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Article

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Aggressiveness of the Electricity Sector and Implications for Energy GDP (Comparative Test of Indonesia-Malaysia)

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ABSTRACT

Keep in mind, energy is fluctuating. The dependence of electricity production from fossil fuels is a valuable lesson for stakeholders to think about and inspire the creation of the latest technology. Although the contribution of fossil fuels has grown the flow of industry in various worlds, they must limit it as early as possible. We set this research up based on a quantitative approach that aims to examine the impact of fossil fuels electricity generation on Gross Domestic Product (GDP) per unit of energy used, electricity production capacity, and access to electricity. Indonesia and Malaysia as countries that represent empirical objectivity to be reviewed on how the causality of the research objectives for the period 2013-2020. We collected the data source through The Global Economy, which is very concerned with highlighting global economic developments. Multiple regression and path analysis support this work. Interestingly, the three findings for the case study in Indonesia support the design hypothesis ($P < 0.05$), whereas the two hypotheses in Malaysia ($P < 0.05$). The determinant of GDP per unit of energy used has met two-way causality. There are short-term and long-term prospects from other relationships that are not significant ($P > 0.05$). Besides the economic element, it does not balance the results due to demographic factors in Indonesia, which are larger in composition than Malaysia. Future agenda need to discuss the implications of further referring to this research.

Keywords: Electricity, Fossil Fuels, GDP of Energy, Indonesia, Malaysia
JEL Classifications: K32; Q38; Q50

1. INTRODUCTION

The Asean Economic Community (AEC) in 2025 is a continuation of the MEA in the 2015 period (Wiko and Kinanti, 2021). The most striking thing about AEC intervening in macroeconomic policies in the ASEAN region is that it is increasingly moving quickly and cohesively to make ASEAN successful globally, centered, inclusive, resilient, sectoral cooperation and connectivity movements, dynamic, cohesive, and competitive (Widiyana and Djatmiko, 2019).

Apart from that, interactions in terms of economic cooperation in ASEAN include finance, tourism, telecommunications, transportation, services, investment, trade, and industry. At the same time, it also expected the agreement to expand Small and Medium Enterprises, minerals, energy, forestry, and agriculture. Moreover, the economic profile at the ASEAN level considers three aspects that have attracted the attention of the global market. ZA et al. (2021) track that the average economic growth in the ASEAN region ranges from 5% to 6%/year, which is to encourage fair development among member countries. The population of ASEAN reached 632 million people in 2015 (Artner, 2017), of which the majority are of productive age. Then, ASEAN is also rich in natural resource commodities such as food crops, minerals, and energy (Pradipta, 2015).

In the last few decades, ASEAN has built an economic reputation that reflects an aggressive power (Goh, 2008). They have the Initiative for ASEAN Integration which functions to create equitable development between Vietnam, Myanmar, Laos, and

Cambodia (CLMV) with Thailand, Singapore, the Philippines, Malaysia, Indonesia, and Brunei Darussalam (ASEAN-6). This is the right moment to strengthen solidarity and promote economic recovery in the BIMP-EAGA region. They highlighted the interesting part on the BIMP-EAGA cooperation platform, which prioritizes concrete projects for accelerating sustainable development (Mansur, 2009). Explicitly, vital programs started by the Indonesian and Malaysian governments, such as environmentally friendly energy security (Shadman et al., 2021).

The Ministry of Energy and Mineral Resources-Republic of Indonesia (2016) noted that the electricity interconnection cooperation between the Indonesian government and the Malaysian government was realized in January 2016 through an extra high voltage overhead line of 275 kilo volts between the Bengkayang Extra High Voltage Substation (GITET) and GITET. Mambong (SESCO Malaysia) after several series of tests. This interconnection refers to the Agreement in the Power Exchange Agreement, where State Electricity Company of Indonesia (PLN) and SESCO Malaysia agree to export-import electricity for 25 periods.

In the first 5 periods, Indonesia will buy electricity from Malaysia for 50 MW at peak load times and 230 MW at peak times. For the next 5 periods, PLN allows to sell electricity to Malaysia. In the early stages of this interconnection, SESCO Malaysia will supply up to 10 MW of electricity and will accumulate it to 50 MW by the end of March 2016. Then, Malaysia will supply 50 MW to Indonesia.

The Conservation (2020) released that Indonesia has a target to provide electric lighting to its entire population by 2020 with an electrification ratio of 100%. In the previous period, namely 2019, the realization of the electrification ratio had reached 98.89%. To achieve this ambitious target, the efforts that have been made include the commitment to develop electricity infrastructure, such as solar power plants, to the outermost, underdeveloped, and leading areas with a special allocation of funds.

Like what happened in Malaysia, ironically, there are still issues of usability, quality, and sustainability of energy access to support productive economic activities besides this magnificent project. The reason is, the achievement of 100% electrification ratio will be trapped in quasi-data because they considered it to capture the complexity of existing problems, especially related to fulfillments electrical energy and clean energy for cooking. They often refer in this to as dual energy poverty.

Without putting aside positive expectations, of course, there will be consequences if you don't immediately clean up. There is no guarantee for them that if it boosted the electricity sector, electricity supplying producers and consumers, in this case the population, can be productive and increase welfare (Setyawan, 2015; Gielen et al., 2019). Impressively, the Gross Domestic Product (GDP) per unit of energy needs to be boosted by power generation and adequate electricity production capacity (EPC), so that residents' access to electrical energy needs can be met. The goal of this paper is to detect the relationship between these four aspects. Will this apply to the current situation or will it hinder it? It needs to be tracked empirically oriented. The six essential points to support the framework of the paper include introduction, theoretical lens and formulation of hypotheses, research methodology, findings, discussion, and conclusions.

2. THEORETICAL LENS AND HYPOTHESES FORMULATION

2.1. Theory of Electrical Energy Economic

Zweifel et al. (2017) argue that the power grid connects customers and generators. The existence of the electricity market because there is a network that aims to create competition between retailers and generators, where access to the electricity network must guarantee third parties (such as residents) transparently. From an economic perspective, this action must be discriminatory, which means facilitating the public interest and representing a monopoly (Alessio, 1981). Otherwise, the electricity grid operator has the potential to abuse and not give the utility a vertical market position. The electricity network needs to be managed wisely, in order to prevent losses that impact decreasing welfare.

2.2. Electrical Energy Market and Sustainability

Today, electricity service has become a basic need for the universe. In fact, the demand continues to increase, which implies that electricity plays an important role in human life (Mueller, 1991). A case study in low-income countries, there are many unmet demand for electricity, resulting in houses without lighting, adequate sanitation, and inadequate economic development. One example of a low-income country is Indonesia. With a large population in the world, there are still many problems with access to electricity (AE) (Cahyo et al., 2018). In fact, Khanna and Rao (2019) predict a large growth of world energy consumption of around 55% during the period 2005-2030. This means that the consumption of coal commodities has increased by 73% and the use of electrical energy has also doubled from the previous one. Nearly half of the increase in energy consumption occurred in India and China, while the rest was for developing countries.

Concerns in the current electricity market, the competition to drive demand response, programs, efficiency levels received great enthusiasm. Because of high competition in the electricity industry, the level of demand has fallen drastically, and the market needs to adopt a new approach by taking advantage of demand opportunities (Faria and Vale, 2011). In addition, recently the international community has paid attention to global issues such as climate change and environmental protection. In the context of development, many organizations actively promote energy complementation and transformation of changing demands by optimizing spatial planning, using renewable energy, and low-carbon energy (Gan et al., 2020).

2.3. Electricity from Fossils

Like it or not, we will face adopting renewable energy, where fossil fuels are very limited. The shift to renewable energy is certainly driven by the wishes of all parties (Timmons, 2014).

Although new technologies have been extracted, but the more pressing needs of fossil fuels are difficult to separate anda continuously evaluated this towards a more friendly climate change. At its peak, it limited the nature of fossil reserves because they always associate the use of fuel with human prosperity. Substantially, it continues to increase. Scholars debate doubts without agreement (Abas et al., 2015). Wilson and Styring (2019) even argue that fossil fuels will continue to be an energy system and an important element in the future. The demand for heating machines is quite high as the cause of winter being more dominant than summer for a country like the UK. Evidently, that electrical energy has helped the needs of the people there for the management of extreme seasonal changes.

Zou et al. (2016) express the global energy revolution as a future agenda. New energy provides insight into the investigation of the global energy development situation in response to future demand. Understanding offers important ideas about the history of energy use and new knowledge about energy sources in a new era after the use of wood, coal, oil, and gas was abandoned. Although the reaction of the industrial sector is still applying fossil energy in several countries, it must make major breakthroughs through technology-based alternatives that protect the ecological environment. The transition from fossil energy to new energy sources needs to be encouraged, so that they commit business people to all these consequences.

2.4. Relationship between Variables

2.4.1. Fossil fuels electricity generation (FFEG) – EPC

Eser et al. (2017) report that in 2030, Central Europe will start prioritizing the operation of conventional power plants into renewable energy systems, where the simulation is initiated with the penetration of renewable energy. Hourly geographic, it converted temporal resolution capacity through individual unit-scale demand, transmission, and generation. The obsession aims to include part load efficiency and ensure that the financial performance of the power plant depends on the variability of its production, thus underpinning its financial viability.

Technological solutions and penetration of renewable energy highlight the risk of investing in the electricity market to meet the future needs of customers. Although fossil fuel-based electricity is required to develop technological relevance that mixes retrofit and new generation investment, Gomelsky and Figueroa (2012) argue that this ambition must still be considered. It makes sense to actualize the following first hypothesis:

Hypothesis 1: FFEG increases EPC systematically.

2.4.2. GDP per unit of energy used – FFEG – EPC – AE

Hirsh and Koomey (2015) comment that over the last decade, the growing role of electricity consumption has had positive implications for public policy and business interests. The relationship between electricity use and economic activity is in a changing trend, but it sheds light on the new reality of lower levels of electricity consumption. Old assumptions are fading away as current trends require utility stakeholders to sustainably.

In each country, there is a significant relationship between economic growth and energy consumption in the long run. Thus, economic growth highly depends on a country's imports, so that the contribution of energy consumption is greater in the aggregate economy. Esen and Bayrak (2017) conclude that state income will increase because the level of energy consumption also increases even though the slop in economic growth is stagnant. Therefore, efficiency in energy consumption is considered as an actual dimension in economic development.

Szustak et al. (2021) are interested in identifying a relationship between GDP and energy production. A shift in focus on electricity production in parts of Europe independent of power sources does not have direct implications for GDP growth. In fact, for some countries, the correlation between GDP and electricity production is stronger, but in case studies in other countries, the correlation is very low. Naturally, climate change becomes a very broad perspective in terms of causality between the two. It is logical to design the following four hypotheses:

Hypothesis 2: GDP per unit of energy used increases EPC systematically.

Hypothesis 3: GDP per unit of energy used increases AE systematically.

Hypothesis 4: GDP per unit of energy used plays a role in systematically increasing the relationship between FFEG and EPC.

Hypothesis 5: GDP per unit of energy used plays a role in systematically increasing the relationship between EPC and AE.

2.4.3. EPC – AE

Salite et al. (2017) surveyed the linkages between rural and urban center' AE and service quality in Mozambique. The surprising thing is that Mozambique is a global energy center with a wealth of resources. However, during the industrial to millennial eras, household activities were disrupted by equipment breakdown due to extreme weather events that exacerbated vibrations and power outages, erratic generation, low consumer growth, and aging transmission infrastructure. The household budget is much smaller than the electricity tariff, where the perspective on increasing investment, affordability, and reliability of modern and clean energy services is still considered poor. The quality of fulfillments electrical energy reflects a poor energy regulator, so that it limited the ability of the population to decide. The government of Mozambique is also unfair and transparent regarding institutions, capacities, performance, and standards for applying electricity tariffs.

Similar to this phenomenon, low-income countries such as Malawi also face serious constraints regarding unlimited energy supplies. Other problems that have an impact are the development of industry, the economy, and the social status of the community. Taulo et al. (2015) reviewed reviews relating to energy demand and supply in Malawi. Energy supply challenges, identification of broad strategies to be implemented, key issues faced by the energy sector, and assessment of the resources exploited to the contribution of electricity supply in Malawi outlines strategies and critiques for modernizing energy supply in order to achieve sustainable economic and social growth. For the last hypothesis, proportionally planned as follows:

Hypothesis 6: EPC increases AE systematically.

3. RESEARCH METHODOLOGY

3.1. Data Set

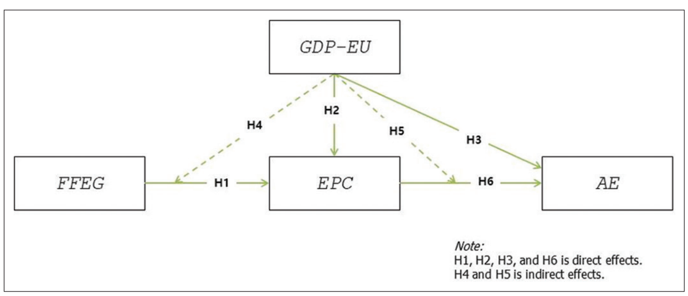
Characteristics of data collected from a trusted international institution, namely The Global Economy (2022). We selected these secondary data based on five parameters relevant to electricity and economic growth with case studies in Indonesia and Malaysia. It limited the data coverage for the period 2013 to 2020. Table 1 describes the operational part of each data.

The four attributes above are quantitative, where empirical testing is carried out to examine the relationship between each of their effects. From here, gross domestic product per unit of energy used (GDP-EU) is an intervening variable that functions to control its effect on FFEG, EPC, and AE. In principle, the six hypotheses expose one-way (short-term) and two-way (long-term) causality. To facilitate understanding of research pathways and procedures, we summarize them in Figure 1.

3.2. Econometric Model

Integration supports the method of multiple regression and path analysis. We process the statistical interpretation mechanism

Figure 1: The Proposed Model



Source: Author own

Tabel 1: List of variables

Items	Information	Position
FFEG	Billions of kilowatt-hours of electricity sourced from fossil fuels (natural gas, coal, and oil).	Independent
GDP-EU	Value to GDP based on constant purchasing power parity in USD generated from one kilogram of oil equivalent to energy throughout the country. Energy use includes electrical energy, renewable energy, solid fuels, natural gas, and oil that is converted into oil equivalents.	Independent, intervening
EPC	Million kilowatts of installed electricity capacity.	Independent, dependent
AE	The percentage of the population's ability to have AE, where electrification data is collected from an international scale, national surveys, and the industrial sector.	Dependent

FFEG: Fossil fuels electricity generation, GDP-EU: Gross domestic product per unit of energy used, EPC: Electricity production capacity, AE: Access to electricity, GDP: Gross domestic product

with IBM SPSS. These two tools are useful for predicting the relationship between FFEG to EPC, GDP-EU to EPC, then EPC to AE, and the determination of GDP-EU to FFEG and EPC and GDP-EU in bridging the effect between EPC and AE. The basic logarithm provisions are formulated as follows (e.g. Roy et al., 2021; Suparjo et al., 2021):

$$lnY = ln\alpha + \beta_1 lnX + ... + \mu$$

From the function of the equation, it is transformed based on the capacity and identity of the variable into the following four components:

$$lnEPC = \beta_0 + \beta_1 lnFFEG_t + \beta_2 lnGDP\text{-}EU_t + \mu_t$$

$$lnAE = \beta_0 + \beta_3 lnGDP\text{-}EU_t + \beta_4 lnEPC_t + \mu_t$$

$$lnEPC = \beta_0 + (\beta_5 lnFFEG_t . \beta_6 lnEPC_t) + (\beta_7 lnGDP\text{-}EU_t . \beta_8 lnEPC_t) + \mu_t$$

$$lnAE = \beta_0 + (\beta_9 lnGDP\text{-}EU_t . \beta_{10} lnEPC_t) + (\beta_{11} lnEPC_t . \beta_{12} lnAE_t) + \mu_t$$

Where: The symbol at ln = natural logarithm, α = constant/unstandardized coefficient, $\beta_1 . \beta_{12}$ = beta/explanatory coefficient, t = time-series, t = error.

In practice, the flow of the instrument will display all paths referring to descriptive statistics, correlation, partial testing, and intervening testing, or the total effect between variables in Indonesia and Malaysia. The demarcation of correlation uses Pearson correlation, where the data must be normally distributed. Correlation produces a positive score (+) and a negative score (−). If the number of positive correlation means the relationship is unidirectional. Unidirectional means that the higher the score on the independent variable, the larger the dependent variable (Darma et al., 2022). According to Priyagus (2021) and Roy et al. (2019), the limit for significance is if the probability is not greater than 5% or $P < 0.05$.

4. FINDINGS

4.1. Descriptive Statistics

Tables 2 and 3 tabulate the descriptive statistical scores of FFEG, EPC, AE, and GDP-EU between Indonesia and Malaysia. There seems to be a striking difference between the two countries. For the mean, the highest score was FFEG in Malaysia at 126.25 and the lowest was in Indonesia at 11.75.

Table 2: Summary of descriptive statistics (Indonesian case)

Items	Mean	Max.	Min.	Std. Dev.
FFEG	119.75	233.5	166.9	21.81
EPC	55.53	65.89	41.84	8.17
AE	97.51	98.85	96	0.98
GDP-EU	10.45	11.65	9.17	1.04
N=8				

Source: Calculation from IBM SPSS. FFEG: Fossil fuels electricity generation, EPC: Electricity production capacity, AE: Access to electricity, GDP-EU: Gross domestic product per unit of energy

In addition, FFEG in Indonesia is superior to Malaysia, where the maximum score comparison is 223.5 with 113.8. From the minimum score, the most dominant is FFEG in Indonesia, reaching 116.9, while Malaysia is only at 117. Furthermore, the largest standard deviation value is FFEG in Indonesia (21.81) compared to Malaysia (5.83).

4.2. Pearson Correlation

Massively, the correlation in each variable is classified into a perfect relationship, where the score is almost close to 1 (Correlation > 0.9). Understanding from Table 4, all relationships are based on probability terms, only six relationships have a two-way relationship significantly (P < 0.01). The series of relationships include FFEG to EPC and AE, and EPC to FFEG and AE.

Then, the interaction between FFEG, EPC, AE, and GDP-EU in Malaysia is calculated by a probability level of 5% and 10% which explains that there is a significant correlation difference (Table 5). The fundamental justification in question is the moderate relationship between AE to EPC and GDP-EU to AE (Correlation < 0.8 and P < 0.05). At P < 0.01, it proved that only FFEG and EPC had a nearly perfect correlation (Correlation = 0.9).

Table 3: Summary of descriptive statistics (Malaysian case)

Items	Mean	Max.	Min.	Std. Dev.
FFEG	126.25	133.8	117	5.83
EPC	31.14	34.53	29.52	1.92
AE	99.96	100	99.8	0.07
GDP-EU	7.76	8.58	6.94	0.56
N=8				

Source: Calculation from IBM SPSS. FFEG: Fossil fuels electricity generation, EPC: Electricity production capacity, AE: Access to electricity, GDP-EU: Gross domestic product per unit of energy

Table 4: Correlation results in Indonesia

Items	FFEG	EPC	AE	GDP-EU
FFEG	1	0.984** (0.000)	0.991** (0.000)	0.914** (0.001)
EPC	0.984** (0.000)	1	0.992** (0.000)	0.915** (0.001)
AE	0.991** (0.000)	0.992** (0.000)	1	0.913** (0.002)
GDP-EU	0.914** (0.001)	0.915** (0.001)	0.913** (0.002)	1
N=8				

Source: Calculation from IBM SPSS, **P<0.01. FFEG: Fossil fuels electricity generation, EPC: Electricity production capacity, AE: Access to electricity, GDP-EU: Gross domestic product per unit of energy used

Table 5: Correlation results in Malaysia

Items	FFEG	EPC	AE	GDP-EU
FFEG	1	0.902** (0.002)	0.836** (0.010)	0.829* (0.011)
EPC	0.902** (0.002)	1	0.715* (0.046)	0.706* (0.050)
AE	0.836** (0.010)	0.715* (0.046)	1	0.777* (0.023)
GDP-EU	0.829* (0.011)	0.706* (0.050)	0.777* (0.023)	1
N=8				

Source: Calculation from IBM SPSS, *P<0.05, **P<0.01. FFEG: Fossil fuels electricity generation, EPC: Electricity production capacity, AE: Access to electricity, GDP-EU: Gross domestic product per unit of energy

4.3. Short and Long Term Effects

Amazingly, from the six hypotheses proposed, the realization is quite balanced with the results that 3 hypotheses are accepted and 3 other hypotheses are rejected. Table 6 concludes that the short-term causality in the relationship of FFEG to EPC (P = 0.006) and EPC to AE (P = 0.001) is significant. The significant achievement between EPC and AE also showed this logical thing through GDP-EU in the long term (P = 0.039).

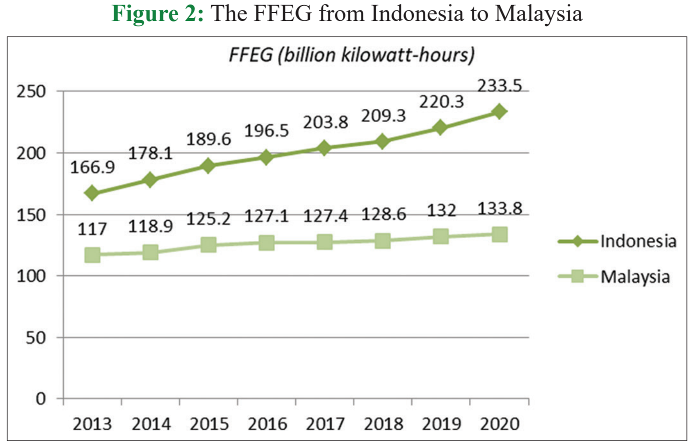
Uniquely, in Indonesia, there is an insignificant effect between GDP-EU on EPC and AE, because the probability of interpreting short-term effects is not interrelated (P = 0.642 and P = 0.812). Returning to the issue, the two-way causality for the long term on FFEG to EPC through GDP-EU, the result is also not significant (P = 0.946).

Valuable things are got based on Table 7 regarding the structure of the relationship in the first hypothesis (P = 0.031) and the fifth is accepted (P = 0.000) which implies that there is a significant effect between FFEG on EPC and EPC on AE through the long-term two-way role of GDP-EU. On the one hand, four hypotheses were rejected because they showed P > 0.05. The peak, GDP-EU to EPC and AE was not significant (P = 0.716 and P = 0.202), EPC to AE also did not have a two-way causality significantly (P = 0.411), and FFEG to EPC through GDP-EU got two-way causality the long-term direction was not significant (P = 0.909).

5. DISCUSSION

Figure 2 outlines data on the development of FFEG and EPC in Indonesia and Malaysia. The increase in these two indicators seems unstoppable, especially in Indonesia. It is understandable that fossil fuel power generation in Indonesia has surged positively from time to time. During the last 8 periods, the highest total power generation in Indonesia was 233.5 billion kilowatt-hours. Compared to Malaysia, the electricity generation there is only around 133.8 billion kilowatt-hours. The average number of power plants that are still actively using fossil fuels from 83 countries in 2020 is only 171.09 billion kilowatt-hours.

Figure 2: The FFEG from Indonesia to Malaysia



Source: The Global Economy, 2022

Table 6: Path analysis for Indonesia

Hypotheses	Relations	Estimate	P	S.E.	Category	Label
H1	FFEG → EPC	0.896	0.006	0.073	*	Accepted
H2	GDP-EU → EPC	0.096	0.642	1.521	*	Rejected
H3	GDP-EU → AE	0.035	0.812	0.131	*	Rejected
H4	FFEG → GDP-EU → EPC	0.086	0.946	1.362	**	Rejected
H5	EPC → GDP-EU → AE	0.003	0.039	0.012	**	Accepted
H6	EPC → AE	0.960	0.001	0.017	*	Accepted

Source: Calculation from IBM SPSS, *Direct path, **Intervening path. FFEG: Fossil fuels electricity generation, EPC: Electricity production capacity, AE: Access to electricity, GDP-EU: Gross domestic product per unit of energy

Table 7: Path analysis for Malaysia

Hypotheses	Relations	Estimate	P	S.E.	Category	Label
H1	FFEG → EPC	1.010	0.031	0.113	*	Accepted
H2	GDP-EU → EPC	−0.131	0.716	1.156	*	Rejected
H3	GDP-EU → AE	0.543	0.202	0.047	*	Rejected
H4	FFEG → GDP-EU → EPC	−0.132	0.909	1.167	**	Rejected
H5	EPC → GDP-EU → AE	0.179	0.000	0.017	**	Accepted
H6	EPC → AE	0.331	0.411	0.014	*	Rejected

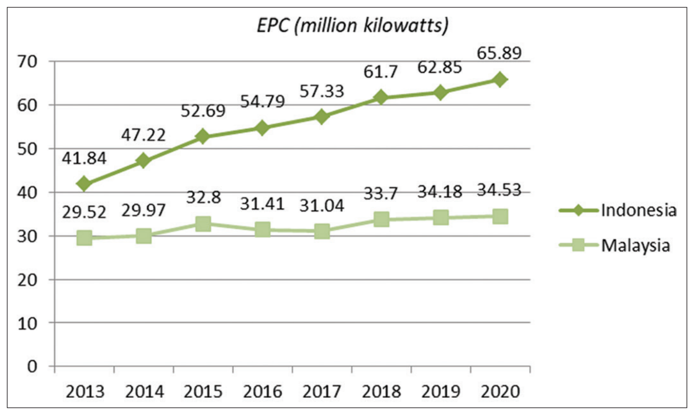
Source: Calculation from IBM SPSS, *Direct path, **Intervening path. FFEG: Fossil fuels electricity generation, EPC: Electricity production capacity, AE: Access to electricity, GDP-EU: Gross domestic product per unit of energy

In line with this, it is very reasonable if the EPC in Indonesia has a value above that of Malaysia. Based on Figure 3, the highest EPC for Malaysia only reached 34.53 million kilowatts, while in Indonesia it almost doubled at 65.89 million kilowatts. Even though this value immediately jumped, Indonesia's reputation for fighting carbon emissions deserves to be highlighted. During 2020, the world average EPC involving 190 countries was only 37.16 million kilowatts.

Although in quantity the number of FFEG and EPC Malaysia is far less than Indonesia, but the good news actually emerges from the success of the Malaysian government in responding to the level of population demand for electricity. Malaysia can control, distribute, and distribute environmentally friendly electricity at affordable rates to household consumers and small industries. Responding to Figure 4, in 2020, the number of electricity access in Malaysia is 100%, while the Indonesian government is close to that or reaching 98.85%. In fact, the world's enthusiasm is based on 197 countries alone, the average AE is 85.68%.

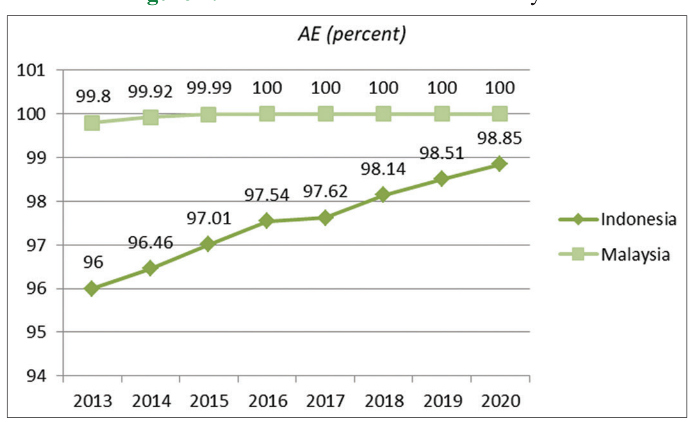
GDP growth per unit of energy in Indonesia is more dominant than Malaysia. This is due to the enthusiasm of the electricity market in Indonesia, which is quite promising because Indonesia is the country with the 4th largest population size after the USA in the 3rd rank. The GDP-EU achievement in Malaysia was 8.19% or a difference of 3.44% from Indonesia in 2020. A contribution of the average GDP-EU to 129 countries was 10.31% per kg of oil. The GDP has been converted to international dollars constantly since 2011 applying PPP. This means that the international dollar exchange rate has the same PPP as GDP as the USD (Figure 5).

Figure 3: The EPC from Indonesia to Malaysia



Source: The Global Economy, 2022

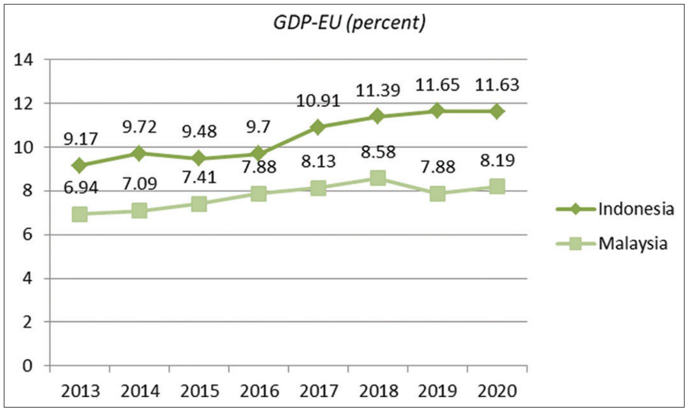
Figure 4: The AE from Indonesia to Malaysia



Source: The Global Economy, 2022

Publications from Handayani et al. (2019) assume that it has not solved the analysis of the diffusion of technology learning with a renewable energy pattern in the accounting electricity pattern. As in Indonesia, the short-term and long-term scenarios for expanding electricity capacity in Java and Bali islands emphasize renewable energy targets. The result, a combination of high and medium technology learning, channeled the total cost of electricity production to explore renewable energy targets. The scenario without accommodating these lessons is much lower than meeting the target in reducing emissions.

Figure 5: The GDP-EU from Indonesia to Malaysia



Source: The Global Economy, 2022

Chen et al. (2017) pioneered an investigation between electricity consumption and GDP in Asia, where there are emerging industries. Selectively, the long-term bidirectional causality between electricity consumption and economic growth is interrelated. Adequate levels of electricity supply ensure greater economic growth. Meanwhile, the one-way short-term causality between economic growth and electricity consumption is efficiency. This finding suggests rationalization in electricity conservation policies to save electricity supply as a breakthrough in order to reduce electricity consumption can be applied even though the waste of electricity can have a negative impact on economic growth.

So far, in developing countries (such as Indonesia and Malaysia), strong economic growth because of the impetus of rapid industrialization and urbanization can stimulate electricity demand. Minimum energy efficiency performance standards in government programs by 2030, supported through energy security, reduction of pollutants and greenhouse gases, and savings from the monetary side (McNeil et al., 2019). These three things are the most important part of reducing electricity demand. Indonesia is taking decisive steps to build power plants independently without reducing the risk of a power shortage that can have fatal consequences for the economy and financial stability.

Most recently, Moner-Girona et al. (2016) confirm that a new method that provides a pathway in the spatial analysis process for universal AE hinders the limitations of the electricity sector in Burkina Faso. The achievement of distribution of access to electrical energy in Burkina Faso from year to year is very simple. A concrete action plan supports development policies in the electricity sector with an electrification strategy. Coordination and planning of network expansion supported its deployment to achieve new energy in the future. What is contradictory is that the paradigm case has proven to be lacking a positive response from national policies, which are still dominated by government subsidies for electricity production from fossil fuels and weak network expansion. It is not effective in achieving the national energy target. Access to stimulate local renewable resources is still experiencing many obstacles.

6. CONCLUSION

This paper is committed to assessing the causality between FFEG and GDP-EU, EPC, and AE, which is divided into 2 objectives (Indonesia-Malaysia). The similarity between these two empirical observations is that, in either Indonesia or Malaysia, FFEG can increase EPC in both directions. Although the impact is short term, FFEG has pumped up EPC significantly. In the long term, EPC also plays a significant vital role in driving AE through GDP-EU performance. Other findings conclude equally insignificant hypotheses, such as GDPE-EU to EPC and AE, and FFEG to EPC through the role of GDP-EU. This is, of course, contrary to the theoretical review. There is a difference in the results between EPC and AE, which for Indonesia is significant, while in Malaysia it is not significant.

Further limitations and recommendations need to support the expansion of the study. Both from empirical statements, theoretical, and practical contributions, we hope it combines relevant elements by deepening or actually comparing electrical energy that comes not only from fossil fuels but also from innovations that are developing. Referring to this research, the policy of the Indonesian-Malaysian government is oriented towards the use of renewable energy with the reason of accelerating the Millennium Development Goal's framework. Decision making in the energy sector is certainly based on the extent of public attitudes. The most important key is the expansion of information without excluding negative sentiment.

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