicators of these nations. Conditional convergence analysis indicates that indigenous gross fixed capital formation and energy from renewable sources generation favorably impact sustainable development, while globalization and fossil-fueled electricity production have negative effects. These results highlight the need for tailored policy frameworks that reconcile economic growth with environmental sustainability, alongside enhanced international cooperation and the promotion of sustainable practices across both convergence clubs.**

Keywords: - *Sustainability, renewable energy, convergence method*

I. INTRODUCTION

The adoption of renewable energy has become one of the key strategies in reducing dependence on fossil fuels and mitigating the impact of global climate change. Over the last decade, numerous nations have transitioned to cleaner energy resources, including solar, wind, and biomass energy, to decrease carbon emissions and meet sustainability goals (IEA, 2020). In developed nations, investments in renewable energy are at higher levels due to increasing state aid, technological changes, and established structures (REN21, 2021). In comparison, developing nations face restrictions related to capital and infrastructure; however, measures to promote renewable energy have begun as a way to improve energy security and reduce reliance on energy imports (UNDP, 2022). The differences between the developed and developing worlds in respect to preparedness and capacity to implement renewable energy is an important area that needs demonstration and additional research in order to understand the full economic implications. In general, renewable energy has significant economic impacts on both developed and developing countries, as modeled with respect to implementation. The main economic implications of renewable energy are the jobs in renewable energy (construction, manufacturing, installation, and operation/maintenance of renewable energy facilities). The IRENA report (2020) reflected more than 11 million worldwide renewable energy-related jobs in 2020. In developed countries, investments in renewable energy technology have also encouraged the formation of long-term stable, high-quality jobs, particularly in research and development of green technologies. In developing countries, job creation is able to help with poverty alleviation in rural areas, especially with skills training and infrastructure.

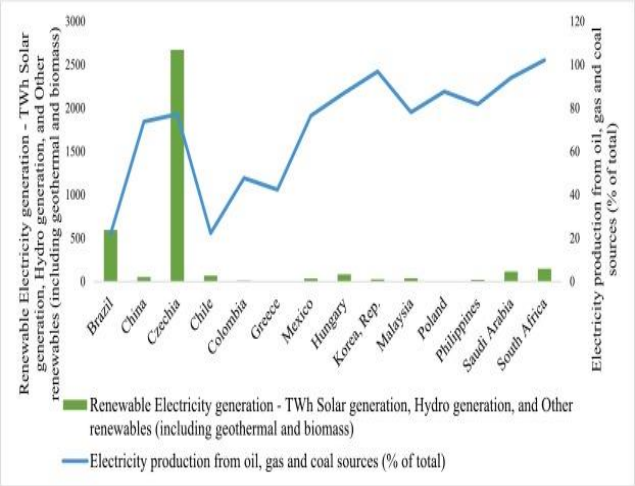
In addition to jobs, renewable energy creates economic benefits in terms of energy security and stability. Utilizing locally available renewable energy resources (solar and wind) reduces dependence on higher-cost fossil fuels imported from elsewhere, and subject to global market price fluctuations. Countries that convert to renewable energy sources are often in a position to provide citizens a lower cost of energy, which makes the energy more affordable to the domestic economy. In developing countries, affordable energy translates into economic stability, which attracts foreign investment with the assurance the energy will be more affordable and environmentally friendly. Thus, renewable energy not only helps the country reduce carbon emissions, but also serves as a strategic tool in strengthening the national economy.

Moreover, the beneficial economic effects of renewable energy are evident in advancements and innovations in technology[1][2][15]. Countries that constantly invest in renewable energy, particularly wealthy nations, frequently occupy a central role in technological advancement and innovation within the field. The resultant developments enhance the sustainability of renewable energy and promote technology exports to other nations, thereby augmenting the country's earnings.

Conversely, for developing nations, embracing renewable energy technologies presents significant opportunity for local capacity enhancement via information and technology transfer. By investing in renewable energy, countries around the world can build more sustainable economies and reduce the negative impact of fossil fuel use.

Although many studies have been conducted on the economic benefits of renewable energy, most studies focus on developed countries or cover only environmental aspects without observing specific differences in economic impacts in developing countries . This study finds a research gap related to comparative analysis between developed and developing countries in the context of the economic impact of renewable energy adoption. Further, past studies have frequently overlooked specific factors that contribute to the success of the energy transition in developing countries such as access to technology, foreign capital, and enhanced policy measures (Sadorsky, 2019). This study seeks to address this gap and understand the differences in economic consequences from the transition to renewable energy in these two categories of countries. This research is becoming urgent as renewable energy is going to be more important in reducing emissions while fostering sustainable economic development (IRENA, 2020). In developing countries, renewable energy has potential to generate new job markets, decrease dependence on imported energy, and increase the
energy access in isolated areas. While developed countries are better placed to use renewable energy to promote innovation and growth in the green technology industry (Apergis & Payne, 2014). With these differences, there is a need to understand the potential economic benefits in two categories of countries as a useful reference for policymakers to develop energy policies that reflect local realities and needs (Zoundi, 2017).

The main aim of this study is to look at different point of view, especially through a comparative analysis of developed and developing countries, which is the main contribution of present study. By using this comparative approach, perhaps it may provide us a better understanding of different factors that helps to shape the success or impacts of the renewable energy economy, e.g. preparedness levels, policy support and access to
the technology (Tiba & Omri, 2017). In this way, the purpose of this study is to present to policymakers and other stakeholders with information of potential strategic initiatives to advance the adoption of renewable energy according to each country's' context. The eventual benefits of the research are envisioned to be two-fold. First, it makes an empirical contribution to the literature related to the renewable energy economy by comparing the impact in developed and developing countries. Second, this research is expected to be the basis for the development of more effective energy policies, by identifying the most appropriate approaches to support a sustainable energy transition in countries with different economic backgrounds.



II. LITERATURE REVIEW

This investigation categories the existing body of studies permormed on sustainable development into three thematic patterns. First, it explores the interrelationship between clean and non-clean energy sources and sustainable development. Second, it examines the complex interplay between globalization and sustainability outcomes. Third, it scrutinizes how control variables—particularly globalization and gross domestic fixed capital formation—affect sustainable development.

Energy Sources and Sustainable Development

- Studies generally confirm that renewable energy enhances sustainable development, while non-renewables hinder progress.
- Chen et al. (2022) and Fang et al. (2022) show that renewable energy positively impacts long-term economic growth in Asia.
- Islam et al. (2022) demonstrate that dependence on fossil fuels reduces sustainability outcomes in ASEAN economies.
- Recent work (Noor et al., 2024) highlights the usefulness of the Sustainable Development Index (SDI), a multidimensional indicator accounting for ecological overshoot, in assessing sustainability.

Globalization and Sustainability

- Globalization exhibits mixed effects, with Shahbaz et al. (2016) suggesting that greater global integration can decouple energy consumption from growth.

- However, broader assessments find that globalization negatively affects sustainability when linked with environmentally harmful industrialization.

III. PROPOSED METHOD

This study utilizes qualitative method along with detailed research approach to find and examine the economic impact of renewable energy adoption in developed and developing countries. Literature studies were chosen as the primary method because they liberate researchers to collect, evaluate, and interpret relevant information from numerous literatures regarding the impact of renewable energy on the economy. With this , this study follows a comparative analysis between the developed and developing countries in terms of economic benefits, challenges, and renewable energy development strategies (Creswell, 2014).[19][20]

Data Source

The research data sources consist of academic journal articles, reports from international organizations such as IRENA, IEA, and UNDP, as well as books that discuss the topic of renewable energy and its economic impact. The articles used in this study were selected based on their relevance to the topic of renewable energy adoption and its economic impact in developed and developing countries, especially publications that discuss aspects of employment, investment, economic stability, and technological developments related to renewable energy (Bowen, 2009). With these, the collection of data will be expected to show a comprehensive picture of the differences in the economic outcomes associated with renewable energy in various economic contexts.

Data Collection Techniques

Methods for data collection are finalized with document collecting methods, in which researchers seek for relevant literature through academic databases such as JSTOR, Science Direct, Google Scholar, and databases of other relevant international organizations. The authors will select literature from the past five years to keep the data as current and pertinent as possible, in consideration of the traditional literature still regarded as important to understand renewable energy economics theory contextually (Miles, Huberman, & Saldaña, 2014).

Data Analysis Methods

The data were analyzed using thematic analysis in order to identify and categorize themes related to the economic impact of renewable energy in developed and developing countries. The data analysis process has two phases of data analysis: data reduction, which involves filtering and selecting appropriate data that fit the purpose and aims of the study, and categorizing data into themes, such as: job creation, stable economic growth, and improvement in technology. Once the data were categorized, the researchers established a sense of understanding of how developed and developing nations differ in context to the use of renewable energy and its economic impact (Braun, & Clarke, 2006). To enhance the findings' rigor, the use of the triangulation of data technique was applied in comparing findings of other literature sources.

IV. RESULTS

The data shown in this table represents articles chosen from the relevant articles on the topic of renewable energy adoption and its economic consequences for both developed and developing countries.[21][22]

Authors	Year	Key findings
[8]	2016	Renewable energy has a positive impact on economic growth in developed and developing countries
[4]	2014	Adoption of renewable energy reduces carbon emissions and stabilizes economies in developing countries
[14]	2022	Renewable energy adoption lowers emissions in developing countries and boosts national income
[10]	2020	Renewable energy creates new job opportunities in developing countries

[13]	2017	Renewable energy is closely related to economic growth and environmental preservation
[7]	2011	Jobs in the renewable energy sector are growing rapidly in developed and developing countries
[6]	2025	Developing countries need financial support to maximize renewable energy adoption
[5]	2007	Renewable energy supports economic sustainability by reducing dependence on fossil fuels
[12][23]	2025	Renewable energy helps developing countries achieve sustainable development goals

V. CONCLUSION

The outcomes of this study suggested that the adoption of renewable energy which has a commending effect on economy and environment in both the developed and developing nations. Renewable energy cause economic development and contributes to job creation, enhanced the quality of life, and reduction of carbon emission that aids the climate change adaptation. This study corresponds with the studies conducted in many nations that underline the importance of renewable energy as a potential driver of a green and sustainable economy that is desired for the future.[24][25]
However, the analysis reveals that the developing countries are still struggling with the significant roadblocks, especially regarding limited infrastructure, concern about accessing financing and imported technology.[26][27] Developing countries require financial assistance as well international help to utilize renewable energy technologies. Through the renewable energy transition, developed countries get benefit from the transition of IIET. But the developing countries require significant technical and fiscal support to catch up on a clean energy, while having a sustainable balance on economic progress.[28][29]

For future research, it will be recommended to study more closely about the funding strategies and models of international cooperation that have the potential to help developing countries in accelerating the uptake of renewable energy. Equity of specific influence of each type of renewable energy technology, for example, solar, wind or bioenergy, on national and local economies that also need to be a focus for future research. With more subtle understanding regarding the technical and socio-economic dimensions to renewable energy in the future, it is hoped that the research will provide more compliant and contextualized strategies to assist with the energy transition in different regional and cultural settings.

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