

The Affecting Electricity Consumption in Indonesia

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Abstract

This research aims to analyze the factors that influence electricity consumption in Indonesia. The data used in this research is panel data for 2020-2022 in 32 provinces in Indonesia. The analysis technique used is Multiple Regression Analysis with Random Effect Model (REM). The dependent variable used is electricity consumption and the independent variables include electricity prices, income and number of customers. The research results show that the price of electricity has a negative and significant effect on electricity consumption. Meanwhile, income and number of customers have a positive and significant effect on electricity consumption. Simultaneously, electricity prices, income and number of customers have a significant effect on electricity consumption.

Keywords Electricity prices, income, number of customers, electricity consumption

INTRODUCTION

Electrical power is a very important need in human life today. The demand for electric power continues to increase over time, in line with developments in science and technology as well as developments in human resources. Apart from that, electric power has a very important and strategic role in realizing national development goals (Ansari, 2017). Electrical energy consumption is also a key variable because it is related to economic activity and economic development. Electrical energy plays an important role in economic development and is an important factor that supports people's welfare (Han, 2004).

In the current era of globalization, electricity is one of the basic needs of an area which is used by four groups of electricity users, namely household, industrial, business and general groups (Darmayanti, 2018). Electricity is a very important energy source for human life, both for industrial activities, commercial activities and in daily household life. Electrical energy is needed to meet the needs of lighting, entertainment, transportation and also production processes involving electronic goods and industrial tools or machines (Rosadi & Syamsul, 2019). Without electricity, it will be difficult for people to carry out their activities, causing a country's economy to suffer (Nilman & Mintargo, 2020).

In Indonesia, per capita electricity consumption is relatively low and still lags behind a number of countries in the ASEAN region (Gumelar, 2017). Even though Indonesia is a tropical country that has potential natural resources (Nirmala, et al. 2023). Akbar Bagaskara, Electricity Systems Researcher, Institute for Essential Services Reform (IESR), said that there are five countries in ASEAN that have not yet achieved a 100% electrification ratio, one of which is Indonesia. Based on the performance achievements of the ESDM sector, Indonesia's per capita electricity consumption in 2022 will only reach 1,173 kWh. This figure is still below the Ministry of Energy and Mineral Resources' target for this year, namely 1,268 kWh per capita. Meanwhile, based on the 2020-2024 Strategic Plan of the Ministry of Energy and Mineral Resources, Indonesia's per capita electricity consumption target in 2022



is 1,408 kWh. Meanwhile, the average electricity consumption in ASEAN itself is around 3,672 kWh per capita (Hasjanah, 2022).

Electricity in Indonesia is entirely managed by BUMN, namely PLN, or the State Electricity Company (Ridlo Al Hakim et al., 2021). Based on the PLN statistical report, electricity consumption in Indonesia in 2020 was 243,582 GWh. The Industrial customer group consumed 72,240 GWh (29.66%), Households consumed 112,156 GWh (46.04%), Business consumed 42,819 (17.58%), and Others (social, government buildings and public street lighting) amounted to 16,368 GWh (6.71%). This figure decreased compared to the previous year's electricity consumption, which reached 245,518 GWh. One of the causes of this decline is the Covid-19 pandemic. Covid in Indonesia first appeared in March 2020, then Government Regulation Number 21 of 2020 concerning Large-Scale Social Restrictions (PSBB) appeared (Yuliawan & Wanniatie, 2021). This Covid pandemic has limited mobility and community activities, especially in the business and industrial sectors, so that electricity consumption has decreased throughout (Faza & Navastara, 2022). However, electricity consumption for the household customer group has increased significantly, from 103,733 GWh in 2019 to 112,156 GWh in 2020. In 2021 electricity consumption will reach 257,634.25 GWh. The increase in electricity consumption is a sign that the economy is starting to improve, especially in the industrial sector. The increase in electricity consumption in 2021 even exceeded electricity consumption in 2019 before the Covid-19 pandemic occurred. Meanwhile, in 2022 it will reach 273,761 GWh, the industrial customer group consumes 88,483 GWh (32.32%), households 116,095 (42.41%), businesses 50,532 (18.46%), and others (social, government buildings and public street lighting) of 18,650 GWh (6.81%).

According to demand theory, consumption is caused by several factors, one of which is price (Sadono Sukirno (2005)). The relationship between price and quantity demanded is inversely proportional (negative). If prices rise, demand will fall and vice versa, *ceteris paribus*. The high price charged for a good or service will cause the expenses to be paid to be more expensive and can reduce purchasing power, resulting in reduced demand (Kristianto, 2015). Based on the PLN Statistical Report for 2020-2022, the average electricity price in Indonesia continues to increase. During 2020-2021, the province with the highest electricity prices was DKI Jakarta Province. Meanwhile, in 2022 Bali Province will occupy the highest position with electricity prices reaching Rp 1,306.49/kWh. Meanwhile, Aceh and West Nusa Tenggara provinces had the lowest electricity prices during 2020-2021. However, in 2022 the province with the lowest electricity price will be Riau Province, namely Rp 974.07/kWh.

Keynes's consumption theory states that the amount of consumption depends on the level of income. The amount of consumption always changes according to the rise and fall of income, if income increases then consumption will increase. Conversely, if income falls then consumption will fall (Indah Pratiwi, 2020). In this study, income is described by GRDP per capita. GRDP is used to evaluate the economic development performance of a region in a certain period (Ciptawaty et al., 2020). Per capita income in Indonesia increases every year. In 2020, there was a decline in per capita income of -3.42%, one of which was caused by the

Covid-19 pandemic. Meanwhile, in the following year there was a significant increase of 8.67% in 2021 and 14.09% in 2022. This increase is in line with electricity consumption in Indonesia. This is in accordance with the theory which states that when income increases consumption will also increase.

Another factor that influences electricity consumption is the number of customers. An increase in the number of customers leads to an increase in the level of electricity consumption, because as more individuals require large amounts of electricity units, consumption also increases. Where when the number of customers using electricity increases, electricity consumption also increases. This is because when the number of customers increases, the use of electronic goods will also increase (Rosadi & Syamsul, 2019). According to PLN's statistical report, in 2018 there were around 79 million customers, an increase of 4.35% compared to the previous year. The largest number of customers is the household customer group with 72 million customers. This figure increased from 69 million in 2019, a significant increase in this group of household customers was triggered by the Covid-19 pandemic which caused many activities to be carried out at home, both work activities using the WFH (Work from Home) system and school activities. with an online learning system. In 2021 the number of customers increased to 82.54 million customers or an increase of 4.49% compared to the previous year 2020. In 2022 the number of customers will reach 85.63 million customers or an increase of 3.75%. This number is the largest during 2020-2022. This increase is the government's effort to achieve the target of electronicization and equal distribution of electricity coverage to facilitate community activities.

Based on this background, this research focuses on how much influence electricity prices, income and number of customers have on electricity consumption in Indonesia. Therefore, this research is entitled "Factors that Influence Electricity Consumption in Indonesia".

LITERATURE REVIEW

The Role of Government

As a tool or institution, the government's task is to achieve national goals. The government is an institution responsible for making collective decisions or policies for society. According to Adam Smith, government has three functions or roles, including:

- a. The function of the government is to maintain national defense and security.
- b. The function of the government is to administer justice.
- c. The government's function is to provide goods that are not provided by the private sector.

The successful performance of the government, institutions, and related agencies can be seen through economic growth. To achieve this level of performance success, the government has three important roles consisting of allocation, distribution, and stabilization (Himannudin et al., 2022). According to M. Guritno (2016), there is a role for government in the economy, namely:

- a. The role of allocation, namely the role of government, is to ensure that economic resources can be optimally utilized.



- b. The role of distribution, namely the role of government to adjust the distribution of income and improve the welfare of society.
- c. The role of stabilization, namely the role of the government to increase employment opportunities and stabilize the prices of goods needed for the economy so that they remain stable.

Public Goods

Public goods are goods that cannot be provided through the market system. Therefore, public goods are provided by the government because the market system fails to provide them. The market system cannot provide these goods because public goods are not only enjoyed by individuals but also by the wider community (Nur, 2010). According to Guritno Mangkoesoebroto (2016), public goods have two main characteristics: non-rival, namely that one consumer's use of a good will not reduce the opportunity for other consumers to also consume the good, and non-excludable, which means that if a public good is available, there is nothing that can prevent anyone from benefiting from the goods. Apart from that, there are other inherent properties, namely that it can be consumed together at the same time (joint consumption), cannot be divided (indivisible), and is externality.

Electrical energy

Electrical energy is the main energy needed for electrical equipment or energy stored in electric current in units of amperes (A) and electric voltage in units of volts (V), with the provision of electrical power consumption in units of watts (W) to be utilized for various purposes. PT. PLN Persero was given the authority to manage electricity in Indonesia, thus, PT. PLN Persero acts for and on behalf of the Indonesian Government in carrying out public service functions in the electricity sector. Electricity is classified as a basic need used by four user groups, namely household, industrial, business, and general groups (Hasid, 2005).

The International Energy Agency (IEA) states that energy, especially electricity, plays an important role in supporting socio-economic development in a country (IEA, 2010). Along with the increase in population, economic growth, and the increase in various activities and the use of means of life that require electricity, the use of electrical energy will continue to increase. Electricity demand that is not balanced by adequate electricity supply will result in a shortage of electricity supply. This will disrupt economic activity because electricity needs in various user sectors cannot be met optimally. Therefore, electricity use must be managed well so that the electricity supply to support the national economy is more secure (Mulyani & Djono, 2018).

Consumption Theory

The general definition of consumption is the use of goods and services that will directly meet human needs (Williams, 2003). Keynes's consumption theory explains the relationship between income received currently (disposable income) and consumption carried out right now. In other words, the income held at a certain time will influence the consumption carried

out by humans at that time. If income increases, consumption will also increase, and vice versa (Hanum, 2019).

According to Keynes, the relationship between disposable income and consumption has a very significant and unidirectional effect. Keynes explained that current consumption is greatly influenced by current disposable income. Keynes also said that there is a minimum consumption limit that does not depend on income level. This means that the consumption level must be met, even though the income level is zero which is called autonomous consumption. If disposable income increases, then consumption will also increase. However, this increase was not as big as the increase in disposable income (Rahardja and Manurung, 2004).

Sukirno (2005) states that the relationship between income and consumption is a unidirectional (proportional) relationship, meaning that higher income can lead to greater consumption expenditure and vice versa, namely if the income level is low then consumption expenditure is also low (Hanum, 2019).

Demand Theory

Demand is also defined as the quantity and quality of goods and services needed by consumers under certain conditions. The demand for a commodity arises because of the consumer's desire and ability, from the desire supported by income to buy a commodity (Rosadi & Syamsul, 2019). According to Naufal M. (2021), consumer demand theory means that the quantity of commodities demanded is a function of or depends on the price of the commodity, consumer income, prices of related commodities and consumer tastes. In function form, it can be written as follows:

$$Q_{dx} = f(P_x, I, P_y, T)$$

Where Q_{dx} is the quantity of commodity X demanded by individuals per time period, P_x is the price per unit of commodity.

According to Sadono Sukirno (2005) in (Naufal et al., 2021), there are several factors that influence the demand for an item, namely: (1) the price of the item itself, (2) the price of other goods, (3) the income of buyers, (4) distribution of income, (5) taste or appetite, (6) population, and (7) expectations about the future.

Theory of Elasticity of Demand

Elasticity is a comparison of the proportional change in one variable with the change in another variable. In other words, elasticity measures the level of sensitivity (change/response) of an economic phenomenon to changes in other economic symptoms, for example measuring how much consumers respond to price changes (Angrasari et al., 1982). Elasticity of demand can be divided into three, namely price elasticity of demand, income elasticity of demand, and cross demand elasticity (Sukirno, 2001).

- a. Price elasticity of demand is a measure of the change in quantity demanded of a product/goods purchased in relation to changes in its price. Price elasticity of demand measures the sensitivity of demand after changes in the price of the product itself



- b. Income elasticity of demand shows the size of the change in quantity demanded of a product/goods purchased as a result of changes in the buyer's income
- c. Cross elasticity of demand shows the size of the change in quantity demanded of a product/goods purchased if there is a change in the price of another good

METHOD

The scope of research

This research is a type of quantitative descriptive research with secondary data. The type of data in this research is panel data, namely a combination of time series data and cross section data (Widarjono, 2018). This research uses data from 32 provinces in Indonesia during 2020-2022.

Variable Operational Definitions

Electricity consumption (dependent variable) is the total amount of electricity used by households, industry, business, social services, government office buildings, and public street lighting in 32 provinces in Indonesia. Electricity consumption data was obtained from PLN statistical reports for the 2020 – 2022 period, which was calculated in Giga Watt hour (GWh) units.

The electricity price (independent variable) in this study is the average selling price of electricity for household, industrial, business, social, government office building, and public street lighting customer groups set by PLN in 32 provinces in Indonesia. Electricity price data is obtained from PLN statistical reports for the 2020 – 2022 period, which is calculated in Rupiah/kWh units.

Income in this research is data on Gross Regional Domestic Product (GRDP) per capita in 32 provinces in Indonesia which comes from the Central Statistics Agency (BPS) during the 2020-2022 period, which is calculated in units of thousands of Rupiah.

The number of customers in this research is the number of customers from households, industry, business, social, government office buildings and public street lighting who consume electrical energy in 32 provinces in Indonesia. Data on the number of customers was obtained from the PLN statistical report for the period 2020 – 2022 which was calculated in percentages (%).

Data Analysis Technique

The data analysis technique in this research uses panel data estimation. The panel data regression model is:

$$\text{LogKL}_{it} = \alpha + \beta_1 \text{HL}_{it} + \beta_2 \text{LogP}_{it} + \beta_3 \text{JP}_{it} + e_{it}$$

Information:

- KL : Electricity consumption (Giga Watt hour)
- α : Constant
- HL : Electricity price (Rp/kWh)
- P : GDP per capita (Thousand Rupiah)
- JP : Number of customers (%)

- $\beta_1, \beta_2, \beta_3$: Regression efficiency
 Log : Logarithm
 e : Nuisance variable (error term)
 t : Cross section unit of 32 provinces in Indonesia
 i : Unit time series 2020 - 2022

RESULTS AND DISCUSSION

Regression Model Selection

Selecting the best model for panel data regression involves three tests, namely the Chow test, Lagrange multiplier (LM) test, and Hausman test, to select the best model between the Common Effects Model (CEM), Fixed Effect Model (FEM), and Random Effect Model (REM).

Table 1 Selection of Panel Data Model Regression

Test	Prob	Decision
Chow	0.0000	FEM
L.M	0.0000	BRAKE
Hausman	0.4713	BRAKE

Source: E-views 10 output results, data processed

Based on the tests that have been carried out, the best model chosen is *Random Effect Model* (REM).

Table 2 Panel Data Regression Results

Variables	Coefficient	t-Statistics	Prob.
C	-0.191343	-0.504513	0.6151
HL	-0.229685	-3.071197	0.0028
LOGP	0.767110	8.510297	0.0000
JP	0.099181	8.305279	0.0000
R-squared	0.637015		
F-statistic	53.81809		
Prob(F-statistic)	0.000000		

Source: E-views 10 output results, data processed

Regression Equations

Based on Table 2, the regression equation for this research is as follows:

$$\text{LogKL} = -0.191343 - 0.229685 \text{ HLit} + 0.767110 \text{ LogPit} + 0.099181 \text{ JPit}$$

The constant value has a positive sign of 0.64366 (antilog of -0.191343) states that if the price of electricity, income, and number of customers are zero or considered constant, then electricity consumption is 0.64366 GWH.

The regression coefficient value of electricity prices has a negative sign of 0.229685, meaning that if there is an increase in electricity prices of Rp 1000/KWh, then electricity



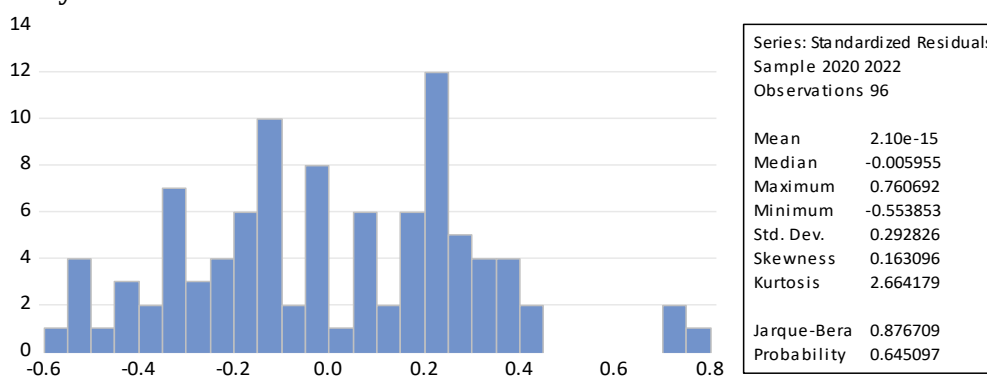
consumption will decrease by 22.9685 GWH assuming the other variables have constant values (*ceteris paribus*).

The regression coefficient value for income has a positive sign of 5.84938 (antilog of 0.767110), meaning that if there is an increase in income of 1%, then electricity consumption will increase by 5.861435% assuming the other variables have constant values (*ceteris paribus*).

The regression coefficient value for the number of customers has a positive sign of 0.099181, meaning that if there is an increase in customers by 1%, then electricity consumption will increase by 9.9181 GWH assuming other variables have constant values (*ceteris paribus*).

Classical Assumption Testing

Normality test



Source: E-views 10 output results, data processed

Figure 1 Normality Test Results

Based on the histogram graph of the test results above, it can be seen that the probability value of 0.646022 is greater than $\alpha = 0.05$, namely $0.646022 > 0.05$. So it can be said that the data is normally distributed.

Multicollinearity Test

Table 3 Multicollinearity Test

	LOGHL	LOGP	JP
HL	1,000000	0.472895	-0.219551
LOGP	0.472895	1,000000	0.059694
JP	-0.219551	0.059694	1,000000

Source: E-views 10 output results, data processed

From the table above it can be seen that there is no multicollinearity in the regression model. This can be seen from the correlation coefficient value between independent variables which is less than 0.80.

Heteroscedasticity Test

Table 4 Heteroscedasticity Test Results

Variables	t-Statistics	Prob.
C	-2.847825	0.0054
HL	0.661548	0.5099
LOGP	1.566462	0.1207
JP	0.468978	0.6402

Source: E-views 10 output results, data processed

The results of the heteroscedasticity test above show that the probability value of each independent variable is more than $\alpha = 0.05$. It can be concluded there is no heteroscedasticity problem in the research.

Autocorrelation Test

Table 5 Autocorrelation Test Results

Number of Observations	R2	Chi-squares calculate	Chi-square table	Conclusion
96	0.637015	61.170912	7.8147	There is no autocorrelation problem

Source: E-views 10 output results, data processed

Based on the Breusch-Godfrey autocorrelation test with the formula $n \cdot R^2$, a calculated Chi-square is obtained 61.170912 greater than the Chi-square table 7.8147. In this way, the regression equation is free from autocorrelation (Widarjono, 2018). So it can be concluded that the final regression model has succeeded in overcoming the autocorrelation problem.

Hypothesis test

T test

Table 6 T Test Results

Variables	t-Statistics	t-table	Prob.	Information
HL	-3.071197	1.98609	0.0028	Significant
LOGP	8.510297	1.98609	0.0000	Significant
JP	8.305279	1.98609	0.0000	Significant

Source: E-views 10 output results, data processed

Based on Table 6 it can be seen that:

Electricity prices have a t-statistic value greater than the t-table value, namely $3.071197 > 1.98606$ with a probability value of 0.0027 smaller than $\alpha = 5\%$ which means that electricity prices have a significant negative effect on electricity consumption.

Income has a t-statistic value greater than the t-table value, namely $8.510297 > 1.98606$ with a probability value of 0.0000 which is smaller than $\alpha = 5\%$ which means that income has a significant effect in a positive direction on electricity consumption.



The number of customers, the t-statistic value is greater than the t-table value, namely $8.305279 > 1.98606$ with a probability value of 0.0000 smaller than $\alpha = 5\%$ which means that customers have a significant influence in a positive direction on electricity consumption.

F test

Table 7 F Test

F-statistics	F-table	Probability	Conclusion
53.81809	2.70	0.00000	Significant

Source: E-views 10 output results, data processed

Based on Table 7, the F test value of 53.81809 is greater than the F-table, namely 2.70 with a probability value of 0.000000 which is smaller than the significance level of 0.05. So that electricity prices, income and number of customers together (simultaneously) have a significant effect on electricity consumption.

Coefficient of Determination Test (R²)

Based on the regression results using the random effect model (REM), the coefficient of determination (R²) value was 0.637015 or 63.70%. This shows that the independent variables (electricity price, income, and number of customers) are able to explain the dependent variable (electricity consumption) by 63.70% while the remaining 36.30% is explained by other variables outside the research model.

The Influence of Electricity Prices on Electricity Consumption in 32 Provinces of Indonesia

Based on the estimation results, electricity prices have a negative and significant influence on electricity consumption in 32 provinces in Indonesia during 2020–2022. This shows that the higher the price of electricity, the electricity consumption will also decrease. This is in accordance with the law of demand for normal goods, which states that the relationship between price and quantity demanded is inversely proportional (negative). If the price rises, the quantity demanded will fall and conversely, if price falls, the quantity demanded will rise. This is because the high electricity prices charged to customers will cause the expenses to be paid to be more expensive and can reduce purchasing power, thereby reducing the use of electrical energy. The existence of a relationship between electricity prices and electricity consumption also indicates the existence of price elasticity. Where changes in electricity prices have a significant impact on electricity consumption, namely when electricity prices increase, electricity consumption will decrease, and vice versa.

This research is in line with research conducted by Amri & Iskandar (2021), which states that the electricity price/tariff variable has a negative and significant effect on the household electricity demand variable in Bengkulu City, as well as research by Nuryati (2022), which shows that the average selling price of electricity for industrial customers has

a significant and opposite influence on electricity consumption on the island of Java. If the selling price of electricity increases, electricity consumption also decreases.

The Influence of Income on Electricity Consumption in 32 Provinces of Indonesia

The results of this research show that income has a positive and significant influence on electricity consumption in 32 provinces in Indonesia during 2020–2022. This shows that the greater the income, the electricity consumption will also increase. The level of per capita income is one indicator to measure the economic condition of a country. When income rises, it will affect the level of national consumption. Per capita income is also an economic indicator in a region. A high level of economic growth allows people's purchasing power to increase. Increasing per capita income is an indication of improving the economy of a region. Increasing per capita income will have an impact on people's income, which means people's purchasing power will also increase (Naufal et al., 2021). Electricity consumption will, of course, also increase as GDP increases, because the government will also further expand the reach of electrical energy and cause more and more people to use this energy. When people's incomes also increase and houses get bigger, the power used will also increase (Darmayanti, 2018).

This result is in accordance with demand theory according to Sadono Sukirno, namely that one thing that influences the demand for a good is income (Naufal et al., 2021). This result is in accordance with Keynes's statement that "a person's consumption is directly proportional to his income", Sukirno (2013). The results of this research strengthen previous results by Nababan & Novester (2022), which states that income has a significant positive effect on household electricity demand in Indonesia. As well as research conducted by Naufal et al. (2021), which shows that in the long-term income has a significant effect on the level of electricity consumption.

The Influence of the Number of Customers on Electricity Consumption in 32 Provinces of Indonesia

The results of this research show that the number of customers has a positive and significant influence on electricity consumption in 32 provinces in Indonesia during 2020–2022. This shows that the more customers there are, the electricity consumption will also increase. The number of electricity customers will increase as the population increases. The increasing population will also increase the number of residential houses, buildings, and electrical equipment, so that the need for electricity will also continue to increase for company operations and household needs (Naufal, 2021). In Indonesia, the household customer group is the largest electricity customer group. This is because the household population in Indonesia is very large and uses a lot of electricity for daily needs, such as lighting, electronic devices, air conditioners, and other household appliances. Therefore, electricity consumption from the household group is much higher than that from industrial and business customer groups.



This research is in line with research Rosadi & Syamsul (2019), which shows that the number of household customers has a positive and significant effect on electricity consumption in Indonesia and research conducted by Johan & Ari Mulianta Ginting (2022), which shows that the number of customers and electrification ratio also have a positive effect on electricity consumption.

CONCLUSION

Based on the results of the panel data model regression analysis using the Random Effect Model (REM) and discussion of the research results, it can be concluded that partially, electricity prices have a negative and significant effect on electricity consumption in 32 provinces in Indonesia in 2020–2022. Meanwhile, income and the number of customers have a positive and significant effect on electricity consumption in 32 provinces in Indonesia in 2020–2022. Meanwhile, simultaneously, electricity prices, income, and the number of customers have a significant influence on electricity consumption in 32 provinces in Indonesia in 2020–2022.

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