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Energy Consumption and Government Policy in Addressing The Rising Fuel Oil Prices

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Abstract

This study aims to determine the effect of economic growth, per capita income, world oil prices and the amount of subsidies on energy consumption in Indonesia both in the short and long term. As well as knowing the policies carried out by the government to overcome the increase in fuel prices. The data used is secondary data from 1972 - 2022 and analyzed using ECM Domowitz-El Badawi and Atlas.ti which is used to organize, explore and analyze data on policies made by the government to overcome rising fuel prices. The analysis shows that economic growth, per capita income and the size of subsidies have a long-run effect on energy consumption, while world oil prices have both a short and long-run effect on energy consumption. The reduction of subsidies that caused fuel prices to increase had both positive and negative effects on society, and the government made several policy efforts to overcome the turmoil that existed in the community. Among them are adjusting fuel prices and prices of other affected goods, limiting ownership of motorized vehicles, maintaining a stable supply of fuel in the long term and increasing supervision and enforcement in fuel abuse.

Keywords: Consumption; Energy; ECM Domowitz-El Badawi; Oil Prices; Subsidies

JEL classification: O13, O44, Q430

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1. INTRODUCTION

Energy plays a crucial role in human survival and is intricately linked to a nation's economy, encompassing both production and consumption processes. The rising use of energy drives the industrialization process, leading manufacturing industries to operate their production machinery, thereby fostering rapid economic growth (Kartiasih et al., 2012). In the year 2022, the total final energy consumption reached 1.18 billion barrels of oil equivalent (BOE) with the industrial and construction sectors becoming the largest consumers, accounting for 537.75 million BOE, followed by transportation with 428.61 million BOE, while households accounted for 161.48 million BOE.

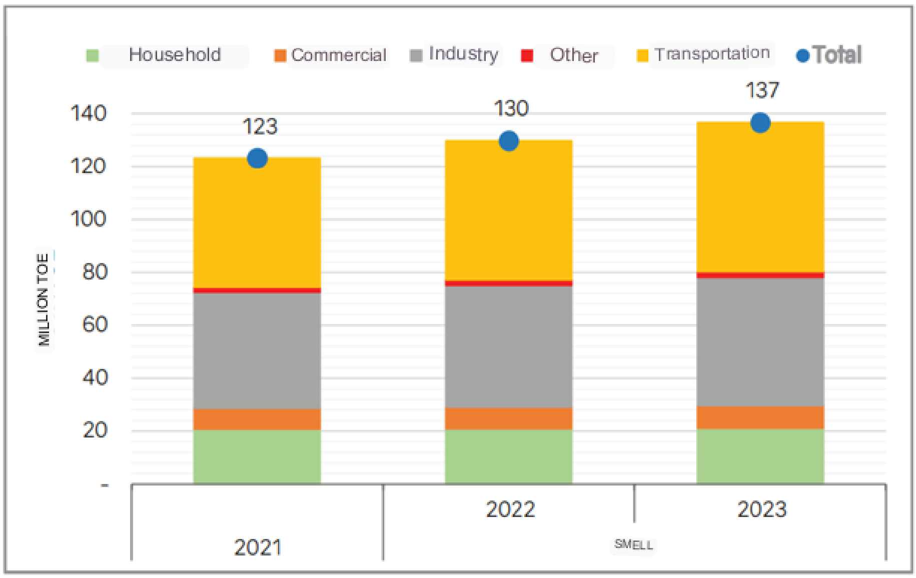

Figure 1. Total Energy Consumption by Sector

Indonesia is among the world's largest energy consumers due to inefficient energy utilization, which can be attributed to the existence of low energy pricing policies (Elinur, 2010). Such policies, characterized by subsidized energy prices, have had adverse consequences, notably a high dependency on non-renewable energy resources. The provision of subsidies not only burdens the state budget but also disrupts the government's fiscal conditions. Moreover, it encourages a preference among the public for using energy derived from fossil fuels.

There is a significant connection between economic growth and energy consumption. In macroeconomic variables, there is economic growth, which is related to energy consumption. The relationship between economic growth and energy consumption has been researched in several countries. There is a tendency that when economic growth increases, energy consumption also increases. Based on research, economic growth influences energy consumption in a short-term relationship (Guo, 2018) and economic growth has a one-way relationship to energy consumption (Istiqomah & Wijaya, 2005). When economic growth occurs, there is an increase in economic activity, so energy consumption will also increase. There is a dilemma when economic growth and energy consumption are related, because if economic growth increases, energy consumption will also increase, causing energy availability in the region to decrease, which will have a negative impact on the economic prospects in the future.

There is an energy consumption theory explaining that per capita income has an effect on energy consumption (Lin & Zhu, 2020); (Nazer & Handra, 2016). This is in accordance with the theory that if per capita income increases then there will be an increase in consumption of goods carried out by individuals. Research conducted in Southeast Asia found that if per capita income increased by 1%, energy consumption would increase by 1.05% (Rezki, 2011b). So if the income elasticity of energy consumption is above 1%, then the country is in the developing country category, and if it is less than 1%, then the country is in the developed country category. Engel's Law can be applied to energy consumption, where if per capita income increases, there will be an increase in energy demand because the use of electronic goods and motorized vehicles also increases, thus resulting in an increase in energy intensity (Kartiasih et al., 2012).

The analysis of final energy demand takes into account variables such as economic growth, population growth, and policies like the energy development roadmap and strategic plan, as depicted in the following diagram (Tim Sekretaris Jenderal Dewan Energi Nasional, 2019).

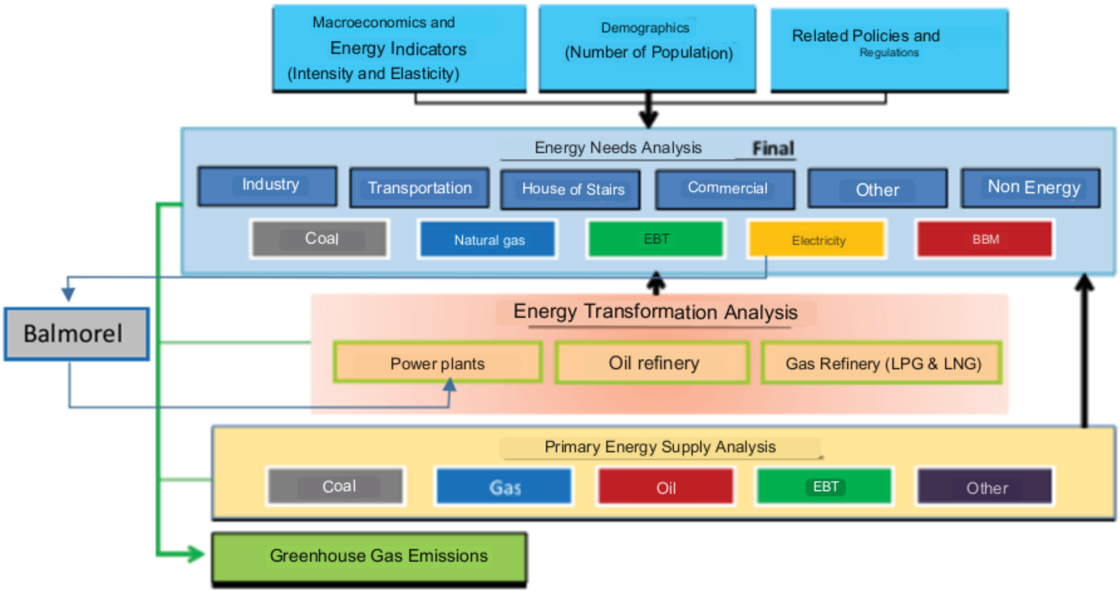

Figure 2. Modeling Analysis Framework for Energy Planning

The concept of energy planning modeling reveals the intricate interplay between macroeconomics, energy indicators, demographic factors, and the influence of energy-related policies and regulations. This modeling approach enables a comprehensive analysis of final energy requirements across various sectors. National Energy Plans (NEPs) serve as a pivotal framework for governments to promote energy conservation and enhance efficiency, thereby shaping future energy consumption trends, whereas macroeconomic variables reflect a correlation between economic growth and energy consumption. Research findings have indicated that economic growth significantly impacts energy consumption in the short term (Guo, 2018) and underscores the unidirectional relationship between economic growth and energy consumption (Istiqomah & Wijaya, 2005).

The energy consumption theory clarifies the impact of per capita income on energy consumption ((Chang-Lin et al., 2020), (Nazer & Handra, 2016), Research conducted in Southeast Asia has indicated that a 1% increase in per capita income corresponds to a 1.05% increase in energy consumption (Rezki, 2011b). When the income elasticity with respect to energy consumption exceeds 1.0, a nation falls into the category of developing countries; if it is less than 1.0, the nation is classified as developed. This principle, akin to Engel's Law, can be applied to energy consumption. As per capita income rises, the demand for energy increases due to greater use of electronic devices and motor vehicles, resulting in heightened energy intensity (Kartiasih et al., 2012).

Domestic energy prices are influenced by global oil prices. A surge in crude oil prices leads to increased subsidies borne by the government, exerting pressure on fiscal conditions (Guo, 2018). To manage energy prices, akin to demand laws, the government must act when global oil prices increase. If the government reduces subsidies significantly in the face of rising global oil prices, domestic energy prices will escalate, subsequently diminishing demand and energy consumption (Kartiasih et al., 2012). The reduction of energy subsidies is expected to redirect funds towards other sectors with greater multiplier effects, yielding positive impacts on both the economy and the environment, with infrastructure investment being one of the potential beneficiaries.

2. RESEARCH METHOD

This study employed the Domowitz-El Badawi ECM Model to analyze the determinants of energy consumption in Indonesia from 1972 to 2022. The dependent variable is the final energy consumption, which represents the total quantity of fuels and energy utilized across sectors including manufacturing, construction, transportation, households, and other consumption sectors, measured in terajoules (BPS, 2018). The independent variables consist of economic growth (%) based on previous research conducted by (Rezki, 2011a); (Acheampong, 2018); (Guo, 2018), per capita income (in Rupiah) accoring to the previous research by (Lin & Zhu, 2020); (Nazer & Handra, 2016); (Kebede et al., 2010), world oil prices (in Dollars per barrel) (%) based on earlier studies carried out by (He et al., 2016); (Dinah Nadhifah et al., 2023), and government subsidies (in Rupiah) In accordance with earlier studies done by (Campbell et al., 2003). The novel feature of this study is that it includes a variable for the amount of energy subsidies supplied by the government, as well as an analytical tool that, in addition to ECM, incorporates Atlas.ti. ECM must be derived first with several stages as follows (Widyawati & Wahyudi, 2016):

a. Specify the expected relationship in the model as follows:

$$Energy\_cons_t = a_0 + a_1\,Growth_t + a_2\,Income_t + a_3\,Price_t + a_4\,Subs_t$$

Where:

$Energy\_cons_t$	=	Energy consumption in Indonesia in period t
$Growth_t$	=	Economic growth in Indonesia in period t
$Income_t$	=	Income per capita in period t

$Price_t$ = World crude oil price in period t

$Subs_t$ = Energy subsidy provided by the government in period t

a0, a1, a2, a3, a4 = Short-term coefficient

b. Form a single cost function in the error correction method as follows:

$$C_t^e = e_1\left(Energy_{cons_t} - Energy_{cons_t^*}\right)^2 + e_2\{(1-B)Energy\_cons_t - f_1(1-B)Z_t)k$$

Where $Energy_{cons\_t}$ is the actual variable, and $Energy_{const}$* is the desired variable and B is the time lag operation. Zt is a vector of variables that affect the desired energy consumption in Indonesia, and ft is a vector of series that are the weights in the adjustment cost component for the corresponding equation. The cost function consists of two components, namely the imbalance cost function and the adjustment cost. The notations e_1 and e_2 are the weights given by economic agents to the two cost functions.

Minimize the cost function from the previous equation against $Energy_{cons\_t}$ $\left(\frac{\partial C_t^e}{\partial Energy_{cons_t}} = 0\right)$ then the following equation is obtained:

$$Energy\_cons_t = eEnergy\_cons_t^* + (1-e)BEnergy_{cons_t} - (1-e)f_t(1-B)Z_t$$

Where $e = \frac{e_1}{e_1+e_2}$ and $(1-e) = \frac{e_1}{e_1+e_2}$

Substitute the equation Energy_cons = a_0 + a_1 Growth + a_2 Income + a_3 Price + a_4 Subs + Ut into the equation above, it becomes as follows :

$$Energy_{cons_t} = a_0e + a_1eGrowth_t + a_2eIncome_t + a_3ePrice_t + a_4eSubs_t + (1-e)Energy_{cons_{t-1}} + (1-e)f_1(1-B)Growth_t + (1-e)f_2(1-B)Income_t + (1-e)f_3(1-B)Price_t + (1-e)f_4(1-B)\,Subs_t$$

The equation can be written again as follows:

$$Energy_{cons_t} = g_0 + g_1Growth_t + g_2Income_t + g_3Price_t + g_4Subs_t + g_5Growth_{t-1} + g_6Income_{t-1} + g_7Price_{t-1} + g_8Subs_{t-1} + g_8Energy\_cons_{t-1} + U_t$$

Where :

$g_0 = a_0e$ $\quad$ $g_5 =- (1-e)f_1$

$g_1 = a_1e + (1-e)f_1$ $\quad$ $g_6 =- (1-e)f_2$

$g_2 = a_2e + (1-e)f_2$ $\quad$ $g_7 =- (1-e)f_3$

$g_3 = a_3e + (1-e)f_3$ $\quad$ $g_8 =- (1-e)f_4$

$g_4 = a_3e + (1-e)f_4$ $\quad$ $g_9 = (1-e)$

The equation presented in this study reveals both short-term relationships and imbalances among the variables, including the inertia in energy consumption (), economic growth (Growth), per capita income (Income), world crude oil prices (Price), and the magnitude of energy subsidies (Subs). This sometimes leads to non-stationary issues at the level of significance. Therefore, to address this, we modify the ECM equation in this research using the following model:

$$DLogEnergy_{cons_t} = \delta_0 + \delta_1 DGrowth_t + \delta_2 DLogIncome_t + \delta_3 DLogPrice_t + \delta_4 DLogSubs_t + \delta_5 Growth_{t-1} + \delta_6 LogIncome_{t-1} + \delta_{7Log} Price_{t-1} + \delta_8 LogSubs_{t-1} + \delta_9 ECT$$

The ECT (Error Correction Term) value can be calculated using the following equation:

$$ECT = Growth_{t-1} + LogIncome_{t-1} + LogPrice_{t-1} + LogSubs_{t-1} - LogEnergy\_cons_{t-1}$$

In addition to utilizing ECM analysis, this research also employs the qualitative analysis tool, Atlas.ti, to organize, explore, and analyze qualitative data in the form of text, documents, interview transcripts, and multimedia. The data processing will yield visualizations that represent the relationships between various elements through the use of graphs and diagrams.

3. RESULTS AND DISCUSSION

3.1. Results

Energy consumption in Indonesia is allocated across various sectors, including industry, households, transportation, and other sectors. The data on final energy consumption in Indonesia for 2020 experienced a decline due to the COVID-19 pandemic. However, as the economic recovery process started to take place in 2021, energy consumption began to rebound.

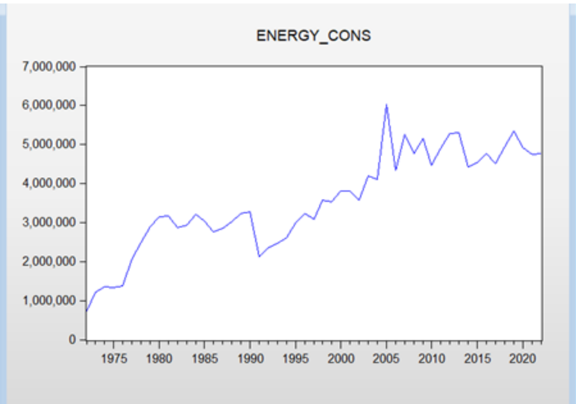

Figure 3. Energy Consumption in Indonesia

Source: Handbook of Energy and Economic Statistic of Indonesia (various year editions)

The elasticity of energy demand in Indonesia remains relatively volatile. When the elasticity of energy demand exceeds one, it indicates a relatively extravagant use of energy, a common occurrence in developing countries. In 2020, the elasticity was recorded at 5.8%, indicating that a 1% increase in economic growth would lead to a corresponding 5.8% increase in energy consumption.

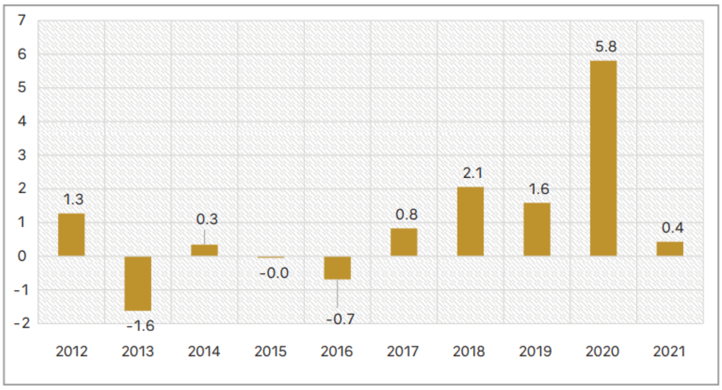

Figure 4. Energy Elasticity in Indonesia
Source: (Secretariate General of The National Energy Council, 2022)

The government plays a crucial role in safeguarding energy resources for the well-being of its citizens, and this necessitates the implementation of a comprehensive national energy policy. This policy can be summarized into three essential pillars: 1) ensuring energy availability, 2) promoting efficient energy utilization, and 3) ensuring energy affordability for the public. Such policies are poised to transform Indonesia's energy consumption patterns, which have historically heavily relied on fossil fuels, particularly petroleum.

The period from 1972 to 2022 witnessed fluctuations in Indonesia's economic growth, heavily influenced by political conditions, global economic trends, and domestic circumstances.

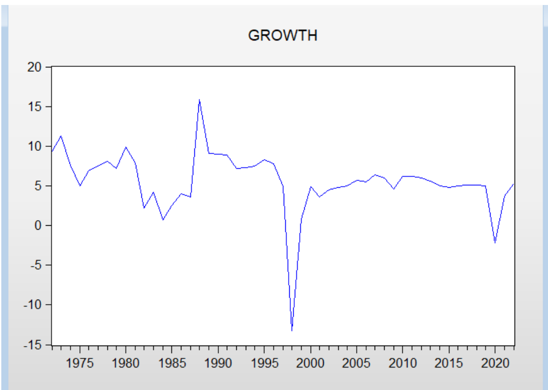

Figure 5. Economic Growth in Indonesia 1972-2022
Source: Central Bureau of Statistics (Various Year Editions)

The average economic growth rate over the aforementioned period stood at 5.86%, with the highest economic growth rate recorded in 1973 at an impressive 11.31%, primarily due to the oil boom. Conversely, the lowest economic growth rate was observed in 1998, plummeting to -13.30% as a consequence of the economic crisis that swept through Indonesia and the rest of the world.

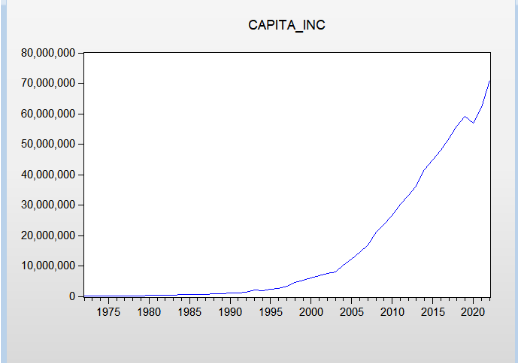

Figure 6. Per capita Income of the Indonesian Population 1972-2022
Source: Central Bureau of Statistics (Various Year Editions)

Over the period from 1972 to 2022, the average per capita income in Indonesia amounted to Rp 15,236,975. By 2019, this figure had surged to Rp 59.1 million, equivalent to 4,174.9 US dollars. It's noteworthy that Indonesia's per capita income was the second lowest among the G20 nations. However, a notable transformation occurred in 2022 when Indonesia was reclassified as a nation with an upper-middle-income status.

The world oil price is one of the influential variables on the macroeconomic conditions in Indonesia. This is because oil serves as the dominant source of energy consumption in Indonesia, which is essential for both production and consumption activities, considering both demand and supply aspects.

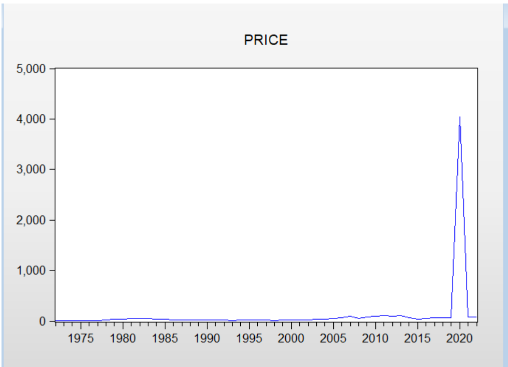

Figure 7: World Oil Price 1972-2022
Source : Handbook of Energy and Economic Statistic of Indonesia

The average world oil price stands at $40.12 per barrel. The lowest recorded world oil price occurred in 1972 at $4.83 per barrel, while the highest was observed in 2013 at $105.48 per barrel. The world crude oil price exhibited an increase following the global crisis in 2008. Government fuel subsidies are closely tied to the volatility of world crude oil prices amid geopolitical uncertainty.

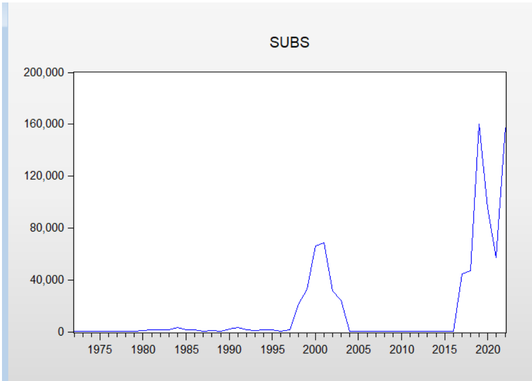

Figure 8: Energy Subsidies in Indonesia 1972-2022
Source : Handbook of Energy and Economic Statistic of Indonesia

The subsidy for fuel oil has experienced fluctuations since 2014 due to the implementation of policies that tie the price of premium gasoline to the fluctuations in global oil prices. This has resulted in reduced productive spending. Therefore, the government must establish a strong priority scale to accelerate the development of infrastructure, including energy infrastructure, renewable energy, food, and transportation. To find the best model, we conducted parameter estimation tests as follows : The parameter model estimation test to find the best model is as follows:

Table 1. Results of Akaike's Information Criterion (AIC) Test

Model	Variable	Coeficient	AIC	F	Probability
1	Constanta	6,59725	-0,520549		
	Growth	-0,01467			
2	Constanta	5,39087	-1,920528		
	LogIncome	0,17333			
3	Constanta	5,76747	-1,545461		
	LogPrice	0,49882			
4	Constanta	6,35809	-0,540013		
	LogSubs	0,05318			
5	Constanta	5,41471	-1,886608	83,6015	0,000000
	Growth	-0,00176			
	LogIncome	0,17116			
6	Constanta	5,84891	-1,694619	64,8052	0,000000
	Growth	-0,01157			
	LogPrice	0,48735			
7	Konstanta	6,45142	-0,539575	3,9775	0,025214
	Growth	-0,00980			
	LogSubs	0,04006			
8	Konstanta	5,46139	-2,285277	93,1648	0,000000
	Growth	-0,00490			
	LogIncome	0,10824			
	LogPrice	0,25272			
9	Konstanta	5,44058	-2,287593	71,7746	0,000000
	Growth	-0,003644			
	LogIncome	0,100833			
	LogPrice	0,265917			
	LogSubs	0,014207			

Source : Data Output

Table 1 reveals that the optimal model involves four independent variables: economic growth, per capita income, global oil prices, and subsidy levels. The Akaike's Information Criterion (AIC) method was employed to determine the best regression model. When the addition of a new variable leads to a decrease in the AIC value, it signifies that the variable can be included in the model. Time series data requires unit root test and cointegration test to see data stationarity. The following are the results of the unit root test and degree of integration test for the variables used in this study.

Table 2. Results of Unit Root and Integration Degree Tests

Variable	Level		1st Difference	
	ADF	Prob	ADF	Prob
LogEnergy_cons	-2.960469	0.0458**	-8.812223	0.0000***
Growth	-4.770756	0.0003***	-9.449905	0.0000***
LogIncome	-3.941842	0.0035***	-5.511354	0.0000***
LogPrice	-2.658175	0.0885*	-8.182317	0.0000***

Variable	Level	1st Difference	Variable	Level
	ADF	Prob		ADF
LogSubs	-2.250946	0.1916	-7.320971	0.0000***

Source: Processed data (2023)
Notes: *** : significant at α = 0,01
** : significant at α = 0,05
* : significant at α = 0,1

Table 2 shows that the variables of economic growth, per capita income, crude oil prices, and subsidies are not stationary at the level, as evidenced by the degree of integration testing. However, all variables became stationary at the 1st Difference with α below 1%. Cointegration testing was employed to determine whether the residual values are stationary at the level or not, ensuring consistency with established theories.

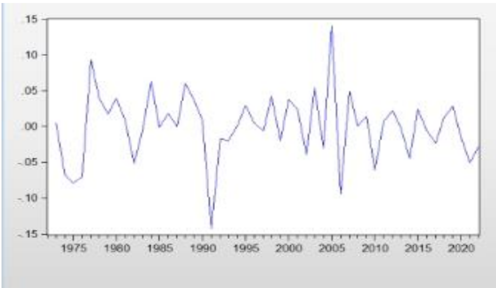

Figure 9. Results of Cointegration Test

Table 3. Results of Cointegration Test

Variable	t-statistic	Probability
Residue	-7.793479	0.0000

Source: Processed data (2023)

The Augmented Dickey-Fuller (ADF) test results indicated that the residual values are stationary at the level, implying that these data are cointegrated. Consequently, the Domowitz-El Badawi Error Correction Model (ECM) test can be conducted. ECM is a technique used to bring short-term conditions into balance toward long-term equilibrium (Gujarati & Porter, 2009).

Tabel 4. Results of the Error Correction Model (ECM) Test for Energy Consumption in Indonesia

Variable	Coefficient	Short Term		Variable	Coefficient	Long Term	
		t-count	t-table			t-count	t-table
Dgrowth	-0.0021	-0.8902[d]	2.042	Growth	-0.0012	-3.7789***	2.042
DLogIncome	0.1821	0.8039[d]	2.042	LogIncome	0.1035	-3.7304***	2.042
DLogPrice	0.1634	2.5726**	2.042	LogPrice	0.1676	-3.9107***	2.042
DlogSubs	-0.0040	-0.3564[d]	2.042	LogSubs	0.0056	-3.8221***	2.042
ECT	0.4202	3.7886***	2.042				

Source: Processed data

Notes : * significant at α 1 %

** significant at α 5 %

*** significant at α 10 %

[d] not significant

Table 3 indicates that the Domowitz-El Badawi Error Correction Model (ECM) can be expressed mathematically as follows:

DLogEnergy_cons = 2,3467 - 0,0021 DGrowth + 0,1821 DLogIncome + 0,1634 DLogPrice - 0,0040 DlogSubs - 0,4207 Growth(-1) - 0,3767 LogIncome(-1) – 0,3498 LogPrice(-1) - 0,4178 LogSub(-1) + 0,4202 ECT

With a significant and positive value of 0.4202 for the Error Correction Term (ECT), the Domowitz-El Badawi Error Correction Model (ECM) utilized in this study is considered valid (Revania, 2014). The long-term regression equation is as follows:

LogEnergy_cons = 5,5847 – 0,0012 Growth + 0,1035 LogIncome + 0,1676 LogPrice + 0,0056 LogSubs

The ECM model used in this research has the BLUE rule as proven using classical assumption tests as well as normality and linearity tests.

The VIF (Variance Inflation Factors) test was used to determine whether or not the variables in the study model were multicollinear. If the VIF score is more than 10, it indicates a link between the independent variables. And if the value is less than 10, then indicates that the independent variables are unrelated. The VIF test utilized in Indonesian energy consumption studies yielded the following results.

Table 5. Result of Multicolinearity Test

Variabel	Coefficient Variance	Centered VIF
Growth	1.13E+09	1.1242
Log_Income	5.88E-05	1.6752
Log_Price	58286.16	1.2006
Log_Subs	19.8969	1.7096

Source: Processed data

The table above shows that the VIF values for all independent variables utilized are less than 10, indicating that the regression model in this study is devoid of multicollinearity. Based on the results of heteroscedasticity testing using the White No Cross test, the χ2 table value (df=9, α=5%) was 16.92 > Obs*R-squared was 2.9383, so it can be concluded that from the model used in this research there is no heteroscedasticity.

Table 6. Result of Heteroscedasticity Test

Obs*R-squared	χ^2 tabel (df=9, α=5%)	Result
2.9383	16.92	there is no heteroscedasticity

Source: Processed data

Autocorrelation indicates that there is a relationship between disturbance variables in the study, which biases the estimated parameters and causes variation to be less than minimal. This makes the model inefficient. The findings of the B-G test are shown in Table 7 below.

Table 7. Result of Autocorrelation Test

	RESID	Probabilitas
F statistik	1.3371	0.2546
Obs *R-squared	1.6574	0.1980

Source: Processed data

The data normality test is used to determine whether the data is normally distributed or not. In this research, the Jarque-Bera method was used. The following are the results of the data normality test.

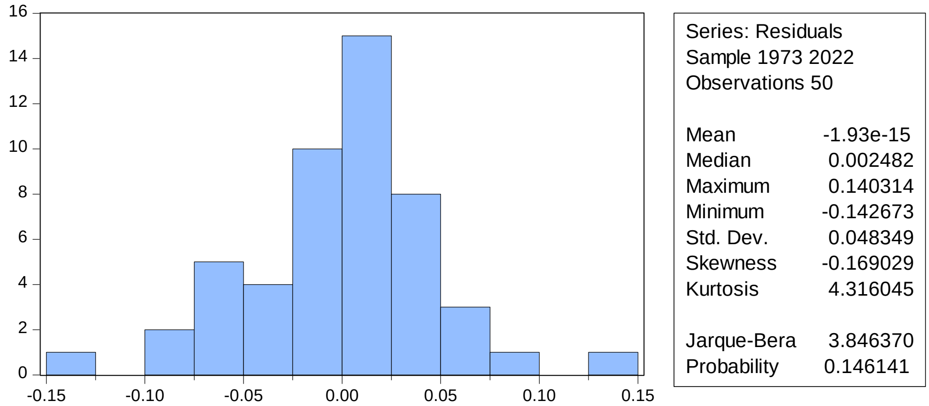

Figure 10. Results of Normality Test

Source: Processed data

Based on this image, it can be seen that the probability of Jarque-bera is 0.3846, which is a value above α= 5 %, so it can be concluded that the data used in this research is normally distributed.

Table 8. Result of Linearity Test

	Value	Probability
t-statistic	0.861412	0.3943
F-statistic	0.742030	0.3943
Likelihood ratio	0.942384	0.3317

Source: Processed data

Based on the results of the Ramsey Reset Test, which is a test to determine the linearity of the data so that the researcher knows that there is a specification error in the regression, then based on table 8, it can be seen that the F statistic probability value is 0.7420 and > α = 5%, so it can be concluded that no error occurred specifications on the initial model.

The F test is used to determine whether the independent factors have any effect on the dependent variable. The F test of Indonesia's energy consumption equation provided the following findings.

Table 9. Result of F-test

	LogEnergy_cons	Uji F
F statistik	3.875947	2,12
Prob (F Statistik)	0.001338	0,05

Source: Processed data

The estimated F value of 3.8759 exceeds the F table (df1 = 9, df2 = 40, α = 5%) of 2.12, indicating that economic growth, per capita income, global crude oil prices and government subsidies all have an impact on energy use in Indonesia. The prof (F statistic) is 0.001338, which is less than the significance level of α = 5%.

3.2. Discussion

In the short term, economic growth does not have a significant impact on energy consumption in Indonesia, consistent with previous research findings that found no significant relationship between economic growth and energy consumption in South Korea (Glasure & Lee, 1998) (Ighodaro, 2010). However, in the long term, economic growth does influence energy consumption. Specifically, a 1% increase in economic growth leads to a 0.0012% decrease in energy consumption. These research findings indicate that as economic growth rates rise, awareness of environmental conservation and energy efficiency also increases. Countries strive to use and consume energy efficiently, taking into consideration the needs of future generations. Furthermore, as a nation advances, its technology utilization, including in industrial, transportation, household, and infrastructure sectors, becomes more sophisticated and energy-efficient. Government policies on energy conservation also play a pivotal role in preserving the environment and ensuring the sustainability of natural resources.

The long-term impact of economic growth on energy consumption exhibits a decline, as revealed by Li et al (Li et al., 2011). In Indonesia, there is a growing awareness of environmental aspects in energy consumption, and energy consumption takes on a U-shaped pattern, as indicated by Rahman (Rahman, 2020). In Indonesia, there is a growing awareness of environmental aspects in energy consumption, and energy consumption takes on a U-shaped pattern, as indicated by (Rahman, 2020). This reflects that the energy conservation policies implemented in Indonesia are aimed at reducing energy demand from consumers. The Indonesian government has formulated policies using tax instruments imposed on specific energy usage, and they have gradually reduced subsidies. In the industrial sector, there is also a shift towards adopting energy-efficient technologies and reducing pollution. Additionally, there is a burgeoning campaign promoting the use of renewable energy sources (Asia Pacific Energy Research Centre, 2013).

In the short term, per capita income does not significantly impact energy consumption in Indonesia. This finding aligns with the research by Carfora et al. (Carfora et al., 2019), which suggests that there is no discernible relationship between per capita income and energy consumption. However, in the long term, per capita income does influence energy consumption in Indonesia, with a coefficient of 0.1035. This means that a 1% increase in per capita income leads to a 0.1035% increase in energy consumption. This result is consistent with the findings of Lin and Zhu (Lin & Zhu, 2020). Importantly, since the coefficient of per capita income is less than one, it can be concluded that energy consumption is a normal necessity. When there are fluctuations in income, the amount of energy consumed does not change drastically, as indicated by Su (Su, 2019).

In the event of a strengthening economy in Indonesia, the long-term energy consumption pattern in the country is expected to follow the trajectory depicted by the Kuznets Curve. The Kuznets Curve illustrates the relationship between economic growth and environmental degradation, where higher per capita income is initially associated with greater environmental degradation. However, beyond a certain turning point, higher per capita income leads to increased environmental awareness, resulting in a reduction in environmental degradation, which also implies a more efficient use of energy (Dong & Hao, 2018).

Energy consumption can also be examined through the Engel Curve. The Engel Curve provides insight into the relationship between income and consumption, indicating that as income increases, consumption tends to rise as well. However, over time, this increase in consumption experiences a diminishing rate of growth. This phenomenon aligns with the findings regarding energy consumption in Indonesia and suggests that in the long term, consumption is likely to decrease as the quality of the economy improves (Nazer & Handra, 2016).

The coefficient for world oil prices stands at 0.1634 and is statistically significant in the short term. This signifies that a 1% increase in world oil prices corresponds to a 0.16% increase in energy consumption in Indonesia. In the long term, a 1% increase in world oil prices results in a 0.17% increase in energy consumption in Indonesia. Such a scenario implies economic stability within a nation (Han et al., 2020). Changes in income tend to shift energy consumption from traditional sources towards modern energy sources. This aligns with the energy ladder theory, where as an individual's income increases, the demand for higher-quality energy also rises. This leads to a transition from traditional energy consumption to cleaner modern energy sources, even in the face of rising prices for modern energy (Han et al., 2020).

In the short term, fuel subsidies do not significantly affect the level of energy consumption. This is because petroleum-based fuels (BBM) are commodities for which there are no close substitutes or inelastic to price fluctuations. Therefore, when fuel subsidies decrease, energy demand does not decrease substantially in the short term (Istiqomah & Wijaya, 2005); (Elinur, 2010). However, in the long term, a 1% increase in energy subsidies results in a 0.0056% increase in energy consumption. Providing subsidies will make prices cheaper and increase real income for both consumers and producers due to increased activities using energy as an input (Kurniawati, 2017). This modest increase in energy consumption relative to the increase in subsidies suggests that Indonesian society has become more prudent in energy use, and government subsidy programs are effectively targeted.

Petroleum-based energy plays a vital role in economic activities. Indonesia's consumption of petroleum-based fuels is substantial, and the country needs to import a significant portion of its petroleum needs. Fluctuations in world oil prices have a direct impact on domestic fuel prices, further burdening the lives of the population, especially those with lower economic means. Based on the analysis conducted using Atlas.ti software, the mapping of the effects of fuel price increases in Indonesia is as follows:

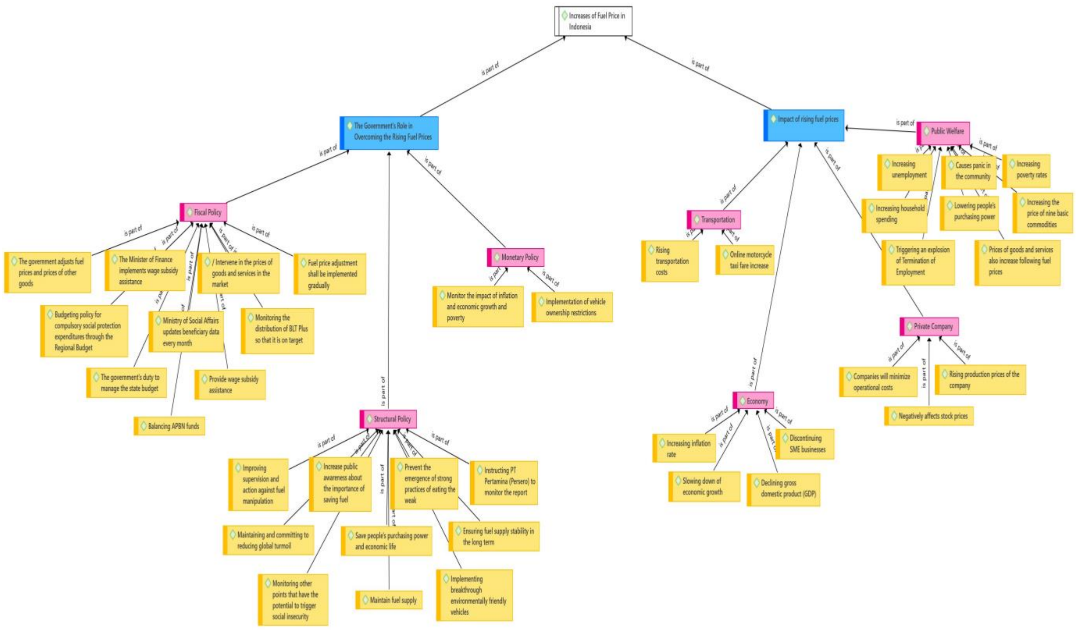

Figure 10. Networking Impact of Fuel Oil Price Increases in Indonesia
Source: Processed data

Figure 10 illustrates that an increase in fuel oil in Indonesia leads to higher prices for nine essential commodities due to distribution factors. The rise in transportation costs prompts businesses to minimize operational expenses. One of the strategies employed by these companies is to reduce their workforce, resulting in increased layoffs and unemployment rates. This, in turn, leads to an uptick in poverty levels and a decline in the overall well-being of the population. The government plays a pivotal role in addressing the impact of gasoline price hikes in Indonesia, as depicted in that figure.

The government plays a crucial role in addressing the increase in fuel oil prices to prevent social upheaval. As observed in the Atlas.ti analysis results, the government will adjust the prices of fuel oil as well as other affected goods, such as staple food prices. Implementing a policy that restricts motor vehicle ownership through progressive taxation is one of the middle-ground approaches to deal with the rising fuel oil prices due to its diminishing supply. The decreasing availability of fuel oil, which is an irreplaceable natural resource, necessitates long-term planning. One of the key policy objectives pursued by the government is to maintain a stable long-term supply of fuel oil. Increased monitoring and enforcement to prevent the misuse of BBM need to be carried out by the government, as this is a sensitive issue for the lower- and middle-income segments of society.

Compensatory measures resulting from the fuel oil price hike are primarily utilized to support welfare enhancement programs for the lower- and middle-income populations. Therefore, the government needs to ensure the precise targeting and distribution of Direct Cash Assistance (Bantuan Langsung Tunai, or BLT). Updating data related to the accurate distribution of BLT benefits to recipients is essential and requires coordination among various interconnected stakeholders, particularly by leveraging the Indonesian Population Single Data (Satu Data Kependudukan Indonesia).

4. CONCLUSIONS

The results can be concluded that economic growth, per capita income, and the amount of subsidies in the short term have no effect on energy consumption in Indonesia, while in the long term they do. This shows that Indonesia is at a stage, where the higher the economic growth, the awareness to conserve energy to protect the environment has been achieved. In addition, it is also influenced by the use of energy that is increasingly efficient and supported by energy-efficient technology. The long-term coefficient value of per capita income is below 1, indicating that energy is a normal good because when income changes either decrease or increase, energy consumption will change less.

World crude oil prices have both short and long term effects and have a positive relationship with energy consumption. This happens because there is a shift in the type of energy consumed by people, from traditional energy to clean energy, which is mostly sourced from petroleum. The increase in people's welfare causes them to consume better quality energy even with the consequence that the price of energy has increased.

The fuel increase policy as an effort to reduce subsidies borne by the government has several impacts, both on the positive and negative sides so that efforts need to be made by the government to anticipate the turmoil that occurs in the community.

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