POLICY JOURNAL OF SOCIAL SCIENCE REVIEW
HTTPS://JOURNALOFSOCIALSCIENCEREVIEW.COM/INDEX.PHP/PJSSR
PJSSR

Policy Journal of Social Science Review

ISSN (Online): 3006-4635
ISSN (Print): 3006-4627
https://journalofsocialsciencereview.com/index.php/PJSSR

PJSSR

Vol. 3 No. 2 (2025)

Policy Journal of
Social Science Review

Causal Relationship Between Renewable Energy, Economic Growth, And Environment

Maria Ashraf
Anam Shehzadi
Asia Naseem
Sadia Ali*

POLICY JOURNAL OF SOCIAL SCIENCE REVIEW
HTTPS://JOURNALOFSOCIALSCIENCEREVIEW.COM/INDEX.PHP/PJSSR
PJSSR

Policy Journal of Social Science Review

ISSN (Online): 3006-4635
ISSN (Print): 3006-4627
https://journalofsocialsciencereview.com/index.php/PJSSR

PJSSR

Vol. 3 No. 2 (2025)

Causal Relationship Between Renewable Energy, Economic Growth, And Environment

Maria Ashraf	Government College University Faisalabad. mariaashraf887@gmail.com
Anam Shehzadi	Government College University Faisalabad. anamshehzadi@gcuf.edu.pk
Asia Naseem	Government College University Faisalabad. asianaseem@gcuf.edu.pk
Sadia Ali	Government College University Faisalabad. Corresponding Author Email: sadiaali@gcuf.edu.pk

Abstract

This study aimed to identify the causal relationship between renewable energy economic growth and the environment in developing countries. The current study investigates the causal relationship along with several variables, including Energy consumption (EC), Consumer price index (CPI), Gross domestic product (GDP), and CO_2 emissions. All the data on variables were collected from World Development Indicators (WDI) for the time period 1990-2021. Auto Regressive Distributed Lag (ARDL) and Granger causality test were applied in the study. Empirical results confirmed the presence of long-run cointegration between variables. Results showed that all coefficients are statistically significant, and their signs are according to economic theory. In both models, the long-run estimated outcomes of ARDL showed that energy consumption and gross domestic product (GDP), and Gross capital formation (GCF) have a significant and positive effect on renewable energy in developing countries. Further, the Consumer Price Index and CO_2 emissions harm renewable energy in developing countries. The Granger causality test showed evidence of bidirectional causality among dependent and independent variables. Based on the results, the study recommended some policies that developing countries should implement to increase the growth rate and generate more sustainable energy and focus on efficient policies to lower the pollution level in developing countries.

Keywords: Renewable Energy; Economic Growth, CO_2 Emissions, ARDL Method, Granger Causality Test

INTRODUCTION

For developing nations to achieve sustainable development, renewable energy potential is a crucial component. Renewable energy potential includes abundant natural resources such as sunlight (solar), wind, water (hydro & tidal), heat from the earth (geothermal) and biomass. Energy's constant demand has been strong in the earlier and is increasing today. The reasons for the high energy demand include population growth, improved lifestyles, increased production, and economic efficiency.

When fossil fuels are used too much, they release too much carbon dioxide (CO_2) into the air. This has bad effects on the environment, such as global warming. ecosystems in a variety of ways, including deforestation, decreasing water quality and availability, acidification of water bodies, and increased entrance of dangerous substances into the biosphere. Renewable energy sources, also known as alternative energy sources, are those features that may be employed to capture energy continuously. Some examples are solar energy, wind energy, biomass energy, and hydropower. (Rathore et al., 2007 & Panwar et al., 2011).

The development effecting of renewable energy projects can reduce migration to metropolitan regions by creating jobs in rural regions. (Bergmann et al 2008). To meet the dependable energy needs of low-population-density urban and rural areas in, an economical ecologically responsive way, one alternative is to harvest renewable energy in a distributed mode (Reddy & Subramanian 1979). To promote sustainable development, reduce energy poverty, and guarantee long-term economic growth, renewable energy is essential in developing nations. Limited access to electricity, dependence on imported fossil fuels, and rising energy demand linked to economic development are just a few of the major energy issues that many developing countries face (Ahmed & Shimada, 2019; Gul et al., 2020).

With significant effects on the economy, environment, and society, renewable energy sources provide essential sustainable solutions that directly support socioeconomic advancement and the accomplishment of the Sustainable Development Goals set forth by the UN (Aboul-Atta & Rashed, 2021; Parmar & Bhande, 2022; Rillero et al., 2020). Importantly, switching to renewable energy sources also helps to mitigate climate change by lowering CO_2 emissions, which enables developing nations to meet their expanding energy demands while also promoting environmental sustainability worldwide (Aduba et al., 2024; Dembicka-Niemiec & Szafranek, 2025). In the given background, the focus of current study is to identify the determinants of Renewable Energy potential in developing countries. And to find the relationship between Renewable energy potential and GDP growth and the environment in developing countries.

The Construction of current study is as follows; next section is about an overview of the review of the literature. Then in 3rd section material & methods are mentioned. Section 4th provides results and discussion, and the last section is about conclusion.

REVIEW OF THE LITERATURE

This section consists of a review of literature related to our study. Many research works have discussed the association between renewable energy potential in developing countries. Some of the related research studies are discussed in this chapter.

Gieraltowska et al (2022) analyzed the connection between development, renewable energy, and CO2 emissions. The data show that switching to renewable energy sources decreases carbon dioxide emissions. Shahbaz et al. (2021) analyzed the effect of economic growth on renewable energy usage in 34 developing nations from 1994 to 2015. They utilized a fully modified ordinary least squares (FMOLS) method to assess the impact of economic growth on renewable energy consumption. According to empirical results, economic expansion reduces renewable energy

POLICY JOURNAL OF SOCIAL SCIENCE REVIEW
HTTPS://JOURNALOFSOCIALSCIENCEREVIEW.COM/INDEX.PHP/PJSSR
Policy Journal of Social Science Review
ISSN (Online): 3006-4635
ISSN (Print): 3006-4627
https://journalofsocialsciencereview.com/index.php/PJSSR
Vol. 3 No. 2 (2025)

demand, while customer values had a statistically minor influence on renewable energy depletion.

Rillero et al. (2020) explored the relationship between Renewable and non-renewable energy consumption, financial progress, per capita income, and trade openness in China. The findings revealed that rising incomes and industrialization had a major impact on the spread of renewable energy in China. In contrast, non-renewable energy consumption benefited from trade liberalization while renewable energy use was harmed.

Eren et al (2019) investigated the influence of economic expansion and financial growth on India's use of renewable energy. According to the findings of the Ordinary Dynamic Least Square (DOLS) estimate, economic growth and financial development have positive, statistically significant long-term effects on the use of renewable energy. Adams et al. (2018) determined that both renewable and non-renewable energy sources support economic growth, while non-renewable sources contribute more heavily than renewable sources. The study's findings showed that democratic governments advance more swiftly than despotic one.

Kim et al, (2017) investigated risks association with renewable energy developments in unindustrialized nations were estimated, and the viability of such investments was evaluated. They estimated volatility and capture uncertainty, they used the key variable of renewable energy projects, particularly in developing nations.

Bhattacharya et al (2016) examined the effect of various countries' economic development on the use of renewable and non-renewable energy sources. They found renewable energy usage had a substantial beneficial influence on economic production. Long-run output elasticity was using time-series analysis. Apergis & Payne (2014) analyzed the causal relationship between renewable energy use and economic growth was broadened utilizing a panel for six Central American countries from 1980 to 2010. The findings of the panel error correction model demonstrated that there was a causal relationship between the use of renewable energy and both long-term and short-term economic growth (Batool et al., 2024; Liaqat et al., 2024; Ashfaq et al., 2024). Shahbaz et al. (2012) analysed the relationship between energy consumption (both renewable and non-renewable) and economic development. The findings show that both the use of renewable and non-renewable energy contributes to economic expansion. Labour and capital were also crucial factors in financial growth.

Apergis & Payne (2011) investigated the relationship between the use of renewable energy and economic growth was enlarged utilizing a panel for six Central American countries from 1980 to 2010. The results demonstrated the positive impact of energy consumption on carbon emissions.

Sadorsky (2009) estimated two empirical models of the consumption and revenue of renewable energy for a panel of developing economies Rising economic activity and energy demand gave emerging economies the chance to increase their usage of renewable energy.

Policy Journal of Social Science Review
ISSN (Online): 3006-4635
ISSN (Print): 3006-4627
https://journalofsocialsciencereview.com/index.php/PJSSR
Vol. 3 No. 2 (2025)

MATERIAL AND METHODS

The main objective of the quantitative approach is to make the hypothesis of the study, build a theoretical model, apply some statical tools for some results, and to make conclusions. This approach is very helpful in empirical analysis in developing countries.

DESCRIPTION OF DATA AND VARIABLES

The study consists of a panel data analysis to check the Renewable energy potential in developing countries. The research work uses secondary data for 20 developing countries from 1990 to 2021. The data on all variables is collected from World Development indicators (WDI).

TABLE 1: DEFINITION OF VARIABLES

Variables	Measurement
Renewable Energy (LogRE)	Consumption of renewable energy as a share of final energy consumption
Gross Domestic Product (LogGDP)	GDP per capita (constant 2015 US$)
Consumer Price Index (LogCPI)	Consumer price index (2010 = 100)
CO_2 Emission ($LogCO_2$)	CO_2 emissions (metric tons per capita)
Energy Consumption (LogEC)	Energy use (kg of oil equivalent per capita)

ECONOMETRIC METHODOLOGY AND MODEL DESCRIPTION

This section describes the specifics of the econometric model used for the current study. In the general model, Renewable energy is the function of gross domestic product, consumer price index, energy consumption, and CO_2 Emission. Which can be written as:

RE=f (GDP, CPI, EC, CO_2)

ECONOMETRIC MODEL

$$RE = \beta 0 + \beta 1 LogGDPit + \beta 2 LogCPIit + \beta 3 LogECit + \beta 4 LogCO_2it + \mu it \ (1)$$

here Log RE = Log of Renewable Energy, Log EC = Log of Energy Consumption, Log GDP = Log of Gross Domestic Product, Log CPI = Log of Consumer Price Index, Log CO_2 = Log of CO_2 Emission and μ = is the error term. Whereas β_0 is the intercept and β1, β2, β3, and β4, are the parameters of coefficients

PANEL UNIT ROOT TEST

Before applying an econometric technique, we must check the stationary of the panel data. Panel data has many estimation and implication problems as it contains cross segments and time sequences. Through the acceptance of the ARDL model, all variables do not have to have the same direction of integration 1(1). Numerous unit root tests are documented as the most common for panel data, several tests applied in this context used such as LLC Pesaran, & shin (2003) and augmented dickey fuller test, etc.

Policy Journal of Social Science Review
ISSN (Online): 3006-4635
ISSN (Print): 3006-4627
https://journalofsocialsciencereview.com/index.php/PJSSR
Vol. 3 No. 2 (2025)

MODEL OF AUTOREGRESSIVE DISTRIBUTED LAG (ARDL)

The next step is to pick a way to estimate the study goals. The results of the unit root significantly impact the choice of estimation method. The Auto Regressive Distributive Lag model (ARDL) is used when some of the study's variables are stationary at I (0) and the rest are stationary at (1) in panel data. Consequently, the unit root findings of the study indicate that the results of both the LLC and Fisher PP tests are inconclusive. Based on the unit root results, ARDL is used to find patterns in the long-term and short-term results of the models in this study. The ARDL method was suggested (Pesaran et al., 1999). The ARDL model is a widely utilized technique in econometrics. The ARDL model is popular because it looks at how different variables are related to each other in the long and short term. The following models will be used to figure out long-term estimates.

$$LogRE= d_0 + \sum^{m}_{i=1} d_1LogECP_{t-i} +\sum^{n}_{i=0} d_2LogGDP_{t-i} + \sum^{0}_{i=0} d_3LogCPI_{t-I} + \sum^{p}_{i=0} d_4LogCO_{2t-i} +\mu1_{t......} \quad (3)$$

In the same short run estimates of ARDL for these models are collected as.

$$\Delta LogRE= d_0 + \sum^{m}_{j=1} d_1\Delta LogECP_{t-J} +\sum^{n}_{j=0} d_2\Delta LogGDP_{t-j} + \sum^{0}_{j=0} d_3\Delta LogCPI_{t-j} + \sum^{p}_{j=0} d_4\Delta LogCO2_{t-j} +\pi ECM_t \; \mu_{1t......} \quad (4)$$

In the above equations 4, *i and j* are long short run elasticities and *Δ* first difference operator while π is the speed of adjustments if the negative sign converges to the long run dynamics. ECM is the error correction term.

GRANGER CAUSALITY TEST

It is simpler to identify the causation trend in panel data analysis when the sequence has a long-term relation. Dumitrescu and Hurlin (2012) proposed a Granger non-causality test to examine the causality path in heterogeneous tables.

RESULTS AND DISCUSSIONS

This section shows all the analysis and results. This study's main objective is to investigate the connections between developing economies' GDP potential and environmental conservation.

RESULTS OF DESCRIPTIVE AND CORRELATION ANALYSIS

Before estimating econometric findings, it is worthwhile reviewing the variables' descriptive statistics. In this regard, this subsection reports the study's descriptive and correlation results, consisting of the variables Mean, Median, Maximum, Minimum, Standard Deviation, and Skewness. Table 2 presents the estimated results of descriptive and correlation analysis. The result showed that all the variables have a positive meaning and, median. Maximum, minimum. On the other hand, the variables LogGDP, and CO_2 Emission have positive skewness, whereas LogRE, LogEC, and LogCPI have negative skewness in these developing countries. The result of the Jarque-Bera test showed that data of all variables is normally distributed and all variables have significant probability values.

TABLE 3: DESCRIPTIVE STATISTICS

	LOG_RENEW	LOG_EC	GDP_LOG	LOG_CPI	CO_2_EMISSION
Mean	3.681597	3.681597	7.564265	4.176678	1.283021
Median	3.965848	3.965848	7.489860	4.386464	0.788852

Policy Journal of Social Science Review
ISSN (Online): 3006-4635
ISSN (Print): 3006-4627
https://journalofsocialsciencereview.com/index.php/PJSSR
Vol. 3 No. 2 (2025)

Maximum	4.554294	4.554294	11.38978	9.695595	11.01890
Minimum	-0.509839	1.480119	4.931484	-5.474017	0.024992
Std. Dev.	0.917608	0.565932	0.979076	1.058783	1.600682
Skewness	-2.105651	-0.647954	2.282144	-2.257191	2.653735
Kurtosis	7.550703	2.706471	10.23390	18.49291	9.964774
Jarque-Bera	1070.024	49.14076	2036.342	7248.076	2134.185
Probability	0.000000	0.000000	0.000000	0.000000	0.000000
Sum	2459.307	2484.522	5052.929	2790.021	857.0580
Sum Sq. Dev.	561.6170	213.6264	639.3798	747.7215	1708.975
Observations	668	668	668	668	668

CORRELATION ANALYSIS

It is a statistical approach to measure the degree of strength among two variables. If there is a correlation between two variables, it means that one is changed due to change in other either positively or negatively.

TABLE 4: RESULTS OF CORRELATION RESULTS

Correlation Probability	Log RE	Log EC	LogGDP	Log $C0_2$	Log CPI	Log GCF
LogRE	1.000000					
Log EC	-0.676386	1.000000				
LogGDP	-0.329798	0.303984828	1.000000			
LogCO_2	-0.779109	0.7141356	0.655299645	1.000000		
LogCPI	-0.005837	0.225101331	0.177345892	0.13741511	1.000000	
Log GCF	0.074320	0.098287	0.160110	0.231754	-0.0532	1.000000

Furthermore Table 4 shows, the results of correlation analysis indicate that Renewable energy is positively correlated with Gross capital formation.

STATIONARITY RESULT

Generally, Secondary data is non-stationary and provide spurious results. To avoid these problems, unit root tests are applied. The present study used the Levin- Lin- Chu (LLC) and Im Pesaran and shin w-stat method to test the stationary of the data. In this section first check to stationarity of all variables at the level if they are non- stationery then takes the first difference (Higon, 2017).

TABLE 5: LLC TEST WITH DEMEAN

Variable	At Level				1St Difference			
	Without trend	P-value	With trend	P-value	Without trend	P-value	With trend	P- value
Log RE	1.66205	0.9517	-1.52719	0.0634	-12.000	0.0000	-9.76770	0.0000
Log GDP	0.87418	0.1910	-4.49885	0.3089	-5.4800	0.0000	-3.41422	0.0000

Policy Journal of Social Science Review
ISSN (Online): 3006-4635
ISSN (Print): 3006-4627
https://journalofsocialsciencereview.com/index.php/PJSSR
Vol. 3 No. 2 (2025)

Log EC	-1.65399	0.491	-2.44374	0.0073	-11.997	0.0000	-9.58785	0.0000
LogCO_2	-3.48285	0.0002	-3.72691	0.0001	-92180	0.0000	-6.55306	0.0000
Log CPI	-4.30438	0.0000	-0.68020	0.2482	-3.1117	0.0000	-1.50836	0.0657

Table 5 shows the t-statistics and p-values with both intercepts and with the trend and intercepts at a level as well as 1st difference for all the variables. The outcomes of the LLC test showed that variable Log CO_2 has a highly significant p-value at a level as well as 1st difference with both intercept and intercept and trend. In the same way, the p-values of the variable LogRE and LogGDP are insignificant at the level with the trend and intercept but it is highly significant at intercept as well as 1st difference with both intercept and intercept and trend at a 1% level of significance that is the indication of rejecting the null hypothesis and acceptance of alternative hypothesis hence, the null hypothesis is the data unit root.

TABLE 6: IPS TEST WITH DEMEAN

Variable	At Level				1St Difference			
	Without trend	P-value	With trend	P- value	Without trend	P-value	With trend	P-value
Log RE	4.12091	1.0000	-1.2089	0.1133	-13.2764	0.0000	-11.5623	0.0000
Log GDP	3.09029	0.9990	-1.6257	0.0520	-7.16633	0.0000	-4.38266	0.0000
Log EC	-1.63390	0.5472	-2.6915	0.0036	-13.5320	0.0000	-11.7773	0.0000
LogCO_2	-1.89730	0.0289	-3.0985	0.0010	-13.0110	0.0000	-11.0056	0,0000
Log CPI	-1.64719	0.0498	-0.0095	0.5038	-6.68702	0.0000	-5.67053	0.0000

This Table 6 shows the outcomes of Im Pesaran and shin w-stat test. The test provided some similar estimates to LLC test Log RE and Log GDP highly insignificant at level with the trend and intercept, but it is highly significant at intercept as well as 1st difference with both intercept and with intercept and trend. The results of table 6 above showed that all variables used in the current study are stationary at the level and first difference. The next stage is to determine the long period and short-term associations between variables. The ARDL model is used for this determination, and the results are shown in the tables below.

AUTOREGRESSIVE DISTRIBUTED LAG MODEL (ARDL)

ARDL approach provides a reliable and well-organized estimator, and it is used to eliminate the endogeneity problem by including lag length in both endogenous and exogenous variables. ARDL model applies to find out the long-run association amongst variables. The results of ARDL models are given in Table 7. The results show that all variables are significantly associated with Renewable energy. The calculated coefficient value for the variable EC is positive and highly significant, implying that a 1% rise in Energy Consumption (EC) will result in a 0.09% increase in Renewable Energy in the long run-in developing countries.

Policy Journal of Social Science Review
ISSN (Online): 3006-4635
ISSN (Print): 3006-4627
https://journalofsocialsciencereview.com/index.php/PJSSR
Vol. 3 No. 2 (2025)

TABLE7: LONG RUN RESULTS OF ARDL

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
LOG_EC	0.091404	0.024662	3.706183	0.0003
GDP_LOG	0.127432	0.016795	7.587303	0.0000
LOG_CPI	-0.094994	0.005367	-17.69985	0.0000
CO2_EMISSION	-0.458600	0.007513	-61.04085	0.0000

TABLE 8: SHORT RUN RESULT

COINTEQ (01)	**-0.326417**	**0.144035**	**-2.266230**	**0.0244**
D (LOG_RE (-1))	-0.079757	0.133432	-0.597733	0.5506
D(LOG_EC)	-0.554391	0.302337	-1.833685	0.0680
D(GDP_LOG)	0.608261	0.469203	1.296370	0.1962
D(LOG_CPI)	-0.294068	0.206631	-1.423155	0.1561
D(CO_2_EMISSION)	-0.204039	0.089193	-2.287599	0.0231
Constant term	0.868564	0.309533	2.806044	0.0055

With a 1% growth in Gross Domestic Product (GDP), there will be a 12.74% increase in renewable energy in the long run in the context of developing countries, according to the predicted value of the variable GDP, which is likewise positive and extremely significant. The finding is consistent with the study by Eren et al,(2019), Abbas et al.(2020), and Mohsin et al (2021), Shabaz et al, (2021), Shehzadi et al (2023). CPI has a negative coefficient value. In the long run, a 1% increase in the Consumer Price Index (CPI) will result in a 9.4% decline in Renewable Energy in developing countries. Coefficient CO_2 has a negative value. Mean that there is a 1% increase in CO_2 Emission there will be a decrease of 45% in Renewable energy in the Long Run-in developing countries.

Short run coefficient value -0.326417 tells us about convergence, it means how much Independent Variables (EC, GDP, CO_2 Emission, CPI) converge to the dependent variable (Renewable energy) and in how much time. This value should be negative and significant. Here the results show that independent variables are likely to converge to a dependent variable which is renewable energy a 32.64% in the short run-in developing countries. We need to investigate the root of the promise of renewable energy in developing nations. Whether the Granger Causality test passes a 5% cutoff determines whether the null hypothesis is accepted or rejected.

TABLE 9: RESULT OF GRANGER CAUSALITY TEST

Direction of Causality	Stat.	Prob.	Causality/ no causality
LogEC→ LogRE	8.68982	0.0002	Causality
LogRE→ LogGDP	0.02297	0.9773	No causality

Policy Journal of Social Science Review
ISSN (Online): 3006-4635
ISSN (Print): 3006-4627
https://journalofsocialsciencereview.com/index.php/PJSSR
Vol. 3 No. 2 (2025)

GDPLog→ Log RE	0.05325	0.9481	No casualty
Log RE→GDPLog	4.515223	0.0113	Causality
LogCPI→ LogRE	0.91636	0.4005	No casualty
LogRE→LogCPI	0.93899	0.3916	No causality
LogCo2EM→LogRE	9.36596	0.0001	Causality
LogRE→LogCO_2 EM	3.30948	0.0372	Causality
GDPLog→LogEC	0.48592	0.6154	No Causality
LogEC→ GDPLog	1.04538	0.3522	No Causality
LogCPI→LogEC	2.53477	0.0801	No Causality
LogEC→LogCPI	8.19071	0.0003	Causality
LogCO_2 EM →LogEC	0.11157	0.8944	No Causality
LogEC→LogCO_2 EM	7.99611	0.0004	Causality
LogCPI→GDPLog	6.13192	0.0023	Causality
GDPlog→LogCPI	1.28909	0.2763	No Causality
LogCO_2 →GDPLog	15.2259	0.0000	Causality
GDPLog→LogCo_2	19.4010	0.0000	Causality
LogCO_2 EM →LogCPI	3.73153	0.0245	Causality
LogCPI→LogCO_2 EM	17.9573	0.0000	Causality

The null hypothesis that there is no causality, in this case, is rejected if the test's probability is less than 5% and accepted if it is greater than 5%. This Table 9 summarizes all the results of the causality test for Renewable energy potential in the case of developing nations, and the study dated 1990- 2021. The table demonstrates that there is no causal link between EC Log of Energy Consumption and EC Log of Renewable Energy, but there is a one-way causal relationship between the two. Renewable energy (RE) and the GDP log have no causal relationship, although there is a one-way connection relationship between Log of Renewable Energy (RE) and Log of Gross Domestic Product (GDP).

The log of the Consumer price index (CPI) and Log of Renewable Energy (RE) have no causality. CO_2 Emission and Log of Renewable Energy (RE) have a two-way causality relationship. Log of Gross Domestic Product (GDP) and LOG of Energy Consumption (EC) have no causality. Energy consumption and the Consumer price index (CPI) have way causality relationship. CPI and GDP have a one-way causal relationship. CO_2 emissions and GDP have a two-way causal relationship with each other. Whereas CO_2 emission and CPI has also two-way causality relationship.

CONCLUSION

The current analysis uses panel data from 1990 to 2021 to identify the factors of renewable energy potential in unindustrialized nations. In this regard 20 developing nations are selected for panel data analysis. In the empirical analysis of the study, renewable energy is used as a dependent variable whereas; independent variables are used such as gross domestic product,

POLICY JOURNAL OF SOCIAL SCIENCE REVIEW
HTTPS://JOURNALOFSOCIALSCIENCEREVIEW.COM/INDEX.PHP/PJSSR
Policy Journal of Social Science Review
ISSN (Online): 3006-4635
ISSN (Print): 3006-4627
https://journalofsocialsciencereview.com/index.php/PJSSR
PJSSR
Vol. 3 No. 2 (2025)

consumer price index, carbon dioxide emission, energy consumption, and gross capital formation. All information is gathered from the World Development Indicator (WDI).
Respectively to check the stationary of data LLC and IPS unit root tests are used for both models. For the empirical estimation of the main objectives in this study, the ARDL estimation technique is applied. Also, finally applied the D-H Granger Causality test is used for the estimation of this objective. The stationary results were then calculated for both sets of emerging countries using the LLC and IPS unit root tests. Overall estimated outcomes of both tests provided mixed results of stationery for two groups.
Overall results of ARDL showed that all variables have a significant association with renewable energy. However, apart from CPI, CO_2 the impact of reaming variables is negative on renewable energy in developing countries. The short run coefficient value was found to be negative as well as highly significant, which implies that short run cointegration exists in developing countries. Finally, the results of D-H granger causality tests showed the bidirectional causality or no causality between several variables such as RE, GDP, EC, CO_2, and CPI variables.
Based on the findings, some policymakers recommended that developing countries source their energy needs from renewable sources. If developing countries use available renewable resources with proper planning and implementation, they could have surplus energy to supply and permanently overcome the energy crisis. Future researchers can build on our work by offering a suitable road map for the use of renewable energy sources in developing countries to alleviate the problem of electricity shortages in all developing countries.

REFERENCES

Abbas, Q., Khan, A. R., Bashir, A., Alemzero, D. A., Sun, H., Iram, R., & Iqbal, N. (2020). Scaling up renewable energy in Africa: measuring wind energy through econometric approach. *Environmental Science and Pollution Research*, *27*(29), 36282-36294.

Aboul-Atta, T. A., & Rashed, R. H.. *Analyzing the relationship between sustainable development indicators and renewable energy consumption*

Adams, S., Klobodu, E. K. M., & Apio, A. (2018). Renewable and non-renewable energy, regime type and economic growth. *Renewable Energy*, *125*, 755-767.

Ahmed, M., & Shimada, K.. *The Effect of Renewable Energy Consumption on Sustainable Economic Development: Evidence from Emerging and Developing Economies*.

Apergis, N., & Payne, J. E. (2011). The renewable energy consumption–growth nexus in Central America. *Applied Energy*, *88*(1), 343-347.

Apergis, N., & Payne, J. E. (2014). Renewable energy, output, CO2 emissions, and fossil fuel prices in Central America: Evidence from a nonlinear panel smooth transition vector error correction model. *Energy economics*, *42*, 226-232.

Ashfaq, M. H., Ali, S., Anam Shehzadi, Q. A., & Shaukat, M. U. (2024) Health Cost and Socioeconomic Status of Drainage Channel Dwellers in Faisalabad, Pakistan. *Journal of Sustainable and Economic Development, 2(2),* 91-98.

Bergmann, A., Colombo, S., & Hanley, N. (2008). Rural versus urban preferences for renewable energy developments. Ecological economics, 65(3), 616-625.

Bhattacharya, M., Paramati, S. R., Ozturk, I., & Bhattacharya, S. (2016). The effect of renewable energy consumption on economic growth: Evidence from top 38 countries. *Applied Energy*, *162*, 733-741.

Btool, Z., Riaz, M. F., Ali, S., & Shehzadi, A. (2024). Estimating The Effect of Macroeconomic Volatility on Different Types of FDI. *Journal of Contemporary Macroeconomic Issues*, *5*, 142-157.

Eren, B. M., Taspinar, N., & Gokmenoglu, K. K. (2019). The impact of financial development and economic growth on renewable energy consumption: Empirical analysis of India. *Science of the Total Environment*, *663*, 189-197.

Gierałtowska, U., Asyngier, R., Nakonieczny, J., & Salahodjaev, R. (2022). Renewable Energy, Urbanization, and CO2 Emissions: A Global Test. *Energies*, *15*(9), 3390.

Gul, I. A., Kayakutlu, G., & Kayalıca, M. O.. *Risk Analysis in Renewable Energy System Investment for a Developing Country: A Case Study in Pakistan*.

Im, K.S., Pesaran, M.H., Shin, Y., 2003. Testing for unit roots in heterogeneous panels. Journal of Econometrics 115, 53–74.

Kim, K., Park, H., & Kim, H. (2017). Real options analysis for renewable energy investment decisions in developing countries. *Renewable and Sustainable Energy Reviews*, *75*, 918-926.

Liaqat, M., Qaiser, I., & Shehzadi, A. (2024). Brain Drain, Key Factors Determining Student's Return Intention from Abroad: Evidence from Pakistan. *Forman Journal of Economic Studies*, *20*(02), 33-53.

Mohsin, M., Kamran, H. W., Nawaz, M. A., Hussain, M. S., & Dahri, A. S. (2021). Assessing the impact of transition from nonrenewable to renewable energy consumption on economic growth-environmental nexus from developing Asian economies. *Journal of environmental management*, *284*, 111999.

Panwar, N. L., Kaushik, S. C., & Kothari, S. (2011). Role of renewable energy sources in environmental protection: A review. Renewable and sustainable energy reviews, 15(3), 1513-1524.

Parmar, K., & Bhande, R.. *Future of Nanotechnology in Solar Energy and Hydrogen Energy*.

Pesaran, M. H., Shin, Y., & Smith, R. P. (1999). Pooled mean group estimation of dynamic heterogeneous panels. Journal of the American Statistical Association, 94(446), 621-634.

Rathore, N. S., & Panwar, N. L. (2007). Renewable energy sources for sustainable development. New India Publishing.

Reddy, A. K. N., & Subramanian, D. K. (1979, September). The design of rural energy centers. In Proceedings of the Indian Academy of Sciences (Vol. 2, No. 3, pp. 395-416). Springer India.

Rillero, P., Koerner, A., Daragmeh, A. K., et al.. *Active Learning Methodologies in a Solar Power, Middle-Grade Curriculum for Palestinian Schools*.

Rillero, P., Koerner, A., Daragmeh, A. K., et al.. *Active Learning Methodologies in a Solar Power, Middle-Grade Curriculum for Palestinian Schools*.

Sadorsky, P. (2009). Renewable energy consumption and income in emerging economies. *Energy policy*, *37*(10), 4021-4028.

Sadorsky, P. (2009). Renewable energy consumption, CO2 emissions, and oil prices in the G7 countries. *Energy Economics*, *31*(3), 456-462.

Shahbaz, M., Raghutla, C., Chittedi, K. R., Jiao, Z., & Vo, X. V. (2020). The effect of renewable energy consumption on economic growth: Evidence from the renewable energy country attractive index. *Energy*, *207*, 118162.

Shahbaz, M., Topcu, B. A., Sarıgül, S. S., & Vo, X. V. (2021). The effect of financial development on renewable energy demand: The case of developing countries. *Renewable Energy*, *178*, 1370-1380.

Shahbaz, M., Zeshan, M., & Afza, T. (2012). Is energy consumption effective to spur economic growth in Pakistan? New evidence from bounds test to level relationships and Granger causality tests. *Economic Modelling*, *29*(6), 2310-2319.

Shehzadi, A. (2023). Energy efficiency and productivity in emerging and developing Asian countries: A firm level analysis. *Journal of Asian Economics*, *88*(C).