THE EFFECT OF ELECTRICITY CONSUMPTION, ECONOMIC GROWTH TOWARDS CO2 EMISSIONS IN INDONESIA ACCORDING TO THE ENVIRONMENT KUZNET CURVE HYPOTHESIS: PATH ANALYSIS AND EMPIRICAL STUDY

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ABSTRACT

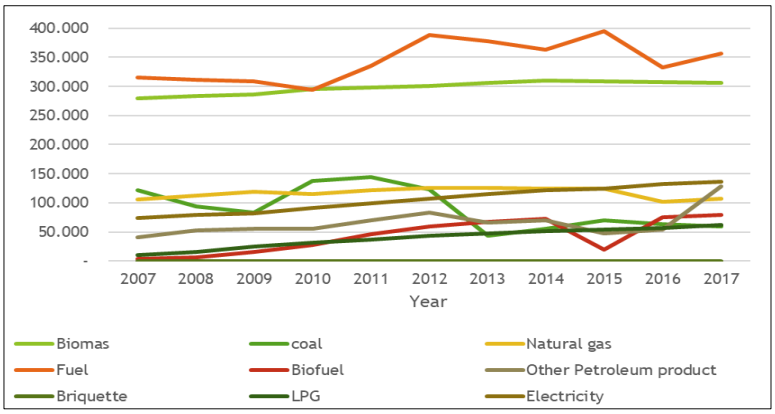
This study examines the influence of the relationship between industrial electricity prices, industrial electricity consumption, foreign direct investment, economic growth, and CO2 emissions.The data used were taken from 1987 to 2019 using the path analysis method.The findings show that that industrial electricity prices have a direct and significant effect on industrial electricity consumption in Indonesia, foreign direct investment has a negative and significant effect on industrial electricity consumption, industrial electricity consumption has a positive but not significant effect on economic growth, industrial electricity prices have a negative but not significant effect on economic growth, direct investment has a positive and significant effect on economic growth, economic growth has a positive but not significant effect on CO2 emissions, Industrial electricity consumption has a positive and significant effect on CO2 Emissions, Industrial electricity prices in Indonesia have a negative and insignificant effect on CO2 Emissions, Direct investment in Indonesia has a negative and insignificant effect on CO2 Emissions. According to the findings,in sum up, the EKC hypothesis does not apply to conditions in Indonesia, this is due to the condition of Indonesia as a developing country that is still not separated from the use of fossil fuels with high emission levels as economic support.

Keywords: Electric Consumption, FDI, Economic Growth, CO2 emission, Environment Kuznet Curve.

INTRODUCTION

The Industrial Era 4.0 demands economic activity that cannot be separated from the use of energy. Almost every sector in economic activity requires energy as a driving force. The industrial and household sectors are sectors that cannot be separated by the presence of energy. Energy is very complex and dynamic in the world of economy, both for consumption needs in the household sector and for consumption in the industrial sector for production activities. According to Stern (2003) the use or consumption of energy is a means to drive the industrialization of the economy as well as a means of accumulation of development capital, either complementary or substitute in producing outputs in the economy.

Figure 1 Indonesia's Energy Consumption by Type (In Thousands of BOE)



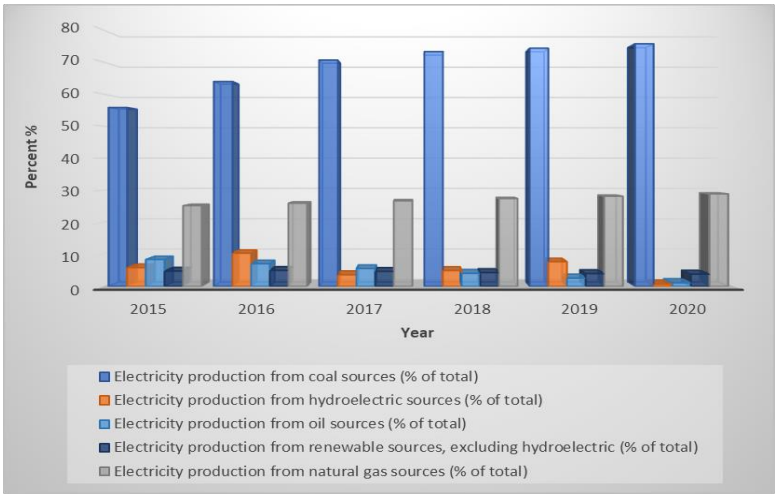
Source: Ministry of Energy and Mineral Resources, 2021 (processed)

The highest energy consumption in Indonesia is still dominated by petroleum with consumption reaching 350,000 thousand BOE in 2017. Meanwhile, coal consumption reaches 300,000 thousand BOE. From the data reflects that fossil energy is still a opiate for energy consumption in Indonesia. Energy needs in the future will continue to increase. The prediction shows that the need for each sector to energy will increase every year. Industrial and household sectors become sectors that have a high level of dependence on energy. According to Purnomo Yusgiantoro (2000) one of the components that affect economic development is the amount of energy consumption nationally, the demand for energy in the manufacturing industry to run machinery is very high. On the other hand, energy contribution support, especially in export receipts and government revenues, becomes a means of development capital accumulation.

The high level of energy consumption, the most widely used energy source is fossil energy. Indonesia is a country that still depends on the existence of fossil resources. Fossil resources are i renewable resources. Even data from the Ministry of Energy and Mineral Resources (ESDM), petroleum and coal become natural resources that are widely consumed in Indonesia. In 2015 the portion of electricity produced from coal was reported to reach about 58.30% and continue to increase in 2020 reaching 75% of

Indonesia's total electricity production. If it is associated with economic structure, it can be said that the utilization of coal has an important role in the Indonesian economy. This is because the contribution of economic sectors whose production process requires electricity to the formation of Indonesia's GDP is recorded at more than 70%. This condition illustrates that the use of coal for power generation has a strategic role for the Indonesian economy. The use of coal for generation can also be said to have an important role for regional economic development, especially areas that are locomotives of economic growth.

Figure 2 Electricity Production By Sources 2015-2020



Source: World Bank , multi – years (processed)

High energy consumption in Indonesia can cause negative impacts on the environment. There are at least three things required in sustainable development, believe maintained or increased all manufacturing capital (factories and machinery), human capital (skills and experience), and environmental capital (forests, as well as air, water and soil quality). An industrial sector-based economic structure that uses more machinery and requires more fuel as energy results in higher air pollution. Total CO2 emissions from electricity production during the period 2009-2019 increased, in 2019 total emissions reached 47.24% of total fuel combustion. Environmental scientists argue that energy consumption is responsible for carbon dioxide (CO2) emissions, which are one of the main causes of the manufacture of greenhouse gases (GHGs) in the atmosphere and produce global warming and climate change. Global warming and climate change are evident from snow and ice melt, rising sea levels, changes in rainfall patterns, increased temperatures in the air and oceans, worsening agricultural and wildlife productivity and reducing labor productivity. Thus, the threat of global warming and climate change has gained greater attention among environmentalists in recent decades.

Environmental degradation can also reduce the pace of economic development by imposing high costs on developing countries through health-related spending and reduced resource productivity. The poorest 20% of the poor in rural and urban areas will experience the consequences of the most acute environmental diseases. Severe environmental degradation, due to population pressures on marginal lands, has led to a decline in agricultural productivity and food production per capita. Since marginal land cultivation is largely the domain of low-income groups, the losses are suffered by those who can least afford it. Similarly, the inability of sanitation and clean water mainly affects the poor and is believed to be responsible for most infectious diseases worldwide. Since solutions to these and many other environmental problems involve increased resource productivity and improved living conditions among the poor, achieving environmentally sustainable growth is identical to our definition of economic development. (Todaro and Smith, 2012:465).

The contribution of this research is divided into two sides. First, the theoretical contribution This research is expected to add insight and knowledge in the economic field, especially the energy economy and its relation to national economic growth and the environmental impacts that occur due to sustainable energy consumption. Second, Provide input for the Central and Regional Governments in implementing policies on the use of fossil energy resources in the future and promote green economy campaigns so that they can be implemented with policies from the government.

EMPIRICAL LITERATURE

The relationship between energy and the economy of a country in general can be seen in several macroeconomic components such as government revenue, export receipts, and balance of payments. According to Griffin and Steele (1989) in Yusgiantoro (2000) the linkage of energy economics with macroeconomics and economic growth can be seen with empirical evidence that has occurred. In the 1970s, there was a world energy crisis that showed a link between these influences. America was experiencing events that significantly affected the world crisis. The 1970s was the first decline in per capita income since the 1930s. At the same time there is a state of inflation that is always stagnant and cannot change for the better. The unemployment rate also looks high. The phenomenon not only occurs in the United States, but also spreads in almost all developed industrialized countries. Maunasinghe (1987) in Yusgiantoro (2000) energy crisis also has an impact on developing countries. The economic development

of developing countries, particularly exporting countries and energy importers, over the past ten to fifteen years since the world energy crisis has clearly demonstrated the linkage of energy to economic growth.

Since economists first proposed the relationship between income changes and environmental quality, the relationship known as the Environmental Kuznets Curve which has become the standard measure in technical discussions about the environment according to Grossman and Krueger (1991) in Bowo (2009) Environmental Kuznets curve describes the relationship between environmental quality expressed with pollutant emissions and per capita income. The relationship between these various environmental degradation indicators and per capita income forms an inverted U. This illustrates the basic idea of the income distribution theory known by Kuznet which finds that the shape of the inverted U curve between indicators meets the level of income.

According to Mark (2006) in Umniati (2015) CO2 emissions have an economic impact, namely (1) CO2 emissions change income and reduce the price value of production results by climate change (climate change) and (2) CO2 emissions result in additional costs for emission reduction. An efficient economic policy chooses a mixture of emission reductions and adjustments where the additional benefit (marginal benefit of reduced GHG concentrations) from reducing greenhouse gas concentrations (Greenhouse Gases) equals the additional cost (marginal cost). Such as a policy that has the lowest cost to reduce greenhouse gas emissions (Greenhouse Gases). CO2 emissions are a manifestation of the cause of environmental damage that has an impact on the economy, an alternative environmental calculation has been proposed by Pearce and Warford. Assets that are in physical form into a formula that has been included in all things of value, not only manufacturing capital (machinery, factories, roads), but also human capital (knowledge, skills and experience), and environmental capital (environmental capital). namely starting from the forest, soil quality, and so on. Based on this definition in (Todaro, 2006), it is explained that the existence of sustainable development requires that all capital be maintained or increased from time to time not to be reduced.

Loesse Jacques Esso et al (2016) researched energy consumption, economic growth and carbon emissions: Cointegration and causality evidence from selected African countries Cointegration, Causality (VAR), Granger Casuality test 12 Sub-Saharan Countries in the African continent (1971-2010). Results from Granger's causality tests show evidence in the short term economic growth is causing CO2 emissions in Benin, the Democratic Republic of Congo, Ghana, Nigeria and Senegal. This implies that economic expansion cannot be achieved without affecting the environment. The reverse causality of CO2 emissions to economic growth occurred in Gabon, Nigeria and Togo, suggesting that environmental policies aimed at reducing air pollution may have adverse effects on economic growth. Then the two-way causality between economic growth and CO2 emissions in the short term is influential in Nigeria and in the long term in Congo and Gabon. In the long run, energy consumption and economic growth are the causes of rising CO2 emissions in Benin, Cote d'Ivoire, Nigeria, Senegal, South Africa and Togo.

Alam, M.M et al (2016) Examining the relationship between economic growth and energy consumption, Co2 emissions used a hypothesis with the Kuznets Curve, which assumes an inverse form of the relationship between income and energy consumption Co2, Economic Growth, Energy Consumption, Population Growth, tested using the EKC Hypothesis. The results showed that CO2 emissions have increased statistically significantly with increased income and energy consumption in all four countries. While the relation between CO2 emissions and population growth was found to be statistically significant in India and Brazil, it was statistically insignificant in China and Indonesia, in the short and long term. Empirical observations from the testing of the environmental Kuznets curve (EKC) hypothesis imply that in the case of Brazil, China and Indonesia, CO2 emissions will decrease as revenues increase. So based on the EKC's findings, it can be said that these three countries should not take any action or policy, which may have a conservative impact on revenues, to reduce their CO2 emissions. Moreover, in the case of India, where CO2 emissions and revenues were found to have a positive relationship, increased revenue over time would not reduce CO2 emissions in the country.

Rahim et al (2018) Examined the Causal Relationship between Electricity Consumption and Economic Growth in Southeast Sulawesi. The causal relationships were examined using autoregressive distributed lag models and Granger causality tests. The test revealed a strong positive causal link between electricity consumption and economic growth in Southeast Sulawesi over the long term. Each increase in electricity consumption by 1% will lead to an increase in economic growth of 0.31%. However, in the short term, the results of this study resulted in a weak but still influential relationship between electricity consumption and economic growth. Therefore, electricity consumption contributes to the economic growth of Southeast Sulawesi in the long term and in the short term.

METHODOLOGY

This study used quantitative approach to observe the influence of industrial sector electricity consumption on economic growth and look at how environmental degradation occurred during Indonesia's economic development period in 1987-2019. The election period was inseparable from second diversification policy in 1987 issued by the Indonesian government after the first policy was made in 1981, as well as the monetary crisis that affected the national economy in 1998. This study observes at how the influence of all variables (industrial sector electricity prices; Direct investment) towards economic growth and its impact on emission CO2.

Variables

The independent variables used in this study consist of 2 variables of Industrial Sector Electricity Price, Direct Investment, Dependent Variables which are the main concerns in this study are industrial sector electricity consumption, economic growth and environmental degradation (Co2 emissions) tested with kuznets curve environment. To avoid the missunderstanding (perception) in this study, the following operational limitations and limitations are drawn up:

Table 1. Variable, Symbol, Position , and Treatmen during Estimation

No	Variable	Symbol	Position	Treatmen during Estimation
1	CO_2 Emission	ENV	Dependen Variable	Natural Logarithm
2	Economic Growth	GWT	Intervening Variable	Natural Logarithm
3	Industry sector electricity consumption	CEL _MAN	Dependen Variable, Independen Variabel, Intervening Variable	Natural Logarithm
4	Industrial sector electricity prices	PREL_MAN	Independen Variable	Natural Logarithm
5	Direct Investment	INV	Independen Variable	Natural Logarithm

Source: Author 2021

Analytical Methods and Models

The results of calculations with IBM SPSS can be found that the number f research on all Sun Structures is > F table of 3.33. Thus, H0 is rejected and H1 is accepted, meaning that there is a linear relationship between the independent variables and the dependent variable in each of the sub-structures examined. The conclusion is that the regression model above is feasible and correct.

Hypothesis Test

The calculation results with IBM SPSS in Figure 5.1 Validity and Hypothesis Test Results in all Sub Structures obtain a probability / significance number of < 0.05. Thus, H0 is rejected and H1 is accepted, meaning that there is a linear relationship between the independent variables and the dependent variable in each of the sub-structures examined. The conclusion is that the regression model above is feasible and correct.

Predictor Accuracy Test

If you look at the calculation results above, the standard error of estimate value is 0.106 < standard deviation of 0.528 (the variable price of electricity in the industrial sector X1), 1.338 (direct investment variable X2). In conclusion, the two independent variables used as predictors are correct.

Autocorrelation Test

Based on the IBM SPSS Run Test Output, the Asymp Sig value is known. (2-tiled) in sub structure 1 of 0.158, greater than 0.05, it can be concluded that there are no symptoms or problems with autocorrelation in structure 1. In structure 2, the Asymp Sig value is known. (2-tiled) of 0.719 greater than 0.05, it can be concluded that there are no symptoms or problems with autocorrelation. in sub structure 3 the asymp sig (2-tiled) value of 0.078 is greater than 0.05, so it can be concluded that there are no symptoms or autocorrelation problems.

Multicollinearity Test

The findings of the calculation of the Tolerance value of the sub-structure multicollinearity test 1, show that there is no independent variable that has a tolerance of less than 0.10 which means there is no correlation between the independent variables whose value is more than 95%. The results of the calculation of the VIF value also show the same thing that there is no single independent variable that has a VIF value of more than 10. In sub structure 2, it shows that there is no independent variable that has a tolerance of less than 0.10, which means there is no correlation between the independent variables whose value is more than 95%. The results of the calculation of the VIF value also show the same thing that there is no independent variable that has a VIF value of more than 10. In sub structure 3, it shows that there is no independent variable that has a tolerance of less than 0, 10 which means there is no correlation between the independent variables whose value is more than 95%. The results of the calculation of the VIF value also show the same thing that there is no one independent variable that has a VIF value of more than 10. So it can be concluded that there is no multicollinearity between independent variables in the regression model for all sub-structures.

This study uses a quantitative approach to observe the influence of industrial sector electricity consumption on economic growth and see how environmental degradation with co2 emission variables occurred during indonesia's economic development period in 1987-2019. The study used track analysis testing. The first model, the Variable Price of Electricity (PREL_MAN) and Direct Investment (INV) as the Independent variable and Economic Growth (GWT) as dependent variables. Industrial sector electricity consumption (CEL_MAN) as an intervening variable in the first model. Then, the second model, there is and additional of independent variables by adding industry sector electricity consumption variables (CEL_MAN) and dependent variables are environmental degragation variables (ENV). Economic growth (GWT) becomes the intervening variable in the second model. Track analysis can be done after the model of the qualified study passes the classical assumption. The requirement is that the data must be normally distributed, not contain multicollinearity, autocorrelation. The path analysis model requires the basic assumptions

in creating an analysis path model. The data used in the study is time series data from 1987-2019. The following is the model in this research.

Model Path Analysis as follows:

$$LnCEL\_MAN = \beta_1 LnPREL\_MAN + \beta_2 INV + e \quad \text{(1)}$$

The first equation observe the effect of industrial sector electricity prices (PREL_MAN) and Investment (INV) on industrial sector electricity consumption (CEL_MAN).

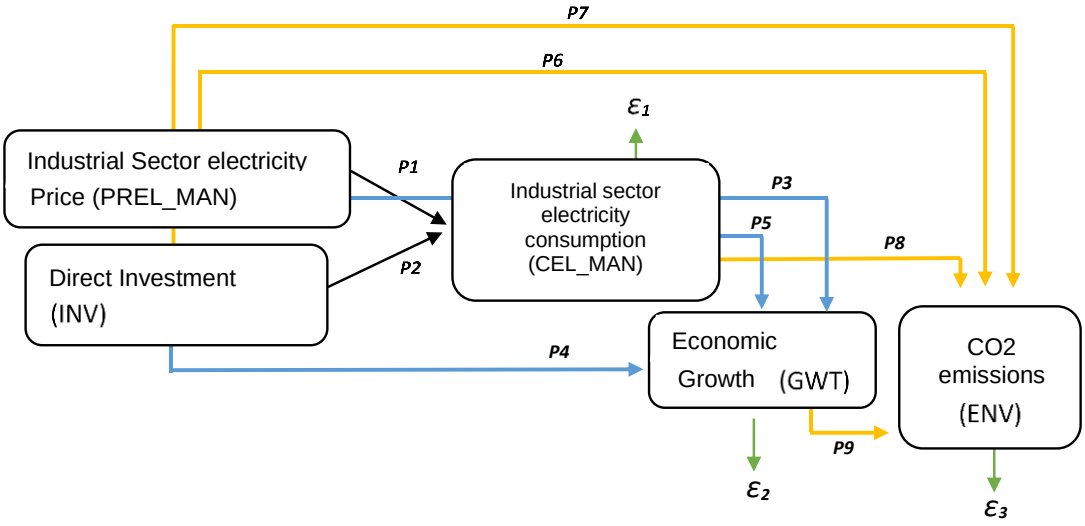
$$LnGWT = \beta_1 LnPREL\_MAN + \beta_2 INV + \beta_3 LnCEL\_MAN + e \quad \text{(2)}$$

The second equation to observe the influence of industrial sector electricity prices (PREL_MAN) and Investment (INV), Industrial Sector Electricity Consumption (CEL_MAN) on Economic Growth (GWT). In this model, the author attempt to add the variables in the electricity consumption of the industrial sector that may have a relationship with the economic growth of a country. Consumption becomes one of the drivers of a country's economy, this is clear from the consumption data that increases every year. The increasing of electricity consumption occurs in several sectors that are closely related to economic movements. Starting from the transportation sector, Industry, Household, commercial and others.

$$LnENV = \beta_1 LnPREL\_MAN + \beta_2 INV + \beta_3 LnCEL\_MAN + \beta_4 LnGWT + e \quad \text{(3)}$$

The third equation observe the influence of industrial (PREL_MAN) and Investment (INV) electricity prices, Industrial Sector Electricity Consumption (CEL_MAN), Economic Growth (GWT) on CO2 Emissions (ENV). Here's the frame of mind for this study:

Figure 3 Framework for Thinking



Source : author, 2021

The addition of the environmental impact variable or CO2 emissions was motivated by the protest against neoclassical assumptions adherents to the flow of new growth. According to the New Growth paradigm, there is a relationship between changes in income and environmental quality, this relationship is known as the Environmental Kuznets Curve which is a standard measure in technical discussions about the environment (Grossman and Krueger, 1991) in Bowo (2009).

The Evironmental Kuznets Curve describes the relationship between the quality of the environment expressed by pollutant emissions and per capita income. This relationship between various indicators of environmental damage and per capita income forms an inverse U curve. This illustrates the basic idea and theory of income distribution introduced by Kuznet which found that there is an inverse U curve between an indicator of inequality and income level. Therefore, the authors included environmental impact variables in this study.

In this study, to determine which variables were statistically significant, path analysis was used with a trimming model approach. Model trimming is a method used to refine the path structure model by removing from the model exogenous variables whose path coefficients are not significant (Ridwan & Kuncoro, 2012). The way to use the trimming model is to recalculate the path coefficients without including exogenous variables whose path coefficients are not significant. The trimming model in this study will be tested using SPSS (Statistical Package for Social Science) software.

Findings and Discussions

Sub-structure Research Validity Test

In this study, the number of samples (n) = 32 and the value of the degree of freedom (DF) / degrees of freedom (DK) with numerator / vector 1: number of variables -1 or 3-1 = 2; and denumator / vector 2: the number of cases-the number of variables or 32-3 = 29. With these provisions, the f table is 3.33.

Table 2 Validity Test Results and Hypotheses

Research Model	Variabel	F Table	F Count	α	Significance	Information
SubStructure 1	Industrial Sector Electricity Consumption (Y1)	3,33	339,008	> 0,05	0,000	Valid
	Industrial Sector Electricity Price (X1)		339,008		0,000	Valid
	Direct Investment (X2)		339,008		0,000	Valid
SubStructure 2	Economic Growth (Z1)		5,706		0,003	Valid
	Industrial Sector Electricity Consumption (Y1)		5,706		0,003	Valid
	Industrial Sector Electricity Price (X1)		5,706		0,003	Valid
	Direct Investment (X2)		5,706		0,003	Valid
SubStructure 3	CO2 emissions (Z2)		33,582		0,000	Valid
	Economic Growth (Z1)		33,582		0,000	Valid
	Industrial Sector Electricity Consumption (Y1)		33,582		0,000	Valid
	Industrial Sector Electricity Price (X1)		33,582		0,000	Valid
	Direct Investment (X2)		33,582		0,000	Valid

Source: author 2021 (data processed)

The results of calculations with IBM SPSS can be found that the number f research on all Sun Structures is > F table of 3.33. Thus, H0 is rejected and H1 is accepted, meaning that there is a linear relationship between the independent variables and the dependent variable in each of the sub-structures examined. The conclusion is that the regression model above is feasible and correct.

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The calculation results with IBM SPSS in Figure 5.1 Validity and Hypothesis Test Results in all Sub Structures obtain a probability / significance number of < 0.05. Thus, H0 is rejected and H1 is accepted, meaning that there is a linear relationship between the independent variables and the dependent variable in each of the sub-structures examined. The conclusion is that the regression model above is feasible and correct.

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Based on the IBM SPSS Run Test Output, the Asymp Sig value is known. (2-tiled) in sub structure 1 of 0.158, greater than 0.05, it can be concluded that there are no symptoms or problems with autocorrelation in structure 1. In structure 2, the Asymp Sig value is known. (2-tiled) of 0.719 greater than 0.05, it can be concluded that there are no symptoms or problems with autocorrelation. in sub structure 3 the asymp sig (2-tiled) value of 0.078 is greater than 0.05, so it can be concluded that there are no symptoms or autocorrelation problems.

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The findings of the calculation of the Tolerance value of the sub-structure multicollinearity test 1, show that there is no independent variable that has a tolerance of less than 0.10 which means there is no correlation between the independent variables whose value

is more than 95%. In sub structure 2, it shows that there is no independent variable that has a tolerance of less than 0.10, which means there is no correlation between the independent variables whose value is more than 95%. In sub structure 3, it shows that there is no independent variable that has a tolerance of less than 0, 10 which means there is no correlation between the independent variables whose value is more than 95%. So, it can be concluded that there is no multicollinearity between independent variables in the regression model for all sub-structures.

Normality Test

The K-S test result in substructure 1 gives a value of 0.89 with a probability of 0.200 that is well above α = 0.05, so it can be concluded that the null hypothesis is acceptable, meaning the data is normally distributed. In substructure 2 the results of the K-S monte carlo sig test with a probability of 0.121 are well above α = 0.05, so it can be concluded that the null hypothesis is acceptable, which means the data is normally distributed. In substructure 3 the K-S test result gives a value of 0.083 with a probability of 0.200 that is well above α = 0.05, so it can be concluded that the null hypothesis is acceptable, which means the data is normally distributed.

Regression Analysis

Table 3 Substructure 1 Individual Significant Test

Variabel	Koefisien	Prob (P-Value)
Kostanta	4,650	0,000
Sektor Industrial Electricity Price(X1)	0,955	0,000
Direct Investment (X2)	-0,031	0,049
Effects Specification		
R-Squared : 0,979	***Prob (F- Statistic) :*** 0,00	

Source: author 2021 (data processed)

From the two independent variables incorporated into the regression model, the industrial electricity price variable and direct investment have a significant effect, this can be seen from the probability of the significance of the industrial electricity price variable of 0.000 and the direct investment variable of 0.049 which is below 0.05, from this it can be concluded that the variable of industrial electricity consumption is influenced by the price of industrial electricity and direct investment with mathematical equations.

Y1 = 4,650 + 0.955X1 - 0.31X2 + e ..... (1)

Table 4 Sub Structure Individual Significance Test 2

Variabel	Koefisien	Prob (P-Value)
Kostanta	-6,462	0,142
Industrial Sector Electricity Consumption (Y1)	0,741	0,105
Electricity Price Sektor Industry (X1)	0,000	0,576
Direct Investment (X2)	0,364	0,006
Effects Specification		
R-Squared : 0,564	***Prob (F- Statistic) :*** 0,010	

Source: author 2021 (data processed)

Of the three independent variables incorporated into the regression model, direct investment variables have a significant effect, this can be seen from the probability of the significance of the direct investment variable of 0.006 which is below 0.05, from this it can be concluded that the variable economic growth is influenced by direct investment with mathematical equations.

Z1 = -6,462 + 0.364Y1 + 0.741X1 + 0.000X2 + e ..... (2)

Table 5 Sub Structure Individual Significance Test 3

Variabel	Koefisien	Prob (P-Value)
Kostanta	-2,010	0,193
Economic growth (Z1)	0,016	0,559
Industrial Sector Electricity Consumption (Y1)	2,406	0,001
Electricity Price Sektor Industry (X1)	-2,300	0,830
Direct Investment (X2)	-0,019	0,347
Effects Specification		
R-Squared : 0,883	***Prob (F- Statistic) :*** 0,00	

Source: author 2021 (data processed)

Of the four independent variables incorporated into the regression model, the Industrial Electricity Consumption variable has a significant effect, this can be seen from the probability of the significance of the Industrial Electricity Consumption variable of 0.001 which is below 0.05, From this it can be concluded that the variable of economic growth is influenced by Industrial Electricity Consumption with mathematical equations.

Z2 = -2,010 + 0.016Z1 + 2.406Y1 + 2,300X1 – 0.19 X2 + e ……..... (3)
Path Analysis

In Sub Structure 1, the value of R^2 (R Square) is 0.958. This R^2 value is used in calculating the value of e1. e1 is a variable variant of industrial electricity consumption which is not explained by industrial electricity prices and direct investment. The magnitude of e1 = 2) = = 0.205.$\sqrt{(1-R}\sqrt{(1-0{,}958)}$

The results of the SPSS output provide the standardized coefficients beta value of capability in equation (1) of 1.009 and significant at 0.000, which means that industrial electricity prices have an effect on industrial electricity consumption. The standardized coefficients beta value of 0.009 is the path value or path p1. The standardized coefficients beta value of direct investment in equation (1) is -0.084 and significant at 0.049, which means that direct investment has an effect on industrial electricity consumption. The standardized coefficients beta value of -0.484 is the path value or p2 path. Based on these results, it can be seen that the regression equation is as follows:

Y1 = 4.650 + 1.009X1 - 0.084X2 + 0.205……..……..……...……(1.1)

The increase in industrial electricity prices and direct investment will affect industrial electricity consumption by 0.205. So from equation (1) it can be seen that every time there is an increase in industrial electricity prices (X1), it will be followed by an increase in industrial electricity consumption (Y1) and every time there is an increase in direct investment (X2), the industrial electricity consumption (Y1) will experience decline.

In Sub Structure 2, the value of R2 (R Square) is 0.318. This value of R2 is used in calculating the value of e2. e2 is a variable variant of economic growth that is not explained by industrial electricity consumption, industrial electricity prices and direct investment. The magnitude of e2 = 2) = = 0.825$\sqrt{(1-R}\sqrt{(1-0{,}318)}$

SPSS output results provide standardized coefficients beta. Industrial electricity consumption in equation (2) is 0.693 and not significant at 0.105, which means industrial electricity consumption has no effect on economic growth. The standardized coefficients beta value of 0.693 is the path value or p3 path. The standardized coefficients beta value of industrial electricity prices in equation (2) is -0.240 and is not significant at 0.576, which means that industrial electricity prices have no effect on economic growth. The standardized coefficients beta value of -0.240 is the path value or p4 path. The standardized coefficients beta value of direct investment in equation (2) is 0.502 and significant at 0.006, which means that direct investment has an effect on economic growth. The value of standardized coefficients beta 0, 502 is the path value or path p5. Based on table 5.42, it can be seen that the regression equation is as follows:

Z1 = -6.462 + 0.693Y1 - 0.240X1 + 0.502X2 + 0.825……..……..(2.1)

The increase in electricity consumption and industrial electricity prices will not affect economic growth, while direct investment will affect economic growth by 0.825. So from equation (2) it can be seen that every time there is an increase in industrial electricity consumption (Y1), it has an effect but is not significant on economic growth (Z1). Every time there is an increase in the price of industrial electricity (X1), it has an effect but is not significant on economic growth (Z1). Every time there is an increase in direct investment (X2), it will be followed by an increase in economic growth (Z1).

In Sub Structure 3, the value of R2 (R Square) is 0.749 This value of R2 is used in calculating the value of e3. e3 is a variant of CO2 emission variable which is not explained by economic growth, industrial electricity consumption, industrial electricity and direct investment. The magnitude of e3 = 2) = = $0.470\sqrt{(1-R\sqrt{(1-0{,}780)}}$

SPSS output results provide standardized coefficients beta economic growth in equation (3) of 0.064 and not significant at 0.559, which means that economic growth (Z1) has no effect on CO2 emissions (Z2). The standardized coefficients beta value of 0.064 is the path value or p5 path. The value of standardized coefficients beta Industrial electricity consumption in equation (3) is 0.868 and significant at 0.001, which means industrial electricity consumption (Y1) has an effect on CO2 emissions (Z2). The standardized coefficients beta value of 0.868 is the path value or p6 path. The value of standardized coefficients beta of industrial electricity prices (X1) in equation (3) is -0.051 and not significant at 0.830, which means that industrial electricity prices (X1) have no effect on CO2 emissions (Z2). The value of standardized coefficients beta 0, 868 is the path value or path p7. The standardized coefficients beta value of direct investment (X2) in equation (3) is -0.107 and significant at 0.347, which means that direct investment (X2) has an effect on CO2 emissions (Z2). The standardized coefficients beta value of -0.107 is the path value or p8 path. Based on table 5.44, it can be seen that the regression equation is as follows.

Z2 = -2.010 + 0.064Z1 + 0.868Y1 – 0.051X1 – 0.107 X2 + 0.470 …….…….(3.1)

Increased economic growth (Z1), industrial electricity prices (X1), and investment (X2) have a but not significant effect on CO2 emissions (Z2), while industrial electricity consumption (Y1) will affect CO2 emissions (Z2) by 0.470. So from equation (3) it can be seen that every time there is an increase in Economic Growth (Z1), it has an effect but is not significant on CO2 Emissions (Z2). Every time there is an increase in industrial electricity consumption (Y1), it will be followed by an increase in CO2 emissions (Z2). Every time there is an increase in the price of industrial electricity (X1), it has an effect but is not significant on CO2 Emissions (Z2). Every time there is an increase in Direct Investment (X2), it has an effect but is not significant on CO2 Emissions (Z2).

FINDINGS AND DISCUSSION

Industry Electricity Price Against Industry Electricity Consumption

The results of the regression test show that the value of the variable coefficient of industrial electricity prices (X1) is 1.009, which is positive, meaning that the price of industrial electricity is directly proportional to industrial electricity consumption (Y1) and the results of the statistical test Ttest (partial test) show a significant value of industrial electricity consumption (Y1) of 0.000 is smaller than 0.05, meaning that the price of industrial electricity (X1) has a significant and significant effect on industrial electricity consumption. Hondroyiannis (2004) examines the determinants of electricity consumption for Greece. The author found that electricity consumption is influenced by real income, prices and weather. In a study related to electricity demand in Kazakhstan. The increase in electricity prices did not reduce electricity consumption in the industrial sector in the research period, even electricity consumption increased despite the increase in electricity prices, this is because the industrial sector must continue to carry out the production process using machine tools and other technologies so that the work done can be more efficient. In the industrial era 4.0, the industrial sector requires electricity whose availability is continuous, affordable, and sufficient. This will support the domestic industry to provide quality and competitive products. To accelerate the implementation of industry 4.0, electrical energy is very much needed in the preparation of digital infrastructure and platforms, including for industrial areas.

Direct Investment in Industrial Electricity Consumption

The results of the regression test show that the value of the direct investment variable coefficient (X2) is -0.084 which is negative, meaning that direct investment (X2) is not directly proportional or not in the direction of industrial electricity consumption and the results of the Ttest statistical test (partial test) show a significant value of direct investment (X2) of 0.049 is smaller than 0.05, meaning that direct investment (X2) has a negative and significant effect on industrial electricity consumption. Direct investment (X2) has a negative and significant effect due to a decrease in foreign direct investment (FDI) causing projects and economic dynamism that aim to create employment opportunities and this has resulted in reduced electricity consumption for industry and for private consumption. Electricity consumption will increase if foreign direct investment (FDI) is allocated to the industrial sector, especially the industrial sector that requires electricity whose availability is sustainable (sustainable), affordable (equity), and sufficient (security). In the case of Indonesia, the reduction in electricity consumption caused by the increase in Foreign Direct Investment (FDI) was caused by several factors. One of the factors causing this is the dependence of the Indonesian industry on the use of petroleum-fueled energy. Foreign Direct Investment (FDI) still dominates the secondary industry and invests in pollution-intensive industries in Indonesia. Meanwhile, investment in tertiary industries such as the financial and technology industries which use more electricity is still relatively low.

Industrial Electricity Consumption toward Economic Growth

The coefficient value of industrial electricity consumption variable (Y1) is 0.693 positively marked, meaning that industrial electricity consumption (Y1) is directly proportional or in line with economic growth (Z1) and the results of the Ttest statistical test (partial test) show the value of the significance of industrial electricity consumption (Y1) of 0.105 greater than 0.05, meaning that industrial electricity consumption (Y1) has a positive but insignificant effect on economic growth (Z1). Economic growth in Indonesia is currently continuing to grow positively, but as the growth is a new problem faced by Indonesia arises, namely the demand for energy is growing rapidly. In other words, economic growth is related to electricity consumption. In line with the opinion of Alyes (2009) who stated that the driver of an economy is energy, especially electrical energy. Energy production that is not able to meet demand can logically disrupt Indonesia's economic growth, but in reality it is not. Despite the energy deficit,

economic growth will continue to grow. Economic growth will increase electricity consumption, but not the other way around. The factors that cause industrial sector electricity consumption to affect but not significant economic growth due to several factors, similar conditions were also found in the study of Abosedra Salah et al (2008) entitled Electricity consumption and economic growth, the case of Lebanon. The study explained the absence of a long-term balance between electricity consumption and economic growth but the existence of direct causality from electricity consumption to Lebanese economic growth. The development of capacity building and infrastructure development of Lebanon's electric power sector are among the factors that will drive the country's economic growth.

Industrial Electricity Prices on Economic Growth

The results of the regression test show that the coefficient value of the industrial electricity price variable (X1) is -0.240 which is negative, meaning that the industrial electricity price (X1) is not directly proportional or not in the direction of economic growth and the results of the statistical test Ttest (partial test) show the significance value of electricity prices. industry (X1) of 0.576 is greater than 0.05, meaning that the price of industrial electricity has a negative but not significant effect on economic growth (Z1). One of the factors causing the decline in economic growth in Indonesia when there is an increase in electricity prices is government consumption. The increase in energy prices has a positive impact on government spending. The intuition is that when energy prices rise, inflation will also increase. This will reduce government spending in real terms. To keep government spending in real terms, government spending should be increased nominally. So there is a direct relationship between rising energy prices and government consumption spending. The public sector is an important institution that explains the various levels of economic growth. Awunyo-Vitor et al (2018) found that the impact of changes in oil prices on economic growth in the long term was not statistically significant and there was a one-way causality relationship of changes in oil prices on economic growth. Erdoan et al. (2020b) conducted a study in GCC countries found that oil price volatility had a negative impact on economic growth in most of the GCC countries. The public sector is an important institution that explains the various levels of economic growth.

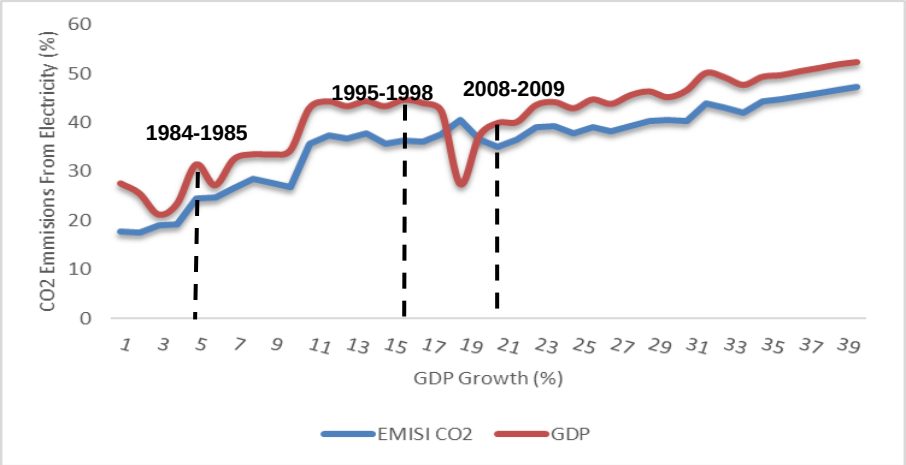
Direct Investment on economic growth

The results of the regression test show that the value of the direct investment variable coefficient (X2) is 0.502, which is positive, meaning that direct investment (X2) is directly proportional to economic growth (Z1) and the results of the Ttest statistic test (partial test) show a significant value for direct investment (X2). of 0.006 is smaller than 0.05, meaning that direct investment (X2) has a positive and significant effect on economic growth (Z1). These results indicate that the entry of foreign direct investment (FDI) into a country will cause an increase in production through the transfer of knowledge, culture and technology so that the amount of production of goods and services will increase. With the increasing technology and increasing knowledge in the production carried out, it is necessary for human resources who are experts in their fields, this must also be supported by increasing the level of education in the country. Because the demand for labor is higher, it will create jobs for workers who have expertise in their fields. Research from Abosedra Salah et al (2008) explains that foreign direct investment has an effect on economic growth. The use of capital encourages economic growth. Causality analysis reveals the feedback effect between electricity consumption and economic growth. Two-way relationship between foreign direct investment and electricity consumption. The increase in foreign direct investment (FDI) and projects and the dynamism of the economy firstly created jobs and secondly has increased the use of electricity for industry as well as for private consumption. Thus, per capita income increases. Agma (2015) examines the role of Foreign Direct Investment on Indonesia's Economic Growth, the study explains. It was concluded that during the last 30 years and after the 1998 crisis, foreign direct investment had a significant positive effect on Indonesia's economic growth. However, before the 1998 crisis, FDI had a negative but not significant effect on Indonesia's economic growth.

Economic Growth Against CO2 Emissions

The results of the regression test show that the value of the variable coefficient of economic growth (Z1) is 0.064, which is positive, meaning that economic growth (Z1) is directly proportional to CO2 emissions (Z2) and the results of the statistical test Ttest (partial test) show a significant value for economic growth (Z1) of 0.559 is greater than 0.05, meaning that economic growth (Z1) has a positive but not significant effect on CO2 emissions (Z2). Based on Kuznet's environmental curve theory, it can be seen that the increasing income of the people, which means economic growth, will initially cause pollution. However, in the end it will improve the quality of the environment because the longer the community tends to reduce economic activities that cause externalities, and with increasing income, society will tend to increase awareness of the environment through the use of environmentally friendly technology. So basically CO2 emissions can reduce economic growth. It follows the theory that if the level of pollution increases this will cause income to decrease. Pollution is considered to be able to directly reduce output which has an impact on decreasing the productivity of capital and labor. According to Stern (2003) CO2 emissions have a strong correlation with GDP. As a result, since 1850, North America and Europe have produced about 70% of all CO2 emissions due to energy production, with the remainder being generated by developing countries.

Figure 4 Economic Growth and CO2 Emissions



Source : World Bank 2020 (Processed)

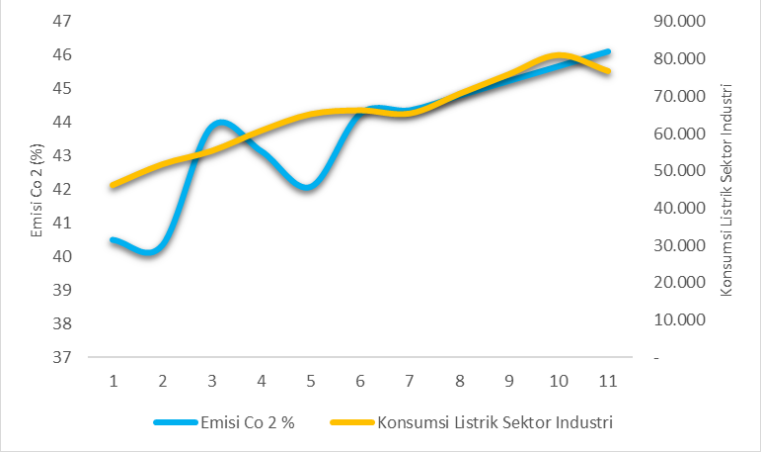
In 2019 the peak of Indonesia's carbon dioxide emissions per capita reached 47.2%, this value increased by 38.10% from 1986. The average increase in carbon dioxide emissions per capita before the first turning point was 21.8%, then this average decreased until the second turning point becomes 4.03%. After the second turning point, carbon dioxide emissions per capita tend to increase again. The increase in carbon dioxide emissions in Indonesia is caused by deforestation that has occurred so far.

Industrial Electricity Consumption toward CO2 Emissions

The results of the regression test show that the value of the variable coefficient of industrial electricity consumption (Y1) is 0.868, which is positive, meaning that industrial electricity consumption (Y1) is directly proportional to CO2 emissions (Z2) and the results of the statistical test Ttest (partial test) show a significant value of electricity consumption. industry (Y1) of 0.001 is smaller than 0.05, meaning that industrial electricity consumption (Y1) has a significant effect on CO2 emissions (Z2), this indicates that industrial electricity consumption (Y1) in Indonesia has a positive and significant effect on CO2 emissions (Z2). The first hypothesis (H1) which states that industrial electricity consumption (Y1) has a positive and significant effect on CO2 emissions is accepted. Thus, when there is an increase of 1 unit in electricity consumption in Indonesia,

For conditions in the study in Indonesia, the increase in CO2 emissions is followed by an increase in energy consumption. When consuming, people use a lot of natural resources and dirty technology, causing environmental damage without any countermeasures. It can be seen that the increasing income of the community will have an impact on economic growth which will initially cause pollution. The Kuznet curve also shows that when people's incomes start to rise, the quality of the environment will get better and the marginal utility of consumption will decrease. So at the same time energy consumption causes high CO2 and is followed by economic growth caused by energy consumption. However, recently the Indonesian government has begun to aggressively issue new policies in an effort to reduce the use of CO2 emissions. This policy is an emission tax policy imposed on motorized vehicles.

Figure 5 CO2 Emissions and Industrial Electricity Consumption



Source : World Bank 2020 (Processed)

In figure 5 CO2 emissions and industrial electricity consumption, CO2 emissions continue to increase and are followed by household electricity consumption levels. The increase indicates that increased electricity consumption in Indonesia will increase the amount of electricity production in Indonesia. Production, in 2011-2015 continued to increase every year, in 2015 the portion

of electricity produced from coal reportedly reached about 58.30% of Indonesia's total electricity production. If it is associated with economic structure, it can be said that the utilization of coal has an important role in the Indonesian economy. This is because the contribution of economic sectors whose production process requires electricity to the formation of Indonesia's GDP is recorded at more than 70%. Total CO2 emissions from electricity production in 2019 totaled 47.24% of total fuel combustion. Environmental scientists argue that energy consumption is responsible for carbon dioxide (CO2) emissions, which are one of the main causes of the manufacture of greenhouse gases (GHGs) in the atmosphere and produce global warming and climate change. Global warming and climate change are evident from snow and ice melt, rising sea levels, changes in rainfall patterns, increased temperatures in the air and oceans, worsening agricultural and wildlife productivity and reducing labor productivity. Thus, the threat of global warming and climate change has gained greater attention among environmentalists in recent decades. As a result, economists and environmentalists are becoming more aware of the environmental consequences of economic growth, which distracts from modest economic growth to environmentally friendly economic growth.

Industrial Electricity Prices toward CO2 Emissions

The results of the regression test show that the value of the coefficient of the industrial electricity price variable (X1) is -0.051 which is negative, meaning that the industrial electricity price (X1) is not directly proportional or not in the direction of CO2 emissions and the results of the Ttest statistical test (partial test) show a significant value for electricity prices. industry (X1) of 0.830 is greater than 0.05, meaning that the price of industrial electricity (X1) has a significant effect on CO2 emissions, this indicates that the price of industrial electricity (X1) in Indonesia has a negative and insignificant effect on CO2 emissions. The first hypothesis (H1) which states that the price of industrial electricity (X1) has a positive and significant effect on CO2 emissions is rejected. Thus, when there is an increase of 1 unit in electricity prices in Indonesia,

The results of this study are in accordance with the predictions of neoclassical economic theory (Ferguson, 1969). If the price of a good rises relative to the price of its substitutes, the demand for that good will fall. In the case of this study, Electricity can be viewed as a resource commodity even in an inefficient market. As a result, when electricity prices increase, producers can replace electricity consumption with other factors of production such as labor or technology by hiring more workers or utilizing energy-efficient technologies. All of these efforts will result in a reduction in CO2 emissions caused by electricity consumption.

Research by Li et al (2020) shows a significant negative impact of energy prices on CO2 emissions. Energy prices play an important role in influencing energy consumption patterns as well as influencing greenhouse emissions caused by energy consumption. Thus CO2 emissions can be reduced effectively by increasing energy prices. The results of this study indicate that the elasticity of energy prices to CO2 emissions is still relatively small, which may be due to the inefficiency of the Chinese energy market which is still subject to tough government regulations. As a result, reducing strict government controls and accelerating energy marketization reforms could facilitate the energy industry to play a greater role in shaping energy consumption patterns and limiting greenhouse emissions.

Direct Investment in CO2 Emissions

The results of the regression test show that the value of the direct investment variable coefficient (X2) is -0.107, which is negative, meaning that direct investment (X2) is not directly proportional or not in the direction of CO2 emissions and the results of the Ttest statistic test (partial test) show a significant value for direct investment (X2). of 0.347 is greater than 0.05, meaning that direct investment (X2) has a significant effect on CO2 emissions, this indicates that direct investment (X2) in Indonesia has a negative and insignificant effect on CO2 emissions. The first hypothesis (H1) which states that direct investment (X2) has a positive and significant effect on CO2 emissions is rejected. Thus, when there is an increase of 1 unit in Direct Investment (FDI) in Indonesia, it will cause a decrease in CO2 Emissions in Indonesia by -0.107.

Foreign direct investment (FDI) has a negative and significant effect on changes in environmental quality as measured by CO2 emissions. Thus, the more open the flow of Foreign Investment (FDI), it can reduce CO2 emissions in a country in a certain period and vice versa. Through foreign direct investment (FDI) will allow countries to specialize in their industries through comparative advantage so that incomes increase, encourage structural transformation, as well as improve technology and human capital along with people's desire for a higher standard of living and are more concerned with environmental quality. . Therefore, appropriate policies are needed for the regulation of foreign direct investment (FDI) in order to be in line with sustainable development. The current debate in both developed and developing countries is to minimize CO2 emissions without compromising rapid economic development. Achieving this delicate balance is difficult for policymakers and businesses alike.

This research is in line with Paramati et al (2017) who explained in a panel study that increasing FDI reduces CO2 emissions per capita in developing countries in the long term. The results showed that there was no statistically significant relationship between FDI and CO2 emissions per capita in the long term. The same is true for CO2 intensity and sectoral share in total CO2 emissions.

CONCLUSIONS AND IMPLICATIONS

Industrial electricity prices have an effect and significant on industrial electricity consumption in Indonesia, direct investment has a negative and significant effect on industrial electricity consumption, industrial electricity consumption has a positive but insignificant effect on economic growth, industrial electricity prices negatively affect but not significant economic growth, direct investment has a positive and significant effect on economic growth, economic growth has an effect. positive but not significant to CO2 emissions, industrial electricity consumption has a positive and significant effect on CO2 emissions, industrial electricity prices in Indonesia have a negative and insignificant influence on CO2 emissions, direct investment in Indonesia has a negative

and insignificant influence on CO2 emissions. The increase in electricity consumption in Indonesia can be categorized as alarming because it is followed by increased CO2 emissions and environmental problems. One of the causes is coal which is the cheapest primary energy generation compared to other types of fossil energy such as gas and oil (BBM). Most of the power generation capacity owned by Indonesia at this time is a power plant that uses a lot of coal. Emissions and environmental damage caused by electricity production must be anticipated by the government. When referring to the targets set by the Kyoto protocol, Indonesia still has not fully implemented the protocol. Governments should start implementing emissions tax policies or the use of fossil fuels imposed on the industry.

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