The Impact of Non-Renewable Energy Consumption on Carbon Emissions in Algeria: An Econometric Analysis for the Period (2000- 2024)

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Abstract:

This study examines the impact of oil consumption on CO_2 emissions in Algeria during 2000–2024. The ARDL model is employed to assess the short-run and long-run relationships between the variables. The ADF test confirms that the variables are integrated of order one, I(1). The Bounds Test establishes the existence of a long-run equilibrium Relationships.

The results show that oil consumption positively and significantly affects CO_2 emissions. This positive effect is significant in both the short run and the long run. The negative and significant error correction term confirms adjustment toward equilibrium. These findings are consistent with economic and environmental theories on fossil fuel consumption. They highlight the environmental consequences of Algeria's reliance on non-renewable energy. The study recommends renewable energy development and greater energy efficiency to reduce emissions.

Keywords: Oil Consumption; CO2 Emissions; ARDL Model; Algeria; Non-renewable Energy; Environmental Economics.

Jel Classification Codes: Q43; Q53; C32 ; O13.

1. INTRODUCTION

In recent decades, environmental issues have gained increasing prominence in economic debates and policymaking, particularly in light of the growing challenges posed by climate change and global warming. Carbon dioxide (CO2) emissions are among the primary drivers of environmental degradation, as they directly contribute to the accumulation of greenhouse gases in the atmosphere. These emissions are closely associated with the intensive use of fossil fuel-based energy sources, including oil, natural gas, and coal, which continue to constitute the primary source of energy in most economies worldwide. Against this backdrop, understanding the relationship between energy consumption and environmental quality has become a central focus of both theoretical and empirical research, given its direct implications for sustainable development pathways and environmental policymaking, particularly in the context of the global commitment to reducing carbon emissions and accelerating the transition towards sustainable energy systems.

Algeria is among the resource-dependent economies, with its economic performance and public finances relying heavily on non-renewable energy resources, particularly oil and natural gas. The continued predominance of fossil fuels in Algeria's energy mix raises concerns about the environmental consequences of energy consumption. mainly due to the growing domestic consumption of energy and the rising demand for energy across various economic activities. Moreover, Algeria's energy sector remains heavily dependent on fossil fuels, making it more vulnerable to environmental challenges associated with high carbon intensity, particularly given the limited use of clean and renewable energy sources.

The study focuses specifically on Algeria and on the relationship between non-renewable energy consumption and co_2 emissions. This country-specific relevant given Algeria's dependence on hydrocarbon-based energy and the continuing importance of fossil fuels in its domestic energy structure. By examining the relationship over the 2000-2024 period, the study seeks to provide empirical evidence on the extent to which non-renewable energy consumption in associated with environmental pressures in Algeria.

Research Problem:

The central problem of this study can be formulated as follows:

To what extent does the consumption of non-renewable energy resources affect carbon emissions in Algeria over the period (2000-2024)?

The main research problem can be broken down into the following sub-questions:

- Is there a long-run equilibrium relationship between the consumption of non-renewable energy resources and carbon emissions in Algeria over the period (2000-2024)?
- What is the impact of non-renewable energy consumption on carbon emissions in both the short and long run?

Hypotheses:

Main hypothesis: Non-renewable energy consumption affects carbon emissions in Algeria positively and in a statistically significant manner over the period (2000-2024).

I. First Sub-Hypothesis: There is a statistically significant long-run equilibrium relationship between non-renewable energy resource consumption and carbon emissions in Algeria over the period (2000-2024).

II. Second Sub-Hypothesis: Non-renewable energy resource consumption exerts a positive and statistically significant impact on carbon emissions in both the short and long run.

1.Literature Review:

1.1.(maysa & ahmed, 2022)

This study aims to examine the impact of renewable energy consumption on both economic growth and carbon dioxide (CO2) emissions in a sample of Arab countries over the period (1990-2018). It also seeks to analyze the nature of the relationship between these variables by highlighting the role of renewable energy in supporting economic growth and contributing to the reduction of environmental pollution, particularly in the context of the growing emphasis on sustainable development.

The study adopts a descriptive approach to analyze the state of renewable energy in Arab countries, along with an econometric approach based on panel data.

A panel autoregressive distributed lag (Panel-ARDL) model was applied, with the use of both MG and PMG estimation methods. The PMG model was selected as the most appropriate based on the Hausman test.

The study also relies on data from the World Bank and the International Renewable Energy Agency, incorporating a set of economic variables such as gross domestic product, renewable energy consumption, capital, labor, and trade openness.

The results show a positive and statistically significant relationship between renewable energy consumption and economic growth in the long run, indicating that the expansion of renewable energy use contributes to the enhancement of economic activity.

The study also finds a negative and statistically significant relationship between renewable energy consumption and carbon dioxide emissions, reflecting its effective role in reducing environmental pollution.

In addition, the results indicate that the impact of renewable energy is more pronounced in the long run compared to the short run. The findings also show that capital, labor, and trade openness all have a positive effect on economic growth.

1.2.(imen & ali, 2024)

This study aims to analyze the pattern of energy consumption in Algeria over the period (2000-2022), with particular emphasis on examining the impact of renewable energy consumption on carbon dioxide (CO2) emissions.

It also seeks to examine the relationship between renewable and conventional energy consumption and their implications for environmental pollution, with the aim of assessing the role of the energy transition in improving environmental conditions in Algeria.

The study adopts two main approaches. A descriptive approach is used to present the theoretical framework on renewable energy, conventional energy, and carbon emissions, while an econometric approach is employed to examine the relationship between the study variables.

A VAR model was applied to annual data for the period (2000-2022), with carbon dioxide (CO_2) emissions as the dependent variable and renewable and conventional energy consumption as the explanatory variables. The analysis included unit root, cointegration, and impulse response tests.

The findings show that renewable energy consumption reduces carbon dioxide (CO_2) emissions, while conventional energy consumption increases them. The results also support the promotion of clean energy use in Algeria.

1.3.(amayeia & khadidja, 2025)

This study aims to analyze the relationship between renewable energy consumption, economic growth, and carbon dioxide (CO_2) emissions using a sample of 50 developing countries, including Arab and African countries as well as BRICS economies, over the period (1990-2020). It also seeks to examine the causal relationship among these variables and determine whether renewable energy use contributes to reducing carbon emissions and achieving sustainable development.

The study uses a descriptive-analytical approach and econometric framework based on panel data for 50 countries over (1990-2020). It applies a Panel VAR model and fixed effects model using EViews 12 to examine the relationships between renewable and non-renewable energy consumption, economic growth, and carbon emissions.

The study finds that renewable energy consumption has a negative impact on carbon emissions in the current period, indicating its role in reducing environmental pollution, while past values of renewable energy consumption show a positive effect on emissions.

The study finds a positive relationship between GDP (economic growth) and carbon emissions, indicating that higher growth is associated with increased pollution. It also confirms a positive relationship between non-renewable energy consumption and emissions, highlighting the need to shift toward clean energy for sustainable development.

1.4. (Mustafa Emir Yucel, 2025)

This study examined the impact of energy consumption on carbon dioxide CO_2 emissions in turkey over the period 1974-2023. The study investigated the relationship between per capita CO_2 emissions, economic growth, renewable energy consumption, and fossil fuel consumption using the

autoregressive distributed lag (ARDL) model and bounds testing approach. The authors employed several unit root tests, including ADF, PP, and KPSS, and analysed both the short-run and long-run relationships among the variables. The empirical findings revealed that fossil fuel consumption has a positive and statistically significant effect on CO_2 emissions the long run, indicating that greater dependence on fossil energy contributes to environmental degradation. In contrast, renewable energy consumption was found to reduce CO_2 emissions in both the short and long run. The results also showed that economic growth increases CO2 emissions in the short run. Furthermore, the negative and statistically significant error correction term confirmed the existence of a long-run equilibrium relationship among the variables. The study concluded that the composition of energy consumption plays an important role in determining environmental quality in turkey and highlighted the importance of shifting toward cleaner energy sources.

Existing studies have largely examined the renewable energy-environment nexus, while comparatively less attention has been given to the specific role of domestic oil consumption in explaining CO_2 emissions in Algeria, particularly over recent periods.

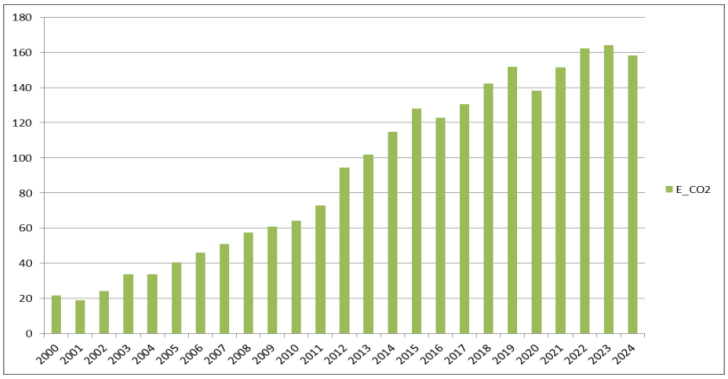
against this background, the present study focuses specifically on the relationship between domestic oil consumption and CO_2 emissions in Algeria over the period 2000-2024. Unlike studies that primarily consider renewable energy or cross-country panel data, this research examines the Algerian case using a time-series ARDL framework, allowing the short-run and long-run dynamics between oil consumption and carbon emissions to be assessed.

2. Analysis of the Evolution of the Study variables

2.1 Carbon dioxide (CO_2) emissions in Algeria over the period (2000–2024)

This is show in the following figure.

Figure (01): Evolution of carbon dioxide (co_2) Emissions in Algeria over the period (2000-2024) (Million Tons)



Source: (bank, 2025)

Carbon dioxide (CO2) emissions in Algeria exhibited a marked upward trend over the period 2000-2024, rising from 21.86 million tons in 2000 to approximately 158.25 million tons in 2024. This increase reflects mounting environmental pressures resulting from the continued dependence on fossil fuels as the primary source of energy. Between 2000 and 2008, emissions grew steadily, largely driven by economic expansion and rising energy demand, particularly in the transport and industrial sectors.

Between 2009 and 2014, the growth in carbon emissions accelerated noticeably, exceeding 100 million tons from 2013 onward. This trend reflects the expansion of energy consumption and the limited availability of clean energy alternatives. Temporary declines were observed, particularly in 2016, when carbon emissions fell compared with 2015. This decrease is attributed to slower economic activity and lower global oil prices.

And a noticeable decline occurred in 2020 as a result of the COVID-19 pandemic, which reduced industrial output and transport activity, leading to lower energy demand. However, this drop was temporary, as emissions increased again from 2021 onward, reaching a peak in 2023 (164.10), before slightly declining in 2024. This goes against efforts toward reducing emissions.

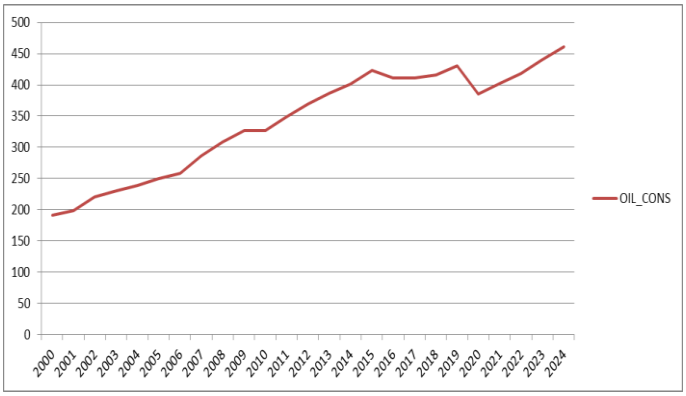
This persistent upward trend in carbon emissions in Algeria reflects the

vulnerability of an energy model heavily reliant on fossil fuels and highlights the urgent need to adopt effective environmental policies aimed at promoting renewable energy use and improving energy efficiency in order to reduce pollution and achieve sustainable development.

2.2 Oil consumption in Algeria over the period (2000-2024)

Figure (02): oil consumption in Algeria over the Period (2000-2024)

(Thousand barrels/day)



Source : (Institute, 2024)

3. Econometric and Economic Model

This section aims to analyse the econometric and economic impact of non-renewable energy consumption on carbon emissions in Algeria over the period (2000-2024), using modern econometric tools that allow for examining dynamic relationships between variables in both the short and long run. It also seeks to interpret the statistical results within an economic framework, taking into account the specific structure of energy consumption in the Algerian economy, which is heavily dependent on fossil fuels, and its implications for carbon emissions levels and environmental balance.

3.1 Study Variables:

The study variables were selected in line with the research objective of examining the impact of non-renewable energy consumption on carbon emissions in Algeria over the period (2000-2024). Carbon dioxide (CO_2) emissions were used as the dependent variable to represent the level of environmental pollution, while oil consumption (OIL_CONS) was employed as the independent variable, serving as a proxy for non-renewable

energy consumption, given its role as one of the primary sources of carbon emissions.

$$E_CO_{2t} = \beta_0 + \beta_1 OIL_CONS_t + \varepsilon$$

Symbol	Meaning
E_CO_2	Carbon emissions
OIL_CONS	Oil consumption
t	Time
ε	Error term

The study data were collected from reliable international statistical sources, specifically the Energy Institute through the Statistical Review of World Energy (2024 and 2025 editions), which provides detailed information on energy consumption, particularly oil as a major non-renewable energy source.

The study also uses data from the World Bank, especially the World Development Indicators (WDI), to obtain information on carbon emissions and other economic variables. These data were taken from the official reports and websites of these institutions due to their reliability and wide use in economic research

The data were processed using EViews 13. The following table presents the study data.

Table (01) : Study Variables

Years	OIL_CONS	E_CO2
2000	191	21.86699261
2001	198	18.93517036
2002	221	24.29022213
2003	230	33.73951461
2004	239	33.90539621
2005	250	40.5215362
2006	258	46.20848976
2007	286	50.93715485

2008	309	57.57893234
2009	327	60.87757882
2010	327	64.38049388
2011	349	72.95409223
2012	370	94.38760309
2013	387	101.9523309
2014	401	114.8464729
2015	423	128.074734
2016	411	122.7633353
2017	411	130.48854
2018	416	142.2471483
2019	431	151.783054
2020	385	138.2909344
2021	403	151.2773715
2022	418	162.1796871
2023	440	164.1059647
2024	461	158.2575641

Source: (Institute, Statistical Review of World Energy 2025, 2025)

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3.2 Stationarity test:

Prior to estimating the econometric models, testing the stationarity of the time series is essential to avoid spurious regression results that may occur even in the absence of a genuine relationship between variables. For this purpose, the Augmented Dickey-Fuller (ADF) unit root test is applied under the following hypotheses:

- H0: The series contains a unit root, i.e., it is non-stationary.
- H1: The series does not contain a unit root, i.e., it is stationary.

Table (02) : Results of the augmented Dickey-Fuller (ADF) tests for the study variables

Variable	At level			At first difference			Integration order
	With intercept	With intercept and trend	Without intercept and trend	With intercept	With intercept and trend	Without intercept and trend	
OIL_CONS	0.6664	0.7976	0.9988	0.0011	0.0044	0.0024	I(1)
E_CO_2	0.9795	0.6521	0.9990	0.0001	0.0004	0.0001	I(1)

Source: Authors' own calculations using EViews 13.

The ADF test results show that both variables (E_CO_2 and OIL_CONS) are non-stationary at their levels, as the p-value are above 0.05. after taking the first difference, both variables become stationary, with p-value below appropriate for analyzing their relationship.

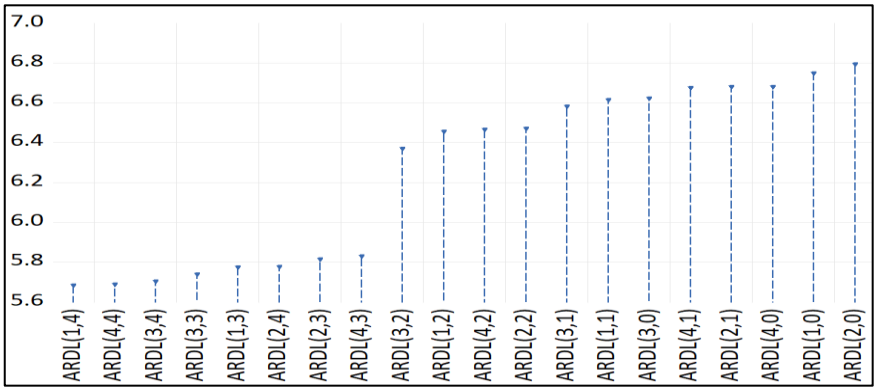
3.3 Model specification

After identifying the variables included in the model, collecting the relevant data, and testing the stationarity of each variable separately, the Autoregressive Distributed Lag (ARDL) approach will be employed

- **Lag length selection**

The optimal lag lengths for the ARDL model were determined using the Akaike Information Criterion (AIC), which is the most widely used criterion for model selection based on the minimum value. The selected specification is ARDL (1, 4), with an AIC value of 5.682475, as shown in the following figure.

Figure (03): optimal Lag length selection test



Source: Authors' own calculations using EViews 13.

- **Bounds test results**

To verify the existence of a long-run equilibrium relationship among the variables included in the model, the ARDL bounds testing approach to cointegration is applied under the following hypotheses

Null hypothesis: there is no long-run equilibrium raltionship among the study variables.

- $\boldsymbol{H_0: \partial_0 = \partial_1 = \partial_2 = \partial_3 = 0}$

Alternative hypothesis: There is long-run equilibrium relationship among the variables in the model..

- $\boldsymbol{H_1: \partial_0 \neq \partial_1 \neq \partial_2 \neq \partial_3 \neq 0}$

To determine whether a long-run equilibrium relationship exists among the study variables, the calculated F-statistic is compared with the critical values provided bay naryan (2005). (Lamia & Azzou, 2017, pp. 134-135)

Table (03) : Results of the bounds test for cointegration

Number of Cointegrating Variables			Trend Type				Sample Size	F-statistic
2			Restricted Constant (Case 2)				21	11.285706
Significance Level	**I(0)**	**I(1)**	**I(0)**	**I(1)**	**I(0)**	**I(1)**		
	*10%		*5%		*1%			
Sample Size = 30	3.303	3.797	4.090	4.663	6.027	6.760		
Asymptotic	3.020	3.510	3.620	4.160	4.940	5.580		

Source: Authors' own calculations using EViews 13.

The ARDL bounds test indicates a long-run relationship between the variables, as the F-statistic (11.28) exceeds the upper critical bound at the 1% significance level (6.760). Therefore, the null hypothesis is rejected, confirming a long-run equilibrium relationship between oil consumption and carbon emissions in Algeria.

3.4 Estimation of the carbon emissions function in Algeria using the ARDL Model

This section presents the estimation of the cointegrating relationship using the ARDL approach, along with the econometric diagnostic tests to ensure the validity of the model.

- **Cointegrating regression**

The results of the cointegrating regression show that the F-statistic is statistically significant (p=0.000000). In addition, the coefficient (0.995433) indicates that the independent variables (X) explain 99.54% of the variation in carbon emissions (Y) in Algeria, while the remaining variation is attributed to variables not included in the model, as shown in the following table.

Table (04): Cointegrating regression estimation using the ARDL Model

Dependent Variable: E_CO2				
Method: ARDL				
Date: 03/29/26 Time: 16:02				
Sample: 2004 2024				
Included observations: 21				
Dependent lags: 4 (Automatic)				
Automatic-lag linear regressors (4 max. lags): OIL_CONS				
Deterministics: Restricted constant and no trend (Case 2)				
Model selection method: Akaike info criterion (AIC)				
Number of models evaluated: 20				
Selected model: ARDL(1,4)				
Variable	Coefficient	Std. Error	t-Statistic	Prob.*
E_CO2(-1)	0.570080	0.087047	6.549073	0.0000
OIL_CONS	0.294715	0.052829	5.578632	0.0001
OIL_CONS(-1)	-0.300568	0.075254	-3.994069	0.0013
OIL_CONS(-2)	-0.051499	0.071557	-0.719699	0.4836
OIL_CONS(-3)	0.187506	0.070090	2.675204	0.0181
OIL_CONS(-4)	0.120798	0.071473	1.690127	0.1131
C	-37.21963	9.453171	-3.937264	0.0015
R-squared	0.995433	Mean dependent var		104.1914
Adjusted R-squared	0.993475	S.D. dependent var		45.05088
S.E. of regression	3.638960	Akaike info criterion		5.682475
Sum squared resid	185.3885	Schwarz criterion		6.030649
Log likelihood	-52.66598	Hannan-Quinn criter.		5.758037
F-statistic	508.5605	Durbin-Watson stat		2.040460
Prob(F-statistic)	0.000000			
*Note: p-values and any subsequent test results do not account for model selection.				

Source: Authors' own calculations using EViews 13.

3.5 Model Diagnostic Tests

Several diagnostic tests are conducted to assess the quality of the estimated model and ensure that it is free from econometric problems. The following tests are performed:

- **Heteroskedasticity Test**

The Breusch-Pagan-Godfrey test is used to detect heteroskedasticity. The results are presented in the following table:

Table (05): results of the autocorrelation test of the error terms

Heteroskedasticity Test: Breusch-Pagan-Godfrey			
Null hypothesis: Homoskedasticity			
F-statistic	1.027847	Prob. F(6,14)	0.4474
Obs*R-squared	6.421788	Prob. Chi-Square(6)	0.3776
Scaled explained SS	2.854162	Prob. Chi-Square(6)	0.8269

Source: Authors' own calculations using EViews 13.

The Breusch-Pagan-Godfrey test was used to examine the presence of heteroskedasticity in the study model.

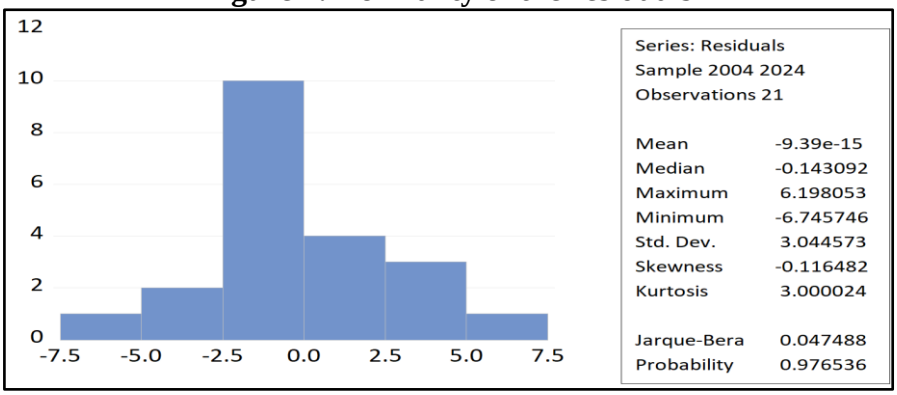
The results indicate that the p-values of both the F-statistic and the Chi-Square statistic exceed the 5% significance level, reaching 0.4474 and 0.3776, respectively.

Therefore, the null hypothesis cannot be rejected, indicating that the model does not suffer from heteroskedasticity and that the error variance is constant. These results support the reliability of the estimated model.

- **Normality test of the residuals:**

The Jarque-Bera (J-B) test was performed to assess the normality of the residuals. The test yielded a Jarque-Bera statistic of 0.742156 and a p-value of 0.689990, which is greater than the 5% significance level. Therefore, the null hypothesis of normality cannot be rejected, indicating that the residuals are normally distributed and that the normality assumption is satisfied, as illustrated in Figure 4.

Figure 4: Normality of the residuals

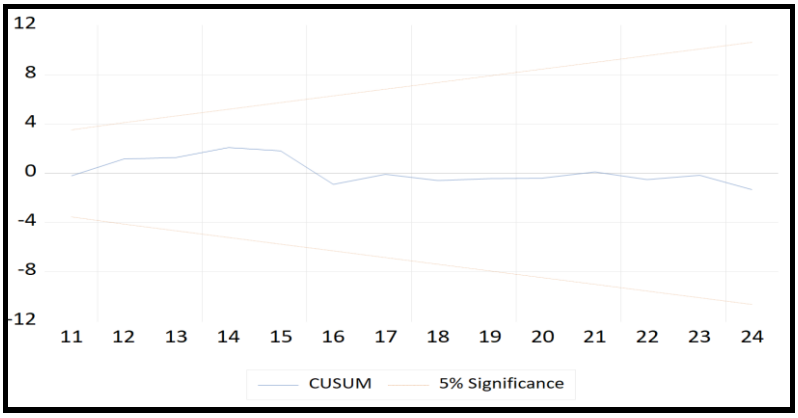


Source: Authors' own calculations using EViews 13.

- **structural stability test of the model**:

To examine the structural stability of the estimated parameters in both the short-run and long-run relationships within the ARDL framework, the CUSUM (Cumulative Sum of Recursive Residuals) test was applied. If the plotted CUSUM statistic remains within the 5% significance bounds, the null hypothesis of parameter stability cannot be rejected, indicating that all estimated coefficients are stable. The following figure presents the results of the test.

Figure 5: Cumulative Sun of Recursive Residuals (CUSUM)



Source: Authors' own calculations using EViews 13.

3.6 Estimation of Short-Run and Long-Run coefficients and the Error Correction Term Using the ARDL Model

After confirming the existence of a long-run Relationship using the bounds test, the error correction term in the short-run ARDL model should be negative and statistically significant, indicating convergence toward the long-run equilibruim. (Hussein, 2020)

- **Short -Run Relationship and Error Correction Term**

The results presented in the table indicate the existence of short-run dynamics among the variables. The estimated error correction term, CointEq(-1) = -0.429920, is negative and statistically significant (p = 0.0000 < 0.05). This coefficient represents the speed of adjustment toward the long-run equilibrium, indicating that approximately 42.99% of the previous period's disequilibrium is corrected in the current period.

The following table illustrates this:

Table 7: Estimation of the Error Correction Model

Dependent Variable: D(E_CO2)				
Method: ARDL				
Date: 03/29/26 Time: 16:02				
Sample: 2004 2024				
Included observations: 21				
Dependent lags: 4 (Automatic)				
Automatic-lag linear regressors (4 max. lags): OIL_CONS				
Deterministics: Restricted constant and no trend (Case 2)				
Model selection method: Akaike info criterion (AIC)				
Number of models evaluated: 20				
Selected model: ARDL(1,4)				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
COINTEQ*	-0.429920	0.069114	-6.220438	0.0000
D(OIL_CONS)	0.294715	0.044219	6.664935	0.0000
D(OIL_CONS(-1))	-0.256805	0.053318	-4.816504	0.0002
D(OIL_CONS(-2))	-0.308305	0.059144	-5.212779	0.0001
D(OIL_CONS(-3))	-0.120798	0.064445	-1.874457	0.0792
R-squared	0.843338	Mean dependent var		5.929431
Adjusted R-squared	0.804173	S.D. dependent var		7.692096

S.E. of regression	3.403936	Akaike info criterion	5.491999
Sum squared resid	185.3885	Schwarz criterion	5.740694
Log likelihood	-52.66598	Hannan-Quinn criter.	5.545972
F-statistic	21.53269	Durbin-Watson stat	2.040460
Prob(F-statistic)	0.000003		
* p-values are incompatible with t-Bounds distribution.			

Source: authors' own calculations using EViews 13.

- **Long-Run Coefficients Estimation**: The long-run relationship can be represented by the following specification, derived from the results reported in the table below.

Table 8: Estimation of the Long-Run Coefficients

Deterministics: Rest. constant (Case 2)				
CE = E_CO2(-1) - (0.583719*OIL_CONS(-1) - 86.573339)				
Variable *	Coefficient	Std. Error	t-Statistic	Prob.
OIL_CONS(-1)	0.583719	0.030336	19.24164	0.0000
C	-86.57334	12.30370	-7.036367	0.0000
Note: * Coefficients derived from the CEC regression.				

Source: Authors' own calculations using EViews 13.

The long-run estimation results using the ARDL model indicate a statistically significant impact of oil consumption on carbon emissions in Algeria. The findings show that the coefficient of oil consumption is 0.583719 with a p-value of 0.0000. This result is consistent with both economic literature and environmental theory, which suggest that reliance on fossil fuel energy sources contributes to the deterioration of environmental quality, particularly in rent-dependent economies such as Algeria.

4. CONCLUSION

This study examined the impact of fossil energy consumption on carbon dioxide emissions in Algeria over the period 2000–2024. Using the Autoregressive Distributed Lag (ARDL) approach, the analysis yielded several key findings, which can be summarized as follows :

- The empirical results reveal a strong positive relationship between oil consumption and carbon dioxide (CO_2) emissions, indicating that

greater reliance on fossil energy is associated with higher levels of environmental pollution. This finding provides empirical support for the main hypothesis of the study, which posits that fossil energy consumption exerts a positive and statistically significant effect on carbon emissions.

- The results of the bounds test provide evidence of a long-run equilibrium relationship between oil consumption and carbon dioxide emissions, indicating that the two variables are linked by a stable long-term relationship. Accordingly, the findings provide support for the first sub-hypothesis of the study.
- The ARDL model results indicate that oil consumption has a positive and statistically significant effect on carbon dioxide emissions in both the short and long run. Furthermore, the error correction term is negative and statistically significant, providing evidence of a systematic adjustment process through which deviations from the long-run equilibrium are corrected over time. These findings provide empirical support for the second sub-hypothesis of the study.
- The study further reveals an overall upward trend in carbon dioxide emissions in Algeria over the long term, although this trajectory has been accompanied by some fluctuations associated with changes in economic activity, particularly the decline in economic activity during the COVID-19 pandemic. This pattern provides further evidence of the close relationship between economic activity and fossil energy consumption.
- In light of these findings, Algeria's continued reliance on fossil fuel-based energy contributes to the growth of carbon dioxide emissions. This finding underscores the importance of promoting a gradual transition toward renewable energy sources and enhancing energy efficiency as key components of a sustainable development strategy.

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