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Analysis of New Renewable Energy (EBT) Electricity on Green Economy in Indonesia and Influence Factors

Yayuk Rufiatun; Evi Gravitiani; Mugi Raharjo

Faculty Economics and Business, Sebelas Maret University, Surakarta 57126, Indonesia

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Abstract

Indonesia's electricity consumption reached 1,109 kilowatt hours (kWh) per capita in the third quarter of 2021. Power generation in Indonesia is dominated by the use of coal which has negative environmental impacts, one of which is carbon emissions (CO2) and extreme climate change. renewable energy, as a strategic option for mitigating environmental problems. This study examines the effect of renewable energy electricity on the green economy in Indonesia. The purpose of this study 1) To analyze the effect of renewable electricity, CO2 emissions, population, economic openness, foreign investment and coal consumption on green gross domestic product in Indonesia. 2) To analyze the effectiveness of government policies in developing renewable electric power in Indonesia. The method used in this study is the error correction model to determine the long-term and short-term effects between variables. The data used in this study is from 1990-2019. The results of the study found that the variables that affect the short and long term green economy in Indonesia are renewable electricity, carbon emissions, population, coal consumption and trade openness. Meanwhile, the variable that does not affect the short and long term green economy in Indonesia is foreign investment.

Keywords: *Green GDP; Renewable Electricity; Population; Coal Consumption; Trade Openness; Foregn Direct Investment*

Introduction

The history of electric energy in Indonesia began at the end of the 19th century. The business of electricity developed for the public interest, starting with a Dutch private company, namely NV. NIGM (Nederlandsch Indische Mataschapij), which expanded its business from only in the gas sector to the electric power sector, was only available to the public when an electricity company called Nederlandche Indische Electriciteit Maatschappij (NIEM) was built. The company is headquartered in the Netherlands. In Batavia, NIEM built a power plant in Gambir on the banks of the Ciliwung River. The PLTU with a capacity of 3200+3000+1350 kW is the first steam power plant in the Dutch East Indies and supplies electricity needs in Batavia and its surroundings. This company then expanded to Surabaya by establishing the Nederlandsche Indische Gas Maatschappij (NIGM). Electricity supply spreads to big cities in Java. The Dutch government then formed s'Lands Waterkracht Bedriven (LWB) in 1927. The company is a state electricity company that manages hydropower plants in several regions in Indonesia,

namely PLTA Plengan, PLTA Lamajan, PLTA Bengkok Dago, PLTA Ubrug and Kracak in West Java, PLTA Giringan in Madiun, the PLTA Test in Bengkulu, the old Tonsea PLTA in North Sulawesi and the PLTU in Jakarta. In addition, in several municipalities, municipal electricity companies have been formed. Literature review articles contain an analysis and commentary of the publications on a specific area of research (latest trends 10 years). In larger subject areas, the review may point to significant works in that topic. However, new and emergent areas might have a small enough body of knowledge to be covered in its entirety. The purpose of the literature review article is to describe the general state or condition of the topic under consideration and to analyze and critique the latest trends and developments in that topic.

After the Netherlands surrendered to Japan in World War II, the electricity and gas companies were also taken over by the Japanese. Everyone in the electricity company was also taken over by the Japanese. Indonesia was only able to nationalize electricity companies, and gas took over electricity and gas companies that were previously controlled by Japan. During World War II, these electricity companies were controlled by the Japanese and after Indonesian independence, on August 17, 1945, these electricity companies were taken over by Indonesia.

Now access to electricity is more evenly distributed. More and more people and areas that can be electrified. The development of the national electrification ratio (RE) in the last 5 years has grown 11 percent. Until September 2020, it was recorded that it had reached 99.15 percent, while in 2015 it had only reached 88.3 percent. The increase in population causes an increase in the activity of every human being and the great demand for practicality and comfort in human life, resulting in an increase in energy consumption. For that reason, until now, the problem of energy needs has become the reason for the nations of the world to go to war. On the other hand, there is a movement to review the relationship between humans and energy, due to concerns that there will be damage to the earth's environment due to energy consumption on a large scale. In the 22nd century, it is estimated that there will be energy scarcity because it is necessary to develop energy to replace this fuel (Afrina, 2015). So population growth drives the demand for electricity to increase.

PT Perusahaan Listrik Negara Persero (PLN) has 6,143 power generating units that use various types of fuel. According to the PLN Statistics report, throughout 2021 PLN's power plants use as much as 3.09 million kiloliters (kl) of fuel oil. This figure increased by 15.76% from 2020 which was only 2.67 million kl. The use of coal to fuel power plants also increased by 2.69% to 68.47 million tons in 2021, compared to the previous year which amounted to 66.68 million tons. The use of gas fuel for PLN's power plants grew 5.16% to 397.76 thousand MMSCF in 2021, compared to the previous year which was 378.25 thousand MMSCF. The use of biomass fuel jumped 2,804% to 282.62 thousand tons in 2021, compared to the previous year which was only 9.73 thousand tons. The fuel usage by PLN in 2013 - 2021 is as follows

Table 1.2 Table of Electricity Consumption based on Fuel In Indonesia 2013 – 2020

Year	Fuel Oil	Coal	Natural Gas	Biomassa
2013	7.474.492	39.601.034	409.89	
2014	7.4331.005	44.604.981	450.19	
2015	5.473.892	48.125.940	456.494	
2016	4.667.032	50.556.446	505.125	
2017	3.598.223	54.711.847	447	
2018	4.055.804	60.481.245	465.419	
2019	3.118.762	67.008.829	479.776	
2020	2.669.946	66.683.392	378.246	9.731
2021	3.090.844	68.474.268	397.765	282.63

Table 1.2 explains that electricity consumption in Indonesia is dominated by coal, which has increased from 2016 of 50,556,446 tons, increased in 2018 of 60,481,245 tons, in 2019 of 67,008,829 tons. In 2020 it decreased to 66,683,392 tons. It again experienced an increase in 2021 to 68,474,268. Oil

is the main source of electricity production in Indonesia. Electricity consumption based on fuel sources from 2013-2021 tends to decrease. Most electricity consumption in Indonesia is coal-fired which has negative environmental impacts, one of which is carbon emissions (CO2) and extreme climate change.

The worsening environmental crisis has become one of the important issues of international debate at the moment. The acceleration of environmental problems is placing enormous pressure on individuals, governments and policy makers. Greenhouse gas emissions caused by fossil-based energy sources have made clean energy sources, such as renewable energy, a strategic option. Although renewable energy is a key factor in mitigating environmental problems, the analysis of its determinants has certain limitations. In the era of globalization, the rapidly increasing demand for energy and the country's dependence on energy shows that energy will become one of the world's biggest problems in the coming century. This requires alternative sources of energy and renewable. Trade openness and renewable energy play a role in reducing climate change and environmental degradation (Laronte, 2020).

Sustainable development has three pillars: economic, environmental and social. Economic sustainability is growth without destroying the economic capital base. Environmental sustainability includes a stable climate and biodiversity. There is a need to integrate three dimensions. Various assessment tools are available to facilitate this integration. However, in practice it is more about reconciliation than integration in dealing with relationships so green economy concepts can help. A green economy is defined as low carbon, resource efficient and socially inclusive. In a green economy, growth in employment and income is driven by public and private investment into economic activities, infrastructure and assets that enable reductions in carbon emissions and pollution, increases in energy and resource efficiency, and prevents loss of biodiversity and ecosystem services (UNEP, 2022). It can be concluded that a green economy is seeking growth from pro-poor environmental investments, this concept can help shift the focus of the debate from reconciliation to relationship synergy. A green economy must address the overall problem of economies of scale, through the placement of materials and energy. GDP growth can continue if we only make green products. The concept of a 'green economy' is useful insofar as it engages policy makers, economists and business actors in critical dialogue with other stakeholders aimed at comparing alternative paths for development. The comparison must then take into account economic criteria in addition to social, political, cultural and ecological sustainability criteria.

Economic policies and practices govern how sustainable development pathways are because they drive two main causes: the overproduction of waste and the overexploitation of natural resources and the main drivers of well-being in employment, education and health. Creating a sustainable future for the environment requires a shared societal commitment to greener jobs, greener production and consumption, and greener technologies for energy, transport, agriculture, waste management, water supply and wastewater sanitation, and disease prevention and health. Not only one sector or topic of concern but all are explicitly related as dynamic socio-economic and ecological systems. Authentic and innovative green economy thoughts and actions can form a new concept of "economy" whose essence is sustainability and social justice.

The concept of a green economy is very important to guide sustainable development policies, because this concept is both at the heart of the matter and regulates the economy in a way that is compatible with local and global ecological prerequisites and long-term dynamics. Humanity faces serious challenges in the coming decades: climate change, loss of biodiversity, increasing inequality and other challenges. This systemic global crisis cannot be tackled in isolation, because everything is interrelated. But our economic system is not well suited to strike a good balance between environmental and social goals. The economy is basically a collection of rules and norms that reward some behavior. In its current form, our economy encourages excessive consumption, degrades communal bonds, and destroys natural wealth. Principle of Planetary Boundary; the green economy protects, restores, and invests in nature. An inclusive green economy recognizes and maintains diverse natural values, functional values in providing goods and services that sustain the economy, natural cultural values that sustain society, and natural ecological values that sustain all life. Principles of Efficiency and Adequacy; Green economy is geared towards supporting sustainable consumption and production. An inclusive green

economy is low-carbon, resource-conserving, diverse and circular. Principles of good governance; Green economy is guided by integrated, accountable and resilient institutions. Evidence-based inclusive green economy, norms and institutions are interdisciplinary by applying good science and economics together with local knowledge for adaptive strategies. (Anwar, 2022).

Efforts to reduce fuel subsidies, especially the elimination of non-renewable energy sources, often face obstacles both in terms of funding and government regulations that are not in line with Harisman (2012). Research from Tien (2019) identifies that the economy is an environmentally friendly economy.

Research Method

The data used in this study is from 1990 -2019. In this study discussing the factors that influence new renewable energy in Indonesia, in this study the authors focused on the dependent variable on green gross domestic product in Indonesia, while the independent variables were renewable electricity, CO2 emissions, population, foreign investment, trade openness, quantity and consumption of coal. data sources used such as from the World Bank. Green GDP here is a development of conventional GDP by adding several environmental aspects and economic indicators. green GDP calculations provide a more realistic economic structure by adding elements of environmental depletion and degradation. Calculation of green GDP with the following equation Hari Kristianto, (2020)

$$GGDP = GDP - Depletion\ Of\ Natural\ Resources - Costs\ Of\ Pollution$$

GGDP : Green Gross Domestic Bruto
GDP : Green Gross Domestic

Table 1, Research Data

No.	Variable	Explanation	Unit	Source
1	**Green Domestic Product (Green Economy) (GGDP)**	The economic output of the sum goods and service within a certain periode of time and reduce environmental depletion cost	**US Dollar**	**Processed**
2	**Electrical Renewable Energy (ELT)**	Geothermal source of electricity, solar energy, sea tides, biomass and hydropower that can reduce electricity	**Kilowatt**	**World Bank**
3	**Emision carbondioxide (CO)**	Carbondioxide gas emisions are fossil feuls derived from deforation of gases such as carbondioxede and methane	**Metric tons per capita**	**World Bank**
4	**Coal Consumtion (COAL)**	Consumtion of coal used for coal power plantss	**Percentage**	**World Bank**
5	**Population (POP)**	People who live in an area or country	**Soul**	**World Bank**
6	**Foreign Direct Investment (FDI)**	FDI is a type of business created by organization from country to contribute for a significant span of time in organizations is another country	**FDI per capita**	**World Bank**
7	**Openess (OPEN)**	Openess is minus imports divided by GDP	**Index**	**processed**

ECM testing should be carried out if there is a protracted relationship that utilizes cointegration. The factors should have been combined if fixed in a like request. The research was conducted using E-views software, after processing the data, the regression results/ parameter estimates were obtained from the model used. The first thing to note is the regression coefficient, probability test, F-test and the coefficient of determination (Rsquared)

Step 1. Unit Root Test This test can be seen as a stationarity test. This is because the preliminary standard is to help whether a certain coefficient of the definitive model is not worth one or not. In this way, the subject of how often the information setting period must be separated to obtain the information to be answered. (Insukindro, 1992).

Step 2. Cointegration Degree Test Most of the timing information is not fixed, it will probably cause erroneous recurrence. Relapse is when there is a high coefficient of assurance but there is no relationship between the autonomous variable and the reliable variablerelationship or relationship. This happens because the relationship between the two factors is timing information that shows the shift as it is. The high coefficient of guarantee in the timing information occurs because the pattern is not the result of the relationship between the two factors.

Step 3. Model Specifications Models that include adjustments to make corrections for t-1 D imbalance is referred to as an error correction model (Error Correction Model).

ECM testing in this study is as follows: Basic Model

GGDP = f (ELT,CO, COAL, POP,FDI,OPEN)

Econometric Models:

$$\mathbf{Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 6}$$

$$\mathbf{GGDP = \beta_0 + \beta_1 ELT + \beta_2 CO + \beta_3 POP + \beta_4 FDI + \beta_5 OPEN + \beta_6 COAL}$$

So that the ECM formula formed for this study is:

$$\mathbf{D(GGDP) = \beta_0 + \beta_1 D(ELT)_t + \beta_2 D(CO)_t + \beta_3 D(POP)_t + +\beta_4 D(FDI) + \beta_5 D(OPEN) + \beta_6 D(COAL)\varepsilon + \beta_8 ECT_{(-1)}}$$

Long term models:

$$\mathbf{D(GGDP)t = \beta_0 + \beta_1 D(ELT)_t + \beta_2 D(CO)_t + \beta_3 D(POP)_t + \beta_4 D(FDI)_t + \beta_5 D(OPEN)_t + \beta_6 D(COAL)_t}$$

Information:

D	= Difference, Xt-Xn
β0	= Constant
β1,..., βn	= Regression Coefficient of Independent Variables
ECT	= Error Correction Term
t	= Time Period
t-1	= Previous time period

Results and Discussion

a. Cointegration Test

Level 1st Different ADF Cointegration Test Results

Null Hypothesis: D(ECT) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=7)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-5.658109	0.0001
Test critical values:	1% level	-3.689194	
	5% level	-2.971853	
	10% level	-2.625121	

*MacKinnon (1996) one-sided p-values.

The table above shows that the ADF t-statistic is -5.658109 while the critical value at the 5% significance level is -2.971853. Therefore the t statistic is greater than the critical value -5.658109 greater than -2.971853 then the residual of equation has been stationary.

b. Error Correction Model Estimation Results

a. Short-Term Estimation Results The Error Correction Model (ECM) model test was conducted to find out the short-term equation. The establishment of the Error Correction Model (ECM) model is intended to determine the effect of the dependent variable on green gross domestic product with independent variables, namely renewable electricity consumption, coal consumption, carbon dioxide emissions, population, foreign direct investment and economic openness in the short term. The following is the Error Correction Model (ECM) equation that can be formed:

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.93E+15	3.40E+15	0.568244	0.5759
LOGCO	-8.16E+15	1.39E+15	-5.879669	0.0000
LOGELT	-7.76E+15	1.32E+15	-5.873471	0.0000
LOGCOAL	-3.24E+14	1.03E+14	-3.152252	0.0048
FDI	-22760.26	12713.41	-1.790256	0.0878
OPEN	0.719214	0.240181	2.994474	0.0069
POP	72991988	7739665.	9.430897	0.0000
ECT(-1)	0.498754	0.199682	2.497742	0.0209

R-squared	0.996402	Mean dependent var	5.99E+15
Adjusted R-squared	0.995203	S.D. dependent var	2.36E+15
S.E. of regression	1.64E+14	Akaike info criterion	68.52608
Sum squared resid	5.63E+29	Schwarz criterion	68.90326
Log likelihood	-985.6281	Hannan-Quinn criter.	68.64421

The table above illustrates the estimation results using the short-term error correction model, which has a residual coefficient e(-1) of 0.498754, a probability value of 0.0209 <0.05 or a 5% degree of confidence. This is in accordance with the ECM-EG criteria which must be negative and significant. So that this research is valid and in accordance with the residual value requirements. Variable coal consumption Most of it is used for electricity, most of the non-renewable power plants in Indonesia which are sourced from coal fuel have a positive coefficient for the green economy in Indonesia. If coal consumption increases by 1 percent then the green economy will increase by 3.24 this is because in the short term the green economy in Indonesia is still dominated by non-renewable power plants. This is

because the use of new and renewable energy is still low. The renewable electricity consumption variable has a negative coefficient on the green economy and has a significant effect on the green economy in Indonesia in the short term. If the consumption of renewable electricity increases by 1 percent, the green economy will increase by 7.76. The Carbon Dioxide Emission Variable has a negative coefficient and has a significant effect on the green economy in Indonesia in the short term. If carbon dioxide emissions increase by 1 percent, the green economy will increase 8.16. The economic openness variable has a positive coefficient and has a significant effect on the green economy in Indonesia. If the openness of the economy increases by 1 percent, the green economy will increase by 0.71. the population variable has a positive coefficient and has a significant effect on the green economy in Indonesia. If the population variable increases by 1 percent, the green economy will increase by 729. Meanwhile, Foreign Direct Investment has a probability value of >5%.

The estimated long-term Error Correction Model results are as follows :

Variables	coefficient	std. Error	t-Statistics	Prob.
C	1.83E+15	3.57E+15	0.510960	0.6142
LOGELT	-7.44E+15	1.35E+15	-5.497492	0.0000
LOGCO	-7.38E+15	1.33E+15	-5.557720	0.0000
LOGCOAL	-3.33E+14	1.03E+14	-3.217038	0.0038
OPEN	0.711820	0.259660	2.741350	0.0116
POPs	70470294	8376011.	8.413348	0.0000
FDI	-28045.37	13681.68	-2.049848	0.0519

R-squared	0.995574	Mean dependent var	5.89E+15
Adjusted R-squared	0.994420	SD dependent var	2.39E+15
SE of regression	1.79E+14	Akaike info criterion	68.67441
Sum squared residual	7.36E+29	Schwarz criterion	69.00135
Log likelihood	-1023.116	Hannan-Quinn criter.	68.77900
F-statistic	862.3289	Durbin-Watson stat	1.047152
Prob(F-statistic)	0.000000		

The table above illustrates the estimation results with the Long-term error correction model having a 5% degree of confidence. Variable coal consumption Most of it is used for electricity, most of the non-renewable power plants in Indonesia which are sourced from coal fuel have a positive coefficient for the green economy in Indonesia. If coal consumption increases by 1 percent then the green economy will increase by 3.33 this is because in the long term the green economy in Indonesia is still dominated by non-renewable power plants. This is because the use of new and renewable energy is still low. The renewable electricity consumption variable has a negative coefficient on the green economy and has a significant effect on the green economy in Indonesia in the long run. If the consumption of renewable electricity increases by 1 percent, the green economy will increase by 7.44. The Carbon Dioxide Emission Variable has a negative coefficient and has a significant effect on the green economy in Indonesia in the long run. If carbon dioxide emissions increase by 1 percent, the green economy will increase by 7.38. CO2 emissions, population. This study uses an error correction model approach to estimate the effect of CO2 emissions, renewable electricity, coal consumption, trade openness, population, foreign direct investment in the long and short term on the green economy in Indonesia. The results of the study show that in the short term and long term the variables that have a significant effect on the green economy are renewable electricity consumption, coal consumption The economic openness variable has a positive coefficient and has a significant effect on the green economy in Indonesia. If the openness of the economy increases by 1 percent, the green economy will increase by 0.71. the population variable has a positive coefficient and has a significant effect on the green economy in Indonesia. If the population variable increases by 1 percent, the green economy will increase by 704. Meanwhile, Foreign Direct Investment has a probability value of > 5%.

In the estimation results of the Error Correction Model, both long term and short term, it shows that the variables of renewable electricity consumption, carbon dioxide emissions, coal consumption, economic openness and population have an effect on green GDP in Indonesia because the probability

value is below a significant value of 5% or 0.05 except for foreign direct investment variables which are has no effect on both the long and short term. The coefficient of determination R2 is used to measure how well the regression line fits the data or to measure the percentage of the total Y variation explained by the regression line. The R2 value ranges from 0 to 1. The closer to 1 the better. In this study the dependent variable CO2 emissions can be affected in the long term and short term. In the long-term regression results obtained R2 of 0.995574 which means that the independent variables namely, renewable electricity consumption, carbon dioxide emissions, coal consumption, economic openness, population and foreign direct investment can affect the Green GDP variable by 99.55% while the remaining 00.45% is influenced by variables other than the research model. Whereas in the short-term regression an R2 of 0.996402 is obtained, which means that the independent variables namely, renewable electricity consumption, carbon dioxide emissions, coal consumption, economic openness, population and foreign direct investment can affect the Green GDP variable by 99.64% while the remaining 00.36% is influenced by other variables outside the research model.

Conclusion

This study uses an error correction model approach to estimate the effect of CO2 emissions, renewable electricity, coal consumption, trade openness, population, foreign direct investment in the long and short term on the green economy in Indonesia. The results of the study show that in the short term and long term the variables that have a significant effect on the green economy are renewable electricity consumption, coal consumption.

While the suggestions put forward in this research are the development of renewable power plants in Indonesia so that Indonesia does not depend on coal power plants which have environmental impacts or environmental degradation in the long term.

References

Muhammad Sohail Amjad Makhdum, Muhammad Usman, Rakhshanda Kousar, Javier Cifuentes-Faura, Magdalena Radulescu and Daniel Balsalobre-Lorente. (2022). *How Do Institutional Quality, Natural Resources, Renewable Energy, and Financial Development Reduce Ecological Footprint without Hindering Economic Growth Trajectory? Evidence from China.*

UNEP. (2022). *Green Economy.*

Muhkamat Anwar. (2022). *Green Economy* Sebagai Strategi Dalam Menangani Masalah Ekonomi Dan Multilateral.

Harisman, R. (2012). Pertumbuhan Hijau Di G20 Dan Strategi Indonesia. 1–13.

web.pln.co.id. 75 Tahun PLN Hadir, Akses Listrik di Indonesia Semakin Merata. Diakses 25 Pebuari 2023. Dari https://web.pln.co.id/cms/media/siaran-pers/2020/10/75-tahun-pln-hadir-akses-listrik-di-indonesia-semakin-merata/.

Wang, X. (2011). Green GDP And Openness: Evidence From Chinese Provincial Comparable Green GDP. Journal Of Cambridge Studies, Vol 6, No.(2006), 1–16.

Maulida Dewi Pangestika, Evi Gravitani,Mugi Raharjo.*(2022). Renewable Electricity Analysis of Indonesia's Green Economy: an Error Correction Model Approach*

Widyawati, R. F., Hariani, E., Ginting, A. L., & Nainggolan, E. (2021). Pengaruh Pertumbuhan Ekonomi, Populasi Penduduk Kota, Keterbukaan Perdagangan Internasional Terhadap Emisi Gas Karbon Dioksida (CO2) Di Negara ASEAN. Jambura Agribusiness Journal, 3(1), 37–47.

Hari Kristianto, A. (2020). Sustainable Development Goals (Sdgs) Dalam Konsep Green Economy Untuk Pertumbuhan Ekonomi Berkualitas Berbasis Ekologi. Business, Economics And Entrepreneurship, 2(1), 27–38.

Insukidro, (1991), Regresi linier Lancung dalam Analisis Ekonomi: Suatu Tinjauan Dengan satu studi kasusbdi Indonesia, Jurnal Ekonomi dan Bisnis Indonesia, No.1 Tahun VI.

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