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Role of Energy Consumption on Economic Growth: Evidence from Nepal

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Abstract

Purpose: *The study aims to investigate the role of energy consumption, especially petroleum and electricity consumption, alongside gross capital formation on the economic growth of Nepal.*

Methods: *The study applies econometric analysis using time series data from 1980/81 to 2023/24. The analysis starts with the Augmented Dickey-Fuller test to check for the stationary data, the Johansen cointegration test for long-run relationships, and Granger causality test to ascertain the direction of causality among the variables.*

Results: *The finding reveals that there is a long-run relationship between the variables. Vector Error Correction Model result reveals that GCF serves as a primary adjusting variable in long run after short run shocks. Petroleum consumption and gross capital formation have positive significant on GDP in short run but electricity consumption shows less impact on short run. Granger causality result suggests that there is unidirectional causality from GDP to GCF, GCF to EC, and PC to GCF. Also, a bi-directional causality in PC and EC, but no direct causality from energy consumption to economic growth.*

Conclusion: *Energy consumption is an influencing factor in the economic growth of Nepal. The result suggests diversifying energy sources, reducing dependence on petroleum, and strengthening investment in energy sector to increase the economic growth of the country to achieve sustainable and balanced growth.*

Keywords: Electricity consumption, Petroleum consumption, Gross capital Formation, Gross domestic product, Cointegration analysis

JEL Classification: Q43, Q44, O13

I. Introduction

Energy is one of the most critical drivers of modern economic development. It provides power to all industrial manufacturing, transport, and communication at the same time as basic service delivery in health and education. The relationship between growth in energy use and economic growth is very close and mostly direct. The International Energy Agency

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(IEA) conducted a study in 2022 and forecasted that a huge increase in global energy consumption would occur by 2040, mainly due to the rise in population, urbanization, and trends in economic growth. At the global level, many studies have been conducted to prove that energy should not be taken as an output of economic activity but rather as an input that gives propulsion to it (Stern, 2011; World Bank, 2020).

The role of energy in the economic development of South Asia is increasing day to day due to the excessive use of energy at various sector. The energy demand continuously rising in SAARC nations due to industrialization, urbanization, and growth in the population. However, the region is facing several challenges in the production and availability of energy. In Nepal, energy has been a problem and a golden opportunity for centuries. According to the 2021 report by Water and Energy Commission Secretariat (WECS), the country is blessed with hydropower potential, being in excess of 83,000 MW but over 60% of the energy used is derived from traditional biomass sources, such as firewood, crop residue, and animal dung, (MoEWRI, 2022) Rapid electricity production has increased access to over 95% since 2022, yet actual electricity consumption is low at approximately 300 KWh per capita per annum (IEA, 2022), which implies that this energy has not been harnessed for productive economic uses, such as its industry or improved agriculture. The purpose of this research is to empirically examine the relationship between energy consumption specifically electricity and petroleum usage and economic growth in Nepal, with gross capital formation also considered as a critical driver of output.

Many studies have tried to clarify the relationship between energy consumption and economic growth at the international and regional levels. Vidyarthi (2015) examined the relationship between energy consumption and economic growth for a panel of five south Asian countries including Nepal. Parajuli et al. (2014) investigated the future primary energy consumption in Nepal. Sim and Kun (2025) study about energy- economic growth nexus in low verses high income economies. Kraft and Kraft (1978) identify the relationship at first in USA. While other studies by Odhiambo (2009); Apergis and Payne (2010) have given varying results about the growth hypothesis, conservation hypothesis, or feedback hypothesis. However, the earlier studies conducted in Nepal relied on simple OLS techniques without considering advanced techniques like ARDL, cointegration and granger causality. Also, the recent research conducted using advance techniques are based on short term time series data, limiting their ability to find long run dynamics.

The findings of the study can be used to make investment decisions, improve energy security, and support Nepal's long-term development objectives. This paper will provide new framework on energy's role in economic development, by contributing fresh analysis from the perspective of Nepal. Since it delves into the causality of energy consumption in relation to GDP, using a methodologically rigorous approach based on up-to-date data, hence it can be of great use while formulating the national energy policy, in investment planning, and in aligning the flow of energy resources in Nepal to an economy carved out along sustainable and equitable growth.

II. Reviews

Literature review involves analyzing and critically assessing previous study to identify similarities and differences. It encompasses discussing major findings and reviewing the methodologies used in previous research on the effect on energy consumption on economic growth in Nepal.

Thematic Review

The focus of this study was on the central theme of the energy and economic growth nexus of Nepal. This study shows how the consumption of energy, particularly electricity and petroleum, and gross capital formation, influence economic performance as shown by GDP. Among these are the energy transition in Nepal, the energy dependency related challenges, and the importance of investing in energy infrastructure as one strong theme of equally

crucial importance is the duality in the role energy plays, being a driving factor of industrial growth and at the same time import reliance of country, especially with petroleum products. Development sustainability is, therefore, a main subject, long-term growth of an economy depends on the availability of energy and effective capital formation. Directionality in causality between variables has also been quite elaborated in this study on whether growth is caused by energy consumption or vice versa, applying econometric testing. The themes put together make a very broad basis of the understanding for the energy-growth-investment dynamic in the changing economic landscape of Nepal.

Theoretical Review

The causality between energy consumption and economic growth has been the central concern of economic literature for several decades as various theoretical models attempted to identify the direction and magnitude of the two variables' causality. Given Nepal's situation where energy consumption and economic development are undergoing rapid transformation, it is significant to appreciate these theories in attempting to develop efficient policy interventions. This review is theoretical, discussing major hypotheses and their relevance to Nepal's energy and economic growth dynamics.

The Growth Hypothesis

According to this theory, energy is essential for industrialization, transportation, and expansion of the service sector, which contribute economic activity. The hypothesis assumes that increased energy use, particularly electricity and petroleum consumption, enhance productivity, industrial output, and enhances GDP growth, Apergis and Payne (2010). Studies such as that of Ghosh (2010) argue that energy is at the core of optimizing the productivity of production, which can translate into higher economic output.

The Conservative Hypothesis

This assumption suggest that as an economy grows, energy consumption is likely to increase naturally with more industrial output, higher levels of transport, and more energy-intensive services. Economic growth, in this perspective, leads to energy consumption, not the other way around (Stern, 2011).

The Feedback Hypothesis

According to this theory, economic growth not only increases energy demand but also provides the resources of finance and technology to raise energy supply, creating a two-way relationship that stimulates more economic activity (Ozturk, 2010).

The Neutrality Hypothesis

The hypothesis states that energy consumption and economic activity have nothing to do with each other and shifts in energy consumption might not necessarily affect economic growth (Stern, 2011).

Empirical Review

Different research was conducted by scholars and policy makers by using these four variables and the variety of study shows different results. Bastola and Sapkota (2015) examined the relationship among energy consumption and economic growth in Nepal, which shows the existence of long run cointegrating relationships among the variables. Sim and Sek (2025) analyzed the energy- growth nexus in low versus high- income economies by taking data from 1990 to 2019 and found that the long-run relationship exists but impact of electricity consumption on economic growth is weaker in low-income economies like Nepal. Vidyarthi (2015) conducted study to examine the relationship between energy consumption and economic growth and found that there is unidirectional causality running from energy consumption and gross capital formation to gross domestic product. Dhungel (2008) conducted research on regional energy trade in South Asia including Nepal, which reveals the existence of unidirectional causality running from gross domestic product and energy consumption. Dhungel (2009) analyzed the relationship between energy consumption and

economic growth and found that there is no direct causality from energy consumption to gross domestic product.

Tang et al. (2016) investigate in their given case involving energy consumption from 1971 to 2011. According to their research, there is a stable and long-run relationship exists between energy consumption and economic growth. Pirlogea and Cicea (2012) examine the relationship between energy consumption by fuel and economic growth in comparative analysis, which shows the relation is unidirectional and natural gas increase economic growth in short-run. Apergis and Payne (2010) investigated a few South Asian nations, including Nepal, by panel data methods. Their result elucidated that energy consumption was positively associated with economic growth in all the South Asian countries, most significantly in the long run, consistent with the Growth Hypothesis. Eggoh et al. (2011) examined the relationship between energy consumption and economic growth for 21 African counties from 1970 to 2006. According to the research, increase in energy consumption increase growth and vice versa from both importers and exporters.

III. Methodology

The research examines the impact of electricity consumption, petroleum consumption, and gross capital formation on the gross domestic product of Nepal. Data spanning from 1980/81 to 2023/24, collected from the official websites of Nepal Rastra Bank and the World Bank, forms the basis of the analysis. Yearly data was utilized to measure each variable. GDP is measured in millions to reflect real economic growth, while electricity consumption and petroleum consumption are measured in tons of oil. Although, electricity is typically measured in kWh or MWh, the Nepal Rastra Bank publishes energy statistics in tons of oil equivalent (TOE) following national reporting standards. Accordingly, the study uses the electricity consumption data in TOE as provided by NRB. Gross capital formation is in millions to measure the level of investment in the economy.

The research approach was explanatory, aiming to elucidate the relationship between the economic growth and the energy consumptions over the period of 43 years. Hypotheses were formulated to test the significance of independent variables on dependent variables. The analysis plan involves descriptive statistics of the variable, followed by correlation, regression, unit root test, residual diagnosis, co-integration test, and causality test. While OLS regression was initially conducted to explore relationships, the main estimation relies on the Johansen cointegration test to capture long-run equilibrium relationships of variables. Despite having 43 years data, the study used Johansen cointegration test because all the variables are integrated at order on I(1) and the test efficiently examines long run relationship among multiple interdependent variables.

Method of Analysis

The method of analysis typically depends on the nature of the research and the type of data collected. Quantitative analysis was done for the numerical estimation of data through statistical methods used to analyze numerical data to identify relationships, trends, or differences between variables. EViews was used for data analysis, facilitating the extraction of necessary information and results through pre-diagnostic and post-diagnostic tests.

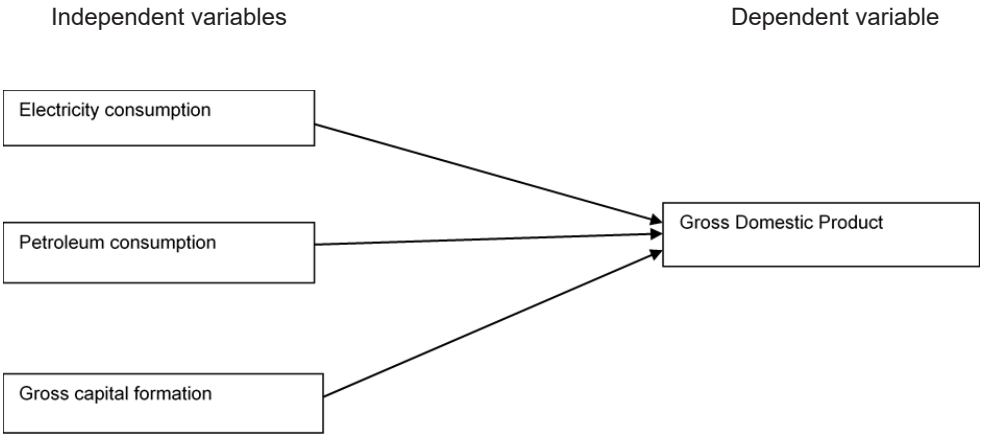
Pre-Diagnostic Test: Before estimating the relationship between energy consumption and economic growth, it is essential to conduct pre-diagnostic tests. These will begin with unit root tests, such as the Augmented Dickey-Fuller (ADF) test, which check whether the time series variables, electricity consumption, petroleum consumption, gross capital formation, and GDP are stationary or not by testing the hypothesis. Identifying the order of integration (I(0) or I(1)) helps in selecting the appropriate econometric model, such as the ARDL model or the Johansen cointegration framework.

Post-Diagnostic Test: After the model has been estimated, a series of post-diagnostic tests was applied to verify the robustness of the results and ensure that classical regression

assumptions hold. These include the Breusch-Godfrey LM test for detecting serial correlation in the residuals and the Breusch-Pagan for checking heteroskedasticity. To confirm the assumption of normality in residuals, the Jarque-Bera test is used.

Figure 1

Research Framework



Note: Adopted from Shahbaz and Lean (2012)

Econometric Model

Using the dependent and independent variable the following function is specified:

Gross Domestic Product (GDP) = f(Electricity consumption, Petroleum consumption, Gross capital Formation) ----------(1)

To make our equation linear and so that the coefficient on the variables are directly interpretable as approximate proportional difference, we have to transfer them into log as shown below

$$lnGDP = \beta 0 + \beta 1 lNEC + \beta 2\, lNPC + \beta 3\, lNGCF + e \quad \text{..... (2)}$$

Where,

lngdp= log of gross domestic product (economic growth)

lngcf = log of gross capital formation

lnpc = log of petroleum consumption

lnec = log of electricity consumption

μ = error term

β_0 = is intercept

β_1, β_2, β_3 are the parameters.

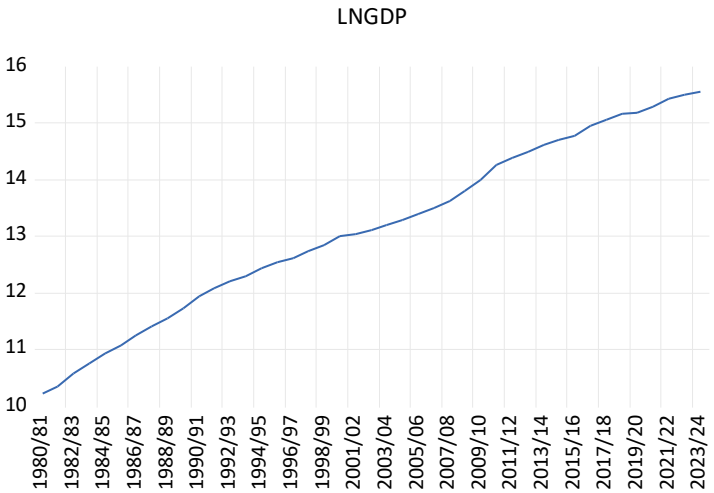
IV. Results and Discussion

This chapter includes the results of the analysis conducted to examine the relationship between energy consumption and economic growth in Nepal. The results are based on time series data, which follows the econometric methods that are outlined in the previous chapter.

Trend Analysis of Log-transformed Variables

Figure 2

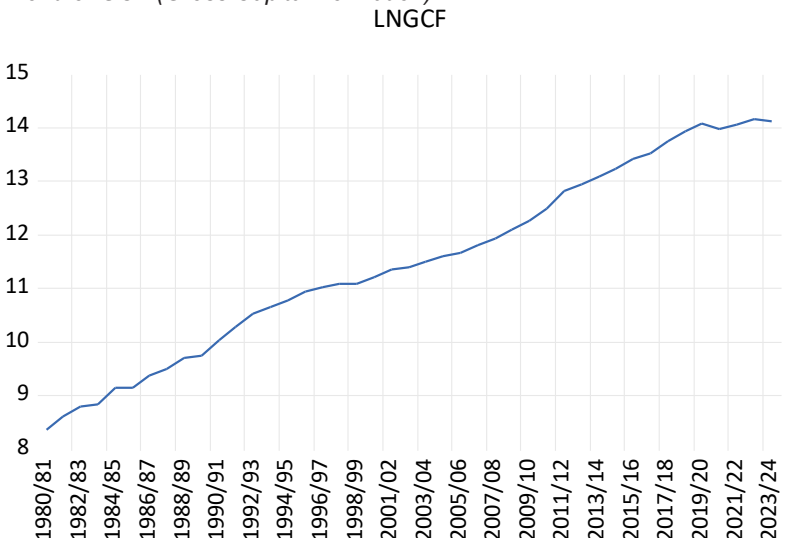
Trend of GDP (Gross Domestic Product)



The graph shows consistent upward movement of the gross domestic product of Nepal, particularly after 2010, which is because of expansion in remittance and increase investment in infrastructure and hydropower projects. At the mid-2000s, the graph reflects a relative slowdown because of socio-political instability. Despite the earthquake at post 2015, the economy shows resilience with steady growth. The graph overall reflects the positive economic development in Nepal and provides a stable foundation for econometric analysis of the energy-growth relationship.

Figure 3

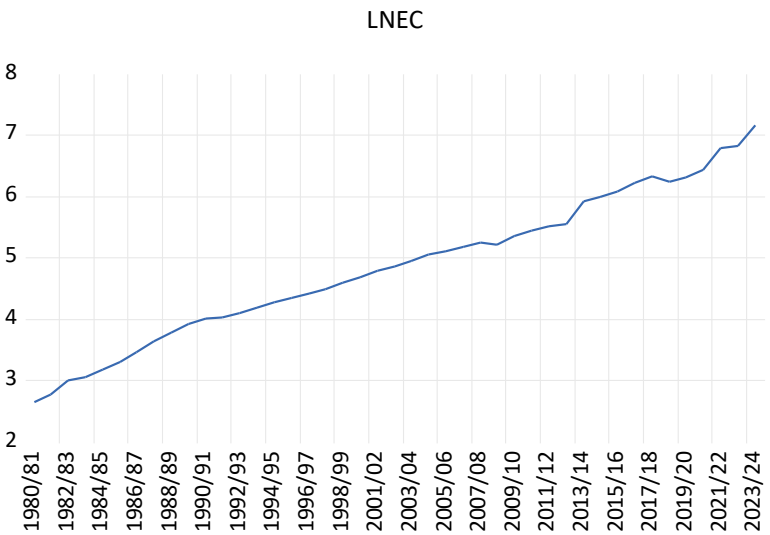
Trend of GCF (Gross Capital Formation)



The graph shows the trend of gross capital formation after transferring into log. The data series over the observed time period shows a consistent upward trend, with certain fluctuations. 1990s were marked by low and volatile gross capital formation because of political instability. The global financial crisis in 2008 slowdown investment and also in 2015 the investment declines because of earthquake. Following a dip during COVID-19 pandemic, now the GCF is rising because of increase of remittance, government projects and private sector investment. The stable and increasing trend of gross capital formation justifies it as a critical driver to increase the economic growth of Nepal.

Figure 4

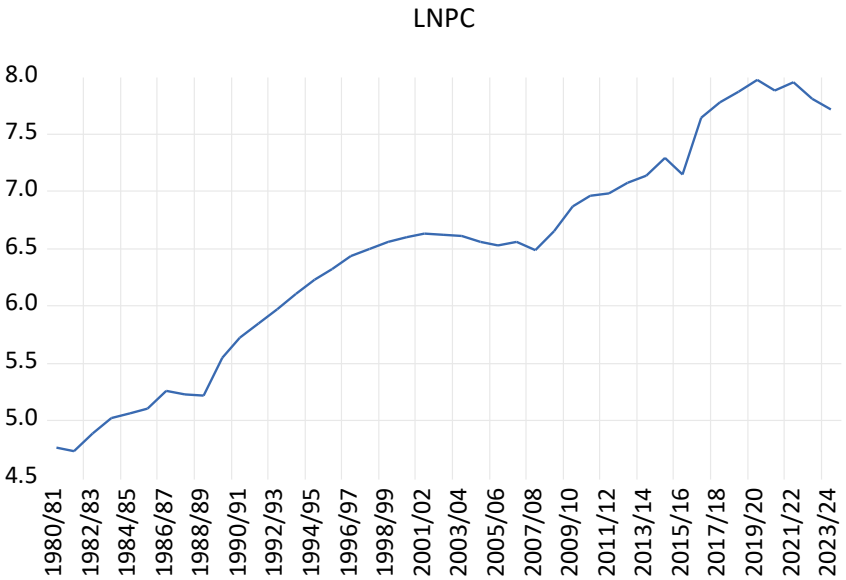
Trend of LNEC (Energy Consumption)



The graph clarifies the energy consumption is increasing continuously, with reflecting both the rise in demand and expansion of generating capacity. From the 1990s the consumption of electricity is rising slowly and after 2010, consumption increases with the development of large-scale hydropower projects and greater industrial demand. The COVID-19 pandemic caused a minor slowdown in industrial and commercial electricity use but demands remain stable. In 2022,2023 energy consumption have a strong growth, increased in hydropower output and higher industrial activities.

Figure 5

Trend of Petroleum Consumption



The graph shows the log-transformed consumption of petroleum in Nepal by year, extrapolating trends in Nepal's reliance on petroleum products. The trend shows a general increase in petroleum consumption, with specific acceleration after the first few years of the 2000s. This is reflected in increasing transport requirements, industrialization, and urbanization. The dramatic spikes in certain years may be due to increasing importation of automobiles, construction activity, and liberalization of trade. But there is a mild downward or flat trend that can be noted, possibly correlating to economic downturns, political unrest, or world oil price increases. The past few years project high but comparatively unstable levels of petroleum consumption, suggesting increasing dependence that can overstretch Nepal's trade balance and energy security.

Descriptive Statistics

Table 1

Descriptive Statistics of the Variables

	GDP	GCF	EC	PC
Mean	1326705	323038.1	235.2581	970.4465
Maximum	5704840	1403804	1090.000	2894.500
Minimum	27310.00	4299.00	14.00000	113.0000
Std.dev	1644461	445729.5	265.4247	860.1467
Skewness	1.316724	1.392041	1.640130	1.128722
Kurtosis	3.49929	3.4482	5.02272	2.983283
Jarque-Bera	12.87194	14.2473	26.60933	9.130936

The descriptive statistics indicate that all variables rise significantly with time, as is evident from their huge range between the minimum and maximum points. High standard deviations illustrate enormous variability, particularly for GDP and GCF. All variables are positively skewed, which means that the smaller values occur more frequently with some outlier high values. Electricity consumption has a peaked distribution (high kurtosis), while others are close to normal. The Jarque-Bera test result shows that none of the variables are normally distributed, which justifies the need for log transformation.

Correlation Analysis

Table 2

Corelation Analysis of the Variables

Co-relation	GDP	GCF	EC	PC
GDP	1.0000			
GCF	0.9890	1.0000		
EC	0.9851	0.9619	1.0000	
PC	0.9670	0.9742	0.9359	1.0000

The above correlation result reveals the strong relation between economic growth and energy consumption. GDP is highly correlated with GCF (0.9898), EC (0.9851), and PC (0.9670), which indicates that economic growth moves closely with energy consumption. The overall result shows strong interconnections among GCF, EC, and PC, suggesting their combined contribution to Nepal's economy. Also, the result shows the existence of high correlation between the independent variables, which shows the possibility of multicollinearity. To address this issue the Variance Inflation Factor (VIF) test is employed in the study.

Unit Root Test

Table 3

Result of Augmented Dickey Fuller (ADF) Rest at I (1)

Variable	Trend t-stat (p value)	Trend and intercept t-stat (p value)
DLNGDP	-4.0335(0.0031)	-4.7121(0.0026)
DLNGCF	-5.7023(0.0000)	-5.8527(0.0001)
DLNPC	-6.6702(0.0000)	-6.7202(0.0000)
DLNEC	-6.9400(0.0000)	-6.8454(0.0000)

The Augmented Dickey-Fuller (ADF) test is done to check the stationary of variables. In this study, the result reveals that all the variables (GDP, GCF, EC and PC) are non-stationary at levels, meaning that their mean and variance change overtime. To address this, all the variables are transferred at first difference after which they became stationary. The DLNGDP, DLNGCF, DLNEC and DLNPC are stationary at two models, i.e. ("trend" and "trend and intercept") with p-value less than 5%. The overall results suggest further time series analysis.

Regression Analysis

Table 4

Result of Regression Analysis

Variables	Coefficient	p-value
dlngcf	0.1775	0.0305
dlnec	0.1199	0.1749
dlnpc	0.1635	0.0113
C	0.0781	0.0000
R-square	0.2882	
F(stats)	0.0044	
D-W test	1.6986	

The regression analysis shows that Gross Capital Formation, and Petroleum Consumption have a significant positive impact on Gross Domestic Product with the p-value less than 0.05, while electricity consumption is not significant in short run. The model explains approximately 29% of the variation in dependent variable is explained by independent variable with = 0.2882, as GDP is influenced by many other factors which are not taken in the model. The Durbin-Watson statistic test shows that there is no any issue of serious autocorrelation. Also, the F-test (p=0.0044) which confirms that the whole model is significant.

Table 5

Variance Inflation Factors

Variable	Coefficient variance	Uncentered VIF	Centered VIF
DLNGCF	0.006239	3.446481	1.022664
DLNEC	0.007528	2.689595	1.014443
DLNPC	0.003770	1.455212	1.015810
C	0.000271	5.618497	NA

The above table shows the results of Variance Inflation Factor (VIF). The results shows that multicollinearity is not a serious concern in the model as the Variance Inflation Factor values of all the independent variables are below the critical threshold of 10. So, the estimated coefficient can be considered to be reliable.

Cointegration Analysis

Table 6

Result of Cointegration Analysis

Johansen Co-integration Analysis

Unrestricted Cointegration Rank Test (trace)

Hypothesized no of CE(S)	Trace statistic	0.05 critical value	Prob
None	52.2975	47.8561	0.0180
At most 1	19.4543	29.7970	0.4606
At most 2	8.2661	15.4947	0.4373
At most 3	2.4295	3.8414	0.1190

Unrestricted cointegration rank test (maximum eigenvalue)

Hypothesized no of CE(S)	Mix eigen statistic	0.05 critical value	Prob
None	32.8431	27.5843	0.0095
At most 1	11.1881	21.1316	0.6284
At most 2	5.8366	14.2646	0.6342
At most 3	2.4295	3.8414	0.1190

The Johansen cointegration test confirms one cointegrating relationship among gross domestic product, gross capital formation, petroleum consumption and electricity consumption. In the trace statistics, one equation indicates a cointegrating relationship with p-value below 0.05, suggesting that these variables are closely interconnected over time. The maximum eigen value also supports at least one cointegration between the variables, as the eigen statistic (32.8431) is above the critical value and the p-value is 0.0095. The overall results show that there is strong long-run relationships that exist between the variables.

Error Correction Model

Table 7

Result of Error Correction Model

Error Correction:	D(LNGCF)	D(LNPC)	D(LNEC)
CointEq1	-0.2517(-5.7371)	0.1594(-1.7664)	0.0189(-0.3183)
D(LNGCF(-1))	0.2452(-2.1072)	0.0859(0.3589)	0.2945(-1.8639)
DLNGCF(-2))	0.0858(0.7534)	0.3815(1.6283)	0.2858(1.8481)
D(LNPC(-1))	0.3851(4.8078)	0.1006(-0.6108)	0.0886(-0.8147)
DLNPC(-2))	0.3276(3.7082)	0.0854(0.4701)	0.1553(-1.2948)
DLNEC(-1))	0.0751(-0.6298)	0.0417(-0.1699)	0.0737(-0.4547)
DLNEC(-2))	0.1686(1.4997)	0.1504(-0.6501)	0.0047(-0.0312)
C	4.7269(-5.5771)	3.0033(-1.7228)	0.2690(0.2338)
LNGDP	0.3610(5.6410)	0.2274(1.7274)	0.0297(0.3419)

The table shows the result of the Error Correction Model about how each variable, Gross Domestic Product, gross capital formation, electricity consumption, and petroleum consumption adjusts to long-run changes overtime. The result reveals the COINTEQ1 is statistically significant and negative in LNGCF equation with the coefficient of -0.25 indicates that approximately 25% of short run disequilibrium is corrected in each subsequent period. This confirms that GCF is most adjusting variable in long run following shocks. However, the petroleum consumption and electricity consumption are statistically insignificant, suggesting that these variables do not adjust in long run after short run shocks.

Granger Causality Test

Table 8

Result of Granger Causality Test

Direction of non-granger causality	F-stats	Prob
GCF	2.06655	0.1414
GDP	53.9331	1.E-11
EC	1.38234	0.2640
GDP	1.89990	0.1643
PC	0.00241	0.9976
GDP	1.95549	0.1562
EC	1.69840	0.1973
GCF	58.6025	5.E-12
PC	6.54304	0.0038
GCF	1.14357	0.3300
PC ≠> EC	4.57253	0.0170
EC ≠> PC	4.77845	0.0144

The Granger Causality analysis reveals an important insight into the dynamic growth and energy consumption in Nepal. The result reveals that there is unidirectional causality between GDP and GCF (Vidyarthi 2015), which indicates that economic growth significantly influences the investment level of Nepal. Higher GDP allows both public and private sector to invest in various sectors. This support growth hypothesis. Likewise, the GCF granger cause EC , which indicates that increase in investment in factories, construction projects and modern machinery require electricity which increase energy consumption. Similarly, the PC Granger cause GCF indicates that the petroleum remains critical input for productive investment. Also, the bi-directional causality between PC and EC suggest that, PC and EC are complementary energy sources. On the one hand, petroleum increases electricity demand as it fuels industrial machineries, transport, which increase electricity use and at the other hand, industries services and household consume more electricity they often require petroleum for complementary purposes such as backup generators, transportation of raw materials, etc. Overall, there is no direct causality between energy consumption to gross domestic product (Dhungel, 2009).

Residual Diagnosis

Table 9

Result of Residual Diagnosis

Description	Obj.	p-value
Breusch-Pagan-Godfrey (Heteroskedasticity)	1.0442	0.7905
Serial LM test (autocorrelation)	5.5719	0.0617
Jarque Bera (normality)	-	0.2193

The diagnosis test indicates that the assumptions of ordinary least square are satisfied. The Breusch-Pagan-Godfrey test is done to check the heteroscedasticity in variables and shows a p-value of 0.7905, which is more than 0.05, suggesting that the residuals are homoscedastic and have constant variance. The Breusch-Godfrey LM test for serial correlation has a p-value of 0.0617, which is more than 0.05, indicating that there is no significant autocorrelation in the residuals. Also, the Jarque-Bera test is conducted to check the normality in residuals. The p-value is 0.2193, which is more than 0.05, indicating that the residuals are normally distributed. Overall, the ordinary least square assumptions are not violated.

Discussions

The study confirms the existence of a long-run equilibrium relationship between gross domestic product, gross capital formation, electricity consumption, and petroleum consumption. The findings align with the (Bastola & Sapkota, 2015). Also, it confirms the growth hypothesis. The VECM test check the dynamics in variable and reveals that gross capital formation (GCF) is the key variable that adjust to restore in long run equilibrium with error correction term of -0.25, which indicates that about 25% of short run deviation is corrected each period. The petroleum consumption and gross capital formation have a significant positive impact on gross domestic product, highlights the role of petroleum as input for industries and construction sectors, but electricity consumption doesn't show a significant impact on gross domestic product in short-run, which can be because of underutilization of hydropower in productive sectors. The Granger Causality test result suggest that there is unidirectional causality from GDP to GCF which shows that economic expansion increase the investment, the causality of GCF on EC shows that increase in investment in industries and hydropower projects increase energy demand, the causality of PC on GCF reflects petroleum as a key input to fuel industries and transportation. Also, the bi-directional causality between petroleum consumption and electricity consumption clarifies that these two-energy source are complementary and need by industrial and service sector simultaneously, but there is no direct causality from energy consumption to economic growth. The finding is aligned with (Dhungel, 2009)

V. Conclusion and Implication

The study confirms the existence of long-run and short-run relationship between energy consumption and economic growth in Nepal. Specially, petroleum consumption and gross capital formation have a positive and significant impact on gross domestic product in the short run, while electricity consumption contributes more in long run. This suggest that petroleum is the immediate driver of transportation and industrial activities and electricity impact becomes more stronger when the investment in productive sector expands. The primary adjusting variable in the study is gross capital formation, which highlights the central role of investment in maintaining economic stability. Also, the granger causality test reveals unidirectional causality from GDP to GCF, GCF to EC, PC to GCF and bi-directional causality between EC and PC, but there is no direct causality from energy consumption to gross domestic product.

The positive and significant short-run impact of petroleum consumption highlights the present scenario of Nepal, where the country is dependent of imported petroleum. The electricity doesn't show high contribution on short run because of underutilization of energy on productive purposes. Over the long run, energy becomes more influencing factor and gross capital formation is the primary factor that correct economic imbalances. Therefore, the government and policymakers should focus on policies that promotes the productive use of electricity in industrial and manufacturing sectors. Nepal's heavy reliance on petroleum imports should be substitute through the promotion of electric vehicles, renewable alternatives and regional energy trade. Also, the investment should be increase in order to utilize the electricity and to increase more demand. The domestic electricity generation will not only strengthen energy security but also support Nepal to achieve sustainable and inclusive economic development.

References

Apergis, N., & Payne, J. E. (2010). Energy consumption and economic growth: Evidence from the Commonwealth of independent states. *Energy Economics, 38*(1), 650-655. https://doi.org/10.1016/j.enpol.2009.08.029

Bastola, U., & Sapkota, P. (2015). Relationships among energy consumption, pollution emission and economic growth in Nepal. Energy, 80, 254-262.

https://doi.org/10.1016/j.energy.2014.11.068

Dhungel, K. R. (2008). Regional energy trade in South Asia: problems and prospects. *South Asia economic journal*, 9(1), https://doi.org/10.1177/139156140700900108

Dhungel, K. R. (2009). Does economic growth in Nepal cause energy consumption. Journal of water, energy and environment, 5, 37-41, https://doi.org/10.3126/hn.v5i0.2485

Eggoh, J. C., Bangake, C., & Rault, C. (2011). Energy consumption and economic growth revisited in African countries. Energy Policy, 39(11), 7408-7421. https://doi.org/10.1016/j.enpol.2011.09.007

Ghosh, S. (2010). Examining carbon emissions and economic growth: Evidence from India. *Energy Policy, 38*(6), 3008–3014. https://doi.org/101016/j.enpol.2010.01.040

International Energy Agency. (2022). *World energy outlook 2022*. IEA Publications. https://www.iea.org/reports/world-energy-outlook-2022

Kraft, J., & Kraft, A. (1978). On the relationship between energy and GNP. *Journal of Energy and Development, 3*(2), 401–403.https://www.jstor.org/stable/24806805

Ministry of Energy, Water Resources and Irrigation (MoEWRI). (2022). *Energy sector synopsis report 2022*. Government of Nepal.

Odhiambo, N. M. (2009). Energy consumption and economic growth nexus in Tanzania: An ARDL bounds testing approach. *Energy Policy, 37*(2), 617–622. https://doi.org/10.1016/j.enpol.2008.09.077

Ozturk, I. (2010). A literature survey on energy–growth nexus. *Energy Policy, 38*(1), 340–349. https://doi.org/10.1016/j.enpol.2009.09.024

Parajuli, R., Østergaard, P. A., Dalgaard, T., & Pokharel, G. R. (2014). Energy consumption projection of Nepal: An econometric approach. Renewable Energy, 63, 432-444.

https://doi.org/10.1016/j.renene.2013.09.048

Pirlogea, C., & Cicea, C. (2012). Econometric perspective of the energy consumption and economic growth relation in European Union. *Renewable and Sustainable Energy Reviews*, 16(8), 5718-5726. https://doi.org/10.1016/j.rser.2012.06.010

Shahbaz, M., & Lean, H. H. (2012). Does financial development increase energy consumption? The role of industrialization and urbanization in Tunisia. *Energy Policy, 40*, 473–479. https://doi.org/10.1016/j.enpol.2011.10.050

Sim, K. Y., & Kun, S. S. (2025). Revisiting the energy-economic growth nexus in low versus high income economies: new evidence using non-linear DCCE, CS, NARDL and CS-NDL approaches. *Energy and environment*, https://doi.org/10.1177/0958305X251315399

Stern, D. I. (2011). The role of energy in economic growth. *Annals of the New York Academy of Sciences, 1219*(1), 26–51. https://doi.org/10.1111/j.1749-6632.2010.05921.x

Tang, C. F., Tan, B. W., & Ozturk, i. (2016). Energy consumption and economic growth in Vietnam. *Renewable & Sustainable Energy Reviews*, 54, 1506-1514. https://doi.org/10.1016/j.rser.2015.10.083

Vidyarthi, H. (2015). Energy consumption and growth in South Asia: evidence from a panel error correction model. *International journal of energy sector management*, 9(3), 295-310, https://doi.org/10.1108/IJESM-10-2013-0002

Water and Energy Commission Secretariat (WECS). (2021). *Annual report on energy resources and consumption in Nepal*. Government of Nepal.

World Bank. (2020). *World development indicators*. https://data.worldbank.org