

The relationship between economic growth, renewable and non-renewable energy consumption in a multitude of countries.

1. Introduction

On one hand, renewable energy comes from natural sources that are infinitely abundant on Earth, such as wind power, solar power, hydro energy and geothermal heat. On the other hand, non-renewable energy is the source of energy that stems from the extraction and subsequent burning of fossil fuels. It is a finite source of energy due to the high volume of use by humans. It has been discovered that there is a relationship between economic growth, air pollution and each of renewable and non-renewable energy. Many countries, including the European union are making every effort to reduce air pollution across Europe. This is achieved by putting new laws on the industrial factories, other polluting factors and supporting the ideas of green facilities to reduce the consumption of non-renewable energy. In an effort to not only protect the environment but also possibly boost the economy and possibly lower their unemployment rate in the next decade.

2. Literature review

Anthropogenic pollution such as rising carbon dioxide (CO₂) emissions, as well as an elevation in other greenhouse gases, significantly impact the environment. Some argue that non-renewable energy sources, which originate from the burning of fossil fuels, are limiting the long-term economic growth. The European Union has made great progress toward an energy sector that is more carbon-free. The Europe 2020 Strategy set three major goals for 2020: a 20% reduction in emissions of greenhouse gases, a 20% increase in the final energy consumption of renewable sources, and a 20% increase in energy efficiency. By 2030, the EU should reduce greenhouse gas emissions by at least 40%, boost the production of renewable energy, and improve energy efficiency by at least 27% (European Commission, 2010). This plan will be the catalyst to increase the economic growth in European union countries as it will inject the workplace with more employees, resulting in a decrease in the rate of unemployment. High growth in the amount of power produced from renewable sources, renewable energy-based distributed generation (RDG), and energy democracy in low-income communities can all be used to create a significant impact on employment generation. While current approaches such as RDG technologies have emerged as a way to achieve sustainable economic growth (Ramos *et al.*, 2018). The relationship between economic growth and the energy growth nexus was studied in 27 European Union countries. Data analysis was achieved using sustainability indicators such as the human development index, financial development index, urban population, renewable energy consumption, non-renewable energy consumption, ecological footprints, carbon emissions, and economic growth indicator. The results demonstrated a two-way negative relationship between economic growth, and renewable energy and more surprisingly a two-way positive relationship between economic growth and non-renewable energy. Moreover, the study suggests that economic growth is positively impacted by ecological footprint, non-renewable energy consumption, and carbon emissions. While the opposite holds true as an increase in renewable energy consumption resulted in a decrease in economic growth. It was evident that while in the long-term renewable energy is bound to positively impact the economic growth in EU countries, it is not quite the case in the short-term (Sharma *et al.*, 2021). Furthermore, Rasoulinezhad *et al.* conducted a study in Commonwealth of Independent States region, which include Armenia, Azerbaijan, Belarus, Georgia, Kazakhstan, Kyrgyzstan, Moldova, Russia, Tajikistan, Turkmenistan, Ukraine, and Uzbekistan over the period of 1992–2015, investigated the links between economic growth, CO₂ emissions, renewable and non-renewable energy consumption. It revealed the existence of a long-term, bidirectional relationship between every variable in the 12 tested countries, with the exception of the relationship between

economic growth and renewable energy consumption. According to the results, there is a short-run panel causation that runs unidirectionally from economic growth, financial openness, and trade openness to CO2 emissions to renewable energy sources (Rasoulinezhad *et al.*, 2018). These results are supported by a study conducted in the 38 top countries for renewable energy consumption over a two decade period. Using long-run output elasticities showed that 57% of the countries used in the study benefitted economically with the increase in renewable energy consumption (Bhattacharya *et al.*, 2015). Iqbal *et al.* (2023) builds on previous research by revealing that in BRICS countries there is a one-way causality from labour force and exports to economic growth, as well as a bidirectional causal relationship between economic growth and foreign direct investment and carbon emissions, meaning that an increase in economic growth leads to an increase in carbon emissions, and an increase in carbon emissions leads to an increase in economic growth. BRICS is a group of countries with rapidly expanding emerging economies made up of Brazil, Russia, India, China, and South Africa. Ivanovski *et al.* (2020) argues that the extent by which economic growth is affected by renewable and non-renewable energy is highly dependent on a country's classification. The study revealed that throughout the majority of the study period, the impact of renewable energy consumption on economic growth in these countries is statistically equivalent to zero. Furthermore, consumption of both renewable and non-renewable energy stimulates economic growth in non-OECD nations.

3. Conclusion

To conclude the relationship between economic growth, renewable and non-renewable energy consumption is a highly complex one. The involvement of a wide range of factors promotes the creation of a nexus, that is not very straightforward to study in the short-term. However, long-term research using various methods, enabled the visualisation of these mechanisms, and their interactions, mainly indicating a positive relationship between economic growth and renewable energy consumption. Additionally, over the past two decades, boosting energy independence and security has been increasingly important in developing the new energy policy framework for many developed countries, particularly for EU nations. Energy independence has also become essential in EU foreign policy challenges and framework due to the consequences of energy security for economic growth, development, and even social cohesion perspectives.

4. Resources:

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