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Article

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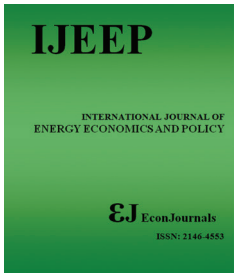

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Multiplier Effect of Energy Infrastructure on GRDP: Horizon in 3 Production Areas in East Kalimantan-Indonesia

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ABSTRACT

The Earth is experiencing a climatic decline that exposes the degradation of the atmosphere. Unfortunately, failure to observe economic growth is not realized by developing markets, which accumulate and exhaust energy resources expansively. Therefore, this article aims to investigate the effect of electricity distribution, gas consumption, and clean water on GRDP which is addressed in three objects (Samarinda-Bontang-Balikpapan). The data interpretation technique uses panel data regression. With a time selection from 2016 to 2021, the results of the analysis verify several vital points, including: (1) The distribution of electricity and clean water has a positive effect and increases GRDP, but in Samarinda, the distribution of electricity has a significant impact ($\rho < 0.05$) and clean water not significant ($\rho > 0.05$); (2) From Bontang, the increase in distribution of electricity and clean water also had a positive effect and significantly increased GRDP ($\rho < 0.05$), but only gas consumption had a negative-insignificant effect on GRDP ($\rho > 0.05$); and (3) In Balikpapan, gas consumption has had a positive-significant impact on GRDP ($\rho < 0.05$), where clean water gas has a positive but not significant increase in GRDP and an increase in electricity distribution has a negative-not significant impact on GRDP ($\rho > 0.05$). In fact, Indonesia as a nation equipped with abundant natural resources is less aware of managing and driving integrated development. That way, energy demand must be balanced with equity policies that protect the environment, restrain greed, and purify nature without overexploitation of natural resources.

Keywords: Electricity Distribution, Gas Consumption, Clean Water, GRDP, Hypothesis Testing, Panel Data Regression
JEL Classifications: L94, L95, F62, F63, C12, C23

1. INTRODUCTION

Since several centuries, Indonesia has been known as a nation rich in natural resources (Hasid et al., 2022). In fact, it is not only popular in the eyes of the media, but also reaches international ears. As a result, many foreign and domestic investors are competing to explore the potential of abundant natural resources to be produced raw and semifinished to fulfil demand capacity (Jiuhardi and Michael, 2022). The intensity output is used as vehicle fuel, energy needs, industrial companies, and research experiments in importing countries (e.g. Priyagus, 2021; Wijaya et al., 2022).

Of the 34 provinces in Indonesia, East Kalimantan is a natural resource-producing region or often referred to as the "treasure pool" for Indonesia (Afkarina et al., 2019; Edwin et al., 2017; Sugiri, 2009; Tadjoeddin, 2007). In fact, East Kalimantan ranks 5th and outperforms areas such as Papua, Aceh, East Java, and South Sulawesi. The province, which is centrally located in Samarinda, reflects the expansive proportion of natural resources. In fact, Balikpapan which has the nickname "Oil City" has an oil production segment of more than 134 thousand barrels per day. This amount includes 60 thousand barrels of crude oil and 74 thousand barrels of oil condensate.

Besides the oil, East Kalimantan has also been awarded by the mining and forestry sectors, particularly natural gas and coal. In addition, the regional units, namely Balikpapan and Bontang, are revitalizing industrial areas to accelerating economic growth. East

Kutai Regency in East Kalimantan has also started clearing land for plantations such as oil palm (Permana, 2022). In the last two decades, a prominent aspect of East Kalimantan universally has been the mining and quarrying sector (Hilmawan and Amalia, 2020). This primary structure actually threatens or presents a "curse" if it is not reformed comprehensively. This is because the energy supply including clean water, electricity and gas networks on a regional scale is still minimal. The non-optimal availability of upstream-downstream infrastructure is seen as a holistic problem. According to Hatcher (2014), Lahiri-Dutt (2018), and Page and Tarp (2020), this repositioning is like that of the African and Asian continents described by Papua New Guinea, Laos, and the Philippines. At the same time, the increase in population in East Kalimantan has also increased the government's attention (e.g. Haryati, 2022; Tarigan et al., 2017). Ideally, it is not only concerned with the essence of business, but energy development which leads to the creation of long-term interactions between natural resource capital and energy channels, where the urgency of basic consumption of society can be fulfilled.

The authority to distribute clean water, electricity and gas subsidies, managed by the government, has been established in urban centres that are represented for all provinces in Indonesia (Astriani et al., 2021). Unfortunately, in East Kalimantan, the clean water management which is accommodated by the Regional Drinking Water Company (PDAM), electricity supplied by the State Electricity Company (PLN), and the State Gas Company (PGN) which empowers gas are in a dilemma due to poor access to transportation, weak capabilities. human resources, the interest of investors who are less interested in partnering and collaborating in terms of expanding supporting facilities, a contradictory institutional climate, until the distance or reach between regions is too far, so that it costs money and takes a long time (Alamgir et al., 2019; Estutama and Kurniawan, 2021). Referring to infrastructure damage will trigger a loss of economic value (Kelly, 2015; Koks et al., 2019; Melvin et al., 2017). Over time, the consequences of material losses also sabotage the distribution of vital energy to the public.

The motivation of this paper is to evaluate the performance of energy infrastructure on Gross Regional Domestic Product in the three energy supply clusters by Samarinda-Bontang-Balikpapan (SBB) in driving the economy. Considering that in developing markets, Indonesia is required to actively take care of nature, reduce pollution, and support the "climate change campaign". At the local level, take the example of East Kalimantan, which always takes the initiative in prioritizing integrated energy security (Nurjaya, 2007; Sambodo, 2016; Turpyn and Adiwitya, 2021). An inclusive energy revolution relies heavily on the quality of conducive infrastructure. In fact, by relying on a large quantity of natural resources, the balance of the energy market is not hampered, the price stability of other commodities is running normally, mitigating the scarcity of energy stocks, and avoiding the element of uncertainty (Ma et al., 2021; Speirs et al., 2015; Taghizadeh-Hesary et al., 2019; van der Ploeg and Poelhekke, 2009; Yergin, 2006). The corridor of papers is reconstructed into five points. Scheme 1: introduction, Scheme 2: theoretical foundation and hypothetical landscape, Scheme 3: methodology, Scheme 4: results and discussion, and Scheme 5: conclusions, implications, recommendations, and limitations.

2. THEORETICAL FOUNDATIONS AND HYPOTHESIS LANDSCAPES

2.1. Theory of Energy Supply and Demand

In essence, energy is one of the key factors that not only encourage economic activity, but also stimulate social pillars. Hasanov and Mikayilov (2020) view that energy has reflected modern life. Countless integration of energy aspects in demographic, environmental, and economic mechanisms. Extension research discusses the demand and supply side of energy in increasing the understanding of the literature. More deeply, the "Energy Cost Theory" which is sometimes referred to as the "Energy Consumption Theory" implies that in the business operations of the production of services and goods, the use of energy resources has a simultaneous economic impact. In the description of Vosooghzadeh (2020), these resources include the procurement and purchase of materials relevant to energy consumption. As a vital anchor for economic growth, energy resources have a systematic impact on the global economy. This need is useful in aligning energy demands that continue to increase in controlling clean technology through cutting-edge innovation, so to reduce costs and achieve environmental sustainability goals (Medlock, 2009). While monitoring the security of energy supply, it is also necessary to ensure that public discussions continue to highlight the area of energy economics.

Alessio (1981) and Shove and Walker (2014) revisit the ambivalent status in "Social Theory" from an institutional and social perspective to understand the changes woven into societal narratives. The concept underlying the approach relies on an energy resource strategy that is consolidated across multiple intersecting technological, political and economic elements. The complexity of competition in the energy market varies greatly within the producer aggregate. However, there are only a few of the energy buying and selling transactions that are classified as "perfectly competitive markets" (Dahl, 2012). Take for example electrical energy, electricity prices on the market can change from time to time and sometimes don't make sense. Short-term responses are difficult to adapt to many human routines. Too, the capital stock that has been obtained is used in the long term in order to meet a more flexible scenario. Enthusiasm for energy efficiency, also adjust the stock. The fluctuations in electricity prices found in countries that apply "low electricity tariffs" actually thwart the allocation and induction of energy substitution towards the use of energy-efficient technologies (Burke and Abayasekara, 2017).

From an academic point of view, the price equilibrium axis based on supply and demand for energy continues to be a policy concern that is expected to contain inconsistencies, especially across countries, sectoral levels, and multidimensional tensions (Chang et al., 2019).

2.2. Energy Infrastructure

In reality, Ogunjobi et al. (2021) argue that the empirical nexus explores that energy infrastructure is closely related to economic

growth and human capital. Redistribution of energy resources in the country, will ensure justice, the welfare of the population, and reduce poverty. In the context of change, Edomah et al. (2017) define energy infrastructure as climate change control. On the basis of critical analysis, the supply of energy infrastructure hints at the legitimacy of cost-effectiveness. In national political-economic development projects, many countries are reframing energy infrastructure, where transformational growth in mapping and extracting sources of nuclear, gas, coal, wind-based power generation, introducing new energy resources for domestic, storage and export, bridging imports, and distribution and transmission systems (Bridge et al., 2018).

Pandey (2020) puts energy infrastructure as the key for a developing and modern society. Although there is no collective meaning of energy infrastructure standards, future goals have been interpreted with general statements on different issues. The mobility of energy infrastructure is undeniable because of the cultural-economic-political struggle to achieve decarbonization, scientists have confirmed that some positions of energy infrastructure override spatial contours at the intersection of low-carbon challenges (Cowell and De Laurentis, 2022; Wiig et al., 2022).

2.3. Hypothesis Sketch

The discussion on the relationship between the production of electrical energy and the growth of Gross Domestic Product (GDP) in selected European countries becomes very important to provide a clear reaction. Szustak et al. (2021) verify that GDP strengthens electricity production and conversely, electricity production also strengthens GDP growth. Constructively, in Southeast Asia, there is a long-term bidirectional causality between electricity consumption and economic growth rates. From short-term causality, there is also a one-way relationship from economic growth to electricity consumption (Chen et al., 2007). Moreover, Enu and Havi (2014) explain that increasing electricity consumption will simulate real GDP per capita in the long term in Ghana. On the other hand, the release of the burden of electrical energy consumption, has a negative impact in the short term. Dagoumas et al. (2020) estimates the endogenous linkage between energy prices and GDP in the periphery of the European Union. The consensus that distinguishes between the two is the long-term effect that creates covariate shocks from the feedback of residential electricity prices and final energy consumption. The degree of global warming continues to whip up to 27 major cities in the world. Statistical relationships about the flow of electrical resources flowing through urban areas, triggering population surges and microeconomic burdens (Kennedy et al., 2015).

Aucott and Hall (2014) examined the correlation between determinants of GDP based on the cost composition and availability of gas and liquid fuel energy. Entering 1950-2013, the root cause of the camouflage of economic growth was government spending on fuel, which accounted for around 5% of GDP. The shocking thing happened in Bangladesh, when natural gas consumption and GDP growth in urban areas, predicted significant cointegration bonds and led to the prospect of a solution to reduce carbon emissions formulated for development planning in Bangladesh (Hasan and Raza, 2022). In fact, Solarin and Shahbaz (2015) clarify trade openness in Malaysia, indicating that natural gas consumption and economic growth are in a positive signal. Yet, the robustness of the long-term relationship provides for the structural breakdown of investment formation. From a normative point of view, the segregation of the natural gas vehicle market in 12 European countries, examines the dynamics of the relationship between natural gas consumption and economic growth. Objectivity refers to the short-long term model, Fadiran et al. (2019) corrects the tension generated by conspicuous natural gas. Following up on previous findings, the fact in China that natural gas consumption is the sector that restores the third-largest economic chain. Li et al. (2019) modified natural gas market data from 30 provinces for 15 periods. Based on empirical studies, the higher the GDP score, the larger the natural gas marginal line.

He and Gao (2021) introduce water and electricity consumption in the balance curve of economic growth in metropolitan Guangzhou (China). A time–series review, from 1950 to 2014, confirms that energy consumption of water and electricity is doubly correlated with economic growth. Environmental pollution from the economic sector in Lithuania is a massive concern for the use of water resources and energy. At the beginning of the transition period, the depression of agricultural, industrial and transportation production polluted the environment more intensively than GDP (Juknys, 2003). The extensive movement of hydropower is a concern in Shenzhen-South China. Although, articulated water resources can pump GDP, but <10% is accommodated to the agricultural sector. The remaining more than 90% of water use tends to be for the life and service sectors of housing, industry, and construction. The agricultural manufacturing crisis was hindered by the gradual modern business. Worse yet, water entry points also lock the progress of traditional agriculture. Apart from that, Li et al. (2013) informed that there is a significant quadratic relationship between water use and GRDP. In a compound lens, countries that are members of the Gulf Cooperation Council (GCC), have limited water resources. Being in an arid region, water production generation has been positively correlated to GDP since 2015 (Al Bannay and Takizawa, 2022). Thus, Boretti and Rosa (2019) reassess the commitment to sustainable development by 2050 through dramatic water savings, even though growth in water demand is vulnerable to expansion of debate and temporary restrictions on water accessibility.

Finally, Figure 1 displays the proportion of variable attributes. Referring to the meta-analysis of a collection of publications and the logic of thinking above, it makes sense to construct a series of hypothetical speculations as follows:

- *Hypothesis one* (H_1). *The increased distribution of electricity, affecting on GRDP*
- *Hypothesis two* (H_2). *The increase in gas consumption, affecting on GRDP*
- *Hypothesis three* (H_3). *The increase in clean water, affecting on GRDP.*

3. METHODOLOGY

3.1. Variable List

Characteristics of variables are designed using two types, including the dependent variable and the independent variable. Because the orientation of this study identifies the role of energy infrastructure

on GRDP, the independent variables are compiled by distribution of electricity, gas consumption, and clean water. Meanwhile, GRDP is positioned as the dependent variable.

Table 1 summarizes the operationalization of variables grouping variable names and abbreviations, profiles, and measurements.

3.2. Data Demarcation

The data set is compiled from government agencies that release economic reports for 2016-2021 or 6 periods. This secondary data set is documented to complete the tabulation. Before being processed, the data is recapitulated first.

3.3. Interpretation Method

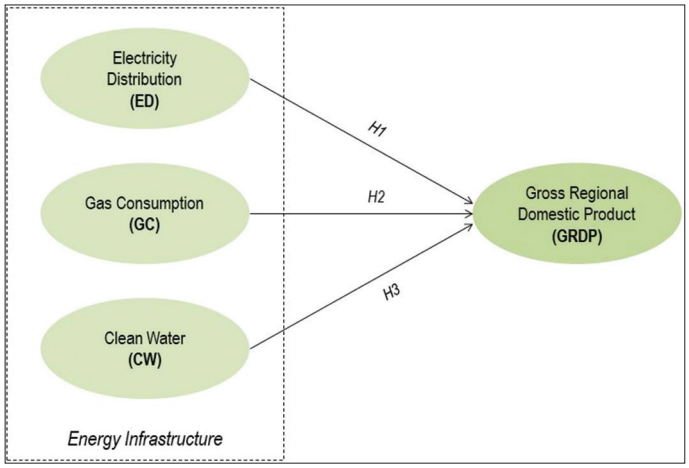
Furthermore, statistical testing uses panel data regression techniques (e.g. Abbasi et al., 2020; Aissa and Hartono, 2016; Enoma and Marcus, 2017; Salahuddin et al., 2017; Sudaryanto, 2019; Zaekhan and Nachrowi, 2012). The mandatory requirement in complying with the panel data procedure is the regression feasibility parameter, including descriptive statistical analysis and correlation approach.

The argument for the basic equation reads as follows:

$$GRDP = f(ED, GC, CW)$$

Then, to eliminate the hypothesis, the expected sign is 5%. Technically, the mathematical decomposition is expressed, thus forming the econometric function below.

Figure 1: Theoretical links between the electricity, gas and water sectors to GRDP



Source: Authors elaboration

$$GRDP_{it} = \alpha_0 + \beta_1 ED + \beta_2 GC + \beta_3 CW + \mu_{it}$$

where, f = function; it = cross section times time series; = constant (intercept); β_1 = beta coefficient on ED; β_2 = beta coefficient on GC; β_3 = beta coefficient on CW; and μ = residue.

4. RESULTS AND DISCUSSION

4.1. Descriptive Statistics

Table 2 claims that scores on descriptive statistics of areas producing electricity, clean water, and gas appear contemporary. When comparing between the three, on the ED variable, the highest Standard Deviation (SD) score is in Samarinda, where it gets 202,709,643.7, while the mean score is the most dominant in Balikpapan which reaches 993,061,185.8. This is in contrast to the GD variable where the largest mean score is in Bontang up to 131.7. At its peak, Balikpapan has the highest SD score of 14.23.

The comparative advantage in the CW variable actually occurred in Balikpapan, which achieved the highest SD score and the mean simultaneously reaching 1,712,448.45 and 24,102,702.5. In line with this achievement, the SD score and mean GRDP were observed to be the largest among the others and were in Samarinda with points of 7.48 and 19.72.

4.2. Pearson Correlation

In Table 3, synchronize causality and two-way interactive using the 5% and 1% significance thresholds. Pearson correlation is useful for examining the partial and probability coefficients (ρ) between the four variables. In more detail, the correlation approach also highlights that there is an interactive relationship from ED to GRDP, then GRDP to ED in Samarinda (r = 0.220; ρ = 0.037). But, CW to ED and ED to CW are opposite, where r = −0.053; ρ = 0.920), CW and GRDP to GC and vice versa (r = −0.105; ρ = 0.843 and r = −0.399; ρ = 0.433). However, GRDP to CW and CW to GRDP is a positive causality, but not significant (r = 0.249; ρ = 0.634).

Uniquely, in Bontang, the interactive relationship between CW and ED was in a very strong correlation of r = 0.961; ρ = 0.002. Yet, there is a negative causality between ED and GRDP (r = −0.459; ρ = 0.360), CW (r = −0.558; ρ = 0.250), and GC (r = −0.649; ρ = 0.163) to GRDP. From this, only positive causality between GS to ED (r = 0.306; ρ = 0.556) and CW to GC (r = 0.442; ρ = 0.381), although both are not significant. Table 3 also confirms that there is only one positive and significant interactive

Table 1: Variable profile

Variable name (label)	Material	Measurement
Electricity distribution (ED)	Electricity sold and distributed to general household customers, commercial/ business, industrial, government, commercial, and specific purposes	kilo Watt hour (kWh)
Gas consumption (GC)	Converted using the Consumer Price Index on gas commodity expenditures per year.	Index
Clean water (CW)	The volume of water distributed to various consumers includes residences, hotels, social institutions, places of worship, hospitals, rest rooms, shops, industry, government agencies, ports, and water tanks.	Cubic meter (m^3)
Gross Regional Domestic Product (GRDP)	Derivation of GDP containing the rate of economic growth at constant prices in 2010 which focuses on the business field of electricity, gas and water supply.	Percentage (%)

Source: Central Bureau of Statistics of East Kalimantan Province, 2022

Table 2: Descriptive statistical matrix

Items	Samarinda (n=24)		Bontang (n=24)		Balikpapan (n=24)	
	SD	Mean	SD	Mean	SD	Mean
ED	202,709,643.7	1,248,189,184	28,924,709.24	211,116,333.2	89,486,322.25	993,061,185.8
GS	13.87	125.05	1.99	131.7	14.23	122.4
CW	4.51	2.43	755,157.16	9,003,423.83	1,712,448.45	24,102,702.5
GRDP	7.48	19.72	4.85	11.49	4.1	9.68

Source: Authors

Table 3: Correlation analysis

Samarinda (n=24)				
Items	ED_Smd	GC_Smd	CW_Smd	GRDP_Smd
ED_Smd	1	0.395 (0.438)	−0.053 (0.920)	0.220* (0.037)
GS_Smd	0.395 (0.438)	1	−0.105 (0.843)	−0.399 (0.433)
CW_Smd	−0.053 (0.920)	−0.105 (0.843)	1	0.249 (0.634)
GRDP_Smd	0.220* (0.037)	−0.399 (0.433)	0.249 (0.634)	1
Bontang (n=24)				
Items	ED_Btg	GC_Btg	CW_Btg	GRDP_Btg
ED_Btg	1	0.306 (0.556)	0.961** (0.002)	−0.459 (0.360)
GC_Btg	0.306 (0.556)	1	0.442 (0.381)	−0.558 (0.250)
CW_Btg	0.961** (0.002)	0.442 (0.381)	1	−0.649 (0.163)
GRDP_Btg	−0.459 (0.360)	−0.558 (0.250)	−0.649 (0.163)	1
Balikpapan (n=24)				
Items	ED_Bpp	GC_Bpp	CW_Bpp	GRDP_Bpp
ED_Bpp	1	−0.689 (0.130)	0.961** (0.002)	0.260 (0.619)
GC_Bpp	−0.689 (0.130)	1	−0.807 (0.052)	−0.013 (0.980)
CW_Bpp	0.961** (0.002)	−0.807 (0.052)	1	0.314 (0.545)
GRDP_Bpp	0.260 (0.619)	−0.013 (0.980)	0.314 (0.545)	1

Source: Authors, Remarks: **P<0.01 and *P<0.05

relationship in Balikpapan involving CW with ED and vice versa (r = 0.961; ρ = 0.002). In different editions, GC and ED (r = −0.689; ρ = 0.130), CW (r = −0.807; ρ = 0.052), and GRDP (r = −0.013; ρ = 0.980) about GS showed a negative correlation. Only ED and CW have positive causality, although it is not significant to GRDP (r = 0.260; ρ = 0.619 and r = 0.314; ρ = 0.545).

4.3. Panel Regression Estimation

Rationally, Table 4 describes the partial testing and simultaneous testing between the variables ED, GC, and CW on GRDP, where there are scores of disparities in S-B-B. It is known that the value is 9,338, where when GRDP increases, it increases ED, GC, and CW by 933.8%. With a coefficient of determination score (R^2) reaching 61.2%, the first model is classified as moderate, where 38.8% are variables outside the model. The Standard Error (S.E) obtained 20.3%, so the overall model feasibility reached 79.7%. Speaking of simultaneous effects, the model explains that ED, GC, and CW have a significant effect on GRDP. For the partial test, only ED was significantly related to GRDP (β = 0.451; ρ = 0.049). Of the other two variables, GC and CW were not significantly related to GRDP (β = −0.554; ρ = 0.460 and β = 0.215; ρ = 0.739).

In the case of Bontang, the research model was concluded to be workable or in a strong model classification, where the R^2 score was 77.3%. With a sample of 24, the SE value reached 36.5% and the remaining 63.5% as factors outside of ED, GC, CW, and GRDP. Simultaneous impact proves that ED, GC, and CW are significantly related to GRDP (β = 2.266; ρ = 0.039). Separately, GC had no significant effect on GRDP (β = -0.030; ρ = 0.951),

Table 4: Influence of ED, GC, and CW on GRDP

Items	Samarinda	Bontang	Balikpapan
Constant	9.338	11.79	13.34
ED	0.451 (0.049)	2.084 (0.026)	−1.820 (0.499)
GS	−0.554 (0.460)	−0.030 (0.951)	1.138 (0.039)
CW	0.215 (0.739)	2.638 (0.013)	2.981 (0.389)
R^2	0.612	0.773	0.675
F. Sig	4.398 (0.017)	2.266 (0.039)	5.422 (0.025)
S.E	0.203	0.365	0.488
N	24	24	24

Source: Authors

while ED and CW on GRDP were significant (β = 2.084; ρ = 0.026 and β = 2.638; ρ = 0.013).

Another response, about the third model, shows that the strength of the study model is 67.5% (moderate). With F-values up to 0.025, it is proven that the simultaneous model between ED, GC, and CW is significant. The residual variable or S.E that was not included in the model reached 51.2% or only 48.8% as a component of the highlighted variable. Contrasting partial consensus from the two previous observations, it was found that GC had a significant effect on GRDP (β = 1.138; ρ = 0.039). From ED (β = −1.820; ρ = 0.499) and CW (β = 2.981; ρ = 0.389) to GRDP, there is no significant effect on GRDP.

4.4. Justification

Today, macroeconomic conditions in Indonesia, which are represented by GDP, are determined by electricity prices and electricity consumption (Adi et al., 2022). Spontaneity, the flow

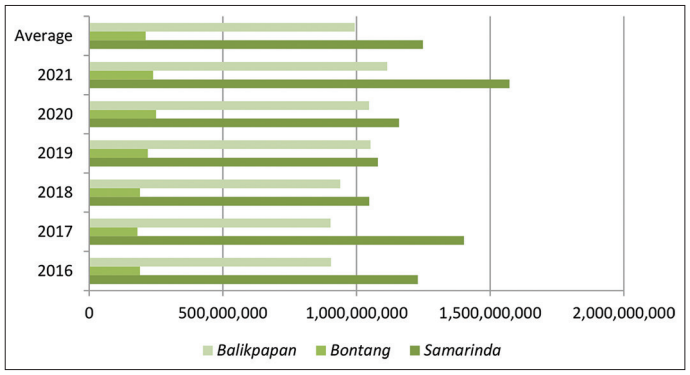
of decisions of investment is a supplement that must be considered regarding the impact of power generation from fossils such as coal on GDP and choosing power plants sourced from renewable energy through alternative solar, wind, hydro, and geothermal power. Hartono et al. (2020) believes that qualifying the four solutions reduces income disparities, creates jobs, and generates the highest net added value for the Indonesian economy.

Furthermore, the deterioration of public regulation has negative implications for electricity consumption. Trends in the level of electricity consumption offer utility formulations about readiness and old assumptions to suppress lower power consumption (Hirsh and Koomey, 2015). In this regard, a case study in a part of China, consortium distribution and transmission prices on electrical energy affects GRDP. Throughout 2010-2019, Li et al. (2022) explores the mechanism for applying electricity prices that protect the average selling price for industrial users which has been proven to cut energy costs for companies, so that regional economic resilience and productivity continue to reform. Valuable lessons befall 10 countries in Latin America due to incidents of wasted energy consumption, where GDP slopes in a long-term relationship (Campo and Sarmiento, 2013). The cohesion guide concludes the poor existence of energy dependence on a two-way path to conservation concerns.

In reality, the weight of the electricity flow in the three production areas in East Kalimantan is still controlled by PT. PLN in Samarinda compared to Bontang and Balikpapan. The permanent principle is applied for reasons of area size, population density level, and of course the high intensity of demand between the other two production areas. To address the demand side, PT. PLN in Samarinda has distributed an average of 1,248,189,184 kWh of electricity. During the 2016-2021 period, the highest electricity production was also from the Samarinda branch, which was around 1,572,114,121 kWh. To meet the target of electricity production demand for 6 periods, PT. PLN in Bontang has distributed an average of 211,116,333 kWh to consumers. That figure is much smaller than PT. PLN, which managed to deliver 993,061,186 kWh of electricity to reach Balikpapan. To anticipate the explosion in demand, the highest electricity capacity sold was in Samarinda, which was 1,572,114,121 kWh. Although Balikpapan is an area with a crude oil production base, electricity distribution still depends on the surrounding area, such as Samarinda (Figure 2). The waste of electrical energy in the capital from East Kalimantan in 2021 was caused by the emergence of SARS-CoV-2 in 2019, so that many campuses and schools closed which required students to adapt online education from home (Pokhrel and Chhetri, 2021; Zalat et al., 2021). As a result, energy resources are sucked in and the internet is wasted to access learning activities (e.g. Chihib et al., 2021; Jiang et al., 2021; Özbay and Dalcali, 2021; Wang et al., 2021).

Kalyoncu et al. (2013) compare the benefits of gas energy consumption with GDP per capita in Armenia, Georgia, and Azerbaijan. For the years 1995-2009, we examine causality in the relationship of gas energy consumption and economic growth. It was revealed that there was a decrease in gas consumption in the S-B-B in 2018, but the graphics jumped again rapidly in 2020-2021. The average gas consumption of these three central cities reached 125.05, 131.7, and 122.4 (Figure 3). Interestingly, Bontang as a base for producing liquefied natural gas resources, experienced a decline

Figure 2: Development of electricity distribution in S-B-B (2016-2021), kWh



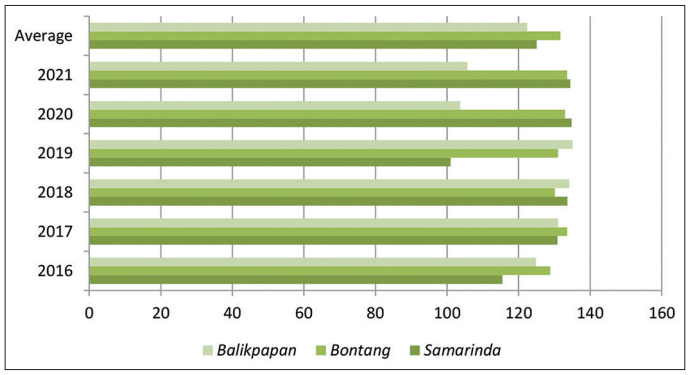
Source: Authors elaboration

in purchasing power parity when the Coronavirus hit the entire country (Roy et al., 2021). This chronology is also experienced by most in East Kalimantan, where there is a shift in consumption to education, internet, medicines, and nutritional intake through improved diet, so that the population adopts a frugal lifestyle (Amalia et al., 2020; Maria et al., 2021). Generally, people in S-B-B are very independent and resilient in gas energy security, although the gas consumption index is highest in Samarinda (134.83) in 2021, while the lowest is in 2019 (101.01). In controlling and suppressing hyperinflation, Bank Indonesia, representing the Regional Inflation Control Team (TPID) collaborates with the government in monitoring basic commodities in the market.

The advantage of Samarinda which has the 3rd longest river in Indonesia is the Mahakam River – 920 km after the Barito River in West Kalimantan (1,086 km). This river stretches from Melak (West Kutai Regency) in the upstream to Samarinda in the downstream. About 41% of the total area of East Kalimantan is traversed by the Mahakam River. The Mahakam River has various benefits such as transportation routes, electricity generation, and drinking water sources (The Katadata, 2021). Thus, the volume of water demand by residents in Samarinda is greater than Bontang or Balikpapan. The average water produced and distributed by PT. PDAM Samarinda throughout 2016-2021 to consumers reached 242,692,868,332.17 m^3, while in Bontang it was 9,003,423.83 m^3 and for Balikpapan it was 24,102,702.5 m^3. Also, to population factors, the geographical location of Bontang and Balikpapan is dominantly traversed by seawater and has fewer tributaries than Samarinda. The highest average growth during the transition from 2019 to 2021 and 2022 or clean water users in S-B-B rose drastically after COVID-19, reaching 6.95% and 1.23%, respectively (see Table 5). At the global level, economic income in the GDP footprint is in an "inverted U" relationship (Cole, 2004). Opinion by Kong et al. (2021) that the trend of increasing water consumption is actually a condition for regional economic development in Yangtze Province (China). Zhao and Li (2020) reiterate that GRDP and urban population have exacerbated the water crisis in 285 cities in China. In the Catalonia region (Spain), the quantity of water consumption is a hidden practice in the temporal changes of GDP (Llop, 2019).

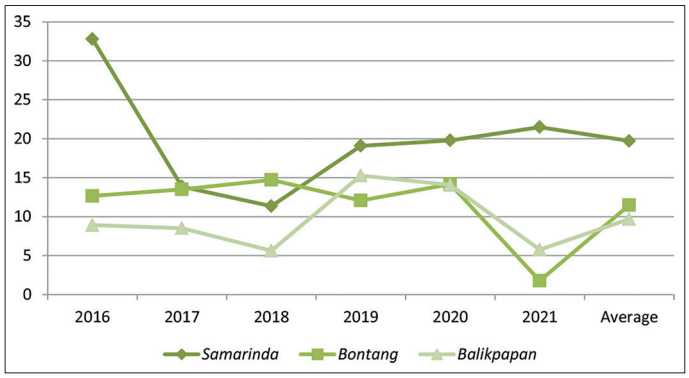
Figure 4 looks at economic growth in the electricity, gas, and clean water sectors in S-B-B. In total, based on 2010 constant

Figure 3: Development of gas consumption in S-B-B (2016-2021), index



Source: Authors elaboration

Figure 4: GRDP growth rate in S-B-B (2016-2021), %



Source: Authors elaboration

Table 5: Development of clean water volume in S-B-B (2016-2021), m^3

Period	Samarinda	Bontang	Balikpapan
2016	209,264,501,261	8,425,010	22,324,821
2017	182,475,227,322	8,399,420	22,980,594
2018	218,224,501,261	8,400,240	22,593,995
2019	272,383,283,926	8,911,938	24,598,268
2020	286,372,879,200	9,847,100	25,879,931
2021	287,436,817,023	10,036,835	26,238,606
Average	242,692,868,332.17	9,003,423.83	24,102,702.5

Source: Authors elaboration

prices, it is summarized that the highest cumulative growth was from Samarinda (19.73%) for 6 periods. Bontang (11.49%) and Balikpapan in third place, which only penetrated 9.69%. The largest GRDP growth in Samarinda for 2016 reached 32.8% and the lowest was 11.34% (2018). In Bontang, the lowest GRDP growth was 1.78 (2021) and the largest was in 2018 (14.72%). Then, the most dominant GRDP growth in Balikpapan in 2019 was around 15.27%, while 5.61% was the lowest growth, which occurred in 2018.

Currently, there are substantial indications that energy systems in industrialized countries must enormous energy consumption at the individual level. Evidently, the chosen instrument is very effective in changing the behaviour of people and households. So far, Burger et al. (2015) noted that there is a reduction in energy consumption in parallel, but changes and understanding of the determinants of energy consumption are not conclusive. Most studies have considered economic motives in industrial energy consumption (Hasanov, 2021). Interestingly, very few studies have reviewed demographic factors. Neither of them incorporates a theoretical basis for combining demographic pillars. Using and studying demographic influences on industrial energy consumption is also sensitive to research.

5. CONCLUSION, IMPLICATION, RECOMMENDATION, AND LIMITATION

This paper has the ambition to investigate the effect between the development of energy infrastructure converted into electricity distribution, gas consumption, and clean water on GRDP in the S-B-B region. According to the research calculations, three main conclusions were found. There are similar hypotheses, both from Samarinda, Bontang, and Balikpapan, where two hypotheses are approved, and one hypothesis is rejected. Empirical estimates show that the distribution of electricity and clean water increases GRDP positively, but only the distribution of gas is significantly related in Samarinda. The increase in gas consumption in Samarinda has reduced GRDP growth. Another insight, obtained based on panel data regression in Bontang, also shows that increasing electricity distribution can increase GRDP in a positive and significant way. The addition of clean water to customers also increases GRDP in a positive and significant way. Another thing, highlights the increase in gas consumption, does not affect GRDP. In fact, the results were negative and insignificant. It is only in Balikpapan that it appears that the addition of electricity distribution to the population during 2016–2021 will actually reduce GRDP growth negatively. The higher the level of consumption of gas and clean water, the higher the GRDP. So far, only gas consumption has greatly affected the GRDP in Balikpapan.

The implication that can be drawn is that the use of resource consumption is still very dependent on electricity, gas, and clean water, so that government intervention in the supply of these three energies cannot be separated from the large demand-supply side. So, regulations must be refined to design more efficient energy management. In addition, forums and partnerships are recommended to re-enforce the rules of thumb as well as send actual messages in the process of restoring integral "energy conservation."

The most glaring weakness of the study is the limited time-lag, so future quantitative studies should expand the use of the data. Besides, the data interpretation method does not only discuss inter-regional aspects, but a wider lens as a reference for comparison allows an encyclopedic review.

REFERENCES

Abbasi, K.R., Hussain, K., Abbas, J., Adedoyin, F.F., Shaikh, P.A., Yousaf, H., Muhammad, F. (2020), Analyzing the role of industrial sector's electricity consumption, prices, and GDP: A modified empirical evidence from Pakistan. AIMS Energy, 9(1), 29-49.

Adi, T.W., Prabowo, E., Prasadjaningsih, O. (2022), Influence of electricity consumption of industrial and business, electricity price, inflation and interest rate on GDP and investments in Indonesia. International

Journal of Energy Economics and Policy, 12(3), 331-340.
Afkarina, K.I.I., Wardana, S., Damayanti, P. (2019), Coal mining sector contribution to environmental conditions and human development index in East Kalimantan province. Journal of Environmental Science and Sustainable Development, 2(2), 192-207.
Aissa, N., Hartono, D. (2016), The impact of geothermal energy sector development on electricity sector in Indonesia economy. Buletin Ekonomi Moneter Dan Perbankan, 19(2), 153-176.
Al Bannay, S., Takizawa, S. (2022), Decoupling of water production and electricity generation from GDP and population in the Gulf Cooperation Council (GCC) countries. Sustainability, 14(9), 5386.
Alamgir, M., Campbell, M.J., Sloan, S., Suhardiman, A., Supriatna, J., Laurance, W.F. (2019), High-risk infrastructure projects pose imminent threats to forests in Indonesian Borneo. Scientific Reports, 9(1), 140.
Alessio, F.J. (1981), Energy analysis and the energy theory of value. The Energy Journal, 2(1), 61-74.
Amalia, S., Lestari, D., Nurjanana, N. (2020), Changes in household consumption during the COVID-19 pandemic: An empirical from Samarinda City, Indonesia. International Journal of Psychosocial Rehabilitation, 24(3), 5603-5614.
Astriani, N., Rubiati, B., Adharani, Y., Afifah, S.S., Salsabila, R., Diffa, R. (2021), The responsibility of the Indonesian government to fulfill the rights to water during the COVID-19 pandemic: Some legal issues. Environmental Policy and Law, 51(5), 327-341.
Aucott, M., Hall, C. (2014), Does a change in price of fuel affect GDP growth? An examination of the U.S. data from 1950-2013. Energies, 7(10), 6558-6570.
Boretti, A., Rosa, L. (2019), Reassessing the projections of the World Water Development Report. npj Clean Water, 2(1), 15.
Bridge, G., Özkaynak, B., Turhan, E. (2018), Energy infrastructure and the fate of the nation: Introduction to special issue. Energy Research and Social Science, 41, 1-11.
Burger, P., Bezençon, V., Bornemann, B., Brosch, T., Carabias-Hütter, V., Farsi, M., Hille, S.L., Moser, C., Ramseier, C., Samuel, R., Sander, D., Schmidt, S., Sohre, A., Volland, B. (2015), Advances in understanding energy consumption behavior and thegovernance of its change-outline ofan integrated framework. Frontiers in Energy Research, 3(2), 29.
Burke, P.J., Abayasekara, A. (2017), The price elasticity of electricity demand in the United States: A three-dimensional analysis. CAMA Working Paper No. 50/2017. The Australian National University, Canberra.
Campo, J., Sarmiento, V. (2013), The relationship between energy consumption and GDP: Evidence from a panel of 10 Latin American countries. Cuadernos de Economia Latin American Journal of Economics, 50(2), 233-255.
Central Bureau of Statistics of East Kalimantan Province. (2022), Samarinda, Bontang, and Balikpapan municipality in figures 2017–2022: Various editions. CV. Mahendra Mulya, Samarinda.
Chang, B., Kang, S., Jung, T. (2019), Price and output elasticities of energy demand for industrial sectors in OECD Countries. Sustainability, 11(6), 1786.
Chen, S.T., Kuo, H.I., Chen, C.C. (2007), The relationship between GDP and electricity consumption in 10 Asian countries. Energy Policy, 35(4), 2611-2621.
Chihib, M., Salmerón-Manzano, E., Chourak, M., Perea-Moreno, A.J., Manzano-Agugliaro, F. (2021), Impact of the COVID-19 pandemic on the energy use at the university of Almeria (Spain). Sustainability, 13(11), 5843.
Cole, M.A. (2004), Economic growth and water use. Applied Economics Letters, 11(1), 1-4.
Cowell, R., De Laurentis, C. (2022), Investigating energy infrastructure through the low carbon challenge: Technologies, governance and socio-spatial effects. Journal of Environmental Policy and Planning, 24(4), 367-374.
Dagoumas, A.S., Polemis, M.L., Soursou, S.E. (2020), Revisiting the impact of energy prices on economic growth: Lessons learned from the European Union. Economic Analysis and Policy, 66, 85-95.
Dahl, C.A. (2012), Measuring global gasoline and diesel price and income elasticities. Energy Policy, 41, 2-13.
Edomah, N., Foulds, C., Jones, A. (2017), Influences on energy supply infrastructure: A comparison of different theoretical perspectives. Renewable and Sustainable Energy Reviews, 79, 765-778.
Edwin, M., Sulistyorini, I.S., Allo, J.K. (2017), Assessment of natural resources and local community participation nature-based in tourism Wehea forest East Kalimantan. Jurnal Manajemen Hutan Tropika, 23(3), 128-139.
Enoma, I.A., Marcus, S.N. (2017), The effect of electricity and gas losses on the gross domestic product in Nigeria. The Nigerian Journal of Business and Management Science, 1(1), 1-18.
Enu, P., Havi, E.D.K. (2014), Influence of electricity consumption on economic growth in Ghana an econometric approach introduction. International Journal of Economics, Commerce and Management, 2(9), 1-20.
Estutama, P., Kurniawan, M.A. (2021), Public works and housing infrastructure planning using environmental carrying capacity consideration: Case study on planning DAM development in Kalimantan Island, Indonesia. The Journal of Indonesia Sustainable Development Planning, 2(3), 257-271.
Fadiran, G., Adebusuyi, A.T., Fadiran, D. (2019), Natural gas consumption and economic growth: Evidence from selected natural gas vehicle markets in Europe. Energy, 169, 467-477.
Hartono, D., Hastuti, S.H., Halimatussadiah, A., Saraswati, A., Mita, A.F., Indriani, V. (2020), Comparing the impacts of fossil and renewable energy investments in Indonesia: A simple general equilibrium analysis. Heliyon, 6(6), e04120.
Haryati, S. (2022), Realizing inclusive economy in new capital Nusantara. Available from: https://en.antaranews.com/news/242017/realizing-inclusive-economy-in-new-capital-nusantara [last accessed on 2022 Aug 23].
Hasan, M.M., Raza, M.Y. (2022), Nexus of natural gas consumption and economic growth: Does the 2041 Bangladesh development goal realistic within its limited resource?. Energy Strategy Reviews, 41, 100863.
Hasanov, F.J. (2021), Theoretical framework for industrial energy consumption revisited: The role of demographics. Energy Reports, 7, 2178-2200.
Hasanov, F.J., Mikayilov, J.I. (2020), Revisiting energy demand relationship: Theory and empirical application. Sustainability, 12(7), 2919.
Hasid, Z., Noor, A., Kurniawan, E.A. (2022), Ekonomi Sumber Daya Alam Dalam Lensa Pembangunan Ekonomi. Surabaya: Cipta Media Nusantara.
Hatcher, P. (2014), Into the deep: The World Bank Group and Mining Regimes in Laos, the Philippines and Papua New Guinea. In: Carroll, T., Jarvis, D.S.L., editors. The Politics of Marketising Asia. Studies in the Political Economy of Public Policy. London: Palgrave Macmillan.
He, Y., Gao, S. (2021), Electricity water consumption and metropolitan economic growth: An empirical dual sectors dynamic equilibrium model. Frontiers in Energy Research, 9, 795413.
Hilmawan, R., Amalia, S. (2020), Coal and mineral and its impact on human development index: An empirical study in south and east Kalimantan region, Indonesia. International Journal of Energy Economics and Policy, 10(1), 488-494.
Hirsh, R.F., Koomey, J.G. (2015), Electricity consumption and economic

growth: A new relationship with significant consequences? The Electricity Journal, 28(9), 72-84.
Jiang, P., Fan, Y.V., Klemeš, J.J. (2021), Impacts of COVID-19 on energy demand and consumption: Challenges, lessons and emerging opportunities. Applied Energy, 285, 116441.
Jiuhardi, J., Michael, M. (2022), Aggressiveness of the electricity sector and implications for energy GDP (comparative test of Indonesia-Malaysia). International Journal of Energy Economics and Policy, 12(3), 323-330.
Juknys, R. (2003), Transition period in Lithuania-do we move to sustainability?. Environmental Research, Engineering and Management, 4(26), 4-9.
Kalyoncu, H., Gürsoy, F., Göcen, H. (2012), Causality relationship between GDP and energy consumption in Georgia, Azerbaijan and Armenia. International Journal of Energy Economics and Policy, 3(1), 111-117.
Kelly, S. (2015), Estimating economic loss from cascading infrastructure failure: A perspective on modelling interdependency. Infrastructure Complexity, 2, 7.
Kennedy, C.A., Stewart, I., Facchini, A., Cersosimo, I., Mele, R., Chen, B., Uda, M., Kansal, A., Chiu, A., Kim, K. G., Dubeux, C., La Rovere, E.L., Cunha, B., Pincetl, S., Keirstead, J., Barles, S., Pusaka, S., Gunawan, J., Adegbile, M., Nazariha, M., Hoque, S., Marcotullio, P.J., Otharán, F.G., Genena, T., Ibrahim, N., Farooqui, R., Cervantes, G., Sahin, A.D. (2015), Energy and material flows of megacities. Proceedings of the National Academy of Sciences of the United States of America, 112(19), 5985-5990.
Koks, E., Pant, R., Thacker, S., Hall, J. (2019). Understanding business disruption and economic losses due to electricity failures and flooding. International Journal of Disaster Risk Science, 10(2), 421-438.
Kong, Y., He, W., Yuan, L., Zhang, Z., Gao, X., Zhao, Y., Degefu, D.M. (2021), Decoupling economic growth from water consumption in the Yangtze River Economic Belt, China. Ecological Indicators, 123, 107344.
Lahiri-Dutt, K. (2018), Extractive peasants: Reframing informal artisanal and small-scale mining debates. Third World Quarterly, 39(8), 1561-1582.
Li, H., Wang, X., Xie, Y., Chen, T., Han, H., Yang, Y. (2022), The impact of transmission and distribution price reform on economic growth in liberalized electricity markets: An inter-provincial panel data analysis. Frontiers in Environmental Science, 9, 755319.
Li, W.J., Li, L.J., Qiu, G.Y. (2013), General nexus between water and electricity use and its implication for urban agricultural sustainability: A case study of Shenzhen, South China. Journal of Integrative Agriculture, 12(8), 1341-1349.
Li, Z.G., Cheng, H., Gu, T.Y. (2019), Research on dynamic relationship between natural gas consumption and economic growth in China. Structural Change and Economic Dynamics, 49, 334-339.
Llop, M. (2019), Decomposing the changes in water intensity in a Mediterranean region. Water Resources Management, 33(5), 3057-3069.
Ma, Q., Zhang, M., Ali, S., Kirikkaleli, D., Khan, Z. (2021), Natural resources commodity prices volatility and economic performance: Evidence from China pre and post COVID-19. Resources Policy, 74, 102338.
Maria, S., Lestari, D., Heksarini, A. (2021), Multiple roles of women employees: Dilematis with family and work during COVID-19 disorders. Hong Kong Journal of Social Sciences, 57, 242-248.
Medlock, K. (2009), Energy demand theory. In: International Handbook on the Economics of Energy. Ch. 5. Cheltenham: Edward Elgar Publishing.
Melvin, A.M., Larsen, P., Boehlert, B., Neumann, J.E., Chinowsky, P., Espinet, X., Martinich, J., Baumann, M.S., Rennels, L., Bothner, A., Nicolsky, D.J., Marchenko, S.S. (2017), Climate change damages to Alaska public infrastructure and the economics of proactive adaptation. Proceedings of the National Academy of Sciences of the United States of America, 114(2), E122-E131.
Nurjaya, I.N. (2007), Indonesian environmental law: Environmental justice system and enforcement. Risalah Hukum, 3(1), 1-12.
Ogunjobi, J.O., Eseyin, O., Popoola, O. (2021), Human capital and energy infrastructure: Implications for economic growth in Nigeria. International Journal of Energy Economics and Policy, 11(3), 149-154.
Özbay, H., Dalcali, A. (2021), Effects of COVID-19 on electric energy consumption in Turkey and ANN-basedshort-term forecasting. Turkish Journal of Electrical Engineering and Computer Sciences, 29(1), 78-97.
Page, J., Tarp, F. (2020), Mining for change: Natural resources and industry in Africa. New York, NY: Oxford University Press.
Pandey, V. (2020), Energy infrastructure for sustainable development. In: Filho, W.L., Azul, A., Brandli, L., Salvia, A.L., Wall, T., editors. Affordable and Clean Energy. Encyclopedia of the UN Sustainable Development Goals. Cham: Springer.
Permana, I. (2022), 5 provinsi yang jadi kolam harta karun Indonesia, nomor 4 menyimpan yang paling diburu dunia. Available from: https://ekbis.sindonews.com/read/779561/34/5-provinsi-yang-jadi-kolam-harta-karun-indonesia-nomor-4-menyimpan-yang-paling-diburu-dunia-1653476720?showpage=all [Last accessed on 2022 Aug 26].
Pokhrel, S., Chhetri, R. (2021), A literature review on impact of COVID-19 pandemic on teaching and learning. Higher Education for the Future, 8(1), 133-141.
Priyagus, P. (2021), Does economic growth efficient and environmental safety? The case of transportation sector in Indonesia. International Journal of Energy Economics and Policy, 11(6), 365-372.
Roy, J., Hasid, Z., Lestari, D., Darma, D.C., Kurniawan, E. (2021), Covid-19 maneuver on socio-economic: Exploitation using correlation. Jurnal Pendidikan Ekonomi Dan Bisnis, 9(2), 146-162.
Salahuddin, M., Alam, K., Ozturk, I., Sohag, K. (2017), The effects of electricity consumption, economic growth, financial development and foreign direct investment on CO_2 emissions in Kuwait. Renewable and Sustainable Energy Reviews, 81(2), 2002-2010.
Sambodo, M.T. (2016), Indonesia has ratified the ASEAN agreement on transboundary haze pollution: Will the haze disappear?, Review of Indonesia Economic and Business Studies, 6(1), 1-28.
Shove, E., Walker, G. (2014), What is energy for? Social practice and energy demand. Theory, Culture and Society, 31(5), 41-58.
Solarin, S.A., Shahbaz, M. (2015), Natural gas consumption and economic growth: The role of foreign direct investment, capital formation and trade openness in Malaysia. Renewable and Sustainable Energy Reviews, 42, 835-845.
Speirs, J., McGlade, C., Slade, R. (2015), Uncertainty in the availability of natural resources: Fossil fuels, critical metals and biomass. Energy Policy, 87, 654-664.
Sudaryanto, A.R.A. (2019), The impact of natural gas demand on renewable energy development: A panel investigation of six Asian countries. Jurnal Ekonomi and Studi Pembangunan, 20(1), 71-88.
Sugiri, A. (2009), Redressing equity issues in natural resource-rich regions: A theoretical framework for sustaining development in East Kalimantan, Indonesia. In: Weber, E.L., editor. Environmental Ethics, Sustainability and Education. Oxford: Inter-disciplinary Press. p107-134.
Szustak, G., Dąbrowski, P., Gradoń, W., Szewczyk, Ł. (2021), The relationship between energy production and GDP: Evidence from selected European economies. Energies, 15(1), 50.

Tadjoeddin, M.Z. (2007), A future resource curse in Indonesia: The political economy of natural resources, conflict and development. CRISE Working Paper No. 35/October, 2007. Oxford: Centre for Research on Inequality, Human Security and Ethnicit.

Taghizadeh-Hesary, F., Rasoulinezhad, E., Yoshino, N. (2019), Energy and food security: Linkages through price volatility. Energy Policy, 128, 796-806.

Tarigan, A.K.M., Samsura, D.A.A., Sagala, S., Wimbardana, R. (2017), Balikpapan: Urban planning and development in anticipation of the post-oil industry era. Cities, 60(Part A), 246-259.

The Katadata. (2021), Daftar 10 sungai terpanjang di indonesia, tersebar di beberapa pulau. Available from: https://katadata.co.id/intan/berita/615e773d648dc/daftar-10-sungai-terpanjang-di-indonesia-tersebar-di-beberapa-pulau [Last accessed on 2022 Aug 28].

Turpyn, J.M.F., Adiwitya, A. (2021), Raising awareness of Indonesia's climate change mitigation by social media campaign. Communicare: Journal of Communication Studies, 8(1), 51-61.

Van der Ploeg, F., Poelhekke, S. (2019), Volatility and the natural resource curse. Oxford Economic Papers, 61(4), 727-760.

Vosooghzadeh, B. (2020), Introducing Energy Consumption Theory and Its Positive Impact on the Economy. Available from: https://www.researchgate.net/publication/341606238-Introducing-Energy-Consumption-Theory-and-Its-Positive-Impact-on-the-Economy-text The 20Energy 20Consumption 20Theory 20 (sometimes,economical 20impact 20of 20these 20operations [Last accessed on 2022 Aug 27].

Wang, Q., Li, S., Jiang, F. (2021), Uncovering the impact of the COVID-19 pandemic on energy consumption: New insight from difference between pandemic-free scenario and actual electricity consumption in China. Journal of Cleaner Production, 313, 127897.

Wiig, A., Karvonen, A., Mcfarlane, C., Rutherford, J. (2022), From the guest editors splintering urbanism at 20: Mapping trajectories of research on urban infrastructures. Journal of Urban Technology, 29(1), 1-11.

Wijaya, A., Awaluddin, M., Kurniawan, A.E. (2022), The essence of fuel and energy consumptions to stimulate MSMEs industries and exports: An empirical story for Indonesia. International Journal of Energy Economics and Policy, 12(2), 386-393.

Yergin, D. (2006), Ensuring energy security. Foreign Affairs, 85(2), 69-82.

Zaekhan, Z., Nachrowi, N.D. (2012), The impact of renewable energy and GDP per capita on carbon dioxide emission in the G-20 countries. Economics and Finance in Indonesia, 60(2), 145-174.

Zalat, M.M., Hamed, M.S., Bolbol, S.A. (2021), The experiences, challenges, and acceptance of e-learning as a tool for teaching during the COVID-19 pandemic among university medical staff. PLoS One, 16(3), e0248758.

Zhao, Y., Li, M. (2020), Effect of water-saving society policy on water consumption in the cities of China: A propensity score matching analysis. International Journal of Environmental Research and Public Health, 17(21), 8171.