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## Article

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# The Relationship between Electricity Consumption and Economic Growth in BRICS Countries

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## ABSTRACT

This study analyzed the Gross Domestic Product (GDP) determinants in Brazil, Russia, India, China, and South Africa (BRICS). The method used in this study is a Fully Modified Ordinary Least Square (FMOLS) panel that can overcome the problem of non-stationary panels and the effect of heterogeneity between countries. The analysis range of this study is from 1992 to 2021, with three independent variables, namely electrical energy consumption, labor force, and gross fixed capital formation (GFCF) or investment. The results showed a significant favorable influence on energy consumption, labor force, and investment in GDP in BRICS countries from 1992 to 2021. This research resulted in a review of one of the policy recommendations to improve the economy in BRICS countries.

**Keywords:** Electrical Energy, FMOLS, GDP, Investment, Labor Force

**JEL Classifications:** E01, E22, P48

## 1. INTRODUCTION

When the global economy was in recession in 2001, it aspired to the acronym BRIC (Brazil, Russia, India, and China) (Branco, 2015). Then in 2010, South Africa joined, and the abbreviation was added to BRICS at the invitation of the Chinese state. Efforts to develop the economy in BRICS countries are no joke. How not? In 2014 when the 11<sup>th</sup> summit was held in BRICS created, the New Development Bank (NDB) and Contingent Reserve Arrangement (CRA), which had far-reaching effects and implications for the global world in general and BRICS members in particular (Iqbal, 2022). The breakthrough by BRICS can accelerate economic growth and socio-economic progress in member countries.

BRICS member states seek to create a peaceful international environment and promote democracy and equality in international relations, which goes against the confrontational Cold War mentality (Priangani, 2015). With the performance of BRICS countries in the economic field, they are certainly indeed optimistic about achieving this goal. BRICS' economic growth is highly anticipated by several

other countries, which was not in 2021 when the Covid-19 pandemic still shook the world. BRICS contributed 25.61014 percent to the world's Gross Domestic Product (GDP) (Figure 1).

The high GDP obtained by a country is one of the indicators of a country's welfare, which is indeed inseparable from the factors that influence it. This requires an in-depth analysis to determine what affects a country's GDP level to produce appropriate and effective regulation. One factor that supports a country's economy is energy, especially electrical energy. Electricity is necessary for economic, social, and cultural progress in all developed, developing, and less developed countries (Kahraman et al., 2020). In addition, electricity is one of the basic needs that are very important for human life, where almost all human activities are related to electrical energy (Sartika and Wibowo, 2017).

Energy can be divided into two, namely renewable energy and non-renewable energy. Based on Figure 2, it can be seen that the use of non-renewable energy, such as coal, natural gas, and petroleum, still dominates the use of energy consumption in BRICS countries.

Although sustainable energy use is still minimal in BRICS countries, BRICS countries strive for sustainable energy use. According to Iqbal (2022), the NDB has approved 70 infrastructure and sustainable development projects worth US\$ 25.07 billion over the past five years, including loans provided under the NDB Emergency Assistance Facility among member states. This shows that BRICS supports sustainable development. One aspect of energy planning is the relationship between the energy sector and economic growth (Sugiyanto, 2017). Here is a picture of electrical energy consumption and GDP in BRICS countries.

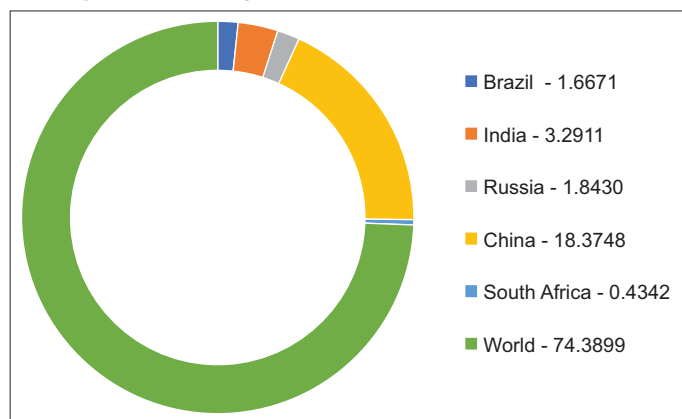
Based on Figure 3, it can be seen that India is the country with the highest average consumption of electrical energy compared to other BRICS countries. However, the GDP value obtained by India is still below China, with a relatively lower average use of electrical energy consumption than India. This shows that other factors affect a country's GDP. GDP is also heavily influenced by human resources. China and India are the most populous countries in the world, making it an opportunity and a challenge for the economy. Based on research conducted by Ali et al. (2012) and Rizal (2018) found that the labor force has a positive effect on GDP, while based on research Gharaibeh (2015) found that the labor force hurts GDP.

Research from Mulyani and Hartono (2018) revealed that based on other than labor and capital stocks, electrical energy is a much-needed input to produce goods and services. Thus, this study includes capital, an investment, to see its effect on GDP. Some economists view that the formation of investment is an essential factor responsible for the growth and development of a country's economy. According to Ain (2019), some economists believe investment formation is essential to a country's economic growth and development. Increasing capital stocks will increase productivity, production capacity, and quality, encouraging economic growth (Astuti, 2018). This is in line with research conducted by Andinata et al. (2018), Ncanywa and Makhanyane (2016), and Ugochukwu and Chinyere (2013) found that investment has a significant positive effect on GDP. Meanwhile, Ahmad et al. (2013) found that investment does not affect GDP. Previous research differences underlie this research to produce the latest studies. The novelty of this study is distinguished by the object of study, the year of analysis, and the combination of variables used to see its effect on GDP. Based on this study, it is hoped that it will become one of the policy recommendations for BRICS countries in particular and then can be adapted by other countries to realize economic prosperity.

## 2. LITERATURE REVIEW

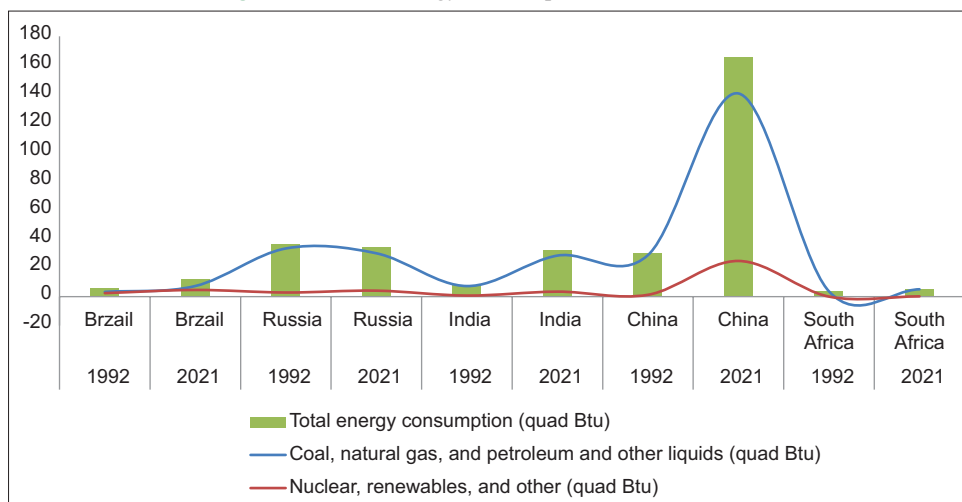
Gross Domestic Product (GDP) is the total value of goods and services produced in a country by both domestic and foreign citizens in a year (Sukirno, 2016). According to Mankiw (2014), economic growth is measured by GDP. One of the factors that significantly affect GDP is energy. Energy as a resource in the economy has an important role, especially electrical energy, which is a primary need for households and companies. Based on Adam Smith's Classical Theory and the neo-classical economic views of Robert Solow and Trevor Swan, four factors affect the economic growth of the population, the number of stocks of capital goods, the area of land and natural resources, and the level of technology used Suryana (2000), in this study using electrical energy consumption to represent natural resource variables.

Figure 1: Percentage of BRICS GDP to World GDP in 2021



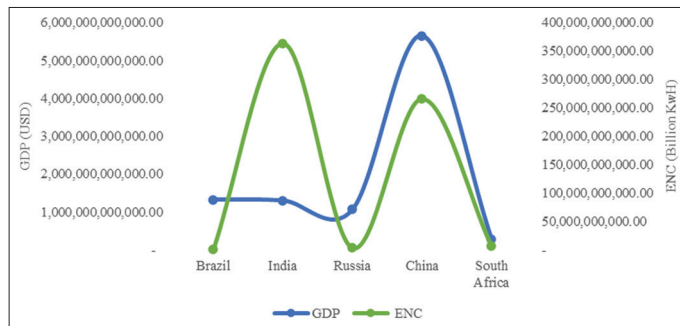
Source: World Bank, Data Processed (2023)

Figure 2: BRICS Energy Consumption in 1992 and 2021



Source: World Bank, Data Processed (2023)

**Figure 3:** Average Electricity Consumption and GDP in BRICS Countries 1992-2021



Source: World Bank, Data Processed (2023)

Energy, including electrical energy, plays a vital role in a country's economy. Electricity is one of the most needed elements in households and enterprises. The amount of electricity consumption is directly linked to a country's economic growth due to the expansion of the global economy and the increase in per capita income demanding electricity-based equipment (Thaker et al., 2019). Based on research conducted by Thaker et al. (2019) in their research entitled "Electricity Consumption and Economic Growth: A Revisit Study of Their Causality in Malaysia" found that electricity consumption has a positive effect on Malaysia's economic growth.

Robert Solow and Trevor Swan, who belonged to the neo-classical age, argued that economic growth stemmed from adding and developing factors affecting aggregate supply. According to Mankiw (2000), Solow's growth model shows that economic outputs are influenced by capital, labor force, and technology changes. This study uses labor force and investment variables to see their effect on economic growth. Related basic models of Solow-Swan theory are shown in Equation (1).

$$Y = F(K, L) \quad (1)$$

Where:

Y = Output

K = Physical capital

L = Labor.

Research conducted by Utami et al. (2021) found interesting results, namely that the population has a negative relationship to economic growth, while the labor force positively influences economic growth. The research conducted by Utama also distinguishes male labor and female labor, where male labor has a negative and significant impact on economic growth. The female workforce significantly influences economic growth in the five countries of the Organization of Islamic Cooperation (Indonesia, Pakistan, Egypt, Nigeria, and Bangladesh). Research from Annisa et al. (2022) found that the labor force significantly affects economic growth.

In addition to natural resources and the labor force, Roy F. Harrod and Evsey D. Domar, commonly known as Harrod-Domar, also stated the importance of investment in economic growth. According to the Harrod-Domar Theory, capital formation is essential in determining economic growth. Arsyad (2016) posits that Harrod-Domar's capital formation theory can increase people's effective

demand and as an expenditure that will increase the ability of an economy to produce goods and services. So it can be concluded that economic growth can increase with investment. This study used Gross Fixed Capital Formation (GFCF) data as an indicator for investment. Gross fixed capital formation is an expenditure made by the government for capital goods investment activities, not for consumption activities, which includes developing and improving infrastructure in a country (Pribadi and Kaluge, 2021).

The positive relationship between gross fixed capital formation and GDP was found to have a significant positive correlation in the research (Andinata et al., 2018). According to Andinata et al. (2018), GFCF, an investment in capital goods, will increase production capacity by increasing the company's capital goods so that total production will impact the amount of income and continuously affect the national income of a country. The study results align with the research (Hussin et al., 2013). Increasing the GFCF will create an expanded scale that can create jobs to increase public consumption and improve a country's economy.

### 3. RESEARCH METHODOLOGY

The type of data in this study uses secondary data, namely data obtained from the World Bank and Energy Information Administration (EIA) institutions. This study used a panel data set from 5 regions covering Brazil, Russia, India, China, and South Africa (BRICS). The period used in this study was between 1992 and 2021. The determination of the research timeframe is based on the availability of the latest data, which includes economic growth, electrical energy consumption, labor force, and investment in BRICS countries. In those years, there was also economic development in the BRICS country. At the same time, the selection of BRICS countries is because the strength of these countries is tremendous, even with a small number. One of the BRICS members is China, with the most populous population in the world, so this study also included labor force variables to see how it affects economic growth in the long term.

To determine the long-term relationship between electrical energy consumption, labor force, and investment to economic growth in BRICS countries from 1992 to 2021, the method used is Fully Modified Ordinary Least Square (FMOLS) with data processing tool EViews 10. This study used a specific model, as seen in equation 2.

$$\text{LNGDP} = \beta_0 + \beta_1 \text{LNENC}_{it} + \beta_2 \text{LNLFL}_{it} + \beta_3 \text{LNGFCFC}_{it} + \epsilon_{it} \quad (2)$$

Where LNGDP is the logarithm of natural Gross Domestic Product (USD), LNENC is the logarithm of natural electrical net consumption (Billion kWh), LNLFL is the natural logarithm of the labor force (Soul), LNGFCF is the natural logarithm of Gross Fixed Capital Formation (USD),  $\beta_0$  is Constant,  $\beta_{1,2,3}$  is Coefficient,  $\epsilon$  is Residual,  $i$  am Region (5 countries of BRICS).  $T$  is time (1992-2021). Here is the analysis method used to see the long-term effect of energy consumption, employment, and investment on economic growth in BRICS countries in 1992-2021.

Based on Figure 4, data collection is the first method after a literature review and hypothesis development. Furthermore, a

descriptive statistical analysis of research variables was carried out. Before the data is tested using the FMOLS method, stationarity, and cointegration tests are carried out. The first is related to stationary testing. According to Widarjono (2018), this method is carried out so that the data avoids spurious regression between dependent and independent variables. Spurious regression is a condition where the coefficient of determination is relatively high, but the relationship between the dependent variable and its independent variable has no meaning. This study used the Augmented Dickey-Fuller (ADF) and Phillips Perron (PP)-Fisher test methods. The provision is that when the probability value is above the significance level (0.05), the data is declared non-stationary, and vice versa. The data is declared stationary when the probability value is below the significance level. A first different stationary test is carried out when the data is not stationary at the level. Data that is already stationary at first different can be continued testing with cointegration tests.

According to Sekaran et al. (2017), a cointegration test was carried out to determine whether the variables studied had a long-term equilibrium relationship. This study uses the Kao Residual Cointegration Test method. Kao in Baltagi (2013) uses a residual-based standard approach of DF and ADF tests to test cointegration in panel data by adopting a step procedure performed by Eagle-Granger. Data is declared cointegrated when the probability value is smaller than the significance level (0.05). After the data is declared cointegrated, the FMOLS test can be carried out.

## 4. RESULTS AND DISCUSSION

### 4.1. Result

#### 4.1.1. Descriptive statistical analysis

Descriptive statistical analysis can explain the data used in the study. The descriptive statistics used in this study used average values (mean), the smallest value (minimum), and the highest value (maximum). Here is Table 1, a descriptive statistical analysis.

Table 1 shows that 150 observations in this study are sourced from 5 BRICS countries and 30 periods ranging from 1992 to 2021. The average value of GDP in 5 BRICS countries in 1997-2021 was

171,000,000,000,000,000 USD. The country with the largest GDP is China in 2021, which is 1,770,000,000,000,000,000 USD. While the country with the lowest GDP is South Africa, only reaching 1,090,000,000,000,000 USD in 2002.

The average electricity consumption in BRICS countries is 11,900,000,000,000,000 billion kWh. China as the country with the most significant electricity consumption in 2021, reached 781,000,000,000,000,000 billion kWh. This figure is far above the average electricity consumption figure in BRICS. Meanwhile, the country with the lowest electricity consumption was South Africa in 1992, with a value of 1,541,000 billion kWh. Related to the labor force in BRICS countries has an average value of 272,000,000 inhabitants. Countries that have an above-average labor force are China and India. Where China was the country with the highest labor force in 2019 which is 796,000,000 people. Meanwhile, the country with the lowest labor force was South Africa in 1992, at 14,888,800.

The investment value in BRICS countries has an average of 2,449,224 USD and based on data obtained, the average investment in BRICS countries in 1992-2021 is above average. This shows that BRICS countries have a high investment value. China was the highest country in 2021, reaching 4,451,877 USD, while South Africa had the lowest investment in 2002, only reaching 1,309,187 USD. Based on the explanation of the statistical analysis, it can be seen that there is a positive relationship between energy consumption, labor force, and investment in GDP. This can be seen in China and South Africa. With the highest GDP, China is accompanied by high energy consumption, labor force, and investment. This condition can also be seen in the South African country with the lowest GDP and energy, labor force, and investment consumption value compared to other BRICS countries during 1992-2021.

#### 4.1.2. Stationarity test

The first condition for FMOLS to be met is that all research variables must be stationary. Research conducted by Manuhutu (2012) suggests that the latest literature shows that panel-based unit root tests have higher strength than unit root tests based on individual time series. In Table 2, it can be seen that only the

Figure 4: Research method procedure

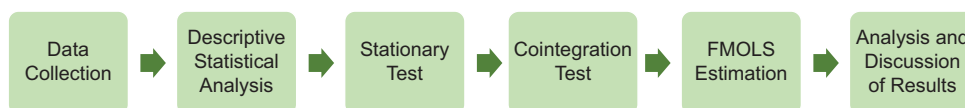


Table 1: Descriptive statistical analysis

Descriptive statistical	GDP	ENC	LF	GFCF
Mean	171,000,000,000,000,000	11,900,000,000,000,000	272,000,000	2,449,224
Median	59,500,000,000,000,000	21,362,507	91,065,653	2,095,359
Maximum	1,770,000,000,000,000,000	781,000,000,000,000,000	796,000,000	4,451,877
Minimum	1,090,000,000,000,000	1,541,000	14,888,800	1,309,187
SD	308,000,000,000,000,000	69,000,000,000,000,000	283,000,000	8,835,720
Skewness	3,288,511	9,569,392	0.79	0.84
Kurtosis	1,362,795	1,048,505	2,016,240	2,492,575
Jarque-Bera	9,763,163	66,676.35	2,152,306	1,923,097
Probability	0.000000	0.000000	0.000021	0.000067
Observations	150	150	150	150

Source: EViews 10, (2023)

labor force variables (LNLF) are stationary at the level and first different. In contrast, the gross domestic product (GDP), electricity consumption (LNENC), and investment (LNGFCF) variables are not stationary at this level. This can be seen from the labor force probability value of less than the significance level (0.05), while other variables have a more excellent probability value than the significance level. Because the data is not stationary at the level, it is necessary to carry out further testing on the first difference. After the first different test was carried out, it was discovered that all variables used in this study were stationary, so the first condition for the FMOL model was met. Thus, the next test can be carried out, namely the cointegration test.

#### 4.1.3. Cointegration test

After the stationary test is carried out and confirmed that all static data is first different, the cointegration test is carried out. The cointegration test is carried out by testing the stationariness of the residual so that an adjustment occurs towards a long-term balance between variables. In other words, according to Buhaerah (2017), two variables are said to be cointegrated if the two random variables move together with the same pattern even though the two variables are each random walks. The cointegration test in this study used the Kao Residual Cointegration Test method. The cointegration test output is presented in Table 3. Table 3 shows that the ADF probability is 0.0000, where the figure is smaller than the significance level. So it can be concluded that the variables used in this study are cointegrated in the long term. Both conditions for the FMOLS test have been met. The next step is to estimate FMOSL.

#### 4.1.4. FMOLS panel model results

Both conditions for conducting the FMOLS test have been met and are related to the FMOLS estimation output shown in Table 4. The use of the FMOLS method to determine the long-term effect of electricity consumption variables, labor force, and investment on gross domestic products in BRICS countries in 1992-2021. Based on Table 4, it can be known the probability value that shows the coefficient and statistical value of each variable used in this study.

The variable t-static values of electricity consumption (LNENC), the labor force (LNLF), and investment (LNGFCF) were 3.615958 and 1.9892296, respectively and 48.94104. As for the t-table value with the degree of freedom (n-k), where n is the number of observations and k is the number of free and bound variables used, the value of the degree of freedom=146 is obtained from (150-4). Based on this, it can be seen that each t-statistical value of the free variable is greater than the t-table value, so it is concluded that the variables of electrical energy consumption, labor force, and investment have a significant effect on GDP in the BRICS country in 1992-2021. In Table 4, it is also known that the regression coefficient ( $R^2$ ) value in this study is 0.995686, meaning that the consumption of electrical energy, labor force, and investment can affect the GDP variable of 99.5686 percent. In comparison, the remaining 0.4314 percent is explained by other variables not included in the model.

## 4.2. Discussion

The value of the coefficient of electrical energy consumption is 0.010430, meaning that if the consumption of electrical energy increases by 1%, then the GDP in BRICS countries will increase

**Table 2: Unit root panel test**

Variable	Root unit method	Level	1 <sup>st</sup> Different
LNGDP	ADF-Fisher	0.8731	0.0000*
	PP-Fisher	0.9347	0.0000*
LNENC	ADF-Fisher	0.9544	0.0000*
	PP-Fisher	0.7849	0.0000*
LNLF	ADF-Fisher	0.0013*	0.0156*
	PP-Fisher	0.0000*	0.0000*
LNGFCF	ADF-Fisher	0.8601	0.0005*
	PP-Fisher	0.8884	0.0000*

Source: EViews 10, (2023), \*significant at 5%

**Table 3: Kao residual cointegration test results**

ADF	t-Statistic	Prob.
	-5.626874	0.0000
Residual variance		0.002600
HAC variance		0.002337

Source: EViews 10, (2023)

**Table 4: FMOLS test results**

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNENC	0.010430	0.002884	3.615958	0.0004
LNLF	0.252419	0.126889	1.989296	0.0487
LNGFCF	0.856046	0.017491	48.94104	0.0000
R-squared	0.995686	Mean dependent var		27.60202
Adjusted	0.995465	S.D. dependent var		1.129759
R-squared				
S.E. of regression	0.076079	Sum squared resid		0.792963
Long-run variance	0.012752			

Source: EViews 10, (2023)

by 0.010430%, *ceteris paribus*. The results of this study are by Classical Economic Theory, where one of the factors of economic growth is natural resources. Electrical energy is included in natural resources vital to a country's economy. This research is also by the Neo-Classical Theory, which states that an increase in energy consumption reflects an increase in the economy (Kraft and Kraft, 1978). The increase in electricity consumption identifies the high purchasing power of electricity by the public (both for household and corporate consumption), which shows that people's incomes are also high to increase GDP, thus to the positive correlation between energy consumption and GDP. Different results are shown by research conducted by Buhaerah (2018) found that electrical energy consumption has no effect on GDP in the long term.

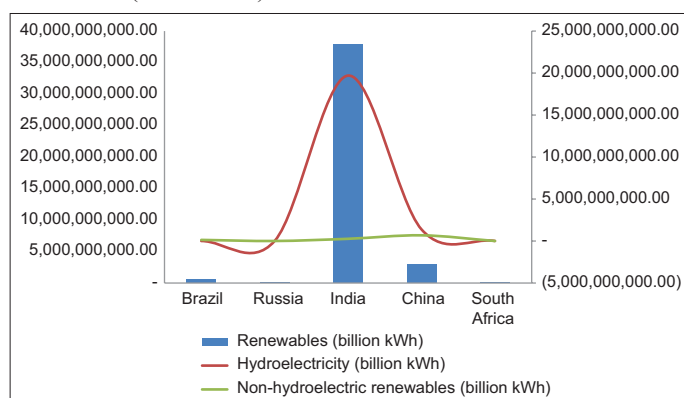
This research is in line with research conducted by Adi et al. (2022) in their research entitled "Influence of Electricity Consumption of Industrial and Business, Electricity Price, Inflation and Interest Rate on GDP and Investments in Indonesia" the findings suggest that the path coefficient on electricity consumption to GDP is 0.951. CR = 37.06 means that electrical consumption has a significant favorable influence on GDP. The results of this study also, in line with research conducted by Shengfeng et al. (2012) in their research entitled "The Relationship between Electricity Consumption and Economic Growth in China," found that there is a one-way positive causality between electricity consumption and economic growth, meaning that electrical energy consumption has a positive effect on economic growth.

The findings in this study are by the phenomenon identified in the descriptive statistical analysis, China with large energy consumption accompanied by high GDP obtained in 2021. Nonetheless, BRICS is a developing country in terms of resource production and management and requires a consistent supply of energy resources; BRICS countries must monitor energy consumption, focusing on the energy supply-demand gap and its components and facilities provided to local and foreign investors (Khan and Osińska, 2021). South Africa, with the lowest average energy consumption compared to other countries, is one of the most intensive economies globally. Based on the report of the (India Council for Research on International Economic Relations (ICRIER) (2021) mentions that South Africa has one of the most energy-intensive economies globally and accounts for about 40% of all electricity on the African continent. In addition, the ICRIER report (2021) states that access to electricity in Brazil has reached almost the entire population with 99.8% housing coverage, 97% of good quality services, and by the end of 2020, as many as 86.7 million electricity meters installed covering 86% of households. The use of large electrical energy consumption can increase economic growth.

This condition still needs to pay attention to the limited resources in meeting the needed electrical energy consumption. Using electricity that does not apply sustainable principles can reduce the country's margins to a low level. In the long run, it is feared that it will harm the environment and lead to expensive repair costs. BRICS countries have an excellent opportunity to realize a sustainable economy. Solar and wind-based power generation has been India's cheapest source of bulk power generation since 2018, driven by successful auctions and falling equipment costs worldwide (Gadre et al., 2020). When viewed from the opportunities in India and China, wind resources are the most targeted potential to develop sustainable energy in these countries. Thus, the following data is related to sources of electrical energy in the BRICS country.

Based on Figure 5, it can be seen that India is the country with the highest consumption of renewable energy compared to other BRICS countries. Moreover, it can be known that the most

**Figure 5:** Average renewable energy sources, renewable energy sources from hydroelectric and non-hydroelectric renewables (Billion kWh) in BRICS countries 1992-2021



Source: IEA, Processed, (2023)

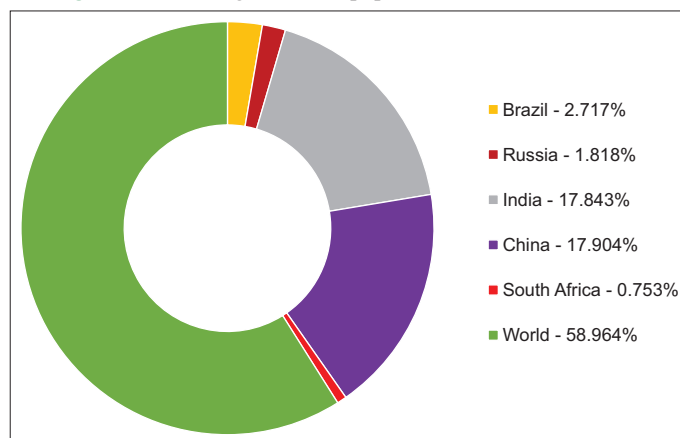
effective use of renewable energy comes from hydroelectric. Thus governments in BRICS countries can optimize hydroelectric use to meet energy consumption needs. The government needs to work with the private sector and the public to use sustainable energy for the long-term sustainability and prosperity of the country.

The value of the labor force coefficient is 0.252419, meaning that if the labor force increases by 1%, then GDP in BRICS countries will increase by 0.252419%, *ceteris paribus*. This study's results support Robert Solow and Trevor Swan's theory that the labor force positively influences economic growth. The study's results do not align with the research conducted by Kurniawan et al. (2021) in his research entitled "Contemporary Indonesian GDP: Context of Analysis at Unemployment, Labor Force and Poor People." The negative influence of the labor force on GDP is caused by the lack of skills of the labor force, so the labor force increases but is not accompanied by increased output which results in a decrease in the amount of GDP.

Research conducted by Larasati and Sulasmiyati (2018) and Nizar et al. (2013) found that the labor force positively and significantly affects GDP. According to Larasati and Sulasmiyati (2018), the country's GDP is calculated based on the total income each resident earns in economic activity and the total costs incurred to obtain goods and services. So that the more productive a country is, supported by the labor force, the more it will increase its GDP. Thus, the labor force can increase GDP in the BRICS countries. The high labor force in BRICS countries that have a positive correlation can also be used as a reference for other developing countries to adopt appropriate policies in each country. The findings in this study follow the phenomenon already identified in the descriptive statistical analysis; China, with the most significant labor force, also corresponds to the high GDP obtained. The relatively lower labor force compared to other BRICS countries is also accompanied by a lower GDP obtained by South Africa compared to other countries. The number of inhabitants certainly influences the high labor force. The following is presented the number of inhabitants in the World and the BRICS Countries in 2021.

Based on Figure 6, it can be seen that 41,036% of the world's population is in BRICS countries. The country with the largest

**Figure 6:** Percentage of world population and BRICS in 2021



Source: World Bank, Data Processed (2023)

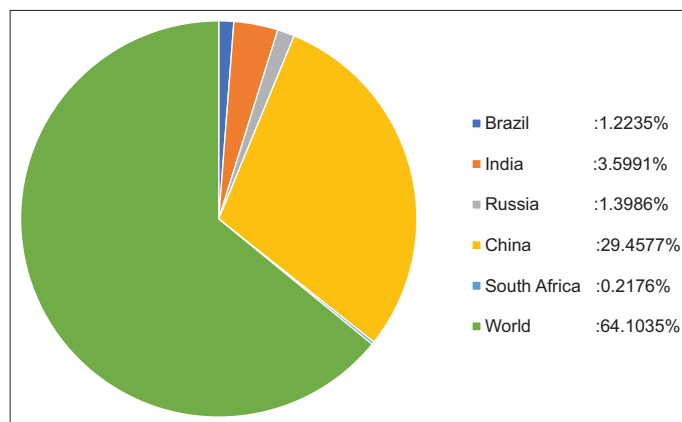
population is China, followed by India. This condition shows that BRICS has a vast population. The high number of people in BRICS countries, especially China and India, needs to be considered to improve the quality of human resources. The government can improve soft and hard skills built since school in collaboration with the private sector. Improving these skills certainly pays attention to the needs of the abilities needed in the future. Because if the increase in population is not accompanied by an increase in the quality of resources, it can cause demographic problems and is not by the sustainable development goals.

The value of the investment coefficient is 0.856046, meaning that if investment increases by 1%, then GDP in BRICS countries will increase by 0.856046%, *ceteris paribus*. The results of this study support Harrod-Domar's theory, which states that capital can increase people's effective demand and as an expenditure that will increase the ability of the economy to produce goods and services. From this statement, it can be seen that investment has a multiplier effect. According to Jhingan (1999), investment can generate income and increase economic production capacity by adding capital stocks. Investment can create jobs to reduce unemployment and poverty, improving welfare.

Research from Yudisthira and Budhiasa (2013) is similar to the findings of this study. Investment is essential in economic development and supports improving the production process, so investment and GDP have a positive influence. The results of this study are supported by findings from (Chandra and Winny, 2021). However, there are differences in the results of research conducted by Djulius (2018) found that investment negatively influences GDP in long-term conditions.

Based on Figure 7, it can be seen that 35.8965% (100-64.103) of world investment is in BRICS countries. The most significant investment is in China at 29.4577%. The high investment in China can improve the economy, and the high GDP of China accompanies this. What needs to be considered when a country has a significant investment value is that the budget for allocating funds should be intended for productive sectors that can improve the economy. Not only physical investment but also human capital investment, this is also considering that

**Figure 7:** Percentage of Investment in BRICS Countries and the World in 2021



Source: World Bank, Data Processed (2023)

China is one of the countries with the most populous population in the world.

## 5. CONCLUSION

Based on the results of FMOLS, it is known that in the long term, the consumption of electrical energy, labor force, and investment significantly positively affect GDP in BRICS countries. Electrical energy consumption in BRICS countries is predominantly supported by hydroelectric. If hydroelectric optimization continues to be pursued, the significant need for electrical energy in BRICS countries can be met without harming the environment. Environmental damage due to economic activities will lead to more expensive repair costs in the future. In other words, optimizing the use of sustainable energy is essential. The phenomenon of BRICS countries can be used as an example for developing countries that need electrical energy to utilize sustainable energy.

The use of sustainable energy can support sustainable development. This is accompanied by efforts to reduce the number of people in countries with high reflections (such as China and India). Improving the quality of human resources through improving the quality of education is very important. It can also delay marriage because a person is educated and gets married at a mature age. If this is done, the existing workforce can have the necessary work skills and create a healthy generation in the future. This can be accompanied by convenience for investors investing in BRICS countries. In addition, BRICS countries should strive for more prosperity in South Africa. Based on the results, value, GDP, investment, and labor force in South Africa occupy the bottom position compared to other BRICS countries. One of South Africa's potentials is gold as a significant mine. The policies implemented in South Africa should provide leeway for investors to invest in the country. Thus, it can create jobs and ultimately improve the South African economy.

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