

# THE IMPACT OF FINANCIAL DEVELOPMENT ON RENEWABLE ENERGY CONSUMPTION IN KENYA

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## ABSTRACT

**Purpose:** Increasing awareness of global warming consequences, together with the call for all countries to take responsibility for reducing their carbon footprint by moving to cleaner energy use motivated this study to examine the impact of financial sector development on renewable energy for Kenya. The study aims to answer the question, ‘Can financial sector development help Kenya to increase renewable energy consumption?’ The study used annual data from 1990 to 2020 to examine the nature of the relationship between the two variables. **Methodology:** The study employed autoregressive distributed lag (ARDL) approach. **Results:** The study found financial development to have a positive impact on renewable energy consumption in the short and long run. **Conclusions:** The results point to the significant role that the financial sector plays in availing resources for cleaner energy projects. **Recommendations:** Policymakers in Kenya should harness the country’s financial sector potential to meet the Sustainable Development Goals aligned to cleaner energy consumption.

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## 1. INTRODUCTION

The role of the financial sector in economic development has attracted the attention of many researchers. The sector plays an important role in financial intermediation from both bank-based and market-based financial development.

It acts as an intermediary between surplus units - those who want to save and deficit units - those who want to borrow (Mohr & Associates, 2015). From this background, the more efficiently the financial system can avail funds to investors and encourage savings, the higher the investment and hence economic growth are. Thus, savings are an important ingredient to economic growth, although external sources of funding like foreign direct investment are now used to augment domestic savings. Concerns about global warming are also encapsulated in the Sustainable Development Goals (SDGs). This has resulted in a wave of businesses, governments, and households investing in renewable energy.

The relationship between financial development and energy consumption depends on the proxy used to measure financial development and energy consumption and the country studied. For example, findings from a study by Saygin & Iskenderoğlu (2022) confirm that in emerging countries stock market variables and some of the banking variables have no influence on energy consumption when total final renewable energy consumption is used. Only private credit by deposit money banks to GDP (%) has a positive effect. On the other hand, when renewable energy consumption in terajoule is used as a proxy for energy consumption, only stock market capitalisation to GDP (%) leads to an increase in energy consumption, the rest of the variables have no effect. A similar finding is also confirmed in Chang (2015).

The Kenya Blueprint - Vision 2030 aims to transform the economy into a newly industrialised middle-income country (Government of the Republic of Kenya, 2007). The vision is based on three pillars, namely, economic, social and political. The economic pillar in Vision 2030 aims to facilitate economic development targeting an average growth rate of 10%. (Government of the Republic of Kenya, 2007). The social pillar aims to build a cohesive and just society where social equity is a priority as well as clean environment, and the political pillar aims to build a political system anchored on a democratic system that protects the rights and freedom of every individual. The economic pillar supports steady economic growth that is commensurate with other support functions from the economy. Rapid economic growth is also associated with high demand for energy consumption. For Kenya, given the social pillar thrust, renewable energy is preferable. The big question is how to achieve an increase in renewable energy consumption among competing government obligations.

Several studies have been done exploring the impact of various macroeconomic variables on economic growth, such as remittances, financial development, and urbanisation. This is based on the developmental goals and visions that regard economic growth as a springboard for other developmental goals, including the

source of finance. In recent times, there has been a rising interest in the link between finance and energy consumption. The main aim of this study, therefore, is to relook at the impact of finance on renewable energy demand in Kenya. This study is important in informing policy on the role the financial sector can play in boosting not only energy consumption capacity, but also the quality of energy used, as the country focuses on clean energy.

Studies that have focused on the impact of financial development on energy consumption have found inconclusive results. However, the scale has been tilted to a positive impact of finance on energy consumption (see: [Prempeh, 2023](#); [Ibrahim, Bukonla & Jamiu, 2021](#); [Chiu and Lee, 2020](#), [Gaies et al., 2019](#); [Chang, 2015](#); [Islam et al., 2013](#)). The inconclusive results in the extant literature make the generalisation of the link between finance and energy demand across domains inappropriate, especially now that loud calls are being made to reduce carbon emissions and foster responsible development. This study will depart from other studies by using the financial development index from the IMF to investigate the nexus between finance and renewable energy consumption in Kenya. The use of the financial index centres on the argument for the best financial development measure between bank-based and financial-based measures. The financial development index is a composite measure of bank-based financial indices and market-based financial indices. This provides a comprehensive measure of financial development that captures the two aspects. Further, the study uses renewable energy consumption as a measure of energy consumption in Kenya. It is hoped that the results will give an unbiased result on the nexus between finance and renewable energy consumption. The ARDL approach has been used in this study to analyse the impact of finance on renewable energy consumption owing to the several advantages that it has over other estimation techniques.

Kenya was selected as a study country because it has made strides in financial liberation and has also taken steps to expand renewable energy consumption. In addition, given that the country is a signatory to the Sustainable Development Goals (SDGs), where environmental sustainability is one of the key deliverables, this study provides insight into the role the financial sector can play in the drive.

The rest of the paper is organised as follows: Section 2 discusses the literature review, and Section 3 outlines estimation techniques. Section 4 dwells on data analysis and discussion of results, while section 5 concludes the study.

## **2. LITERATURE REVIEW**

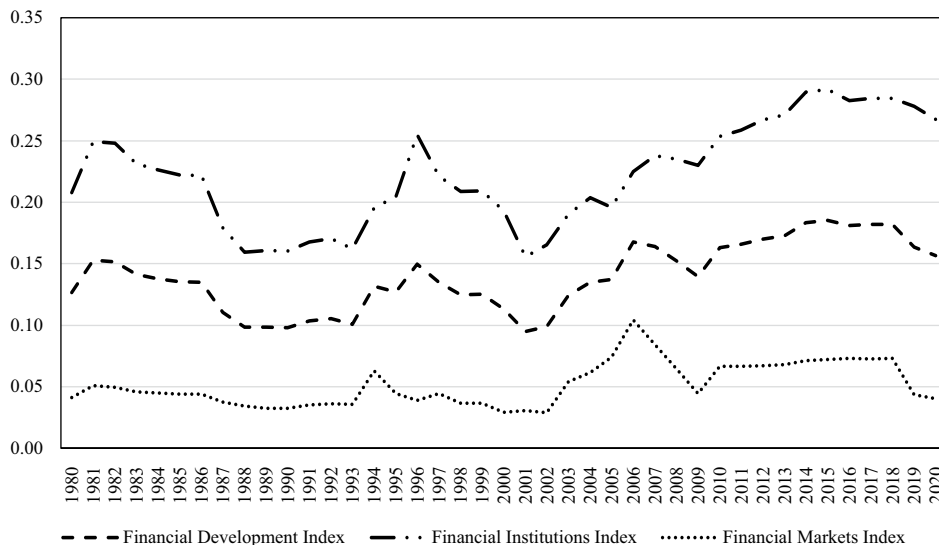
### **2.1 Financial development and energy consumption dynamics in Kenya**

#### **Financial development**

The Kenyan financial system is fairly developed in comparison to other SSA countries (UNESCO, 1997). Kenya has experienced growth in commercial and non-commercial institutions and has witnessed an expansion in the services offered.

Several factors in the 1980s and 1990s ushered in the urgent need for financial reforms. Some of the factors that weakened the financial sector resulting in a less important role in economic development were loss of control of the money supply by the central bank, non-compliance by the financial institution to regulatory requirements, lack of authority by the central bank to carry out monetary policy, accommodation of the government that was experiencing chronic fiscal deficits and lack of a level playing field in the financial sector. These were some of the factors that lead to financial reforms and financial liberalisation (UNESCO, 1997). The reforms were important to strengthen the financial system, provide a strong legal and regulatory framework, build capacity within the central bank to implement monetary policy and carry out bank oversight (UNESCO, 1997). It is against these structural and institutional deficiencies that financial sector reforms were implemented in the mid-1980s. The reforms aimed to promote an efficient, market-oriented financial system, improve financial intermediation, avail suitable monetary policy instruments, relax control over interest rates, and strengthen the framework for the supervision of financial institutions. There was a revamp of the legal and regulatory framework to support the new reforms. Reforms in the legal and regulatory framework included amendments to the Capital Bank of Kenya Act, the Capital Market Authority Act, and the Banking Act. The revised Banking Act of 1991 strengthened the ability of the central bank to oversight on commercial banks and imposition of penalties in cases of non-compliance. In the capital markets, the amendment of the Capital Markets Authority Act saw the creation of a broad-based Board of Capital Markets, which reflected the composition of the actors in the market (UNESCO, 1997). There was also the removal of Capital Markets Committees' role in regulating shares, the removal of double taxation, and the abolition of stamp duties on retail share transactions. Institutional reforms included the removal of fragmentation of financial institutions by requesting non-bank institutions to move to commercial bank space or merge with other commercial banks (UNESCO, 1997). The entry into the financial sector was made strict and a higher minimum requirement to

open a commercial bank. The trends in the financial sector captured by Financial Institution Index, Financial Market Index, and Financial Development Index are presented in Figure 1.



**Figure 1:** Trends in financial development 1980 -2020

Source: IMF, 2023.

Figure 1 reports the trends in financial development in Kenya during the study period (IMF, 2023). The Financial Development Index mimics the trends in the Financial Institution Index (bank-based measure) and the Financial Market Index (market-based measure) during the study period (IMF, 2023).

It is not surprising that the Financial Development Index mimics the movements in the Financial Institution and Financial Market indices since it is made up of a summation of the two indices. Although the three variables trended together, the Financial Market Index remained low and never broke the 0.12 mark (IMF, 2023). This points to the smaller role that the market-based financial sector has in financial development in Kenya. This is the opposite from the bank-based measures, where the indices remain above the financial development index (IMF, 2023).

### Energy consumption developments

The National Energy Policy guides energy-related matters in Kenya, and this is a successor policy from the energy sector concessional Paper No 4 of 2004 (Ministry of Energy, 2018). The National Energy Policy was a culmination of

major changes in policy driven by the Vision 2030 blueprint. The discovery of oil and coal also added to the benefits of a policy that ensures there is a legal, institutional and regulatory framework (Ministry of Energy, 2018). The policy makers in Kenya also recognise several challenges associated with availing clean energy to Kenyans and meeting the targets set in Vision 2030 (Ministry of Energy, 2018). The main objectives of the energy policy are to use energy to accelerate economic development; promote energy efficiency and conservation; promote capacity building in the sector through research, training and development; promote diversification of energy supply sources to build capacity; promote indigenous primary sources of energy; improve access to affordable, competitive and reliable energy services (Ministry of Energy, 2018). Some of the challenges highlighted include reliable quality supply, high capital outlay, high cost of energy, and low levels of industrialisation and competitiveness, among other challenges. The thrust of the policy rests on enhancing power generation capacity and diversification of the energy mix (Ministry of Energy, 2018). The National Energy Policy comprehensively covers all energy sources on how the country can harness them with minimum negative effects on the environment and at affordable prices, such that the poor categories of the population are able to afford them. The responsibility for protecting the environment and developing a sustainable system through the safety of dams, hydraulic engineering, public investment, and energy policy. The country's government is responsible for country planning and the development of gas and electricity infrastructure, and aligning the energy sector regulatory, policy and legal framework with the constitution. Apart from the National Energy Policy, the energy sector is governed by the Energy Act No 12 of 2006, the Geothermal Resources Act No 12 of 1982 and the Feed in Tariff Policy of 2008 (Ministry of Energy, 2018). There are several stakeholder institutions responsible for energy, for example, the Ministry of Energy and Petroleum, Energy Tribunal, Kenya Power and Lighting Company Limited, Rural Electrification Authority, Kenya Electricity Transmission Company Limited, and Independent Power Producers, among other supporting instruments (Ministry of Energy, 2018).

Kenya has made progress in the electrification of both rural and urban areas, with 71.44% of the population having access to electricity in 2020 (Our World in Data (2023)). This contrasts with 10.9% in 1990, according to Our World in Data (2023). The same development was reported on the proportion of the population with access to clean fuel for cooking. Steady growth was experienced from 1990 to 2020, recording an average of 31.59% (Our World in Data, 2023). Kenya consumes 7.86 billion kWh of electricity per year, which gives a per capita of 148kWh in 2020 (Our World in Data, 2023). Renewable energy consumption

grew steadily from 1990 to 2009 when consumption took a downward turn until 2020 (World Bank, 2023). The decline in renewable energy consumption over the years is concerning, given the drive to clean energy sources. Thus, making this study is pertinent to establish the role the financial sector can play in increasing renewable energy consumption.

## 2.2 Empirical Literature Review

A few studies have been conducted on the impact of financial development on energy consumption with conflicting results. This includes studies such as Sadorsky (2010), who studied the impact of financial development on energy consumption in 22 emerging economies. This was tested by applying the generalised method of estimates on panel data covering the period from 1990 to 2006. The findings showed that when stock market variables are used as a proxy, financial development has a positive impact on energy consumption. Using the Generalised methods of moments (GMM) model and banking sector development as a proxy for financial development, Brunnschweiler (2010) confirmed similar results for non-OECD developing and transition economies for the period from 1980 to 2006. Çoban and Topcu (2013) conducted a similar study for the European Union (EU) member countries over the period from 1990 to 2011. The study used banking sector development and stock market development as proxies for financial development. Using the system-GMM model, the findings confirmed that financial development has no significant effect on energy consumption in the EU. However, when the members of the EU are categorised into old and new members the findings suggest strong evidence of the positive effect of financial development on energy consumption for new members, while the effect of financial development on energy consumption in old members depends on the measure of financial development used. When banking variables are used, financial development is found to have an impact that displays an inverted U-shaped pattern.

For Malaysia, Islam et al. (2013) employed the autoregressive distributed lag (ARDL) approach to cointegration on time series data covering the period from 1971 to 2009. The findings confirmed that financial development has a positive impact on energy consumption. Corresponding results were confirmed by Komal and Abbas (2015) in the case of Pakistan. Al-mulali and Lee (2013) investigated the impact of financial development on energy consumption for the Gulf Cooperation Council using data from 1980 to 2009. The study used ordinary least squares, and a long-run positive impact was confirmed. Using the panel cointegration test, Furuoka (2015) examined the impact of financial development

and energy consumption in a panel of Asian countries. The findings confirmed that financial development has a positive impact on energy consumption. It was also found that energy consumption is a driving factor for financial development in Asia.

Using the fixed-effects linear regression model, [Chang \(2015\)](#) examined the impact of financial development on energy consumption in 53 countries. The study used panel data covering the period from 1999 to 2008. It was found that in the case of non-high-income countries, financial development leads to an increase in energy consumption when private and domestic credit is used as financial development indicators, while it leads to a decline when the value of traded stocks and stock market turnover is used in advanced economies. The findings also confirmed a positive effect of the value of traded stocks and stock market turnover in high-income countries of emerging markets and developing economies. A similar finding was confirmed by [Ibrahim, Bukonla & Jamiu \(2021\)](#) for Nigeria, using the ARDL Bounds cointegration approach on time series data covering the period from 1971 to 2014.

[Kakar \(2016\)](#) conducted a similar study in Pakistan and Malaysia over the period from 1980 to 2010. Using the Johansen cointegration test and vector error correction model, the study found that financial deepening improves energy use in both countries in the long run. No significant relationship was found in the short run. [Anton and Nucu \(2020\)](#) reported similar results for 28 European Union member countries over the period from 1990 to 2015. [Eren, Taspinar and Gokmenoglu \(2019\)](#) studied the impact of financial development and economic growth on renewable energy consumption in the case of India. The study employed annual time series data from 1971 to 2015. Employing dynamic ordinary least squares (DOLS) estimation, the study found financial development and economic growth to have a positive impact on energy consumption. For MENA countries, [Gaies et al. \(2019\)](#) also studied the impact of financial development on energy consumption using the dynamic panel GMM model on panel data covering the period from 1996 to 2014. The results confirmed that financial development has a positive impact on energy consumption. It was also confirmed that a non-linear and inverted U-shaped relationship exists between financial development and energy demand for the MENA region.

[Razmi et al. \(2020\)](#) examined the impact of stock market value on renewable energy consumption using ARDL in a time series covering the period from 1990 to 2014 for Iran. The study employed two measures for renewable energy consumption, that is, the consumption of hydro, solar, wind, and nuclear energies as well as that of combustible renewables and waste energies. The findings

confirmed a positive significant relationship between stock markets and energy consumption in the long run, while there is no significant relationship in the short run. [Mukhtarov et al. \(2020\)](#) used the VECM techniques on a time series of data covering the period from 1993 to 2014 for Kazakhstan. The findings confirmed a positive impact of financial development on energy consumption. Using the Panel smooth transition regression model, [Chiu and Lee \(2020\)](#) reported similar findings for 79 OECD and non-OECD countries. The findings confirmed that the banking sector development has a larger impact on energy consumption. [Ciftci et al. \(2020\)](#) found similar results for emerging markets using the Toda-Yamamoto method on time series data covering the period from 1971 to 2014. [Ma and Fu \(2020\)](#) carried out a similar study for 120 selected developing and developed countries. The study employed a generalised method of moments on panel data, covering the period from 1991 to 2014. The findings confirmed that financial development leads to an increase in energy consumption.

[Prempeh \(2023\)](#) examined the impact of financial development on renewable energy consumption in Ghana. The study applied the ARDL bounds testing approach, Gregory, Bayer-Hank, FMOLS, CCR, DOLS and VECM on time series data covering the period from 1990 to 2019. The findings confirmed a positive impact of financial development on energy consumption. [Habiba and Xinbang \(2023\)](#) investigated the impact of financial development on renewable energy using data from seven emerging (E7) countries. Employing the Method of Moments Quantile Regression (MMQR) the study found overall financial development, financial market-related development and financial institution-related development to have a positive impact on renewable energy. However, the effect was found to be greater with financial market-related development. In the same spirit, [Sun, Zhang and Gao \(2023\)](#) analysed the impact of financial development on renewable energy for 103 economies using data from the period 1991-2014. Using the dynamic panel model, the study found financial development to have a positive impact on renewable energy consumption. Financial development was found to promote renewable energy consumption more in developed economies. A summary of the empirical studies is given in Table 1.

**Table 1.** Literature review on the impact of financial development on energy consumption

<b>Author and date</b>	<b>Country</b>	<b>Estimation techniques</b>	<b>Financial development indicators</b>	<b>Conclusion [The impact of financial development on energy consumption]</b>
Sadorsky (2010)	22 Emerging countries	GMM estimation techniques	Stock market variables Banking variables Foreign direct investment	The positive effect when stock market variables are used
Brunnschweiler (2010)	Non-OECD developing and transition economies	GMM	Banking Sector variables	Positive effect
Çoban and Topcu (2013)	27 European countries	GMM	Stock market variables Banking sector variables	Positive effect for new EU member An inverted U-shaped pattern confirmed for old members when banking variables are used
Islam et al (2013)	Malaysia	ARDL bounds testing approach	Banking sector variables	Positive effect
Komal & Abbas (2015)	Pakistan	system GMM estimation technique	Banking sector variables	Positive effect
Furuoka(2015)	Asian countries	Panel cointegration test	Banking sector variables	Positive effect
Kakar (2016)	Pakistan and Malaysia	Johansen cointegration and error correction techniques	Banking Sector variables	Positive effects in the long run
Anton and Nucu (2020)	28 countries in the European Union (EU)	Fixed effects regression model	- Bank-based financial sector variables -Stock market development variables	Positive effect
Gates et al (2019)	MENA countries	Dynamic panel GMM model	Banking Sector variables	Positive effect
Razmi et al (2020)	Iran	ARDL model	Stock market variables	Positive effect

Author and date	Country	Estimation techniques	Financial development indicators	Conclusion [The impact of financial development on energy consumption]
Chang (2015)	53 high- and non-high-income countries	Fixed-effects linear regression model; 1999 -2008	Banking Sector variables Stock market variables	Positive effect in all groups when banking sector variables are used. Negative effect in advanced economies when stock market development is used. Positive effect in emerging and developing countries when stock market development is used.
Mukhtarov et al (2020)	Kazakhstan	Johansen cointegration and error correction techniques 1993 to 2014	Banking Sector variables	Positive effect
Chiu and Lee(2020)	34 OECD countries	PSTR model with fixed effects; 1984 - 2015	Banking Sector variables Stock market variables	Positive effect
Durusu-Ciftci, Soytaş & Nazioğlu (2020)	Emerging markets	Toda-Yamamoto method; 1971 - 2014	Banking Sector variables	Positive effect
Ibrahim, Bukonla & Jamiu (2021)	Nigeria	ARDL Bounds cointegration approach; 1971 - 2014.	Banking Sector variables	Positive effect
Prempeh (2023)	Ghana	ARDL bounds testing, Bayer-Hank, Gregory and Hansen cointegration, VECM, FMOLS, CCR and DOLS tests; 1990 - 2019.	Financial development index	Positive effect

Source: Authors' compilation

### 3. MATERIAL AND METHODS

This study used the ARDL approach to estimate the link between finance and renewable energy consumption. The technique was used owing to the numerous advantages that it has over other modern time-series techniques.

#### Variables

The key variables used in this study include financial development measured by an index from the IMF financial database and renewable energy (REW) measured as a percentage of final energy consumption. Other variables included in our model as control variables include economic growth, urbanisation and trade. The definitions of these variables and our data sources are presented in Table 2.

**Table 2.** Variable description and source

Variable		Definitions of variable (Measurement)	Source
Renewable energy consumption	REW	Renewable energy consumption as a share of total final energy consumption	WDI
Financial development	FDI	Financial development Index	IMF
Economic growth	ECOG	Rate of change of GDP	WDI
Urbanisation	URB	Population living in urban areas as a proportion of the population	WDI
Trade	TOP	Exports +Exports/GDP	WDI

WDI = World Bank Development Indicators of the World Bank.

IMF = International Monetary Fund Database

Source: Authors' compilation

#### Model Specification

The general model used in this study can be presented as follows:

$$REW = \pi_0 + \pi_1 FDI + \pi_2 ECOG + \pi_3 URB + \pi_4 TOP + \varepsilon_t \dots\dots\dots (1)$$

Where:

*REW* = Energy consumption measured by renewable energy

*FD* = Financial sector development

*ECOG* - Economic growth

*URB* = Urbanisation

TOP - Trade openness

The ARDL-bounds model specification is given in Equation 2.

$$\Delta REW_t = \pi_0 + \sum_{i=1}^n \pi_{1i} \Delta REW_{t-i} + \sum_{i=0}^n \pi_{2i} \Delta FD_{t-i} + \sum_{i=0}^n \pi_{3i} \Delta URB_{t-i} + \sum_{i=0}^n \pi_{4i} \Delta TOP_{t-i} + \vartheta_1 REW_{t-1} + \vartheta_2 FDIX_{t-1} + \vartheta_3 URB_{t-1} + \vartheta_4 TOP_{t-1} + \eta_{1t} \dots\dots\dots(2)$$

Where:

$\pi_0$  = Constant

$\pi_{1i}$ - $\pi_{4i}$  = Short-run coefficients

$\vartheta_1$ - $\vartheta_4$  = Long-run coefficients

$\eta_{1t}$  = Error term.

**Error Correction Model Specification**

In the ARDL approach, cointegration is tested on the variables in Equation 1 in order to establish whether a cointegration relationship exists between REW and its regressors. By using this approach, estimation involves a test of cointegration. Upon confirmation of cointegration, the ECM model can be specified as follows:

$$\Delta REC_t = \pi_0 + \sum_{i=1}^n \pi_{1i} \Delta REW_{mt-i} + \sum_{i=0}^n \pi_{2i} \Delta FDIX_{t-i} + \sum_{i=0}^n \pi_{3i} \Delta ECOG_{t-i} + \sum_{i=0}^n \pi_{4i} \Delta URB_{t-i} + \sum_{i=0}^n \pi_{5i} \Delta TOP_{t-i} + \rho_1 ECM_{t-1} + \mu_{1t} \dots\dots\dots(3)$$

Where *ECM* is the error correction term;  $\rho_1$  is the coefficient of the *ECM*. The coefficient of the error correction term is expected to be negative and less than one (1).

**4. RESULTS AND DISCUSSIONS**

**Unit Root Test**

The results of the unit root test based on the Dickey-Fuller Generalised Least Squares (DF-GLS) test and the Phillips-Perron (PP) test are reported in Table 3.

**Table 3.** Unit Root Test Results

<b>Panel 1: Dickey-Fuller Generalised Least Squares (DF-GLS)</b>				
Variable	Stationarity of all Variables in Levels		Stationarity of all Variables in First Difference	
	Without Trend	With Trend	Without Trend	With Trend
REW	0.1481	-1.3157	-4.3998***	-5.1551***
FD	-1.2448	-1.1169	-5.3159***	-5.4109***
ECOG	-3.6226***	-3.9050***	-	-
URB	-2.0316**	-3.6358**	-	-
TOP	-0.9146	-2.5032	-5.6435***	-5.8772***

<b>Panel 2: Phillips-Perron (PP)</b>				
Variable	Stationarity of all Variables in Levels		Stationarity of all Variables in First Difference	
	Without Trend	With Trend	Without Trend	With Trend
REW	0.4394	-0.5870	-4.8712***	-8.2515***
FD	-1.2602	0.7441	-5.2236***	-5.2170***
ECOG	-3.5423**	-3.9047**	-	-
URB	-1.7948	-2.0209	-5.7055***	-6.7541***
TOP	-0.8289	-2.4979	-5.6626***	-6.1858***

Note: \*, \*\* and \*\*\* denote stationarity at 10%, 5% and 1% significance levels respectively.

Source: Authors' compilation

All the variables included in the model are either I(0) or I(1), according to the results reported in Table 4. This implies that we can now proceed to use the ARDL to examine the cointegration relationship between renewable energy and its regressor. The results of cointegration are reported in Table 4.

**Table 4.** Cointegration Results

Dependent variable	Function		F-statistic		Cointegration Status	
REW	F(REW FD, ECOG, URB, TOP)		4.720***		Cointegrated	
Pesaran <i>et al.</i> (2001), Table CI(iii), Case III, p.300.	<b>1%</b>	<b>5%</b>	<b>10%</b>			
	I(0)	I(1)	I(0)	I(1)	I(0)	I(1)
	3.74	5.06	2.86	4.01	2.45	3.52

Note: \*\*\* denotes statistical significance at the 1% level.

Source: Authors' compilation

The results reported in Table 4 confirmed the presence of cointegration in the model. This implies that our model should be estimated in short- and long-run timeframes.

The optimal lag length used in this study was selected based on the Akaike Information Criteria (AIC), which gave the most parsimonious model. The model lag selection was (1, 1, 2, 0, 1,) for renewable energy (REW), financial development (FD), economic growth (ECOG), urbanisation (URB) and trade openness (TOP), respectively. Results from the estimation are presented in Table 5.

**Table 5.** Short run and Long run results

Regressors	Coefficient	T-ratio
<b>Panel A – Long run Results</b>		
C	23.528***	4.680
FD	0.7100*	1.8640
ECOG	0.2979*	2.0973
URB	-0.8233	-1.1274
TOP	0.0604	0.3619
<b>Panel B – Short-Run Coefficients</b>		
DFD	0.1378**	2.3607
DECOG	-0.1014	-0.6079
DECOG1	0.5385***	3.1443
DURB	-0.2638**	-1.9841
DTOP	0.1060**	2.2245
ECM (-1)	-0.3204***	-3.2984
R-squared – 0.7021		
S.E of Regression – 1.2320		
Akaike Info Criterion – -51.0674		
R-Bar Squared – 0.6252		
F-Stat (10, 28) – 4.7488[0.001]		
Schwarz Bayesian Criterion – -57.9039		
DW-statistic – 1.9726		

Note: \*\*\*, \*\* and \* denote stationarity at 1%, 5% and 10% levels of significance, respectively.

Source: Authors' compilation

The results presented in Table 5 confirmed that finance has a positive effect on renewable energy consumption in Kenya in the short and long run. This is confirmed by a significant coefficient for financial development at 10% in the long run and 5% in the short run. These results suggest the reliance of Kenyans on renewable energy financing from the financial sector. This finding is consistent with previous studies, such as Prempeh, 2023; Gaies et al., 2019; Chang, 2015; Islam et al., 2013, among others.

Other results show that economic growth has a positive impact on renewable energy in the long run only. This confirms the importance of growth as a source of income to households and firms, thereby creating the financial ability to

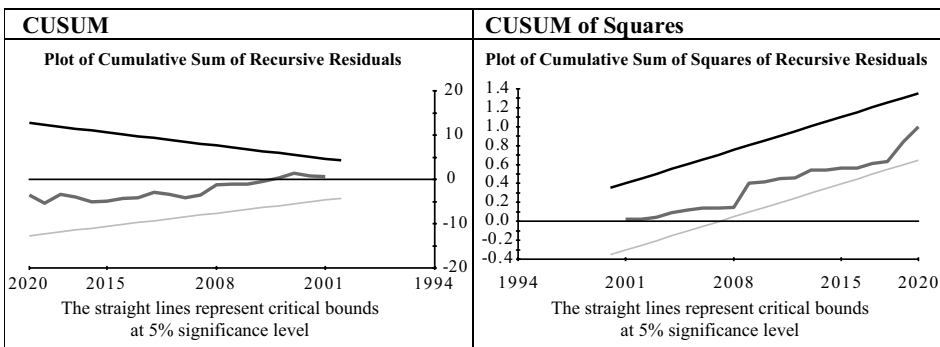
consume cleaner energy. The impact of urbanisation on renewable energy was, however, found to have a negative impact, but in the short run only. The study found trade openness to have no significant impact on renewable energy demand, irrespective of the time considered. The model is a good fit with an explanatory power of 70%. The error correction (ECM) rate of adjustment whenever there is a disequilibrium in the economy was found to be -0.320 with a negative sign as expected and significant at 1%. It takes slightly over three years for the economy to get back to equilibrium after a disequilibrium in the economy, according to the findings of this study. Diagnostic results are reported in Table 6 and Figure 2.

**Table 6.** Diagnostic Results

LM Test Statistic	Results
Serial Correlation	0.021 [0.883]
Normality	0.481 [0.786]
Functional Form	1.114 [0.291]
Heteroscedasticity	1.224 [0.269]

Source: Authors’ compilation

The results reported in Table 6 confirm that the model is free from serial correlation. It also shows that the model has passed other diagnostic tests, such as functional form, normality test and heteroscedasticity. Figure 2 also confirms that the model is stable at 5% level of significance.



Note: 5% level of significance

**Figure 2.** Stability Tests  
Source: Authors’ compilation

## 5. CONCLUSIONS

This study examined the impact of financial sector development on renewable energy consumption for Kenya during the period between 1990 and 2020. The motivation behind this study was to find out whether financial development has played any significant role in Kenya's journey to successful cleaner energy use. Financial development was measured by the financial index computed by the IMF, which incorporates both bank-based and market-based indices. To fully specify the model, growth, trade openness and urbanisation were added to the model as control variables. Employing the ARDL approach, the study found financial development to spur renewable energy consumption in Kenya, irrespective of the time considered. The findings of this study confirm the important role that financial development can play in fast-tracking the country's journey to clean energy use and in the reduction of its carbon footprint. It is recommended that Kenya should continue to educate its population on clean energy sources and to buttress green financial development. Furthermore, it is important for the government to increase financial inclusion to broaden financial access for projects aligned with renewable energy.

### Conflict of Interests

The authors declare there is no conflict of interest.

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## УТИЦАЈ ФИНАНСИЈСКОГ РАЗВОЈА НА ПОТРОШЊУ ОБНОВЉИВЕ ЕНЕРГИЈЕ У КЕНИЈИ

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### САЖЕТАК

Сврха: Повећање свијести о посљедицама глобалног загревања, заједно са позивом свим земљама да преузму одговорност за смањење свог угљичног загађења преласком на чистију употребу енергије, мотивисали су ову студију да испита утицај развоја финансијског сектора на обновљиве изворе енергије за Кенију. Студија има за циљ да одговори на питање: „Може ли развој финансијског сектора помоћи Кенији да повећа потрошњу обновљиве енергије?“ Студија је користила годишње податке од 1990. до 2020. да би испитала природу односа између ове двије варијабле. Методологија: Студија је користила приступ ауторегресивног дистрибуираног кашњења (АРДЛ). Резултати: Студија је показала да финансијски развој има позитиван утицај на потрошњу обновљиве енергије у кратком и дугом року. Закључци: Резултати указују на значајну улогу коју финансијски сектор има у искориштавању ресурса за пројекте чистије енергије. Препоруке: Према томе, креатори политике у Кенији треба да искористе потенцијал финансијског сектора земље како би испунили циљеве одрживог развоја који су усклађени са чистијом потрошњом енергије.

**Кључне ријечи:** *Кенија, финансијски развој, обновљива енергија, потрошња енергије, ауторегресивно дистрибуирано кашњење*