



**ORIGINAL RESEARCH PAPER**

**Economics**

**ENERGY USE AND ECONOMIC DEVELOPMENT IN INDIA – SOME EMPIRICAL EVIDENCE**

**KEY WORDS:**energy use, electric power consumption, GDP percapita

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**ABSTRACT**

Energy usage plays a pivotal role in economic development. It is like an engine which drives growth of the economy. Both fuel and electricity usages have a long lasting effect on growth of the economy. This paper examines the effect of energy use and electricity consumption on GDP of India for the period 1972 - 2014. In the first instance, energy use energy use(kg of oil equivalent per capita) has been used as independent variable and GDP per capita constant (2015 US\$) as dependent variable. In the second instance, power consumption(kWh per capita) has been used as independent variable. The paper finds that there is a positive and significant impact of energy use(coefficient – 3.22), electric power consumption (coefficient – 1.67) on GDP percapita. From this it is clear that energy consumption has a positive impact on economic growth.

**INTRODUCTION:**

Economic development of a country is dependent on several factors among them optimal energy use and utilization is an important input in establishing industries and bringing new innovations which will raise output. Optimal energy use maximizes the benefits for the individual and also for the entire economy. Individuals will be able to improve their performance and productivity with energy availability with affordable prices. For providing clean energy to individuals, industries and other institutions scaling up energy efficiency is important.

For economic progress access to affordable and sustainable energy is vital. In the event of any shock to energy supply due to internal or external causes (factors) the developing countries face lot of difficulties. Since energy is an essential input for several activities increase in energy prices or reduction in energy supply will have an adverse impact on individual households and on economy as a whole. If developing economy resort to renewable energy sources it will help them to mitigate the problem of climate change. When we use renewable energy sources it will help to overcome the problem of volatility in energy prices. Solar and wind energy which is available in abundance will be cost effective and also serves as a permanent source of energy to an economy. Producing clean energy through renewable sources will reduce environmental pollution and will have no adverse effects on the health of the people. This will result in sustainable development of the economy.

Economic development is a long term process which involves several factors. Increase in production and productivity of labor and capital contribute to increased output. In addition to these factors energy is a crucial input in the growth process. Energy use in the form of power and other sources like oil and petroleum drive the production process. In the absence of continuous energy supply the production will be thwarted. Access to clean and affordable energy source will accelerate the output.

Energy supply improves the efficiency of production process. It will also save time and make the other factors like labor and capital more productive and efficient. Uninterrupted power supply is necessary for computerization and internet connectivity. They have become crucial for production in manufacturing and other sectors.

Before industrial revolution economies were dependent on availability of organic energy sources like fire wood, man power and horse power. In the 21<sup>st</sup> century with new innovations and technological progress new energy sources other than conventional sources like coal have come into existence. In the context of sustainable development clean

and affordable energy is now crucial. This will not only lead to increase in production but also will have a positive impact on people's lives and health. Clean energy sources can unlock the possibilities of exponential production and growth. Investment in energy infrastructure will directly and indirectly lead to growth.

Electricity is a key factor of production because it is not substitutable with other factors; non-availability of electricity for firms and other business units will constrain output. Proper use of electricity will speed (accelerate) up the process of production. Consumption of electricity will directly improve the wellbeing of the household in various ways. In the modern time all the consumer durables like washing machine, robots etc. will make the lives of the consumers comfortable. The usage of consumer durables powered by electricity will save time and improve efficiency of the individuals and therefore and giving more time for production work. The modern communication devices like internet revolutionize the modern man's life in every walk of life by saving the time and money.

It has brought in a revolution in various sectors and new business activities have sprung up with the advent of electricity. The heavy machinery or the smallest devices used in production always require power. Without power the production cannot happen. Every household requires electricity for the day today activities.

Power is crucial for computers, internet communications. The service sector like banking, insurance, health, everything depends on electricity for functioning. From e-commerce, e-payments to a small vendor and individual consumer, without power life will not move ahead. This study tries to find out the impact of power consumption on growth.

**Review of Literature:**

Anita Kumari, et al (2016) studies the relationship of economic growth and electric power consumption using Johansen co-integration method for India. The study period was 1974 - 2014. It was found that between economic growth and power consumption there was no long-run relationship in India. There was a one-way causal direction between economic growth to electric power consumption.

Aviral K Tiwari et al (2021) studied the causal relationship between power consumption and economic growth for the period 1961 to 2015. Tests like panel integration tests with structural breaks and panel VAR based impulse response model was used to understand the relationship. The author concludes that there was a long run relationship between economic growth and power consumption. At the state level unidirectional causality was observed between electricity

consumption and growth. In the agricultural sector between power consumption and growth a unidirectional causality was recorded.

Bassem Kahouli (2018) examines the four way linkage electricity consumption, CO2 emissions, R&D stocks and economic growth for Mediterranean countries. The study period was 1990-2016. The methods used was GMM, 3SLS and SUR. The paper finds a strong feedback effect among the four variables. There was unidirectional causality from electricity to R&D stocks. Further unidirectional causality between R&D stocks and economic growth, R&D stocks and CO2 emission was found. The paper suggests that to control environmental degradation using energy efficient technologies will help the growth process.

Ch. Sravan and Prajna Paramita (2022) examined the causal relationship between renewable electricity production, electricity imports and electricity consumption in India.

The study uses Vector Error Correction model and Wald-Granger causality test. It was found that the renewable electricity production will be positively affected by greenhouse gas emissions and natural resource rents.

Ciro Eduardo Bazan Navarro et al (2023) estimate the relationship between electric power consumption per capita and real GDP per capita in Peru for the years 1971-2014. Granger causality test was used to analyze the relationship. It was found that economic growth causes increase in electric power consumption. The paper also analyses and evaluates the investments in electricity generation, transmission etc. through renewable sources. The paper suggests that clean and green energy is necessary for power demand to be sustainable.

Muhammad Shahbaz, Thi Hong Van Hoang et al (2017) examine the asymmetric relation between energy consumption and economic growth by incorporating financial development, capital and labor into the production function. The study period covered was from 1960 Q1 to 2015 Q4. The nonlinear autoregressive distributed lag bounds testing approach was applied to examine the asymmetric co integration between the variables. The causal association between the variables was also estimated. The results indicate co integration between the variables in the presence of asymmetries. The results showed that only the negative shocks to the energy consumption had an impact on economic growth. It was also found that economic growth was affected by negative shocks to financial development. The study concludes that symmetrically, capital formation causes economic growth and there was a neutral effect of labor force on economic growth in India.

Muhammad Shahbaz et al (2020) examine the factors that play a part in causing CO2 emissions. The paper takes into account four factors that is economic growth, R & D expenditure, financial development and energy consumption. The bootstrapping bounds testing was used to estimate the short-run and long-run relationship in UK from 1870 to 2017. The paper found that there was a co integration between the four factors and CO2 emission. It was concluded that financial development and energy consumption leads to environmental degradation. The important finding of the study was that R & D expenditure helps to reduce CO2 emission. The study estimates a U-shaped relation between financial development and carbon emission. The paper suggests that financial development and R & D expenditure can be key tools in tackling carbon emission.

Rajesh H. Acharya et al (2019) examine the relation between energy poverty and economic development in India. The authors estimate the Multidimensional Energy Poverty Index and an index of development at the district level using the

household level data. The results show that energy poverty is widespread in India with variations across the states and districts. It was found that there was a declining trend in energy poverty with the exception of few bigger and less developed states. It was also found that there is a negative relationship between economic growth and energy poverty, and the strength of the relationship has increased during the study period. Education has a greater impact on reducing energy poverty compared with income. It was also found that there was a high correlation between energy poverty and socio-economic backwardness, in urban India energy poverty is lower compared to rural India.

Vanessa Ndlovu et al (2020) examine the causal relationship of energy on economic growth taking into consideration the role of R & D expenditure. The paper uses panel data method proposed by Emirmahmutoglu and Kose for the period 1996–2015 for BRICKS. In Brazil and South Africa, a one directional causality was found from Non-RE (Renewable energy) to GDP. There as there was a one directional causality from Non-RE to R & D in Brazil, Russia, China. In countries such as Russia, India and South Africa, a one directional causality between GDP and R&D was found.

**METHODOLOGY AND RESULTS :**

This paper studies the impact of energy use and power consumption on GDP for the years 1972 to 2014. The data was collected from world development indicators. This paper calculates the influence of energy use (kg of oil equivalent per capita) and power consumption (kWh per capita) on GDP per capita constant (2015 US\$). Two separate simple regression models have been used. The first model employs energy use as independent variable and GDP as dependent variable. The coefficient of 3.224 for energy use shows that for every 1% change in independent variable (energy use) GDP changes by 3.224%.

**Table I**

Dependent variable Y – GDP  
Independent variable X – Energy use

Variable	Coefficient	St. error	t-statistic	p>  t
X	3.224	0.062	51.81	0.000

Source: World Development Indicators – worldbank.com  
The independent variable is statistically significant suggesting that the energy use is a significant variable that contributes to GDP.

The second model takes into account electric power consumption as independent variable. The coefficient of power consumption is 1.66%. The statistical significance of power consumption indicates that it is significantly impacting the GDP. The paper finds that both energy use and power consumption have a significant impact on GDP.

**Table II**

Dependent variable Y- GDP  
Independent variable X – Electric power consumption

Variable	Coefficient	St. error	t-statistic	p>  t
X	1.665	0.040	41.50	0.000

Source: World Development Indicators – worldbank.com

**CONCLUSION:**

Many factors influence economic development. In the context of ever changing development activities energy in terms of oil and natural gas and also power consumption have become crucial inputs in the growth process. This paper attempts to study the impact of energy on growth (GDP) for India for the period 1972 to 2014. The paper concludes that energy use and power consumption have a significant impact on GDP. This confirms the important role of energy consumption in raising economic growth.

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