International Journal of Social Science and Human Research

ISSN (print): 2644-0679, ISSN (online): 2644-0695

Volume 08 Issue 04 April 2025

DOI: 10.47191/ijsshr/v8-i4-70, Impact factor- 8.007

Page No: 2535 - 2542

Electricity Consumption and Economic Growth in The Democratic Republic of Congo: Empirical Analysis.

Camille Augustin Kabasele Dikangala[1], Khonde Mabiala Jean-Pierre[2]

[1]Chairman of the Board of Directors of the National Agency for Electrification and Energy Services in Rural and Peri-Urban Areas (ANSER), Master in Economic Policy Management and PhD student in Electrical Engineering,

[2]Master in Economic Policy Management, in Governance of Organizations for International Development and researcher at the University of Kinshasa, Faculty of Economic Sciences.

ABSTRACT: This study analyzes the relationship between economic growth and electricity consumption in the Democratic Republic of Congo. It assesses the impact of different levels of electricity consumption (low, medium, and high voltage) on growth, using the ARDL model to explore the short- and long-term dynamics between the variables.

The results show that only high-voltage consumption sustainably stimulates growth, while low-voltage consumption has a negative effect, and medium-voltage consumption has no significant long-term impact. In the short term, high- and low-voltage consumption contribute positively but weakly to growth, unlike mediumvoltage consumption, which has a negative effect. These findings highlight the current low energy efficiency and the need for structural reforms to strengthen the contribution of electricity to economic development.

KEYWORDS: Economic growth, energy consumption, cointegration.

I. INTRODUCTION

Electricity has been a fundamental driver of economic development since the Industrial Revolution of 1780, transforming production structures, consumption patterns, and investment dynamics. By fostering urbanization, industrialization, and the modernization of societies, it has established itself as an infrastructure as vital as roads or education. The strategic role of electricity in development is well established, as it determines economic efficiency and overall productivity.

However, despite global progress, Africa continues to face a profound energy crisis. According to the African Development Bank (2023), more than 640 million Africans are without electricity, with an access rate of less than 40%. In sub-Saharan Africa, electricity consumption per capita remains very low compared to developed countries: 180 kWh for Africa, compared to 13,000 kWh in the United States and 6,500 kWh in Europe. This energy insecurity hinders industrial development, limits the emergence of modern services, and exacerbates social and economic inequalities.

The Democratic Republic of Congo is a stark illustration of this reality. With per capita consumption of only 0.27 tonnes of oil equivalent, it remains well below African averages. Access to electricity is limited to less than 10% of the population (SIE Energy Information System Report, 2016). Supply remains concentrated in industrial and commercial areas, marginalizing low-income households. This structural deficiency is hampering the achievement of the Sustainable Development Goals.

While some countries have focused on expanding energy supply through large grids, this strategy has proven insufficient. It is now important to rethink energy policies by integrating social, economic, and human dimensions. The link between electricity consumption and growth must be better understood in order to design interventions adapted to the local context. This study is based on this perspective.

As Hounkpatin (2013) states, the availability of sufficient, reliable, and high-quality electricity in a country significantly improves household welfare, promotes the development of small businesses and industries, supports the service and government sectors, and boosts ICT and agricultural productivity. These elements collectively constitute levers of economic growth, particularly depending on a country's demographic evolution.

Between 1980 and 2023, the DRC experienced unstable economic growth and a contrasting trend in its electricity consumption. Although total consumption increased from 3,921 GWh to 16,069 GWh, per capita consumption remained virtually unchanged, revealing stagnant access to electricity. This dynamic contrasts with growing demand, particularly in the mining sector.

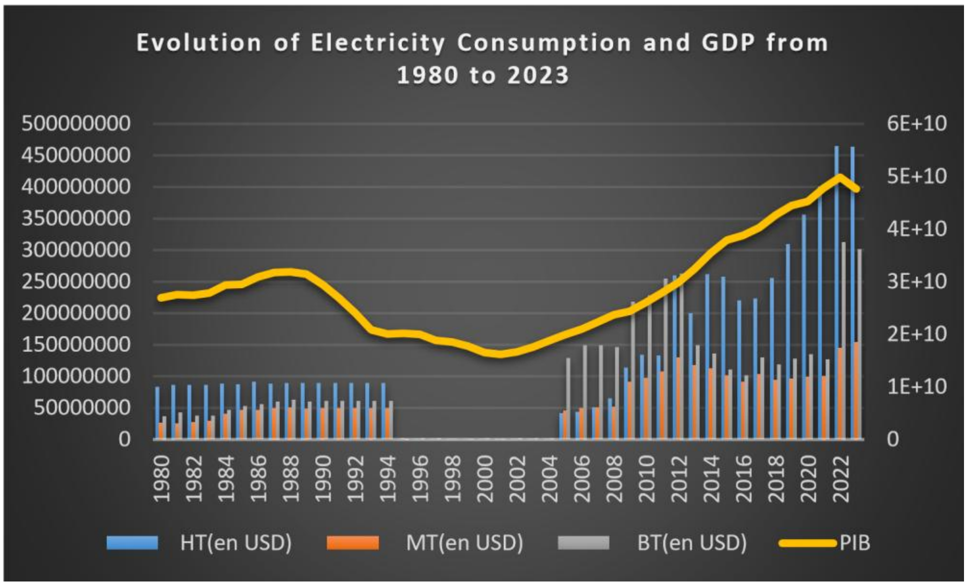
Economically, GDP, estimated at $68.6 billion in 1980, fell sharply in the 1990s and 2000s due to conflict and political instability, before recovering in the mid-2000s thanks to mining exports, reaching $66.9 billion in 2023. This situation raises the question of the effectiveness of energy consumption in supporting sustainable growth.

The study seeks to determine the impact of electricity consumption on economic growth in the DRC. It is based on the assumption that sustainable development requires strong economic growth, which in turn depends on final and industrial electricity consumption. Few studies have addressed this topic in Africa, and even fewer in the Congolese case. By analyzing data from 1980 to 2023, this research aims to answer the following questions: Does electricity stimulate economic growth in the DRC?

Methodologically, the study begins with a brief evolution of electricity consumption and economic growth data followed by a review of the relevant literature, highlighting the main theoretical models and empirical results. It is based on the theory of endogenous growth. Empirically, the study uses the ARDL (Auto-Regressive Distributed Lag) approach developed by Pesaran and Shin (1999) to assess the short- and long-term dynamics between electricity consumption and economic growth, while taking into account the structural economic characteristics of the DRC.

II. EVOLUTION OF ELECTRICITY CONSUMPTION AND ECONOMIC GROWTH IN THE DRC

Between 1980 and 2023, the Democratic Republic of Congo (DRC) experienced a complex and evolving relationship between its economic growth and electricity consumption. While the country's GDP exhibited a generally upward trend, marked by periods of expansion and contraction, electricity consumption, broken down by high, medium, and low voltage levels, remained stagnant for much of the first period before accelerating in the mid-2000s. This discrepancy suggests a structural mismatch between economic performance and energy access, highlighting chronic under-electrification, limited infrastructure investment, and institutional weaknesses. Analyzing the combined evolution of GDP and electricity consumption over this four-decade period reveals key insights into the DRC's development trajectory and highlights the central role of energy in achieving sustained and inclusive growth.



Source: Authors, from the various annual publications of the BCC and SNEL

Between 1980 and 2023, the Democratic Republic of Congo (DRC) experienced a fluctuating relationship between economic growth and electricity consumption, whether at high, medium, or low voltage. While GDP generally grew steadily, national electricity consumption remained stagnant until the mid-2000s, revealing a clear disconnect. This divergence suggests the existence of structural problems of access to energy, due to under-electrification, particularly in rural areas, or a reliance on alternative energy sources outside the official electricity grid.

During the 1980s, the Congolese economy experienced modest growth, with GDP increasing from $27 billion to $32 billion. However, electricity consumption increased only slightly, particularly for high-voltage networks, which increased from $82 million to $89 million. The stability of electricity prices during this period suggests that economic gains were not linked to improved electrification, but rather to commodity exports and mining. Energy infrastructure remained largely confined to urban areas, thus limiting its impact on development.

The 1990s were marked by economic collapse due to political instability, armed conflict, and hyperinflation. GDP fell sharply, from $29 billion in 1991 to $16 billion in 2000. Electricity consumption, at all voltage levels, also collapsed, particularly after 1994, reflecting the deterioration of infrastructure and the sharp decline in industrial activity during the Congo wars. This period marked a low point for economic and energy performance.

Recovery efforts began between 2001 and 2004, with GDP rebounding to $19 billion. Yet electricity consumption remained extremely low, indicating that post-conflict recovery did not significantly extend to the energy sector. Infrastructure remained dilapidated, and investments were fragmented and poorly coordinated. Lack of institutional capacity and financing hampered efforts to restore national electrification, leaving the energy gap unaddressed despite economic recovery.

A turning point occurred in 2005, with significant Chinese-backed investments in energy infrastructure. Electricity consumption increased sharply at all voltage levels, with no change in prices, indicating a real improvement in access and supply. GDP crossed the $20 billion mark, and between 2005 and 2008, energy consumption nearly doubled. This sharp increase suggested a revival of industrial and urban electricity demand and marked a period of renewed momentum for national electrification.

From 2009 to 2016, rising electricity prices coincided with growing demand, particularly for high-voltage electricity, which more than doubled. This trend highlighted the strategic importance of electricity in industrial activities, where reliability outweighed cost. However, after peaking in 2014, consumption began to decline again due to aging infrastructure, technical losses, and poor grid management. This volatility revealed the fragility of the energy sector, despite continued GDP growth.

The 2017-2022 period saw a new phase of growth, driven by the expansion of small hydropower plants and improved distribution, particularly in urban areas. High-voltage electricity consumption increased sharply, as did GDP, which reached $49 billion in 2022. However, in 2023, both electricity consumption and GDP declined slightly due to political uncertainties and falling global commodity prices. These developments reflect the energy sector's vulnerability to internal and external shocks, highlighting the need for systemic reforms to align economic growth with sustainable and inclusive electrification.

III. ELECTRICITY CONSUMPTION AND ECONOMIC GROWTH IN EMPIRICAL LITERATURE

In recent decades, the link between energy consumption and economic growth has attracted sustained academic interest, particularly in light of development policy and environmental sustainability concerns. The seminal works of Sims (1972, 1980), Granger (1981, 1983), and Kraft and Kraft (1978) established the methodological framework for causality and cointegration analysis in this field. However, their findings, particularly Kraft and Kraft's (1978) finding unidirectional causality from GDP to energy consumption in the United States, have been widely contested. Akarca and Long (1980), using a different sample period, obtained inconsistent results, while Yu and Hwang (1984) pointed out that causality results can vary considerably across time periods, revealing both unidirectional and non-existent relationships. These initial divergences highlighted the sensitivity of empirical results to model assumptions, time coverage, and country-specific factors.

Subsequent research extended these investigations to a broader geographical scope. Masih and Masih (1996), using Johansen cointegration and VECM techniques, revealed long-run cointegration and diverse causal patterns in six Asian economies. They found that energy consumption caused GDP in India, GDP caused energy consumption in Indonesia, and mutual causality existed in Pakistan. Meanwhile, Asafu-Adjaye (2000), analyzing four Asian countries using an error-correction model, observed unidirectional causality from energy to GDP in India and Indonesia, but bidirectional causality in Thailand and the Philippines. These results not only confirmed the non-uniform nature of the energy-growth relationship but also highlighted the importance of regional dynamics and methodological frameworks.

Similar heterogeneity appeared in the study by Glasure and Lee (1997), where standard Granger tests indicated unidirectional causality from energy to GDP in South Korea and no causality in Singapore. However, under the vector error correction model (VECM), they observed bidirectional causality in both countries.

Similarly, Yang (2000) found bidirectional causality between electricity consumption and economic growth in Taiwan from 1954 to 1997. In Canada, Ghali and El-Sakka (2004), using cointegration and ECM, confirmed longrun bidirectional causality between energy consumption and output. Chiou-Wei et al. (2008), using linear and nonlinear Granger tests, detected mixed trends in Asian NICs and the United States: no causality in the United States and South Korea, GDP-led energy consumption in the Philippines and Singapore, and energy-led growth in Taiwan and Malaysia.

In Africa and the Middle East, the results are equally mixed. Wolde-Rufael (2005), applying panel cointegration to 19 African countries, found that in countries such as Nigeria and Sudan, GDP drove energy consumption, while the reverse was true in the Democratic Republic of Congo (DRC) and Ghana. In many others, no significant causality was found, highlighting the structural and institutional diversity of the continent. Similarly, Mehrara (2007), in a study of 11 oil-exporting countries from three continents, concluded that there was long-run unidirectional causality between per capita energy consumption and per capita GDP, reinforcing the importance of energy in supporting long-term economic growth in resource-dependent economies.

In Turkey, empirical evidence is also conflicting. Soytas and Sari (2001, 2003) demonstrated unidirectional causality between energy and GDP, while Altinay and Karagol (2004), using Hsiao's methodology, found no causality. However, Altinay et al. (2005), using more advanced causality tests such as the DoladoLütkepohl and Toda-Yamamoto procedures, confirmed a unidirectional relationship between electricity consumption and GDP. This methodological diversity highlights how different testing approaches can lead to divergent policy implications regarding energy conservation and economic growth.

Cross-national studies have further reinforced these complexities. Yu and Choi (1985), in their comprehensive panel analysis, found no causality in countries such as the United States, the United Kingdom, Brazil, and Poland, but found unidirectional causality from GDP to energy consumption in South Korea and from energy to GDP in the Philippines. Erol and Yu (1987), using similar Granger-based tests in Western economies, reported unidirectional causality in West Germany, bidirectional causality in Italy, and no causality in France, Canada, or the United Kingdom. These findings underscore the importance of institutional, economic, and technological variation across nations in shaping energy growth dynamics.

Large-scale panel studies have sought to synthesize these variable findings. Chontanawat et al. (2008), analyzing over 100 countries, observed that 70% of OECD countries exhibited causality between energy consumption and GDP, compared to 46% of non-OECD countries. This suggests that developed economies are more energy dependent, implying that aggressive energy conservation policies could further limit growth in these regions. Narayan and Singh (2007), using panel cointegration for Fiji, also confirmed long-run unidirectional causality between electricity consumption and GDP, further validating the relevance of energy in small island economies.

Country-specific studies also provide valuable insights. Hwang and Gum (1992), investigating Taiwan, found bidirectional causality using cointegration and ECM, while Cheng and Lai, using a modified Hsiao test, identified unidirectional causality from GDP to energy. Paul and Bhattacharya (2004), analyzing India between 1950 and 1996, found bidirectional causality using ECM and Johansen tests, thus strengthening the hypothesis of a feedback relationship in some South Asian economies. In Pakistan, Aqeel and Butt (2001), incorporating employment as a control variable, concluded that economic growth drove energy consumption, highlighting the influence of labor dynamics in the energy-growth relationship.

China, with its rapid industrial expansion, offers another compelling case. Shiu and Lam (2004), covering the period 1971–2000, found unidirectional causality between electricity consumption and GDP, supporting the energy-led growth hypothesis. Yang (2000) also reported bidirectional causality in Taiwan over a longer period, suggesting that results may differ not only across countries but also across decades within countries. These nuanced findings highlight the importance of considering structural transformation, urbanization, and energy sector reforms when assessing the energy-growth nexus.

In sum, the empirical literature consistently reveals the absence of a universally applicable causal link between energy consumption and economic growth. The nature and direction of this relationship depend heavily on each country's specific economic structures, the time horizon considered, and the econometric methodologies employed. Whether energy stimulates growth, whether growth leads to an increase in energy demand, or whether both occur simultaneously remains a contextual question. This variation implies that policymakers should be cautious in generalizing findings and adopt energy strategies tailored to their country's specific stages of development and institutional capacities.

IV. EMPIRICAL ANALYSIS OF THE RELATIONSHIP BETWEEN ELECTRICITY CONSUMPTION AND ECONOMIC GROWTH

Understanding the link between electricity consumption and economic growth remains crucial, especially in developing countries. In the DRC, the last forty years have been marked by significant economic and energy fluctuations. This study analyzes the short- and long-term relationships between these two variables from 1980 to 2023, using the Autoregressive Distributed Lag (ARDL) model. It examines the impact of electricity consumption on GDP, taking into account structural and political reforms. The results aim to guide sustainable energy policies and economic development strategies.

1. Econometric specification

Neoclassical growth theory, as originally formalized by Solow (1956), explains long-run economic growth through the accumulation of physical capital, the expansion of the labor force, and technological progress. This fundamental model posits that output (GDP) growth is driven by increases in inputs—capital and labor—as well as improvements in total factor productivity (TFP), which accounts for the effect of technological progress. However, later extensions of the neoclassical framework have emphasized the role of additional factors of production, such as energy, as vital components in maintaining and improving economic output.

In this broader view, energy, particularly electricity, was recognized not only as an intermediate input but also as a critical driver of productivity across all sectors of the economy. Researchers such as Kraft and Kraft (1978) and Stern (1993) empirically investigated the relationship between energy consumption and GDP growth, revealing a significant interdependence. Electricity, as a refined and versatile form of energy, is indispensable for industrial processes, digital infrastructure, utilities, and modern agriculture. As such, its availability and reliability have a direct impact on an economy's ability to operate efficiently and grow sustainably.

Incorporating electricity into a production function involves considering it as a complementary input to capital and labor. Therefore, the empirical specification can be derived from an augmented Cobb-Douglas production function, where output Yt at time t is a function of capital (Kt), labor (Lt), and electricity consumption ELCt Referring to previous work, we will retain the integration of energy into the production function and we will use the production model of Chang and Lee (2008). This choice is not only motivated by the ability of this model to determine the direction of causality between economic growth and energy consumption but also by its specificity in distinguishing between long-term and short-term causalities. This model is written as follows:

$$Y = f(Ks, L, E) \quad (1)$$

Or :

- Y represents total output or real GDP,
- Ks: the real capital stock, - L: work and - E: energy.

This model has been modified taking into account the specificities of the Democratic Republic of Congo. In logarithmic form, the econometric model to be estimated is presented as follows:

$$\mathbf{LnPIB} = \boldsymbol{\alpha_0} + \boldsymbol{\alpha_1}\mathbf{ln}\boldsymbol{FBCF_t} + \boldsymbol{\alpha_2}\,\boldsymbol{lnConsHT_t} + \boldsymbol{\alpha_3}\boldsymbol{lnConsMT_t} + \boldsymbol{\alpha_4}\,\mathbf{ln}\,\boldsymbol{ConsBT_t} + \boldsymbol{\alpha_5}\,\boldsymbol{LnIPC_t} + \boldsymbol{\alpha_6}\,\boldsymbol{LnOUV_t} + \boldsymbol{u_t}$$

The LPIB variable represents the base-10 logarithm of constant gross domestic product (GDP). LFBCF is the abbreviation for the base-10 logarithm of gross fixed capital formation, which serves as a proxy for investment. This variable allows us to control for the direct impact of capital accumulation on GDP. It also allows us to analyze whether electricity consumption complements or replaces physical capital. LConsbt, the base-10 logarithm of low-voltage electricity consumption, allows us to assess how access to electricity for domestic and artisanal use influences economic growth by reflecting the effect of residential and informal electrification.

LConsmt is the base-10 logarithm of medium-voltage electricity consumption and provides insight into how non-intensive productive sectors contribute to economic growth through their energy consumption. LConsht, the base-10 logarithm of high-voltage electricity consumption, highlights the role of large, often exportoriented, industrial units in driving their growing electricity needs. PFRV refers to the base-10 logarithm of the consumer price index and functions as a macroeconomic control variable, useful for examining how inflation can alter the relationship between electricity and growth by influencing purchasing power and production costs. LOUV, the base-10 logarithm of economic openness, helps assess how trade integration affects both economic growth and electricity demand, with more open economies able to attract more investment and therefore greater energy consumption. Finally, U represents the error term.

This specification allows us to empirically test the hypothesis that electricity consumption plays a statistically significant role in economic growth, beyond traditional capital and labor inputs. Furthermore, it provides a basis for policy discussions on energy infrastructure investments as a long-term development lever. Depending on the stationarity properties of the variables, estimation methods such as ARDL, VECM, or Granger causality tests may be appropriate to explore short- and long-term dynamics.

2. Stationarity test of variables

To study stationarity between variables, the literature proposes several unit root tests. Two unit root tests are commonly used, namely the Augmented Dickey-Fuller (ADF) test and the Phillips-Perron (PP) test. In this work, we used the Augmented Dickey-Fuller (ADF) test to test stationarity between variables.

Table 1. Series Stationarity Test Results

Variables	**In level**			**In difference**			Model	**Order of integration**
	ADF	VCM(5%)	Decision	ADF	VCM (5%)	**Decision**		
LPIBR	0.22	-1.95	DS type Ns	-2.09	-1.95	S	1	I(1)
LFBCF	1.47	-1.95	DS type Ns	-4.32	-1.95	S	1	I(1)
LCONHT	0.13	-1.95	DS type Ns	-6.31	-1.95	S	1	I(1)
LCONSMOT	0.17	-1.95	DS type Ns	-6.17	-1.95	S	1	I(1)
LCONSBT	0.19	-1.95	DS type Ns	-6.27	-1.95	S	1	I(1)
LIPC	-2.11	-1.95	S				1	I (0)
LOUV	0.18	-1.95	DS type Ns	-8.11	-1.95	S	1	I(1)

Source: Authors based on Eviews10 results NB: S= Stationary, NS= Non-stationary

From reading Table 3, we see that the variables in the model are integrated of different orders. The variables LPIBR, LFBCF, LCONSHT, LCONSMT, LCONSBT and LOUV are integrated of order 1 (stationary after the first difference) and the variable LIPC is integrated of order 0 (stationary at level). Given thatthe series are integrated at different orders, the Engle and Granger cointegration test (bivariate case) and that of Johansen (multivariate case) are ineffective, and makes the cointegration test at the limits appropriate (Pesaran et al., 2001).

3. Result of the Estimates

Before estimating the long- and short-run relationships, robustness checks were performed, including tests for normality, heteroscedasticity, and error autocorrelation. The results of these tests confirm that the residuals exhibit all the desired properties. The normality test indicates that the residuals follow a normal distribution. In addition, the results of the heteroscedasticity and autocorrelation tests show that the null hypotheses of no heteroscedasticity and no autocorrelation are both accepted.

a) Robustness tests

Table 2. Robustness Test

Hypotheses (H0)	Tests	
		F Statistic & Probability
Normality	Jarque-Bera	0.683 (0.711)
Absence of autocorrelation	Breusch-Godfrey	3,400 (0.07)
Absence of heteroscedasticity	Breusch-Pagan-Godfrey	0.787 (0.80)
Specification	Ramsey (Fisher)	0.620 (0.448S)

Source: Authors, from the different residue tests

b) Long-term relationship estimation results

Table 3. Long-Term Relationship

	Regression
LFBCF	0.145 [2.91]**
LCONSHTS	0.255 [4.79]*
LCONSMOT	-0.061 [-0.73]
LCONSBT	-0.157 [-2.89]*
LIPC	0.0008 [0.04]
LOUV	0.166 [2.85]**
Constant	19,529 [21.77]*

Source: Authors

- The dependent variable is the growth rate of real GDP per capita.
- Terms in brackets correspond to t-statistic.
- ***, **, * used to designate Tests significant at the 1%, 5% and 10% threshold respectively.

According to the long-term regression, the variables Gross Fixed Capital Formation (LFBCF), High Voltage Electricity Consumption (LCONSHT), Low Voltage Electricity Consumption (LCONSBT) and Economic Openness (LOUV) are statistically significant. On the other hand, Medium Voltage Electricity Consumption (LCONSMT) and the Consumer Price Index (LIPC) are insignificant at the 5% level.

According to this equation, a one percent increase in gross fixed capital formation, high-voltage electricity consumption, and economic openness would generate an increase in growth of 0.15, 0.26, and 0.177 percent, respectively. In other words, high-voltage electricity consumption would have a positive and significant effect on economic growth in the DRC, but its impact remains very low, which suggests that the country's economic structures do not yet allow for optimal exploitation of its energy potential. On the other hand, lowvoltage electricity consumption would have a negative and significant effect on economic growth.

Table 4. Short-Term Relationship

Variables	&T-Student Coefficients
D(LFBCF)	0.065 (4.81)* **
D(LCONSHT)	**0.056** **(3.10)******
D(LCONSMT)	-0.117 (-3.65)***
D(LCONSBT)	0.044 (2.06)**
D(LIPC)	-0.108 (-2.14)**
D(LOUV)	0.90 (7.35)***
CointEq(-1)*	**-0.76** **(-5.73)*****
R-squared **Adjusted R-squared** **F-statistic**	0.991 **0.978** **8,205**

Source: Author

- The dependent variable is real GDP per capita in logarithm.
- ***, **, * used to designate Tests significant at the 1%, 5% and 10% threshold respectively.

In the short term, the dynamics are somewhat different. High-voltage and low-voltage electricity consumption have a positive and significant impact on economic growth, albeit slightly. This can be explained by the more immediate use of energy in production and consumption, suggesting that any change in access to electricity generates relatively rapid economic repercussions. In contrast, medium-voltage consumption retains a negative and significant effect in the short term, which could reveal dysfunction or low productivity in the sectors that rely on it.

These results corroborate those of Lee and Chang (2008), who show that energy plays an important role in growth, particularly when it is used for productive purposes. Furthermore, Stern (2000) states that energy is a fundamental input in the production process and that its contribution to growth depends on the country's level of industrialization and energy efficiency. The case of the DRC confirms these analyses, highlighting the importance of a strategic orientation of energy policy towards higher value-added sectors.

V. CONCLUSION

This article analyzed the relationship between electricity consumption and economic growth in the Democratic Republic of Congo (DRC). The main objective was to assess the impact of electricity consumption on the country's economic growth by examining the long-term and short-term relationships between these two variables. In other words, to understand how different levels of electricity consumption (low, medium, and high voltage) interact with economic growth. To do this, the study used the ARDL approach to capture the short- and long-term relationships between the variables studied.

Empirical results show that the effect of electricity consumption on economic growth varies depending on the voltage level. In the long run, an increase in high-voltage electricity consumption boosts economic growth by 0.26%. In contrast, medium-voltage consumption has an insignificant effect, and low-voltage consumption has a negative effect, reducing growth by 0.16%, suggesting inefficiency in the use of this form of energy. In the short run, economic growth is positively influenced by high- and low-voltage electricity consumption, while medium-voltage electricity consumption has a negative impact.

The low elasticities observed reflect a limited sensitivity of growth to variations in energy consumption, thus highlighting the weaknesses of the current electricity system and the need for structural reforms to improve national energy performance.

REFERENCES

1) International Energy Agency. (2018). World Energy Statistics: Global Energy Balance Review. https://www.iaea.org/publications/magazines/bulletin/bull471/spanish/article14sp.pdf
2) African Development Bank. (2018). African Economic Outlook.
3) Central Bank of Congo. (2016). Annual report.

4) World Bank. (2018). Systematic Country Diagnostic: Policy Priorities to Reduce Poverty and Promote Shared Prosperity in a Fragile Post-Conflict Country (Report No. 112733-ZR).
5) Dickey, D.A., & Fuller, W.A. (1979). Distribution of the estimators for autoregressive time series with a unit root. Journal of the American Statistical Association, 74(366), 427–431.https://doi.org/10.2307/2286348
6) Esseghir, A., & Haouaoui, L. (2011). Economic growth, energy consumption and sustainable development: The example of the Mediterranean region. International French-speaking conference "Sustainable development: debates and controversies", UAQUAP, ISG Tunis, December 15-16.
7) Esseghir, A., & Haouaoui, L. (2017). Economic growth, energy consumption and sustainable development in the Mediterranean region. Political Economy Review, 127(4), 611–640.https://doi.org/10.3917/redp.174.0611
8) Georgescu-Roegen, N. (1979). Energy and Economic Myths: Institutional and Analytical Economic Essays. Pergamon Press.
9) Ghali, KH, & El-Sakka, MIT (2004). Energy use and output growth in Canada: A multivariate cointegration analysis. Energy Economics, 26(2), 225–238.https://doi.org/10.1016/S01409883(03)00056-2
10) Grosset, F., & Nguyen-Van, P. (2015). Energy Consumption and Economic Growth in Sub-Saharan Africa (Working Paper No. 2015-29). BETA, University of Lorraine.
11) Heuraux, C., Guinebault, A., Augé, B., Ouédraogo, L., Keita, S., & Gemenne, F. (2010). Energy, Growth and Sustainable Development: An African Equation. French Institute of International Relations.
12) IMF (International Monetary Fund). (2024). Democratic Republic of the Congo: 2023 Article IV Consultation. IMF Country Report No. 24/58.https://www.imf.org/
13) IEA (International Energy Agency). (2023). Electricity Information: 2023 Edition.https://www.iea.org/
14) Johansen, S. (1991). Estimation and hypothesis testing of cointegration vectors in Gaussian vector autoregressive models. Econometrica, 59(6), 1551–1580.https://doi.org/10.2307/2938278
15) Lee, C.-C., & Chang, C.-P. (2008). Energy consumption and economic growth in Asian economies: A more comprehensive analysis using panel data. Resource and Energy Economics, 30(1), 50–65.https://doi.org/10.1016/j.reseneeco.2007.03.003
16) Massachusetts Institute of Technology. (2014). 2014 Outlook. http://globalchange.mit.edu/research/publications/other/special/2014Outlook
17) Ministry of Energy and Water Resources. (2016). Energy Information System (EIS), 2014 energy report.
18) Ministry of Water Resources and Electricity. (2013). National Report on Sustainable Energy for All by 2030 – National Program and Strategy. UNDP-DRC.
19) Ministry of Water Resources and Electricity. (2014). Atlas of Renewable Energy in the DRC. UNDPSNV.
20) Ministry of Water Resources and Electricity. (2017). Annual Report – Electricity Directorate.
21) OECD. (2012). African Economic Outlook 2011/2012 – Democratic Republic of Congo.www.oecd.org/dev/pea
22) Pesaran, M. H., Shin, Y., & Smith, R. J. (2001). Bounds testing approaches to the analysis of level relationships. Journal of Applied Econometrics, 16(3), 289–326.https://doi.org/10.1002/jae.616
23) Pokrovsky, V. N. (2003). Energy in the theory of production. Energy, 28(9), 769-788. https://doi.org/10.1016/S0360-5442(02)00146-6
24) National Electricity Company (SNEL). (2016). Annual report.
25) Spreng, D., & Schwarz, J. (1994). Energy and its importance for the economy. Ravel-Industrie Collection.
26) Stern, D.I. (1993). Energy and economic growth in the USA: A multivariate approach. Energy Economics, 15(2), 137–150. https://doi.org/10.1016/0140-9883(93)90033-N
27) Thompson, P. (2006). The relationship between energy and GDP: A panel data approach. Energy Economics, 28(5–6), 690–702.https://doi.org/10.1016/j.eneco.2006.03.010
28) World Bank. (2024). World Development Indicators.https://databank.worldbank.org/