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Analyzing the Relationship Between Electricity Access and Renewable Energy on Indonesia's Economic Growth from 1985 to 2022

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ABSTRACT

This study aims to analyze the relationship between access to electricity and renewable energy on economic growth in Indonesia, using a quantitative descriptive approach. Time series data from 1985 to 2022 was sourced from World Development Indicators and Our World in Data. The Vector Error Correction Model (VECM) was used in this study after the existence of cointegration between variables was proven. The estimation results found that all independent variables have a positive and statistically significant relationship with economic growth, with the surprising finding that, in the long term, the impact of renewable energy (1.14%) is relatively greater than the impact of electricity access (0.29%) on economic growth. Going forward, the contribution of renewable energy to economic growth is predicted to increase in line with the SDG targets. Indonesia's energy sector reforms have had a significant impact in reducing the effects of climate change and freeing the country from fossil fuels.

***Keywords**: Economic Growth, Access to Electricity, Renewable Energy, VECM*

INTRODUCTION

Over the past four decades, Indonesia's economic growth has experienced complex dynamics. From 1985 to 2022, it faced various global economic pressures, such as the Asian financial crisis in 1997–1998, the global economic crisis in 2008–2009, the trade war between the United States and China from 2015–2019, the COVID-19 pandemic in 2020, and the impact of the Russia-Ukraine conflict in 2021–2022 (World Bank, 2022; IMF, 2023). These crisis upheavals significantly impacted national economic performance and exceeded the government's capacity to maintain economic stability.In confronting these global pressures, the role of economic policy has been vital. Properly designed policies can strengthen national competitiveness, maintain macroeconomic stability, and encourage sustainable development. Conversely, ineffective policies have the potential to weaken the economy and reduce investment attractiveness (Pafadnam, 2024).

Generally, economic growth is a crucial indicator for measuring a nation's progress and the well-being of its society (Rasnino et al., 2022). Several economists have identified various fundamental factors influencing this growth. Samuelson (2004) states that economic growth is determined by four main factors: human resources; natural resources (including fertile land, oil and gas, forests, water, and mineral raw materials); capital formation; and technological advancement and innovation. Todaro (2006)

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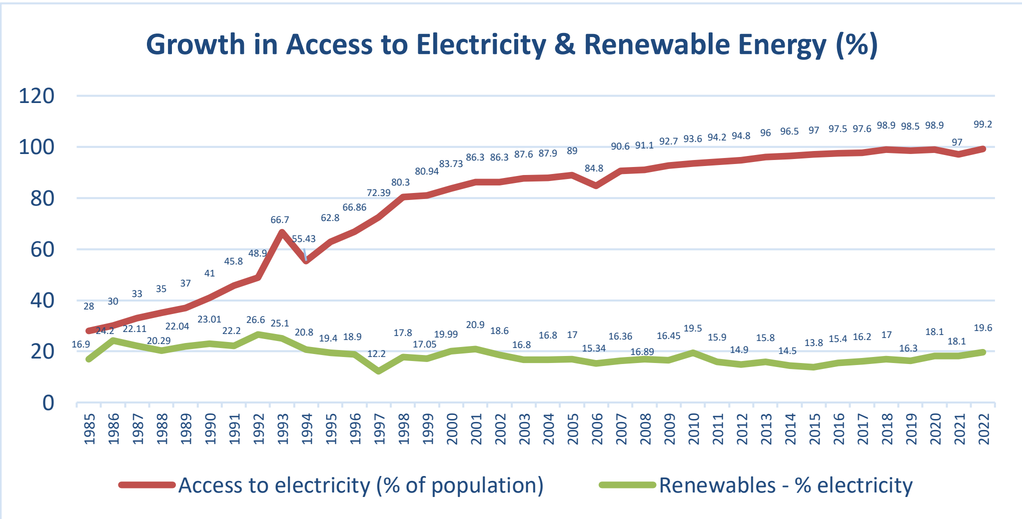
identifies three main components influencing economic growth: capital accumulation (in the form of new investments in land, physical equipment, and human resources), population growth (which increases the labor force), and technological advancement. Meanwhile, Sukirno (2006) defines economic growth as an increase in the quantity of goods and services produced due to the development of a society's economic activities. Finally, Arsyad (2015) emphasizes four main factors influencing economic growth: capital accumulation, population growth, technological development, and resource availability.

To achieve sustainable economic growth while simultaneously supporting the realization of the Sustainable Development Goals (SDGs) the United Nations' global development agenda from 2015 to 2030—a strategic approach is needed that considers several important factors, such as investment, technological development, and infrastructure development (United Nations, 2015). Technology and innovation play a crucial role in accelerating the achievement of the SDGs. By utilizing eco-friendly technologies and renewable energy, countries can enhance development efficiency, respond to the challenges of climate change, and expand access to clean energy to support long-term energy needs (OECD, 2018; UNDP, 2020).

One crucial aspect of this technology and innovation is access to electricity, which has now transformed from a secondary need into a primary one. Electricity is no longer merely a complement; it has become an essential basic infrastructure supporting the production and consumption of goods and services. Consequently, the availability of reliable and affordable electricity plays a vital role in driving national economic growth (Uhr DdAP, 2019). This concept is reinforced by various studies (Adom, 2011; Ibrahiem, 2015; Iyke, 2015; Sarkodie, 2020), which also emphasize the importance of electricity as a catalyst for improving the quality of life and a key driver of sustainable economic development.

Image 1. Growth in Access to Electricity and Renewable Energy (%)
Source : Our World In Data

Based on Image 1.1, Indonesia's electricity access growth has shown a significant upward trend. Initially, only about 28% of the population had electricity access in 1985. This figure rapidly



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increased, reaching 99.2% by 2022. This achievement marks a substantial success in efforts to promote equitable development and improve the quality of life for the community. Electricity access is a fundamental prerequisite for economic and social development, as it facilitates productive activities, lighting, education, and access to information (World Bank, 2018). Although the percentage of electricity access has nearly reached 100%, significant challenges remain in ensuring equitable and reliable access, particularly in remote and outer areas. These areas often pose major obstacles to achieving universal access (International Renewable Energy Agency (IRENA), 2020).

Electricity is an essential commodity widely consumed across various sectors, with its demand continuously growing. This demand is driven by several structural factors, including urbanization, industrialization, population growth, rising living standards, and the modernization of the agricultural sector. Consequently, a shortage of electricity supply not only causes disruptions in economic activities but also has the potential to hinder the overall economic growth of a region (Azam A, 2020). In the context of economic development, access to electricity is fundamental in driving economic growth while simultaneously reducing poverty and income inequality (Fuso Nerini, 2018). Equitable electricity access enables communities, especially in underdeveloped areas, to engage in productive activities that can improve their living standards.

Furthermore, the widespread availability of electricity has been consistently linked to sustainable economic growth. This is reinforced by various empirical studies, such as those by (Dilip Ahuja, 2008); (Jung et al., 2018); (Njiru & Letema, 2018); (Kumar. J & Majid, 2020); (Mayer, 2022); and reports from the (International Energy Agency, 2020), all of which show a positive relationship between increased electricity access and national economic growth. The need for electricity is also crucial in supporting operations across various strategic sectors, including industry, public facilities, government institutions, and households. These four sectors, directly and indirectly, contribute significantly to economic growth (Twas, 2008); (Arner et al., 2020). Therefore, developing reliable and inclusive electricity infrastructure is a primary prerequisite for supporting a comprehensive and sustainable development agenda.

While electricity offers numerous positive impacts on economic and social development, its provision and increased access still face several significant challenges. These challenges create a persistent gap between energy supply as a production input and continuously rising demand, especially in developing countries. Many regions struggle to meet their electricity needs due to limited infrastructure, inadequate distribution networks, low energy supply capacity, and high dependence on non-renewable resources like fossil fuels (Kumar, 2020).

In Indonesia, the use of renewable energy in electricity consumption shows a fluctuating and rather discouraging trend. Although it initially rose from 15.9% in 1985 to a peak of 25.1% in 1993, its contribution then sharply declined and stabilized in the 15-20% range until 2022. In that year, the portion of renewable energy only

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reached 19.6%. This figure is relatively low when compared to Indonesia's vast renewable energy potential, which includes geothermal, hydro, solar, wind, and biomass (ESDM., 2022). The high dependence on fossil fuels, which account for approximately 80% of Indonesia's total electricity supply during the research period, risks driving energy import dependence, increasing pressure on the trade balance, and triggering economic volatility, in addition to negative environmental impacts (IEA, 2021). Therefore, diversifying energy sources from fossil fuels towards renewable energy is a crucial strategic step, as it's believed to foster sustainable economic growth while simultaneously reducing greenhouse gas emissions (Işık, 2021).

Growing global concerns over crude oil price volatility, environmental degradation, and climate change are prompting various countries, including Indonesia, the Philippines, and Thailand, to actively expand their renewable energy production capacity. This effort is being undertaken as an alternative to fossil fuels such as coal, oil, and natural gas. The utilization of renewable energy is often associated with a reduction in environmental impact and an increase in national energy security (Madaleno & Nogueira, 2023). However, fluctuations in global oil prices, often triggered by geopolitical dynamics and changes in energy policy, can create instability in government revenue and the industrial sector. On the other hand, international pressure to reduce emissions and transition to clean energy sources also pushes governments to implement energy sector reforms. Unfortunately, these reforms often yield inconsistent outcomes and create uncertainty for both investors and businesses (Suriyankietkaew & Nimsai, 2021).

Various studies have explored the relationship and influence between the use of new and renewable energy and economic growth. Researchers like (Akadiri, 2021a), (Rafindadi, 2017), and (Bhattacharya, 2016) found that renewable energy can stimulate economic growth by creating employment opportunities, fostering technological innovation, and reducing dependence on fossil fuel imports. These positive findings are further supported by a range of studies including (Satrianto et al., 2024), (Rehman, 2019), (Prasetyani, 2024), (Abdibekov et al., 2023), (Danuletiu, 2014), (Allam, 2021), (Sarkhanov, 2022), (Shahbaz, 2022), (Manzoor, 2021), and (Rahman et al., 2024).

Other research has found a negative and insignificant relationship between renewable energy consumption and economic growth, as discovered by (Alola, 2021), (Işık, 2021), and (Mert, 2016). These findings might be attributed to the high initial costs of renewable energy projects, inadequate technological capabilities, and the dominance of traditional energy sources in the respective countries. (Gunarto, 2024) states that developing countries are unable to undertake energy transitions in the same way as developed countries, which would, of course, hinder economic activity. According to (Slimane, 2024) and (Akadiri, 2021b), these limitations will become barriers to trade, lead to a lack of technology transfer, or result from the dominance of traditional energy exports in each country.

LITERATURE REVIEW

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Economic Growth

The Solow growth model provides an analytical framework for understanding the factors that determine long-term economic growth. In this model, Solow identifies three main pillars influencing economic growth: the availability of investment capital, labor, and technological progress. In the short term, increased investment and labor growth can drive economic expansion. However, in the long run, technological progress becomes the key factor because it enables increased production efficiency and fosters innovation, ultimately contributing to enhanced productivity and sustainable economic growth (Solow, 1956).

Meanwhile, the endogenous growth theory, emerging in the 1980s through contributions by (Romer, 1993) and (Lucas, 1988), offers an approach that emphasizes economic growth originating from internal (endogenous) factors, such as technological progress, innovation, human capital, and government policies. Unlike the Solow model, which assumes technology as an exogenous factor, endogenous growth theory views technological advancement as a result of economic activity itself. Within this framework, the role of human capital becomes crucial, as differences in knowledge, technology, investment capacity, and infrastructure are the primary causes of disparities in per capita income between countries. According to (Sukirno, 2006), economic growth reflects the extent to which economic activities can generate increased income for the public over a period. Beyond just increasing output and efficiency, economic growth also leads to the creation of a more inclusive society by providing equal opportunities for all (To & Vo, 2020).

Electricity Access

Several economic theories, including Rostow's stages of economic growth theory, support the view that electrification has a direct impact on economic growth through several mechanisms. Electrification facilitates the transition from traditional to modern stages of economic development and promotes the process of industrialization. Furthermore, the benefits of electrification also include increased access to productive opportunities through reduced transaction costs. These impacts further drive the growth of the industrial sector, enhance the asset value of the poor, reduce income inequality, and accelerate the rate of economic growth (C. Calderon, 2004; ND Rao, 2017).

The endogenous growth theory highlights that electrification can spark innovation and technology-driven economic growth. It speeds up the development of industrial, educational, and technological sectors, which in turn collectively boosts labor productivity and drives long-term economic growth. However, academic literature also stresses that the full benefits of electricity access are only realized when accompanied by supportive services and other related activities (Bastakoti, 2006; Winther et al., 2017). This support is essential for promoting higher educational attainment, creating broader business opportunities, strengthening gender equality, and increasing local incomes.

Sustainable Development Theory emphasizes that electrification must not only be expanded but also be based on renewable energy to avoid damaging ecosystems. Without electricity access, the path out of poverty will be narrow and prolonged. Renewable energy is closely linked to various Sustainable Development Goals (SDGs), such as health, food security, poverty reduction, and climate change (World Bank, 2017; Terrapon-Pfaff et al., 2014).

In line with this, the theory of electricity causality also affirms a reciprocal relationship with economic growth. Electrification not only impacts aspects of production and income but is also closely linked to broader socioeconomic development. Access to electricity is causally connected to income-generating activities, market production, household economic activities, healthcare services, local population density, education, as well as patterns of social interaction and community networks (F. Riva, 2018; Ulsrud et al., 2011).

Within the framework of the Solow-Swan growth model, electricity functions as a component of physical capital (K), directly increasing an economy's productive capacity. Beyond that, electricity also supports technological advancement (A) by fostering innovations that enhance the efficient use of labor and capital. This aligns with the Cobb-Douglas production function, which indicates that improvements in electricity infrastructure can boost the productivity of production factors, both capital (K) and labor (L). Research by (Adam Brenneman, 2002) and (PR Agenor, 2006) strengthens this argument, concluding that increased electricity access contributes significantly to a rise in employment opportunities and overall economic productivity.

Renewable Energy

Renewable energy (RE) refers to energy sources derived from sustainable natural processes that will not be depleted. These sources include solar, wind, hydro, geothermal, and biomass. For example, solar energy is produced through the use of solar panels that adopt technology and innovation. These panels can convert sunlight into electricity via the photovoltaic process, or utilize solar heat for direct heating or large-scale electricity production. The definition of renewable energy consumption refers to the utilization of energy resources that are naturally available and inexhaustible (Radmehr et al., 2022).

In the economic context, New and Renewable Energy (NRE) plays a crucial role in economic growth. Various economic theories explain the relationship between NRE use and economic development. For example, endogenous growth theory states that economic growth is influenced by investment in human capital, innovation, and technology. In this context, NRE can promote these aspects, thereby increasing productivity and stimulating stable, sustainable economic growth. In line with this, (Tahir, 2015) found that substantial investment and technological advancement will play a vital role as long as countries have renewable energy as a source of development.

Energy Transition Theory highlights that shifting from fossil fuels to renewable energy requires substantial initial investment but will yield significant long-term benefits. Countries that invest in New and Renewable Energy (NRE) are better prepared to face future energy crises, enhance national energy security, and reduce dependence on fossil fuel imports. This also helps mitigate the impact of energy price volatility on economic stability. Research by (Tiba, 2017) supports this view through their study, which showed that Saudi Arabia could reduce its use of fossil fuels and greenhouse gas emissions by utilizing renewable energy.

In line with this, the theory of sustainable development emphasizes that economic growth must be aligned with environmental preservation to ensure resource availability for future generations. In this context, investing in renewable energy not only expands energy access but also creates green jobs and promotes environmentally friendly economic growth. This theory is supported by (Tiba, 2017), who argues that the outcomes of renewable energy development can lead to a reduction in greenhouse gas emissions, a decrease in the energy trade deficit, and the creation of new employment opportunities.

From a green economy perspective, the transition to renewable energy is a vital strategy for reducing dependence on fossil fuels and lowering carbon emissions. This growth model emphasizes economic stability and resilience against energy and environmental crises. Investment in green energy is also believed to lower public healthcare costs resulting from air pollution. Case studies by (Karatayev, 2016; Tiba, 2017), (Myrzabekkyzy, 2022), and (Saiymova, 2023) demonstrate that countries utilizing renewable energy can reduce their national greenhouse gas emission levels through the diversification of energy sources and the transition to renewable energy in their energy production.

METHODS

This research utilized secondary data from 1985 to 2022, sourced from Our World in Data and the World Development Indicators. It is a quantitative descriptive study. The independent variables are electricity access and renewable energy. The statistical software used is Eviews 12, and the testing method employs the Vector Error Correction Model (VECM) framework.

Table 1: Variable Descriptions

No	Variable Name	Variable Symbol	Period	nit of Measurement	Data Source
1.	Electricity Access	ACL	Annual	Percentage (%)	https://data.worldbank.org/

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2.	Renewable Energy	EBT	Annual	Percentage (%)	https://ourworldindata.org/
4.	Gross Domestic Product (US$)	GDP	Annual	Index	https://ourworldindata.org/

Source: Author's Data Processing (2025).

RESULTS AND DISCUSSION

The data estimation process begins with conducting descriptive statistical analysis, followed by several testing stages such as stationarity testing using the Augmented Dickey-Fuller (ADF) test at the same degree (level or difference), optimal lag testing, VAR stability testing, cointegration testing, Vector Error Correction Model (VECM) testing, impulse response analysis, and variance decomposition.

Table 2 : Descriptive Statistical Analysis

	GDP	ACL	EBT
Mean	1.68E+12	76.94342	18.40027
Median	1.35E+12	86.95000	17.42621
Maximum	3.50E+12	99.20000	26.63868
Minimum	5.16E+11	28.00000	12.15713
Std. Dev	9.19E+11	23.46093	3.223231
Observations	38	38	38

Source: Processed data, 2025.

Based on Table 2, the data distribution indicates that the data is non-stationary. Therefore, a stationarity test is subsequently conducted.

Table 3: ADF Stationarity Test Results at Level and First Difference

Variable	Level (Prob.)	Description	First Difference (Prob.)	Description
GDP	1.0000	Non-stationary	0.0065	Stationary
ACL	0.1705	Non-stationary	0.0000	Stationary
EBT	0.1035	Non-stationary	0.0000	Stationary

Source: Data processed using EViews 12, data analysis conducted in 2025.

Based on Table 3, all variables at level are proven to be non-stationary, while at the first difference level I(1), all variables show stationarity as the probability values at the first difference are less than 0.05.

Table 4: Results of Optimal Lag Length Test

Lag	LogL	LR	FPE	AIC	SC	HQ

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Lag	LogL	LR	FPE	AIC	SC	HQ
0	-1150.617	NA	4.64e+26	69.91616	70.05221	69.96193
1	-1019.944	229.6669	2.92e+23	62.54206	63.08625*	62.72517*
2	-1009.044	17.17508	2.65e+23	62.42694	63.37926	62.74737
3	-1002.899	8.565812	3.27e+23	62.59997	63.96043	63.05772
4	-988.0287	18.02522*	2.47e+23*	62.24416	64.01276	62.83924
5	-977.6755	10.66688	2.60e+23	62.16215*	64.33889	62.89456

Source: Data processed using EViews 12, analysis conducted in 2025

Based on Table 4, in determining the optimal lag length, it can be seen that the AIC value at lag 5 is lower than the AIC values at other lags. Therefore, lag 5 is recommended as the optimal lag for the model.

Table 5: VAR Stability Test Results

Root	Modulus
0.957822	0.957822
-0.769223 - 0.469987i	0.901439
-0.769223 + 0.469987i	0.901439
-0.894019	0.894019
0.638810 - 0.619474i	0.889846
0.638810 + 0.619474i	0.889846
-0.389720 - 0.792741i	0.883357
-0.389720 + 0.792741i	0.883357
0.236084 - 0.795384i	0.829682
0.236084 + 0.795384i	0.829682
-0.396731 - 0.635874i	0.749488
-0.396731 + 0.635874i	0.749488
0.674079	0.674079
0.174477 - 0.402469i	0.438661
0.174477 + 0.402469i	0.438661

No root lies outside the unit circle.
VAR satisfies the stability condition.

Source: Data processed using EViews 12, analysis conducted in 2025

In the VAR stability test for all variables, it can be concluded that the use of the VAR model is valid, as all roots have modulus values less than one. If the VAR stability test is not satisfied, the Impulse Response Function analysis would become invalid

Table 6: Johansen Cointegration Test Results

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.542340	36.18034	29.79707	0.0080
At most 1	0.319101	11.94983	15.49471	0.1594
At most 2	0.001136	0.035247	3.841465	0.8510

Source: Data processed using EViews 12, analysis conducted in 2025

Cointegration testing is a prerequisite for using the VECM model. The purpose of the cointegration test is to determine the long-term relationship between variables that have fulfilled the requirement of being stationary at the same degree, namely at the first difference level. If cointegration is found, the VECM testing stage can be conducted; however, if no cointegration is found, then the VAR in difference model will be applied. The cointegration test among variables shows the presence of cointegration when the trace statistic value is greater than the critical value, and vice versa. Based on the cointegration test results above, there is an indication that the trace test shows cointegration, as the trace statistic value is greater than the critical value at two ranks at the 5% confidence level, indicated by an asterisk (*). Therefore, the result of this cointegration test also answers the research question, confirming the existence of cointegration.

Table 7: Results of the Vector Error Correction Model (VECM) Test

Variable	Coefficient	t-statistik	t-tabel	Description
C	-73.15298			
ACL	0.293673	4.39204	2,0322	Signifikan
EBT	1.149153	2.15286	2,0322	Signifikan

Source: Data processed using EViews 12, analysis conducted in 2025

Table 7 shows the VECM estimation results, indicating that in the long run, all independent variables—namely electricity access and renewable energy—have a significant positive relationship with Indonesia's economic growth. The coefficient of the electricity access variable is 0.293673, meaning that an increase in the electricity access index leads to a 0.29 percent increase in economic growth, assuming other factors remain constant (ceteris paribus). Meanwhile, the coefficient of the renewable energy variable is 1.149153, which implies that when the renewable energy index increases, economic growth rises by 1.14 percent.

The following presents the long-run equation based on the regression coefficients estimated using the VECM model:

GDP= -73.15298+ 0.293673$ACL_{t-1}{}^{*}$ 1.149153$EBT_{t-1}{}^{*}$..........................(1)

Equation (1) shows that all independent variables, namely electricity access and renewable energy, have a significant positive relationship with economic growth, with a significance level (α) of 0.05 or a t-statistic value greater than the t-table value.

The VECM estimation results indicate that in the short run, there is a significant relationship between the independent variables and the dependent variable. For example, the GDP lag-1 variable has a significant positive relationship with a coefficient value of 2.10202.

The following presents the short-run equation based on the regression coefficients estimated using the VECM model:

$D(\text{GDP}) = 0.030890 + 2.10202 D(GDP(-1))^{*}$ ....(2)

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The short-run Equation (2) shows that the first lag of the GDP variable has a significant positive relationship, with a coefficient of 2.10202 and a significance level (α) of 0.05. This means that a one-point increase in the GDP index from the previous year will lead to a 2.10 percent increase in current GDP, assuming other factors remain constant (ceteris paribus).

Impulse Response Function (IRF)

Impulse response analysis is conducted to observe both the short-run and long-run responses of one variable to a shock from another variable. It aims to assess how far the effects of a shock extend before the economy returns to a stable point and potentially moves toward improvement. In Figure 1, a positive shock (increase) in GDP leads to a sharp initial rise in GDP itself (up to around 5 periods), followed by a slight decline and stabilization at a lower positive level. This is an expected response and indicates the persistence of the economic shock.

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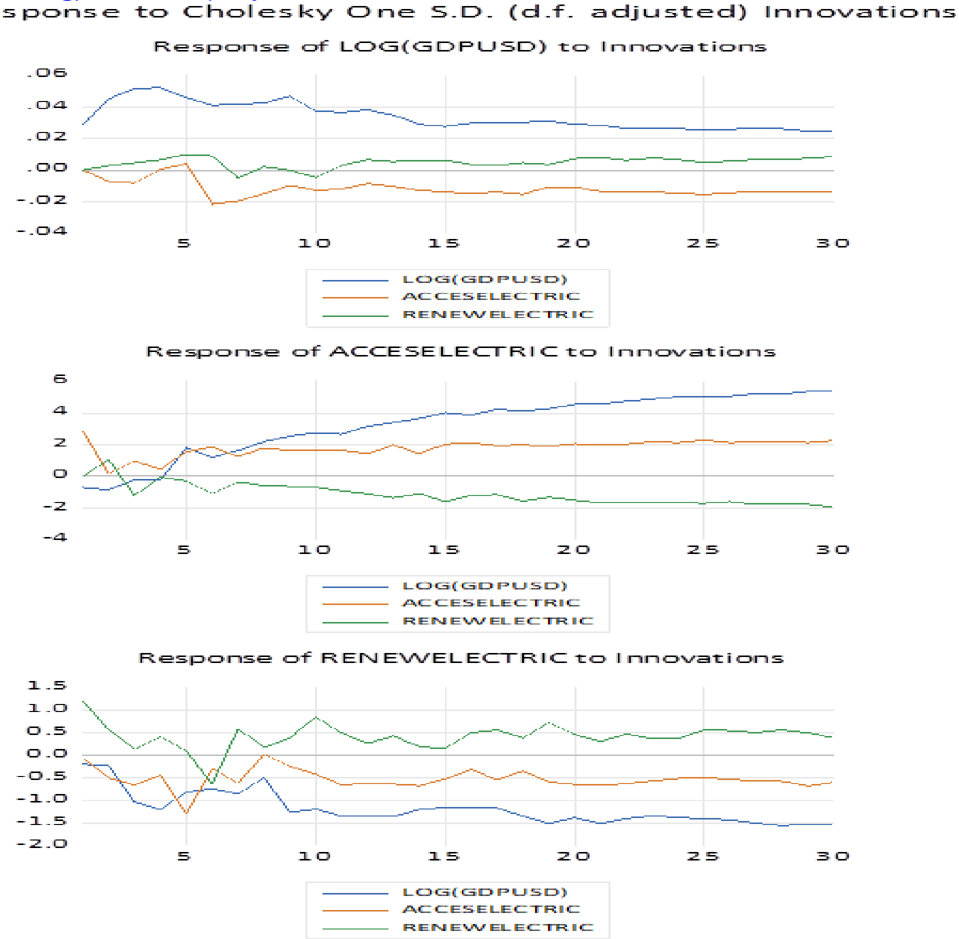

Image 2. Impulse Response of Electricity Access, Renewable Energ to Economic Growth

The response of electricity access initially shows a slight decline (around periods 5–7), then gradually increases and stabilizes at a small positive level. This initial decrease may indicate that during periods of rapid economic growth, resources are allocated to other, more urgent sectors, or that economic growth temporarily creates inequality that hinders electricity access for a portion of the population (for example, in underserved or remote areas). However, in the medium to long term, sustained GDP growth enables increased investment in electricity infrastructure, leading to improved electricity access.

An increase in GDP initially leads to a decline in the share of renewable energy (during periods 1–5), followed by a slight increase and eventual stabilization around zero or slightly negative. This is a crucial finding in the context of Indonesia. A positive economic shock (GDP growth) tends to drive an overall increase in energy consumption. However, if this increased demand is largely met by more accessible or cheaper fossil energy sources in the short term (e.g., coal for power generation), the share of renewables relative to total energy consumption may decline or stagnate. This reflects a growth-versus-sustainability dilemma in Indonesia, where the urgency of economic growth (rapid energy provision) often outweighs the priority of energy

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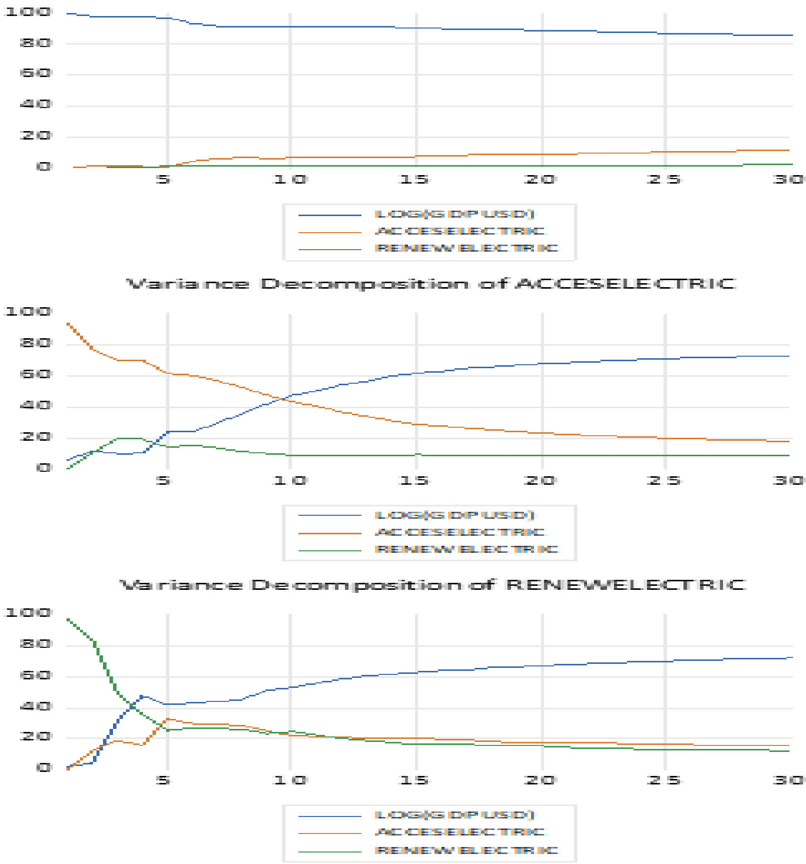
transition.

It indicates that Indonesia is at a crossroads. To achieve sustainable development goals and fulfill climate commitments, a paradigm shift in policy is needed. Policies must explicitly integrate economic growth with a clean energy transition, addressing barriers related to cost, regulation, and technology to accelerate the development of renewable energy. Furthermore, future expansion of electricity access should also be based on cleaner energy sources.



Variance Decompositions (VD)

Variance decomposition explains the percentage of variability in a variable that is caused by itself or by other variables in the system. It helps to understand the extent of influence among variables in both the short and long run. In the early periods, nearly 100% of the variation in GDP is explained by shocks to GDP itself. Over time, the contribution of GDP shocks to GDP variation gradually declines but remains dominant (around 85–90% by period 30). This indicates that economic fluctuations are largely driven by internal shocks within the economy itself.

Image 3. Variance Decompositions of Electricity Access, Renewable Energy to

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The contribution of shocks to electricity access to GDP variation is very small in the early periods (close to 0%) and gradually increases, stabilizing at around 5–10% by period 30. This indicates that although electricity access has a positive impact on GDP (as seen in the IRF), fluctuations in electricity access are not a major driver of GDP variation. Its impact is more related to long-term growth or stabilization rather than being a source of short-term fluctuations.

The contribution of shocks to the share of renewable energy to GDP variation is also very small, even lower than that of electricity access (remaining below 5% by period 30). This indicates that movements in the share of renewable energy do not have a significant impact in explaining GDP fluctuations. This is consistent with the IRF findings, which show that positive shocks to renewable electricity do not strongly drive GDP.

Based on the previous forecast results, it can be concluded that the variation in Indonesia's economic growth is largely explained by internal shocks within the economy itself. Factors such as electricity access and renewable energy, while important for development and sustainability, are not the primary drivers of short-term GDP fluctuations. Their role is more as long-term growth drivers or supporting factors for economic stability

DISCUSSION

Electricity Access and Long-Term Economic Growth

Electricity access and economic growth have been among the key areas of empirical evaluation regarding the role of energy as a driver of economic development. Access to electricity services is highly relevant to societal progress due to its positive effects on socio-economic development. Evidence shows that access to electricity enhances educational and employment opportunities for household members, especially when they also gain access to information technology and live in environments free from atmospheric pollutants (Salinas, 2022).

The United Nations Millennium Development Goals (MDGs) marked a universal recognition that access to modern energy—such as electricity—is central to achieving several other Sustainable Development Goals (SDGs), including good health and well-being, education, gender equality, clean water and sanitation, among others (UN, 2015; IEA, 2017a; IEA, 2017b; IEA, 2018; Birol, 2018; McCollum, 2018). Access to modern energy services like electricity is essential for human development, which in turn accelerates progress toward goals such as SDG 4 (quality education), SDG 5 (gender equality), and SDG 8 (decent work and economic growth) (HDR, 2016; Collste, 2017; Acharya, 2019; Sadath, 2017).

The results of this study find that the electricity access variable has a positive and significant relationship with Indonesia's economic growth during the research period, with a coefficient of 0.293673. This means that an increase in the electricity access index leads to a 0.29 percent rise in economic growth. This finding is consistent with and supports previous studies that have found a positive and significant impact, such as those by Rao (2013), Bhattacharyya (2013), Niez (2010), Adenikinju (2005), van Gevelt (2014), Yang (2003), Peng (2006), David (2015), and Bensch (2011). Electricity access is widely linked to sustainable economic growth, as also demonstrated by Dilip Ahuja (2008), Jung et al. (2018), Njiru & Letema (2018), Kumar J. & Majid (2020), Mayer (2022), the International Energy Agency (2020), Twas (2008), and Arner et al. (2020).

Other studies have also found that increased electricity access has a positive relationship with economic growth, although there are still concerns regarding its environmental impact (IRENA, 2015). Therefore, policies are needed to support the development of energy sources and the diversification away from fossil fuels toward renewable energy. Such policies would not only reduce dependence on fossil energy sources but also help lower energy costs and maintain long-term or sustainable energy security.

Renewable Energy and Long-Term Economic Growth

The results of this study find that renewable energy has a positive and significant relationship with Indonesia's economic growth during the study period, with a coefficient of 1.149153. This means that when the renewable energy index increases, economic growth rises by 1.14 percent, ceteris paribus. This finding adds to the body of evidence and aligns with the hypothesis developed by Li et al. (2021), which found a positive correlation between renewable energy and GDP growth, indicating that renewable energy sources have a significant impact on economic growth in South Asian countries.

Similar findings have been reported in several previous studies, which state that renewable energy has a significant positive impact on economic growth, such as those conducted by Satrianto et al. (2024), Rehman (2019), Prasetyani (2024), Abdibekov et al. (2023), Danuletiu (2014), Allam (2021), Sarkhanov (2022), Shahbaz (2022), Manzoor (2021), Bhattacharya (2016), and Rahman et al. (2024). In the study by Alper (2016), using the VECM Granger causality approach to examine the relationship between renewable energy consumption and the economy across eight new European Union (EU) countries from 1990 to 2009, a positive impact on economic growth was found.

The relationship between electricity access, renewable energy, and economic growth is very close and is believed to be mutually influential. Reliable electricity supply is a key pillar in facilitating sustainable economic growth. Interestingly, the increase in electricity access has not been accompanied by a corresponding increase in energy supply, and there are concerns that energy availability is becoming more limited, with renewable energy sources not yet being optimally developed. Countries that rely on fossil fuel imports often face price volatility, which can disrupt macroeconomic stability. Renewable energy, which is generally produced locally, offers greater price certainty and helps reduce the risks associated with energy price fluctuations.

Several challenges often arise in efforts to increase the supply of renewable energy in Indonesia. These include the archipelagic distribution of the country's renewable energy potential, limited capacity of the electricity grid to absorb power, and the intermittent nature of some renewable energy sources, which requires large-scale storage systems. In addition, the domestic generation capacity remains limited in terms of technology, and market uncertainties also pose barriers, preventing the country from reaching its renewable energy targets (Secretariat General of the National Energy Council, 2022).

If the Indonesian government seeks a significant increase in the share of renewable energy, policies must specifically target and address the shocks originating from GDP—namely, how economic growth can be directed to support renewable energy, rather than the other way around. This may involve stronger investment incentives for renewables, supportive regulations, or even a restructuring of the energy sector (IRENA, 2020).

Conclusion

The results of this study indicate that there is cointegration between the dependent variable economic growth and the independent variables electricity access and renewable energy in Indonesia. Therefore, the appropriate model selected for this study is the Vector Error Correction Model (VECM). The estimation results show that both electricity access and renewable energy have a positive and significant relationship with economic growth in Indonesia in the long run. Electricity access has a positive and significant relationship with economic growth in Indonesia. This is because the continuous improvement in electricity access serves as a driver of economic growth. Electricity, which was once considered a secondary need, has now become a primary necessity, serving as a fundamental infrastructure that plays a vital role in the production and consumption of goods and services. It is also crucial for industry, business, education, and households factors that can stimulate economic growth and improve societal welfare. Renewable energy has a significant positive relationship with economic growth in Indonesia because it can reduce energy production costs and decrease dependence on fossil fuel sources. As a result, it eliminates the need for energy imports, thereby reducing long-term concerns in the energy sector. Overall, Indonesia has succeeded in expanding electricity access, which has proven to be a foundation for economic growth. However, the main challenge ahead is how to align strong economic growth with the acceleration of the transition toward renewable energy, considering the complexity of short-term relationships and potential trade-offs. This requires leveraging the long-term positive potential of renewable energy for sustainable economic development and a cleaner environment.

REFERENCE

Abdibekov, S. U., Kulbay, B. S., Gridneva, Y. E., Kaliakparova, G. S., Ashimbayev, T. A., & Perneyeva, G. A. (2023). The Relationship between the Share of Renewable Energy in Total Energy Consumption and Economic Growth: Kazakhstan and Turkiye

Comparision. *International Journal of Energy Economics and Policy*, *13*(5), 24–30. https://doi.org/10.32479/ijeep.14567
Acharya, R. S. A. (2019). Kemiskinan energi dan pembangunan ekonomi: Bukti tingkat rumah tangga dari India. *Energi Dan Bangunan*, *183*, 785-791.
Adam Brenneman, K. M. (2002). *Keterkaitan infrastruktur dan kemiskinan*.
Adenikinju, A. (2005). Analisis Biaya Kegagalan Infrastruktur di Negara Berkembang: Kasus Sektor Listrik di Nigeria. *Konsorsium Riset Ekonomi Afrika., 148*.
Adom, P. (2011). Hubungan konsumsi listrik-pertumbuhan ekonomi: kasus Ghana. *Jurnal Int. Kebijakan Ekonomi Energi* , *1*, 18–31.
Akadiri, S. A. A. A. A. (2021a). Peranan energi terbarukan Konsumsi energi dalam pertumbuhan ekonomi: Bukti dari negara-negara berkembang. *Jurnal Internasional Pembangunan Berkelanjutan Dan Ekologi Dunia*, *28*(8), 722–733.
Akadiri, S. A. A. A. A. (2021b). Peranan energi terbarukan Konsumsi energi dalam pertumbuhan ekonomi: Bukti dari negara-negara berkembang. *Jurnal Internasional Pembangunan Berkelanjutan Dan Ekologi Dunia, 28*(8), 722–733.
Allam, M. , N. R. (2021). Hubungan antara energi terbarukan konsumsi dan pertumbuhan ekonomi: Kasus 3 negara Mediterania. *Jurnal Pembangunan Florida Selatan*, *2*(4), 5776–5786.
Alola, A. A. U. S. A. S. (2021). Energi terbarukan konsumsi di negara-negara UE-28: Implikasi kebijakan terhadap target keberlanjutan lingkungan. *Sciendo*, *45*(4), 2488–2500.
Alper, A. , O. O. (2016). Peran konsumsi energi terbarukan dalam pertumbuhan ekonomi: Bukti dari kausalitas asimetris. *Tinjauan Energi Terbarukan Dan Berkelanjutan*, *60*, 953–959.
Arner, D. W., Buckley, R. P., Zetzsche, D. A., & Veidt, R. (2020). Sustainability, FinTech and Financial Inclusion. *European Business Organization Law Review*, *21*(1), 7–35. https://doi.org/10.1007/s40804-020-00183-y
Azam A, R. M. S. M. A. M. Y. J. (2020). Hubungan Kausalitas Antara Pasokan Listrik dan Pertumbuhan Ekonomi: Bukti dari Pakistan. *Energi*, *13*, 837.
Badan Energi Internasional. (2020). *Tinjauan Kebijakan Energi Jerman.*
Bank Dunia. (2017). *Laporan Keadaan Akses Listrik 2017*.
Bastakoti, B. P. (2006). The electricity-livelihood nexus: some highlights from the Andhikhola Hydroelectric and Rural Electrification Centre (AHREC). *Energy for Sustainable Development*, *10*(3), 26–35. https://doi.org/10.1016/S0973-0826(08)60541-4
Bensch, G. , K. J. , P. J. (2011). Dampak elektrifikasi pedesaan di Rwanda. *Jurnal Efektivitas Pembangunan*, *3*(4), 567–588.
Bhattacharya, M. , P. S. O. I. , B. S. (2016). Dampak konsumsi energi terbarukan terhadap pertumbuhan ekonomi: Bukti dari 38 negara teratas. *Applied Energy*, *162*, 733–741.
Bhattacharyya, S. (2013). Elektrifikasi Pedesaan Melalui Sistem Off-Grid Terdesentralisasi di Negara-negara Berkembang. *Dordrecht: Springer*.
Birol, F. (2018). Energi adalah Inti Agenda Pembangunan Berkelanjutan hingga 2030. Organisasi Energi Internasional. *Https://Www.Iea.Org/Newsroom/*

Nomico Journal
E-ISSN : 3046-6318
https://nawalaeducation.com/index.php/NJ/index
Vol.2.No.5 June 2025
DOI : https://doi.org/10.62872/dzy8n933
News/2018/March/Energy-Is-at-the-Heart-of-the-Sustainable-Development-Agendato-2030.Html.
C. Calderon, L. S. (2004). *Dampak Pembangunan Infrastruktur terhadap Pertumbuhan dan Distribusi Pendapatan.*

Collste, D. , P. M. , C. S. (2017). Koherensi kebijakan untuk mencapai SDGs: menggunakan model simulasi terintegrasi untuk menilai kebijakan yang efektif. *Sustainability Science*, *12*, 921-931.
Danuletiu, D. (2014). Energi terbarukan dan ekonomi pertumbuhan: Bukti dari tanda kausalitas jangka panjang panel. *Jurnal Internasional Ekonomi Dan Kebijakan Energi*, *4*(4), 578–587.
David, M. (2015). *Laporan Situasi Energi Zimbabwe*. Https://Www.Eneken.Ieej.or.Jp/Data/6239.Pdf.
Dilip Ahuja, T. M. , S. D. ,. (2008). Energi berkelanjutan untuk negara-negara berkembang. *EN. S. Surv. Perspect. Integr. Environ. Soc.*, *2*(1), 1–48.
ESDM. (2022). Handbook of Energy & Economic Statistics of Indonesia. *Kementerian Energi Dan Sumber Daya Mineral.*
F. Riva, H. A. E. H. S. P. E. C. (2018). Akses listrik dan pembangunan pedesaan: keragaman dinamika sosial-ekonomi yang kompleks dan diagram kasual untuk menggambarkan energi yang lebih tepat,. *Keberlanjutan Energi. Dev.*, *43*, 203–223.
Fuso Nerini, F. , T. J. , T. L. B. I. , P. P. , B. M. , B. A. , S. C. , C. B. V. , A. G. , M. B. M. Y. (2018). (2018). Memetakan sinergi dan trade-off antara energi dan tujuan pembangunan berkelanjutan. *Energi Alam*, *3*(1), 10-15.
Gunarto, T. , C. U. , Y. D. , M. A. , P. A. W. H. (2024). Perbandingan konsumsi energi terhadap pertumbuhan ekonomi di negara berkembang Asia dan negara maju Asia. *Jurnal Internasional Ekonomi Dan Kebijakan Energi*, *14*(1), 264–271.
Hanke, J. E. , & W. D. W. (2005). *Business forecasting. Pearson Educación*.
HDR. (2016). *Pembangunan Manusia untuk Semua*. Https://Hdr.Undp.Org/En/2016-Laporan.
Huwaida, H. (2019). *Statistika Diskriptif* (A. Pratomo, Ed.; 1st Edition). Poliban Press.
Ibrahiem, D. M. (2015). Renewable Electricity Consumption, Foreign Direct Investment and Economic Growth in Egypt: An ARDL Approach. *Procedia Economics and Finance*, *30*, 313–323. https://doi.org/10.1016/S2212-5671(15)01299-X
IEA. (2017a). *Energi Berkelanjutan untuk Semua 2017-Kemajuan Menuju Energi Berkelanjutan.*
IEA. (2017b). *Prospek Akses Energi: Dari Kemiskinan Menuju Kemakmuran.* . Https://Webstore.Iea.Org/Pandangan-Energi-Dunia-2017.
IEA. (2018). *Energi, Air, dan Tujuan Pembangunan Berkelanjutan,*. Tersedia Dari: Https://Webstore.Iea.Org/Energy-Water-and-the-Sustainable-Development-Goals.
IEA. (2021). *World Energy Outlook 2021*.
IMF. (2023). *World Economic Outlook: A Rocky Recovery.*
IRENA. (2015). *Biaya Pembangkitan Energi Terbarukan pada tahun 2014.*
IRENA. (2020). Global Renewables Outlook: Energy Transformation 2050. *International Renewable Energy Agency*.

Işık, C. , O. İ. , G. M. (2021). Efek asimetris dari Konsumsi energi terbarukan terhadap pertumbuhan ekonomi: Bukti dari negara-negara D-8. *Ilmu Lingkungan Dan Penelitian Polusi*, *28*(25), 2832636-32648. – 25.

Iyke, B. N. (2015). Electricity consumption and economic growth in Nigeria: A revisit of the energy-growth debate. *Energy Economics*, *51*, 166–176. https://doi.org/10.1016/j.eneco.2015.05.024

Jung, T. Y., Huh, M., & Moon, J. (2018). Goal 7: affordable and clean energy. In *Sustainable Development Goals in the Republic of Korea* (pp. 65–84). Routledge. https://doi.org/10.4324/9781351067478-5

Karatayev, M. , H. S. , K. Y. , C. M. (2016). Terbarukan penyerapan teknologi energi di Kazakhstan: Penggerak kebijakan dan hambatan dalam ekonomi transisi. *Tinjauan Energi Terbarukan Dan Berkelanjutan*, *66*, 120-136.

Kumar, C. M. M. (2020). Energi terbarukan untuk pembangunan berkelanjutan di India: Status terkini, prospek masa depan, tantangan, lapangan kerja, dan peluang investasi. *Energy. Sustain. Soc*, *10*, 1–31.

Kumar. J, C. R., & Majid, M. A. (2020). Renewable energy for sustainable development in India: current status, future prospects, challenges, employment, and investment opportunities. *Energy, Sustainability and Society*, *10*(1), 2. https://doi.org/10.1186/s13705-019-0232-1

Li, Q., Cherian, J., Shabbir, M. S., Sial, M. S., Li, J., Mester, I., & Badulescu, A. (2021). Exploring the Relationship between Renewable Energy Sources and Economic Growth. The Case of SAARC Countries. *Energies*, *14*(3), 520. https://doi.org/10.3390/en14030520

Lucas, R. J. (1988). Tentang mekanisme pembangunan ekonom. *Jurnal Ekonomi Moneter*, *22*, 3–42.

Madaleno, M., & Nogueira, M. C. (2023). How Renewable Energy and CO2 Emissions Contribute to Economic Growth, and Sustainability—An Extensive Analysis. *Sustainability*, *15*(5), 4089. https://doi.org/10.3390/su15054089

Manzoor, D. , S. M. , A. Z. (2021). Peran keuangan keterbukaan pembangunan dan perdagangan dalam mendorong konsumsi energi terbarukan: Bukti dari negara-negara D-8. *Ilmu Lingkungan Dan Penelitian Polusi*, *28*(9), 11255-11268.

Mayer, A. (2022). Fossil fuel dependence and energy insecurity. *Energy, Sustainability and Society*, *12*(1), 27. https://doi.org/10.1186/s13705-022-00353-5

McCollum, D. E. L. B. S. , P. S. , P. S. , R. J. , K. V. , M. J. N. M. , S. A. R. K. (2018). Menghubungkan tujuan pembangunan berkelanjutan melalui keterkaitan energi. *Environmental Research Letters*, *13*, 033006.

Mert, M. , B. G. (2016). Apakah investasi asing langsung dan energi terbarukan Bagaimana konsumsi energi mempengaruhi emisi CO2? Bukti baru dari pendekatan panel ARDL terhadap negara-negara Lampiran Kyoto. *Ilmu Lingkungan Dan Penelitian Polusi*, *23*(21), 21669–21681.

Myrzabekkyzy, K. , K. B. , R. D. , K. I. , P. Z. (2022). , Analisis hubungan kausalitas antara pertumbuhan ekonomi dan produksi energi serta investasi teknologi di Kazakhstan. *Jurnal Internasional Ekonomi Dan Kebijakan Energi*, *12*(6), 123-126.

ND Rao, S. P. (2017). Akses energi dan standar hidup: beberapa observasi tentang

Nomico Journal
E-ISSN : 3046-6318
https://nawalaeducation.com/index.php/NJ/index
Vol.2.No.5 June 2025
DOI : https://doi.org/10.62872/dzy8n933
tren terbaru, Environ. Res. Biarkan. *Environ. Res. Biarkan.*, *12*(2), 025011.
Niez, A. (2010). Studi Komparatif tentang Kebijakan Elektrifikasi Pedesaan di Negara-negara Berkembang. *Paris: OECD, IEA*.
Njiru, C. W., & Letema, S. C. (2018). Energy Poverty and Its Implication on Standard of Living in Kirinyaga, Kenya. *Journal of Energy*, *2018*, 1–12. https://doi.org/10.1155/2018/3196567
OECD. (2018). *OECD Science, Technology and Innovation Outlook 2018*. OECD. https://doi.org/10.1787/sti_in_outlook-2018-en
PBB. (2015). *Transformasi Dunia Kita: Agenda 2030 untuk Pembangunan Berkelanjutan*. Https://Www.Un.Org/Ga/Search/View_doc.Asp?Symbol=a/Res/70/1&lang=E.
Peng, W. , P. J. (2006). Elektrifikasi pedesaan di Tiongkok: Sejarah dan institusi. . *Tiongkok Dan Ekonomi Dunia*, *14*(1), 71–84.
PR Agenor, B. M.-D. (2006). *Infrastruktur Publik dan Pertumbuhan: Saluran Baru dan Implikasi Kebijakan,*.
Prasetyani, D. , G. E. , C. M. , J. A. B. S. (. (2024). Dua dekade hubungan kualitas lingkungan bisnis kelapa sawit: Pendekatan bibliometrik. *Jurnal Ekonomi Dan Kebijakan Energi Internasional*, *14*(1), 290–300.
Radmehr, R., Shayanmehr, S., Ali, E. B., Ofori, E. K., Jasińska, E., & Jasiński, M. (2022). Exploring the Nexus of Renewable Energy, Ecological Footprint, and Economic Growth through Globalization and Human Capital in G7 Economics. *Sustainability*, *14*(19), 12227. https://doi.org/10.3390/su141912227
Rafindadi, A. O. I. (2017). Dampak energi terbarukan konsumsi terhadap pertumbuhan ekonomi Jerman: Bukti dari uji kointegrasi gabungan. *Tinjauan Energi Terbarukan Dan Berkelanjutan*, *75*, 1130–1141.

Rahman, M., Keat, N. W., Masud, M. A. K., & Albaity, M. (2024). Powering Growth: The Dynamic Impact of Renewable Energy on GDP in ASEAN-5. *International Journal of Energy Economics and Policy*, *14*(5), 118–130. https://doi.org/10.32479/ijeep.16541
Rao, N. (2013). Apakah pasokan listrik (yang lebih baik) meningkatkan pendapatan usaha rumah tangga di India? *Kebijakan Energi*, *57*, 532–541.
Rehman, A. (2019). Hubungan akses listrik, pertumbuhan penduduk, Pertumbuhan ekonomi di Pakistan dan proyeksi hingga tahun 2040: Pendekatan AnARDL menuju kointegrasi. *Jurnal Internasional* , *13*(3), 747–763.
Romer, P. (1993). Perubahan teknologi endogen. Jurnal Ekonomi Politik. *Jurnal Ekonomi Politik*, *98*, 71–103.
Sadath, A. A. R. (2017). Menilai tingkat dan intensitas kemiskinan energi menggunakan Indeks Kemiskinan Energi Multidimensi: Bukti empiris dari rumah tangga di India. *Kebijakan Energi*, *102*, 540–548.
Saiymova, M. , T. M. , S. K. , B. Z. , J. R. (2023). Analisis regresi vektor otomatis tentang hubungan antara konsumsi energi terbarukan dan pembangunan ekonomi di Turki dan Kazakhstan. *Jurnal Internasional Ekonomi Dan Kebijakan Energi*, *13*(2), 309–315.
Salinas, M. , R. M. , S. M. (2022). Propuesta de Soluciones Tecnológicas Para Enfrentar la

Pobreza Energética dan Mitigar el Cambio Climático en el Contexto de las Energías Renovables dan Tecnologías Inteligentes. *Https://Dspace.Utalca.Cl/Pegangan/1950/13408*.
Sarkhanov, T. , H. N. (2022). Analisis ekonometrika energi terbarukan Konsumsi energi dan pertumbuhan ekonomi: Kasus Kazakhstan dan Kyrgyzstan. *Jurnal Internasional Ekonomi Dan Kebijakan Energi*, *12*(6), 163-167.
Sarkodie, S. A. , & A. S. (2020). Akses Listrik dan Ketimpangan Pendapatan di Afrika Selatan: Bukti dari Analisis Bayesian dan NARDL. *Energy Stategy Reviews*, *29*(100480).
Satrianto, A., Ikhsan, A., & Samad, K. A. (2024). Analysis of Renewable Energy, Environment Quality and Energy Consumption on Economic Growth: Evidence from Developing Countries. *International Journal of Energy Economics and Policy*, *14*(4), 57–65. https://doi.org/10.32479/ijeep.15981
Sekretariat Jenderal Dewan Energi Nasional. (2022). *Laporan Analisis Nerasa Energi Nasional*.
Shahbaz, M. , S. S. H. S. , S. S. (2022). hubungan antara konsumsi energi terbarukan dan degradasi lingkungan di 10 negara dengan tingkat polusi tertinggi: Wawasan baru dari pendekatan kuantil-ke-kuantil. *Energi Terbarukan*, *180*, 1294-1310.
Slimane, S. (2024). Dampak pendapatan sumber daya terhadap pendapatan non-sumber daya pendapatan pajak di negara-negara pengekspor minyak: Bukti dari analisis nonlinier. *Jurnal Internasional Ekonomi Dan Kebijakan Energi*, *14*(1), 272–280.
Solow, R. (1956). Kontribusi terhadap Teori Pertumbuhan Ekonomi. *Jurnal Ekonomi Triwulanan*, *70*(1).
Sukirno, Sadono. (2006). *Ekonomi Pembangunan*. Kencana Prenada Media Group.
Suriyankietkaew, S., & Nimsai, S. (2021). COVID-19 Impacts and Sustainability Strategies for Regional Recovery in Southeast Asia: Challenges and Opportunities. *Sustainability*, *13*(16), 8907. https://doi.org/10.3390/su13168907
Tahir, M. , A. T. (2015). Hubungan Perdagangan Internasional keterbukaan dan pertumbuhan ekonomi di negara-negara berkembang beberapa dimensi baru. *Jurnal Studi Ekonomi Dan Perdagangan Luar Negeri Tiongkok*, *8*(2), 123–139.
Terrapon-Pfaff, J., Dienst, C., König, J., & Ortiz, W. (2014). A cross-sectional review: Impacts and sustainability of small-scale renewable energy projects in developing countries. *Renewable and Sustainable Energy Reviews*, *40*, 1–10. https://doi.org/10.1016/j.rser.2014.07.161

Tiba, S. , O. A. (2017). Survei literatur tentang hubungan antara energi, lingkungan, dan pertumbuhan ekonomi. *Renewable and Sustainable Energy Reviews*, *69*, 1129-1146.
Twas. (2008). Energi berkelanjutan untuk negara-negara berkembang. . *SAPI EN. S. Surv. Perspect. Integrasi Lingkungan. Soc.*, *2*(1), 1–48.
Uhr DdAP, C. A. U. JGZ. (2019). Estimasi elastisitas permintaan listrik di rumah tangga Brasil dan implikasi kebijakan. *Energi Pol*, *129*, 69–79.
Ulsrud, K., Winther, T., Palit, D., Rohracher, H., & Sandgren, J. (2011). The Solar Transitions research on solar mini-grids in India: Learning from local cases of innovative socio-technical systems. *Energy for Sustainable Development*, *15*(3), 293–

Nomico Journal
E-ISSN : 3046-6318
https://nawalaeducation.com/index.php/NJ/index
Vol.2.No.5 June 2025
DOI : https://doi.org/10.62872/dzy8n933

303. https://doi.org/10.1016/j.esd.2011.06.004

UNDP. (2020). *The Sustainable Development Goals Report 2020*.

United Nations. (2015). *Transforming Our World: The 2030 Agenda for Sustainable Development* (A/RES/70/1; A/RES/70/1).

van Gevelt, T. (2014). Elektrifikasi dan pembangunan pedesaan di Korea Selatan. *Energi Untuk Pembangunan Berkelanjutan*, *23*, 179–187.

Winther, T., Matinga, M. N., Ulsrud, K., & Standal, K. (2017). Women's empowerment through electricity access: scoping study and proposal for a framework of analysis. *Journal of Development Effectiveness*, *9*(3), 389–417. https://doi.org/10.1080/19439342.2017.1343368

World Bank. (2018). *Lighting Up and Powering Up: The State of Electricity Access in Developing Countries*.

World Bank. (2022). *Indonesia Economic Prospects: Navigating the Global Storm*.

Yang, M. (2003). Elektrifikasi pedesaan dan pengurangan kemiskinan di Tiongkok. *Kebijakan Energi*, *31*(3), 283–295.