

Regression Analysis of Electrical Energy Sold and the Connected Capacity as Determinants of Gross Regional Domestic Product (GRDP) at Constant Prices in Bandung City

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ABSTRACT

This study aims to examine the influence of electricity sales and installed capacity on the Gross Regional Domestic Product (GRDP) at constant prices in Bandung City. The analysis is based on secondary data covering the period from 2010 to 2017, obtained from the Central Bureau of Statistics (BPS) of Bandung City and the State Electricity Company (PLN). In addition, the study evaluates the extent to which these variables contribute, both individually and jointly, to regional economic growth, while also identifying the variable with the most dominant impact on GRDP. The research employs a multiple linear regression approach, complemented by partial significance testing (t-test) and simultaneous testing (F-test). All statistical computations are conducted using SPSS version 24.0. The findings indicate that installed electricity capacity exerts a positive and statistically significant effect on GRDP at current prices in Bandung City, suggesting that an expansion in electricity capacity stimulates economic activity. In contrast, electricity sales demonstrate a negative yet significant relationship with GRDP, implying that electricity consumption has not been optimally translated into value-added output, likely due to the predominance of non-productive sectors. Collectively, both variables exhibit a significant impact on regional economic growth, highlighting the importance of strengthening electricity infrastructure to support sustainable economic development in Bandung City.

Key words: Bandung City; PRDB; Electrical Energy Sold; Connected Capacity

INTRODUCTION

Electrical energy constitutes a fundamental requirement that holds a strategic role in supporting contemporary societal activities as well as regional economic advancement (Widyastuti et al., 2020). Virtually all sectors of the economy—including industry, commerce, services, and households—are highly dependent on the availability of a reliable and continuous electricity supply (ESDM, 2022). The provision of sufficient electrical energy not only enhances societal well-being but also serves as a critical foundation for the expansion of productive sectors and the improvement of regional competitiveness (Rachmawati, 2020). From an economic development perspective, the growth in electricity consumption and sales is frequently interpreted as a proxy for rising economic activity and improved levels of public welfare (Sukirno, 2021).

Along with developments and population growth, the need for electricity in Indonesia continues to rise, including in urban areas like Bandung (Damayanti et al., 2020). Bandung is one of the largest centers of economic activity in West Java Province, with a diverse economic structure encompassing trade, services, the creative industry, tourism, and manufacturing (Pramezwar, 2021). The growth of these sectors requires reliable electricity support, both in terms of installed capacity and the amount of electricity sold to customers.

In line with ongoing development and population expansion, the demand for electricity in Indonesia has continued to increase, particularly in urban centers such as Bandung (Damayanti et al., 2020). As one of the primary hubs of economic activity in West Java Province, Bandung exhibits a diverse economic composition, encompassing trade, services, creative industries, tourism, and manufacturing (Pramezwar, 2021). The sustained growth of these sectors necessitates a dependable electricity supply, both in terms of adequate installed capacity and the volume of electricity distributed to consumers.

As a metropolitan area characterized by a high degree of urbanization (Fauzi et al., 2024), Bandung has experienced substantial growth in the number of electricity customers, installed capacity, and the volume of electricity sales. Data published by the Badan Pusat Statistik (BPS) indicate a consistent annual increase in electricity customers, reflecting the expansion of population and economic activities in the city (BPS, 2023). This upward trend is evident not only within the household sector but also across commercial and industrial segments (Kartika et al., 2024). Moreover, the rise in installed capacity signifies an enhancement of electricity infrastructure, enabling broader support for economic operations across multiple sectors.

An increase in electricity consumption within a region is generally associated with positive economic growth, as it reflects heightened production activities, greater economic mobility, and rising levels of public consumption (Maisarah, 2024). Accordingly, the growth in electricity sales and installed capacity in Bandung City can be presumed to contribute to the expansion of Gross Regional Domestic Product (GRDP) at constant prices. Nevertheless, the magnitude and significance of these relationships must be empirically validated through a quantitative approach, particularly by employing regression analysis.

Multiple regression analysis was employed to assess the extent to which electricity sales and installed capacity affect the Gross Regional Domestic Product (GRDP) at constant prices in Bandung City. This methodological approach offers an empirical representation of the relationship between developments in the electricity sector and real regional economic growth. Furthermore, the findings of this study are expected to enhance understanding of the role of the energy sector in regional development, while also providing valuable insights for local governments and relevant stakeholders in formulating effective and sustainable

Therefore, this study holds significant relevance within the framework of sustainable development. The findings are expected to reinforce empirical evidence that effective provision and management of electricity contribute positively to regional economic growth. Moreover, the results can serve as a strategic reference for decision-making in electricity infrastructure planning in Bandung City, ensuring coherence with broader economic development objectives while enhancing overall societal welfare.

METHOD

This study uses a quantitative approach, employing multiple linear regression analysis, to measure the relationship and influence between electricity sales and connected capacity on Bandung City's Regional Gross Domestic Product (GDP). This quantitative approach utilizes numerical data and statistical analysis..

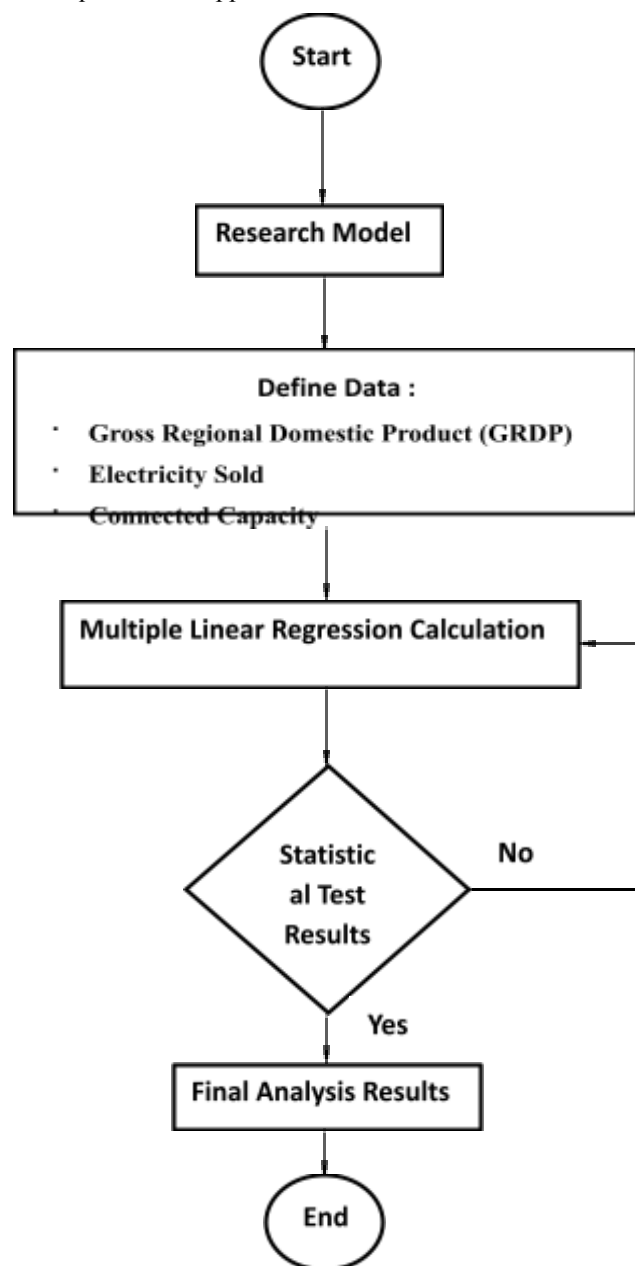


Figure 1. Research Flow Diagram

The data used in this study is secondary data obtained from official agencies from 2010 to 2017, namely:

- Perusahaan Listrik Negara (PLN) for electricity sales data (in mWh) Connected Capacity (kVA).
- Biro Pusat Statistik (BPS) for Gross Regional Domestic Product (GRDP) data at constant prices (in millions of rupiah).

Table 1. Research Variables and Operational Definitions

No	Variable	Variable type	Operational Definition	Unit
1	Gross Regional Domestic Product (GRDP)	Dependen (Y)	Gross value added of all economic sectors in the city of Bandung at constant prices	Billion Rupiah
2	Electricity Sold	Independen (X ₁)	Total electrical energy sold in one year in the city of Bandung	Megawatt-hour (MWh)
3	Connected Capacity	Independen (X ₂)	the total maximum electrical capacity that is physically installed and ready for use by customers	Kilo Volt Ampere (kVA)

Data analysis was carried out using multiple linear regression to determine the effect of electricity sold (X₁) dan Connected Capacity (X₂) to GRDP (Y). The regression model used is as follows:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2$$

Keterangan:

Y = Gross Regional Domestic Product (GRDP)

X₁ = Electricity Sold

X₂ = Connected Capacity

β₀ = Konstanta

β₁, β₂ = Regression coefficient of each independent variable

Researchers use multiple linear regression analysis to predict how the value of a dependent variable will change in situations where the values of two or more independent variables that function as predictors are increased or decreased (manipulated). Therefore, if there are at least two independent variables, multiple linear regression analysis will be used (Zano et al., 2019). This analysis is used to provide a comprehensive overview of how the independent variables (Electricity Sold and Connected Capacity) affect the dependent variable.

The F statistical test is used to measure the influence of each independent variable (X) on the dependent variable (Y) in the regression model (Ghozali, 2018). In this study, the influence of each independent variable (X₁ and X₂) on GRDP is measured separately. According to Sugiyono (2019), a Sig. value <0.05 indicates that the independent variable has a significant influence on Y. Conversely, a Sig. value >0.05 indicates that the independent variable does not have a significant influence on Y.

The T-statistic test (simultaneous) is used to determine whether the dependent variable (Y) and each independent variable (X) have a significant influence on each other (Ghozali, 2018). In this study, the influence of both independent variables (X₁ and X₂) on GRDP is measured independently. A significance value of less than 0.05 indicates that the independent variable has a significant influence on Y. Conversely, a significance value of more than 0.05 indicates that the independent variable does not have a significant influence on Y (Sugiyono, 2019).

The coefficient of determination (R²) is a measure of how well a model can explain the dependent variable. In this study, the coefficient of determination (R²) is used to determine how much variation in GDP changes can be predicted. An adjusted R² value greater than or nearly equal to 1 indicates that the independent variable (X) is able to provide almost all the information needed to predict variations in the dependent variable (Y) (Sugiyono, 2019).

RESULTS AND DISCUSSION

According to the publication of the Perusahaan Listrik Negara (PLN) of Bandung City, the connected capacity recorded in Bandung City shows an increasing trend from year to year. In 2010 it was recorded at 1,662,374 kVA, then increased to 2,080,149 kVA in 2013. and reached 2,534,641 kVA in 2017. Meanwhile, for electrical energy sold (Energy sold shows the amount of energy consumed in units such as MWh), from the same data it was recorded that in 2012 energy sold in Bandung City was 3,850 MWh, then increased in 2013 to 4,033 MWh and reached 4,200 in 2017. The following table shows the number of electricity and energy customers sold from 2012 to 2017 in Bandung City.

Table 2. Sold Energy and Electricity customers from 2010 until 2017 at Bandung City

Year	Sold Energy (MWh)	Connected Capacity (kVA)
2010	3,492	1,662,374
2011	3,591	1,787,401
2012	3,850	1,934,675
2013	4,033	2,080,149
2014	4,163	2,184,155
2015	4,091	2,287,234
2016	4,180	2,421,751
2017	4,200	2,534,641

(Source: PLN of Bandung City)

At the beginning of the period, namely 2012 to 2014, electricity sales continued to experience a significant increase. This is in line with the rapid economic growth of Bandung City, supported by the expansion of the trade, services, and tourism sectors that drive high electricity demand. The number of PLN customers in Bandung City also continues to grow, especially from households and small businesses. Electricity sales slowed in 2015. This decline can be attributed to several factors, including energy efficiency policies that began to be implemented by a number of business and office customers, the national economic conditions that slowed down in that year, which had an impact on decreasing energy consumption in the industrial and trade sectors, changes in community consumption patterns, such as the use of energy-efficient electrical equipment and increased awareness of household electricity savings.

However, after 2015, sales trended upward again in 2016 and 2017, along with economic recovery and new customer growth. Growth in the property sector, tourism, and the use of modern electronic devices among urban residents have contributed to increasing electricity demand in this city.

During the period 2010 to 2017, the Gross Regional Domestic Product of Bandung City at constant prices (2010 series) showed a consistent increasing trend every year. In 2010 the Gross Regional Domestic Product was 102,154.91 million then increased in 2017 by 172,851.96 million. This increase in the real GRDP value can be seen as an indicator that various economic sectors—such as the processing industry, trade, services, and construction—have expanded their production and added value in Bandung City. With real value growth (constant prices), it means that the increase is not only due to rising prices, but also due to an increase in the quantity of output or real production. Tabel berikut menunjukkan PDB Kota Bandung pada harga konstan dari tahun 2010 hingga 2017.

Table 3. Gross Regional Domestic Product at constant prices for Bandung City 2010 – 2017

Year	GRDP (Billion)
2010	102,154.91
2011	110,234.44
2012	119,632.25
2013	129,005.46
2014	138,960.94
2015	149,580.38
2016	161,227.83
2017	172,851.96

(Source: BPS of Bandung City)

Table 4. Results of Multiple Linear Regression Analysis

Model	Unstandardized Coefficients		Sig.
	B	Std. Error	
(Constant)	16882.060	9904.188	.149
Sold Electricity	-24.401	4.401	.003
Connected Capacity	.102	.004	.000

(Source: Results from SPSS)

From Table 4, the regression equation is as follows: $Y = 16882.060 - 24.401X_1 + 0.102X_2$. The following explanation can be obtained based on the regression equation mentioned earlier:

The value of 16,882,060 means that when $X_1 = 0$ and $X_2 = 0$, the value of Y (GRDP) is estimated at 16,882,060 units (billions of rupiah). This indicates the baseline value of GRDP without any contribution from electricity sales and installed capacity. A positive constant value indicates the presence of other factors outside the model that still contribute to Y.

The coefficient of -24.401 indicates that every 1 unit increase in X_1 (electricity sold) will decrease the value of Y (GRDP) by 24.401 units, assuming X_2 remains constant. Increases in electricity sales are not always accompanied by increases in economic value added. Most likely, electricity consumption occurs more in the household sector (non-productive consumption), rather than the industrial or commercial sectors that produce direct economic output.

A coefficient of 0.102 means that every 1-unit increase in X_2 (installed electrical power) will increase Y by 0.102 units, assuming X_1 remains constant. An increase in installed power indicates an increase in the electrical capacity available to new customers or economic activities. This supports regional economic growth because more productive activities (industry, business, and services) can operate without energy constraints.

All independent variables—electricity sold and connected capacity—have a significant influence on the dependent variable, H_0 is rejected and H_1 is accepted, according to the F test results table. Thus, it can be concluded that H_0 is rejected and H_1 is accepted, with a significance value of 0.000 or <0.05 .

Table 5. F Test Results

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	4305374125.	2	2152687063.	1751.904	.000 ^b
Residual	6143849.752	5	1228769.950		
Total	4311517975.	7			
a. Dependent Variable: GRDP					
b. Predictors: (Constant), Connected Capacity, Sold Electricity					

(Source: Results from SPSS)

The T test was conducted to test the partial influence of the independent variables, namely Sold_Electricity (X_1), Connected_Capacity (X_2), on the dependent variable, namely GRDP (Y).

Table 6. T Test Results

Model	Sig.	Kriteria

Sold_Electricity	.003	H ₁ accepted
Connected_Capacity	.000	H ₁ accepted

(Source: Results from SPSS)

Based on Table 6 above, it can be seen that the Sold_Electricity and Connected_Capacity variables have a positive and significant influence on the Determinants of Gross Regional Domestic Product (GRDP) at Constant Prices in Bandung City.

Table 6. Multiple Determination Coefficient (R²)

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
	.999 ^a	.999	.998	1108.49896
a. Predictors: (Constant), Connected_Capacity, Sold_Electricity				

(Source: Results from SPSS)

Based on Table 6, the research results are very strong and accurate in explaining the influence of Connected Capacity and Sold Electricity on GRDP. The nearly perfect R² value (0.999) indicates that these two variables significantly influence GRDP in Bandung City.

CONCLUSION

In conclusion, this study shows that installed electricity capacity plays a crucial and beneficial role in driving regional economic growth in Bandung City. Greater capacity enables productive activities across various economic sectors to flourish. Conversely, electricity use does not always generate economic value—especially when most of it is used for non-productive purposes. Consequently, allocating and improving the efficiency of electricity use is crucial. Overall, regional GDP is significantly influenced by installed capacity and electricity sales. To achieve sustainable economic development, strengthening electricity infrastructure and ensuring its productive use is a crucial strategy.

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