International Information and Engineering Technology Association
Advancing the World of Information and Engineering

Mathematical Modelling of Engineering Problems
Vol. 10, No. 2, April, 2023, pp. 720-726
Journal homepage: http://iieta.org/journals/mmep

The Influence of the Relationship Between the Economic Development of Countries Using Renewable Energy and the Relationship with Environmental Effects

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Special Issue: Hybrid Renewable Energy Systems and Integration

https://doi.org/10.18280/mmep.100244

Received: 2 October 2022
Accepted: 23 December 2022

Keywords:
renewable energies, economic growth, energy consumption environmental impacts, developing countries

ABSTRACT

For economic growth and progress, nations must have access to renewable energy sources. The amount of energy a country uses affects its economic growth. According to studies by academics from around the world, economic growth is a major factor in the rate of global energy consumption growth. These studies were done globally. This was discovered because these two variables are linked. In the first part of our investigation, we analyzed previous studies and investigations on expanding economies and energy use. These studies and investigations examined the link between growing economies and energy use. These studies were conducted to better understand the relationship between growing economies and energy use. This article examines the relationship between economic growth and renewable energy use in Organization of Petroleum Exporting Countries (OPEC) member countries from 1990 to 2015. We analyzed this connection using relevant data. According to this study, the increased use of renewable energy in some OPEC countries is driving economic growth.

1. INTRODUCTION

Energy has always played a very important role in human life and is one of the factors that make economic growth possible [1]. A significant part of our energy consumption comes from fossil fuel sources such as oil, coal and natural gas, while it will take millions of years to replace these fuel sources, so it is predicted that these sources will end in the not too distant future [2]. Considering the importance of the issue, many countries are trying to invest in new technologies to be able to use renewable energy sources such as solar energy, wind energy or water energy and even geothermal energy, which leaves less environmental pollution as compared to fossil energy [3]. Today, energy, as a factor of production, contributes greatly to the growth and development of different countries. Because of this, the relationship between energy and economic growth is one of the issues that has received attention. The question is whether it is enough to rely only on fossil and exhaustible resources for economic growth, or whether renewable energies should also be used to solve the problem.

Statistical studies show that the biggest cause of environmental pollution by man-made factors are the production, conversion and consumption of all types of energy, while energy consumption in the world has not only remained constant, but has faced a growing trend [4]. Forecasts indicate an increase in energy consumption in the coming years due to the increase in population, the desire for prosperity and the increase in GDP per capita in the world. The consequence of consuming this amount of energy will be an increase in carbon dioxide emissions from 3.6 gig tons of carbon in 1998 to 9.5 gig tons in 2021 [5].

Most developed countries with high economic growth can afford to invest in renewable energy due to the high cost of building facilities and technical equipment. Developing countries with a lot of renewable energy potential lack capital and technical knowledge and cannot afford the huge costs of renewable energy projects [6]. First, he discussed the research's theoretical foundations and then its internal and external context. The research method is next. Final section tests hypotheses [7].

OPEC members face greater energy consumption while striving to boost GDP and growth [8]. Increased nonrenewable energy usage and economic development create questions about how nations will satisfy their energy demands [9].

The increasing accumulation of carbon dioxide in the atmosphere due to the use of fossil fuels is a global problem that requires a global solution, so all countries must reduce their greenhouse gas emissions as soon as possible [10]. Increasing renewable energy consumption reduces CO_2 and other greenhouse gas emissions [11].

Increasing renewable energy consumption is an efficient way to decrease global warming. Population expansion and rising global consumption have raised the significance of renewable energies [12]. Even nations that export crude oil are diversifying their energy portfolios for the reasons outlined. Renewable energy consumption and economic development are crucial in energy sector policy [13]. It is impossible to use the same policy prescriptions for countries with different economic structures, so the direction of causality and the type of relationship between renewable energy consumption and economic growth should be determined first [14].

Energy consumption is a function of technology and energy price. Wei et al. [15] expected that with the increase in economic activities, energy consumption will increase. Based on this, it can be said that there is a significant relationship between economic growth and energy consumption.

Halkos et al. [16] have investigated the threshold effects of energy prices on the development of renewable energies under systems with different economic growth rates for member countries of the Economic Cooperation and Development Organization in the time period of 1997-2006, using the threshold regression model in panel data (PTR). It shows that countries with high economic growth can respond to high energy prices by increasing the use of renewable energy, while countries with low economic growth are less inclined to change the level of renewable energy [17].

Nguyen et al. [18] introduced and estimated an experimental model of Group 7 renewable energy consumption for 1980-2005. This study's cumulative panel estimates show that real per capita GDP and per capita carbon dioxide emissions are the main long-term drivers of per capita renewable energy consumption. Oil price increases have had a small negative effect on renewable energy consumption. Long-term elasticities estimated from the FMOLS panel co-accumulation model show that a 10% increase in real per capita GDP increases renewable energy consumption by 8.44%, while a 1% per capita increase in Carbon dioxide increases renewable energy consumption by 23.5%.

For both panel devices, the heterogeneous panel counteraction test indicates the existence of a long-term equilibrium relationship between real GDP and renewable energy consumption, real gross capital accumulation and labor force. The results of error correction models show a two-way causal relationship between renewable energy consumption and economic growth in both short-term and long-term conditions [19].

For the period of 1980-2015, the relationship between renewable energy consumption and economic growth in 20 member countries of the Organization for Economic Cooperation and Development has been investigated using panel counteraction tests and error correction models [20]. The results show that there is an accumulation relationship between renewable energy consumption, economic growth, capital and labor force. In addition, the coefficients of the variables are positive and statistically significant.

Using cointegration tests and its error correction, the relationship between renewable and non-renewable energy consumption and economic growth has been investigated in 80 countries [21].

Carbon dioxide emissions, nuclear and renewable energy usage, and actual U.S. GDP from 1960-2007 were studied. Using a modified Granger causality test, they discovered that nuclear energy use causes carbon dioxide emissions without feedback, whereas renewable energy consumption does not. Nuclear energy usage and economic growth have no causal link, but renewable energy consumption has a one-way causal association with GDP [22].

Simionescu [23] found a long-term association between economic growth indicators and renewable energy use in two groups. This study shows a long-term association between renewable energy consumption, its share, capital creation, labor force, oil revenue, and education costs with GDP, GDP per capita, urban and rural family income. Long-term use of renewable energy and other factors boosts economic development and prosperity, according to research (OECD).

Tamba et al. [24] have investigated the relationship between economic growth and the consumption of major petroleum products during the period of 1994-2008. The results of the research show that in the short term, there is no Granger causality relationship between the consumption of petroleum products and GDP, but in the long term, there is a relationship between it is established from consumption of products to GDP. Nain and Kamaiah [25] by using the method of Toda and Yamamoto have investigated the Grangerian causality relationship between the consumption of energy carriers and economic growth during the years 2001-2009. The results show that there is a one-way Grangerian causality relationship from the final consumption of energy, petroleum products and electricity consumption to economic growth and a one-way Grangerian causality relationship from economic growth to natural gas consumption and solid fuel consumption. Alola and Uzuner [26] have studied the causal relationship between energy consumption, employment and gross domestic product in Niagara during the period of 2015 to 2018 using the method of co-accumulation analysis and Hsiao's causality test. The results obtained from Hsiao's causality express the one-way causality from energy consumption and employment to gross domestic production and from employment to energy consumption Implementing energy-saving initiatives in the context of job development programs should be done carefully so as not to impair production.

The purpose of this study was to investigate the relationship between renewable energy consumption and economic growth in selected crude oil exporting countries using the panel data technique, and the direction of causality between renewable energy consumption and economic growth in OPEC member countries was determined.

In this article, we have tried to examine the relationship between economic growth and the use of renewable energy sources in different OPEC member countries during the 25-year period between 1990 and 2013. For the first time, we were able to analyze this relationship using data collected over the relevant period.

2. METHOD

In Niagara, we will investigate many topics and, using new econometric methodologies, we will attempt to find the short-term and long-term link between the model's variables and the sort of relationship. If the causal link is established, renewable energy sources will be preferred based on their influence on economic development in the nations under consideration. Based on this, the panel error correction model (ECM) is used to investigate the causal link between real GDP and each of the six renewable energy sources. The panel methodology has numerous benefits for studying growth, the most notable of which is that it allows us to incorporate the influence of removed factors that persist through time in the regression. Another benefit of this strategy is that the delayed values of the explanatory variables may be employed as instrumental variables in emergency situations, therefore removing distortions produced by measurement and simultaneity issues. Most econometric models utilized in earlier decades were based on the premise of time series dependability. Later, when the instability of additional time series was discovered, the usage of variables was contingent on executing the required reliability tests. The resultant estimates will not have the issue of spurious regression if the variables are static; however, if the variables are not static, we must evaluate the co-integration connection between the dependent variable and the independent variables.

The study was carried out with the emphasis on theoretical notions gathered via the technique of a library of books, local and international publications. The study includes research examples and articles on the environmental costs of power generation.

Many studies produced over the past two decades reveal that air pollution causes irreversible harm to both human health and the ecosystem. Environmental accounting is a collection of standards that improves the accounting system's capacity to recognize, document, and report the consequences of environmental degradation and pollution. Environmental accounting is based on treating environmental expenses as one of the allowable costs in economic and calculating processes and incorporating the environment as a source of capital. The goal of environmental accounting is to give managers with information that will assist them in evaluating performance, making choices, controlling, and reporting. Making smarter business choices, investing in more environmentally friendly air technology (green industries), and restructuring industrial processes and goods may all greatly cut or eliminate many environmental expenditures. Removed because some of these charges may not add value to the system or product. Better management of environmental expenses has the potential to increase performance and provide large societal benefits.

According to the opinions of neoclassical economists, energy is one of the main factors in the production function. For example, some colleagues argued in their article that in the total production function, energy is a factor of production, which has an inseparable and weak relationship with the labor force [27]. The proposed production function is:

$$Q = F(G(K,E),L) \tag{1}$$

where, Q: total production function, K: capital, E: energy and L: labor force.

Of course, a group of neoclassical economists believe that energy has a small role in economic production and is an intermediate input, and the only factors of production are labor and land. In this function, energy and capital are combined to produce G and after the combination G is obtained with the labor force, the total product; therefore, energy has a weak separable relationship with labor.

Researchers state that energy is the only factor and the most important factor of growth. Labor and capital are intermediary factors that require energy to be employed. In addition, citing neoclassical economists, it states that energy is indirectly effective on economic growth through its effect on labor and capital.

It was expressed the relationship between energy consumption and economic activities based on the production function [28].

$$(Q_1, \dots, Q_M) = F(A, X_1, \dots, X_n, E_1, \dots, E_p) \tag{2}$$

where, Q_i: production of various goods and services, X_i: various production facilities such as capital, labor force, E_i: various energy facilities such as oil, coal, A: technological status or productivity index of all factors.

In this function, the relationship between energy and total production is affected by factors such as substitution between energy and other inputs, technological changes, changes in the composition of energy factors, and changes in the composition of production products. In the new theories of growth, although the energy factor is included in the model, its importance is not the same in different models. Choosing the right energy policy depends on the relationship between economic growth and energy consumption, and to make the right decision, policy makers must know whether economic growth leads to more energy consumption or the opposite of this relationship. The study of the relationship between energy consumption and economic growth is examined through four hypotheses:

1. The neutral hypothesis that rejects the existence of a relationship between them;
2. Energy conservation hypothesis: which expresses the one-way causality from economic growth to energy consumption;
3. The hypothesis of energy leading to growth: which assumes a one-way causality from energy consumption to economic growth;
4. The feedback hypothesis: based on this view, energy consumption and economic growth influence each other.

In the process of economic development, the economic structure has undergone changes and the contribution of different economic sectors in the economy also changes. With the development and growth of the industrial sector, a sharp increase in the energy consumption of this sector will occur in order to continue the process of economic growth. In addition, with economic growth, the wealth of consumer's increases and the share of consumer budgets from industrial goods increases, and the industrial sector begins to change in response to this demand and continues to operate on a large scale. On the other hand, with the increase in household income and wealth, their demand for energy-related luxury goods (cars, larger houses, heating and cooling devices, etc.) increases, and energy consumption increases with the increase in consumption in the household and transportation sectors. The increase in household income is the result of the increase in economic growth. In addition, with the increase in economic growth, the prosperity of the service, transportation and trade sectors that consumers. The effectiveness and efficiency of energy increases, reduce the final cost of energy, and this causes an increase in energy consumption. This effect is known as the rebound effect [29]. With these explanations, for energy consumption, they specified a function in the form of Eq. (3):

$$EC = F(Y, P, \dots) \quad (3)$$

Economists have long recognized that the private market economy has negative consequences for the environment and human health. These negative consequences include hazardous odors, dirty water, damaging gases released by factories and workshops, and so on. Furthermore, as population and productivity grow, so does the usage of natural resources. Despite resource constraints, environmental and human concerns exist. One of these resources is water, which has caused major issues in many nations despite the current water shortage crisis. Currently, there are three types of researchers. They compute the ecological footprint, land, water, and carbon. The ecological footprint of land determines how much land is utilized in an economy and the amount of understanding about the land. The quantity of direct and indirect water usage is assessed in the water ecological footprint. The carbon footprint was formerly described as "the whole set of greenhouse gas emissions created by an organization, event, product, or individual." However, because calculating the total amount of carbon footprint is impossible due to the large amount of data required and the fact that carbon dioxide is also produced by natural events, this new definition for carbon footprint is proposed: "a measure of the total amount of carbon dioxide produced." The carbon dioxide and methanol production associated with a certain population, system, or activity, taking into account all sources, sinks, and storages in the time and location of that population, system, or activity.

This study is practical in terms of causal-analytical technique and goal, and the method of information collection is likewise of the document-library kind. Statistics and information for the essential variables in the model are retrieved from the Ministry of Energy and the World Repository's time series data bank in the form of yearly time series from 2001 to 2003. Several strategies for identifying and explaining the long-term link between variables have been offered. The Engel-Granger technique, ARDL, and the well-known Johanson-Joselius approach were all first presented as the Engel-Granger method. Because the hypotheses derived from joint test data are invalid. As a result, strategies that modify the long-term dynamic pattern and lead to correct estimates of model coefficients should be utilized. The Johansen-Josilius model was an alternative model that was able to overcome the flaws of the Engel-Granger approach by developing a vector co-accumulation method based on the maximum right projection. Its work is based on a vector auto regression model (VAR) in the form of Eq. (4):

$$Xt = \sum_{i=1}^{p} \emptyset iXt - i + \varepsilon t \quad (4)$$

where, *Xt* represents a vector containing variables. *Φi* is the matrix of coefficients and *εt* is a remaining element and *p* is introduced as the maximum interval length for the VAR model. In this method, to show the short-term dynamics, equations can be written in the form of the Eq. (5) devices:

$$\Delta Xt = \Pi Xt - 1 + \sum_{i=1}^{p-1} \Gamma i \Delta Xt - i + \varepsilon t \quad (5)$$

where, *Π* and *Γ* matrices represent the short-term and long-term relationships between model variables, respectively. Assuming that matrix *Π* has rank *r*, matrix *Π* can be decomposed in the form of Eq. (6):

$$\Pi = \alpha\beta \quad (6)$$

In Eq. (7) *α* is the matrix of adjustment of short-term relationship to long-term relationship with dimensions *r*×*P*, and *β* is the convergence vector between *r*×*P* variables. If we consider the rank of the matrix *Π* as *r*, this condition is satisfied in the following three cases:

n=*r*, in which case all the variables are vector (*Y*), *I*(*0*) and the appropriate method to estimate the model is VAR estimation at the level of variables.

r=0, in which case there is no reliable linear combination of *Y* vector variables, and the appropriate method for model estimation is VAR estimation in the first order difference of variables.

$0<r\leq n-1$, in which case there are *r* stable linear combinations of variables and *Y* vector method or in.

Other words *r* Johansson's counteraction vector is used to estimate the counteraction vectors. The Johansen-Josilius estimation model provides the maximum likelihood for *α* and *β*. Also, to determine the degree of the matrix *Π* and to achieve the convergence relations, the effect matrix tests (*χ*trace) and maximum eigenvalues (*χ*max) are used. In order to use the Johansen-Jusilius method, one must first calculate the optimal number of endogenous variables. Then, by using the values of the variable level, he formed the VAR model and determined its value using the Akaik (AIC), Schwartz (SBC) and Hanan Kovin (HQC) criteria. After that, using the effect matrix tests (*χ*trace) and the maximum eigenvalues (*χ*max) to determine the convergence vectors and extract the long-term relationship.

3. RESULT AND DISSCUSION

When an impulse as high as one standard deviation occurs, instantaneous response functions demonstrate the dynamic behavior of variables throughout time. This tool may be used to examine the interrelationships between variables in the SVAR model.

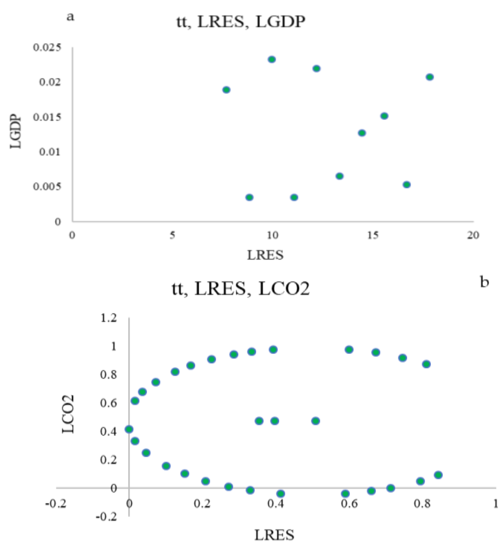

Figure 1. a) Analysis of the instantaneous response of LGDP to the Local Renewable Energy Source (LRES) shock; b) Analysis of the instantaneous response of LCO_2 to the LGDP shock

Figure 1 depicts the responsiveness of system variables to structural impulses of one standard deviation over the following 25 periods. As seen in Figure 1, the variations in CO_2 in response to the GDP shock remained unaltered until the first period, and since then it has demonstrated a positive reaction to this business, indicating that this positive response is not a changing condition. It continues till the conclusion of the time, but the tendency is upward. According to the final assessment, the reaction of the Paraguayan economy to the GDP shock is anticipated to be positive. Figure 1 depicts the influence of the RES shock and the reaction of GDP changes to this shock over a period of twenty-five years. GDP changes did not alter until the third quarter, and the fourth period reveals a favorable but very minor reaction to this firm. This reaction has also varied, and it will continue to have an impact until the conclusion of the 25th period. In the estimate of the link between GDP changes and RES, a positive value has also been assessed.

Figure 2 depicts the influence of the RES Company on CO_2 variations for up to twenty-five time periods. This graph demonstrates that CO_2 did not respond to the RES shock until the first period, and from the first period to the third period, it has an upward tendency, and from this stage on, it displays a rising declining pattern, implying that the corporation will continue to do so until the end of the period. According to the final calculation, the reaction of CO_2 changes to the RES firm in the Paraguayan economy is expected to be favorable.

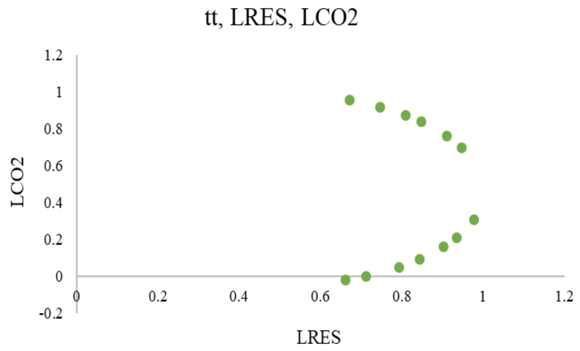

Figure 2. Analysis of the instantaneous response of LCO_2 to the LRES shock

Instant reaction functions are used to check the sign and how each variable changes due to different structural shocks; however, each company has a different degree of importance in the fluctuation of variables; thus, the analysis of variance method can be used to compare the importance of each shock. This technique specifies how much each structural shock contributes to the variation of the variables in the short and long run. Based on this, it will be addressed in Figures 3, how much the variation of the prediction error in the two variables GDP and CO_2 is explained by the firms included in the variables in the model. Figure 3-a depicts the contribution of various shocks to the variation in real output across time. Based on this, it can be shown that the actual production firm has the highest share of its oscillations throughout this 20-year period, with RES and CO_2 companies ranking second and third in terms of explaining the variance of the prediction inaccuracy. Figure 3-b depicts the explanatory power and contribution of various shocks to CO_2 variation. As can be observed, the CO_2 shock has a stronger explanatory power than other shocks, and the GDP and RES shocks are listed next, such that during this 20-year period, GDP has always had a higher explanatory contribution than RES. As a consequence, it will be more important.

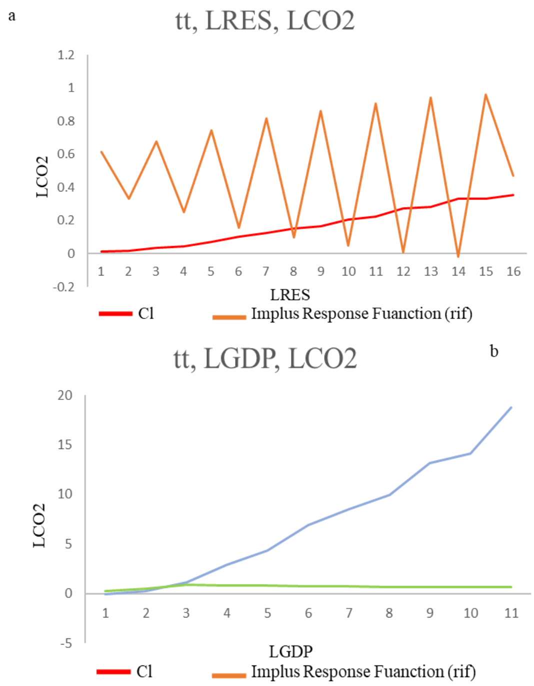

Figure 3. a) Variance analysis of LGDP forecast error; b) Variance analysis of LCO_2 prediction error

Concerns about the depletion of nonrenewable energy supplies and the pollution created by their usage have shifted most governments' emphasis to renewable energy in recent years (RES). As a result, intensive research into RES and ways of collecting this energy source has resulted in a rise in renewable energy output in both developed and developing nations. Our objective is to evaluate the issue of increasing the percentage of renewable energy sources in the generation of electricity, which may have an influence on the gross domestic product while also having an effect on greenhouse gas emissions. Several methodologies were employed to study the issue, including the SVAR method, which pays attention to the interrelationships of all variables and may forecast the consequences of policies and significant economic changes. Thus, for the nation of Paraguay, a three-variable SVAR model of (RES', GDP, CO_2) was developed in this work. This topic will be examined further utilizing this model, instantaneous response functions, and variance analysis. How will the positive shock affect renewable energy consumption?

The findings of calculating the GDP and CO_2 structural models demonstrate that a positive shock in renewable energy consumption has a beneficial influence on changes in economic growth. Because energy is a driving factor in economic growth and development, such a positive link is predicted to be developed. However, contrary to predictions, good involvement in RES has a beneficial influence on CO_2 emissions, and we can see that in the Paraguayan economy, the use of renewable energy has not lowered CO_2 emissions, which may be ascribed to the low percentage of this sector. Despite the large capacity of RES in Paraguay, relatively little use of this energy source has been made, and on the other hand, weak and antiquated technology in the domestic manufacturing process has led to increased CO_2 emissions in more energy usage. This may play a significant role in canceling out the favorable effects of employing RES.

Furthermore, variance analysis reveals that the contribution of RES to explaining the variation of GDP and CO_2 forecast error is minimal.

Based on the findings, it is recommended that politicians prioritize increasing the share of renewable energy in total energy produced in the country, because despite the high initial cost of renewable energy production, the increase in GDP as a result of using this energy can compensate for the initial costs and bring more stable and reliable economic growth, due to the stable and stable nature of renewable energy. In addition to boosting energy security by diversifying the country's energy portfolio, this will benefit people's health owing to its environmental friendliness.

On the other hand, since the price of non-renewable energy sources has a lot of fluctuations and in oil-dependent economies, these fluctuations directly enter the society's economy, so it seems that it is possible to pay more attention to renewable energies, of course, based on the capacities existing in each region, reduced the intensity of economic fluctuations and created a more stable economic growth in the society. Therefore, governments can formulate policies and create guidelines for the widespread use of renewable energy. Therefore, in order to support the development of clean energy and consequently reduce environmental pollution due to energy production and consumption, comprehensive development banks are able to accelerate the development of renewable energy and increase efficiency by providing financing and technological support. Emphasize more energy.

4. CONCLUSION

Energy economics examines growth and use. Warming and Kyoto influenced energy policy. Nonrenewable OPEC energy needs policy changes. These countries need resources. OPEC's economic growth and renewable energy use were studied from 1985 to 2014. Renewables and GDP are 10% Grangerian.

Two experiments had independent variables. In many countries, this link is critical because renewable energy use has risen quickly compared to fossil energy use while renewable energy prices have fallen. Renewable energy and regulation could help. This bothers some. Global energy. Research and acquisitions have been boosted by rising oil prices and alternative energy. Oil-producing countries should invest in renewable energy, says research. In underdeveloped countries, costs, lack of investment, and legislation hinder renewable energy (including Niagara). Weather and technology may slow renewable energy growth in poor countries.

Sustainable development requires energy. Fossil fuels and resources threaten sustainability. Economic, social, and environmental effects of renewable energy.

Renewable energy affects macroeconomics. This study evaluates renewable energy's impact on employment, value added, GDP, and well-being. Renewable energy creates jobs. Renewables create service hubs. Happiness, GDP. Emerging nations create jobs and prosperity faster than wealthy nations.

This study reviews renewable energy. Studies show renewable energy and value chain expansion create value. Each solar module's value chain is over $750. Wind: $10/MW.

We researched renewable energy's effects. Multiple factors affected happiness. Globally, renewable energy improved health 6.5%. Renewable resources could boost Paraguay's GDP and employment. Price and environmental impacts of fossil fuels.

Globally, we emphasize income, health, education, employment, and welfare. Well-being could replace GDP in renewable energy assessments. The economy affects growth. GDP demonstrates economic health. GDP doesn't measure health or depletion. Economy, society, and environment affect well-being. Renewable energy has three components. Checking health, describing attributes, and assessing strengths and weaknesses are crucial.

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