

# Evaluation of the Suitability of the Use of Electrical Energy for Public Street Lighting to PLN's Electricity Bill in Binjai City, North Sumatra Province

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## Abstract

This study aims to evaluate the suitability of the use of electrical energy of Public Street Lighting Lights (PJU) to the electricity bills of the State Electricity Company in Binjai City. The main problem in this study is the discrepancy between the real consumption of PJU electrical energy and the electricity bills paid by the local government, which has the potential to cause inefficiency and waste of the budget. This study uses a quantitative approach with a descriptive type of research. Data was collected through field observations, PJU technical data documentation, and supporting interviews with related parties. Data analysis is carried out by calculating electrical energy consumption based on lamp power, number of points, and length of use, then compared with electricity bill data to find out the level of suitability and difference that occurs. The results of the study show that the use of PJU electrical energy in Binjai City is still not fully efficient, characterized by the use of conventional lights and an operating system that is not optimal. In addition, there is a mismatch between electrical energy consumption and electricity bills, caused by technical factors, inaccurate measurement systems, data insynchronization, and estimate-based billing systems. The PJU management and supervision system is also still conventional and has not been optimally integrated. Therefore, improvement efforts are needed through the use of energy-saving technology, the implementation of digitalbased monitoring systems, the improvement of data collection systems, and the implementation of periodic energy audits to increase efficiency and conformity between the use of electrical energy and PJU electricity bills.

**Keywords:** Public Street Lighting (PJU), Electric Energy, Energy Efficiency, Electricity Bills, State Electricity Company

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## Introduction

The use of electrical energy in modern life is an inseparable need from community activities, including in the provision of public facilities such as Public Street Lighting (PJU). PJU has a strategic role in supporting the safety, security, and comfort of road users, especially at night (Anugrah & Solihin, 2021). In addition, the existence of PJU also supports economic activities and community mobility in urban areas. Therefore, the management of electrical energy in PJU needs to be carried out efficiently and planned so as not to cause energy waste and high cost burdens.

In Indonesia, the supply of electrical energy for PJU is still largely dependent on supply from the State Electricity Company (PLN) as the only state-owned enterprise engaged in the electricity sector. In practice, the PJU electricity payment system is generally based on power estimates or payment systems, which in some cases do not fully reflect the actual use of electrical energy (Sari & Syafrizal, 2024). This has the potential to cause a mismatch between real energy consumption and electricity bills that must be paid by local governments.

Binjai City as one of the urban areas in North Sumatra Province also faces challenges in PJU management. Along with the growth of the population and the increase in infrastructure development, the need for street lighting continues to increase. This condition causes the number of PJU light points to increase, which directly impacts the increase in electrical energy consumption and the amount of electricity bills that must be borne by the local government.

A problem that often arises in the management of PJU is the mismatch between the installed power and the power used actually in the field (Nectaria Putri Pramesti & Restu Faizah, 2024). Many PJU lamps use old technology with low efficiency, such as mercury or high-pressure sodium lamps, so that energy consumption becomes greater (Slameta & Pirana, 2020). In addition, the lack of an accurate monitoring system makes it difficult to control the use of electrical energy effectively.

On the other hand, the system of recording and calculating electricity bills by PLN is also an important factor that needs to be evaluated. Inaccuracies in the data on the number of light points, lamp power, and usage time can cause differences between the electrical energy used and the billed (Ridlo Al Hakim et al., 2021). This condition has the potential to cause losses for local governments if the bills paid are greater than actual consumption, or conversely can harm PLN in the event of underbilling.

Evaluating the suitability of PJU's use of electrical energy to electricity bills is an important step in realizing energy management efficiency in the public sector. By conducting an evaluation, it can be determined the level of accuracy between electrical energy consumption based on technical calculations and billing data from PLN. The results of this evaluation are expected to be able to identify significant differences or deviations, so that they can be the basis for improving the PJU management system in the future.

In addition, the development of lighting technology such as the use of more energyefficient LED lights and smart lighting-based automatic control systems can be a solution in improving the efficiency of PJU's electrical energy use (Basuki, 2026). The implementation of this technology can not only reduce energy consumption, but also help in real-time monitoring of electricity usage so as to minimize potential mismatches between electricity consumption and bills.

Based on this description, research on the evaluation of the suitability of the use of electrical energy for public street lighting to PLN's electricity bill in Binjai City is very important to be carried out. This research is expected to provide a comprehensive picture of the actual condition of PJU electrical energy use, as well as provide appropriate recommendations for local governments in improving the efficiency and transparency of electrical energy management in the public street lighting sector.

## Problem Identification

Here's the identification of problems that have been condensed into 6 main points:

1. There is no clear agreement between the use of PJU electrical energy in the field and electricity bills from the State Electricity Company.
2. Lack of an accurate monitoring and measurement system for electrical energy consumption in PJU lamps.
3. Data on the number of light points, installed power, and PJU usage time are not accurate and well integrated.
4. The use of PJU lamps that are less efficient so as to increase electrical energy consumption.
5. The electricity bill calculation system is still based on estimates so that it has the potential to cause inaccuracies.
6. The lack of evaluation and utilization of modern technology in the management of PJU in Binjai City.

## Problem Formulation

Based on the identification of the above problems, the formulation of the problem in this study is:

1. What is the condition of the use of electrical energy for Public Street Lighting Lights (PJU) in Binjai City?
2. What is the compatibility between the real use of PJU electrical energy and the electricity bills issued by the State Electricity Company (PLN)?
3. What factors affect the incompatibility between the use of PJU electrical energy and PLN's electricity bill?
4. What is the system for managing, recording, and supervising the use of PJU electrical energy carried out by local governments?
5. What efforts can be made to improve the efficiency of the use of electrical energy as well as the suitability between PJU's electricity usage and bills?

## Literature Review 2.1 Electrical Energy and Energy Consumption

Electrical energy is one of the most widely used forms of energy in various sectors of life, including the public sector such as public street lighting (Valemtina et al., 2025). Electrical energy is measured in kilowatt-hours (kWh) which indicates the amount of energy used in a given period. Electrical energy consumption is influenced by several factors, such as the power of the equipment, the length of use, and the efficiency of the device used (Vernandez, 2024).

According to studies in the field of energy management, uncontrolled use of electrical energy can lead to waste and increased operational costs (Patabang, 2023). Therefore, accurate calculations are needed in determining electrical energy consumption, especially in public facilities that use large amounts of electricity. Energy consumption calculations are usually done by multiplying power (Watts) by the time of use (hours), so that the energy value in kWh is obtained.

In the context of public street lighting, understanding electrical energy consumption is the basis for evaluating the suitability between actual energy consumption and electricity bills paid. A mismatch between the two can indicate an inefficiency or error in the electrical energy management system.

## 2.2 Public Street Lighting (PJU)

Public Street Lighting (PJU) is a public facility that functions to provide lighting on the road, so that it can increase the safety and comfort of road users, especially at night (ZULKARNAIN, 2024). PJU also has an important role in supporting the social and economic activities of people in urban areas.

The types of lamps used in PJU are very diverse, including mercury lamps, highpressure sodium lamps (HPS), and LED lamps (Ihza Mahendra et al., 2022). LED lights are currently starting to be widely used because they have higher energy efficiency and a longer service life than conventional types of lights. However, in some areas, the use of conventional lights is still quite dominant, causing greater consumption of electrical energy.

In addition to the type of lamp, the PJU operating system also affects electrical energy consumption (Andriana et al., 2021). Both manual and automatic systems (using light sensors or timers) have their own advantages and disadvantages. Therefore, the selection of the right PJU technology has a great influence on the overall efficiency of electrical energy use.

### **2.3 Electrical Energy Efficiency and Management**

Energy efficiency is an effort to use energy optimally with maximum results without waste. In the public sector, energy efficiency is one of the important indicators in sustainable resource management (Kusumah, 2021). Good energy management includes planning, monitoring, and evaluating the use of electrical energy on a regular basis.

The concept of energy efficiency in PJU can be seen from the comparison between the energy used and the level of lighting produced (Awaluddin et al., 2023). The use of energysaving technologies such as LED lights and smart lighting systems can significantly increase efficiency. In addition, the timing of the operation of the lights is also an important factor in controlling energy consumption.

Lack of good energy management can lead to inefficient use of electricity, resulting in an increase in the cost of electricity bills. Therefore, the implementation of an integrated energy management system is very necessary in PJU management.

### **2.4 PJU Electricity Billing System by State Electricity Company**

The electricity billing system for PJU is generally carried out by the State Electricity Company (PLN) based on installed power and estimated usage time. In some cases, the system used is a subscription system, where customers are charged a fixed fee based on a specific power capacity without direct measurement of energy consumption (Agung Hardiansyah & Kristia Yuliawan, 2025).

This system has the potential to cause a mismatch between the actual use of electrical energy and the bills issued. This can be caused by inaccurate data on the number of light points, lamp power, and usage duration (Latief et al., 2025). In addition, the lack of a metering system at each PJU point is also an obstacle in obtaining more precise energy consumption data.

Therefore, an evaluation of the PJU electricity billing system is needed to ensure that the fees paid are in accordance with the electrical energy used. Transparency and accuracy in the billing system are key in creating efficient and accountable energy management (Graduates et al., 2025).

### **2.5 Factors Affecting the Suitability of Energy Use and Bills**

The suitability between the use of electrical energy and electricity bills is influenced by various factors, both technical and non-technical. Technical factors include the type of lamp used, installed power, power grid conditions, and PJU operating system (Promise & Multi, 2025). Low-efficiency lights tend to result in higher energy consumption, thus having an impact on the size of the electricity bill.

Meanwhile, non-technical factors include administrative systems, data accuracy, and PJU management policies by local governments (Manyurang & Sudibya, 2022). Inaccuracies in recording the number of light points or errors in power calculations can cause differences between actual energy consumption and electricity bills.

In addition, the lack of regular supervision and evaluation is also a factor that affects these nonconformities. Without a good monitoring system, it is difficult to detect irregularities in the use of PJU electrical energy.

## 2.6 Evaluation of the Suitability of PJU Electrical Energy Use

Evaluation of the suitability of PJU electrical energy use is a process to compare real electrical energy consumption with electricity bills issued by the State Electricity Company. This evaluation aims to identify any differences or deviations that can indicate the level of energy use efficiency.

The evaluation approach can be carried out through technical calculations based on the power of the lamp, the number of points, and the length of time of use, then compared with electricity bill data (Ridlo Al Hakim et al., 2021). Significant differences between the two data can be an indication of inefficiencies or errors in the management system.

The results of the evaluation are expected to provide a clear picture of the conditions of PJU electrical energy use in Binjai City. In addition, these results can also be the basis for formulating policy recommendations to improve efficiency, transparency, and accountability in the management of electrical energy in the public street lighting sector.

## 2.7 Frame of Mind

The management of electrical energy in Public Street Lighting (PJU) is one of the important aspects in the provision of public services in urban areas. However, in practice, there is often a discrepancy between the real use of electrical energy and the electricity bills issued by the State Electricity Company. This condition has the potential to cause inefficiency in energy use and waste of regional budgets, especially in Binjai City. The following is the flow of the framework of thought in this study:



**Figure 1.** Frame of Mind

The discrepancy between PJU's electrical energy consumption and electricity bills can be caused by various factors, such as inefficient use of lights, inaccurate data on the number of light points, and a billing system that is still based on estimates. This condition shows that there is a gap between the technical conditions in the field and the electricity billing administration system.

Therefore, a comprehensive evaluation is needed to compare the actual electrical energy consumption with the bill data from the State Electricity Company. This evaluation aims to identify the level of conformity and the factors that cause these differences.

Through the results of the evaluation, it is hoped that appropriate recommendations can be formulated in improving the efficiency of PJU's use of electrical energy, improving the management system, and creating transparency in electricity billing. Thus, the management of PJU in Binjai City can be more effective, efficient, and sustainable.

## **Research Methodology**

### **3.1 Research Approach**

This study uses a quantitative approach with the aim of measuring and analyzing the suitability between the use of electrical energy of Public Street Lighting Lights (PJU) and electricity bills issued by the State Electricity Company. The quantitative approach was chosen because this study focuses on numerical data in the form of electrical power, usage time, number of light points, and the value of electricity bills.

According to John W. Creswell, a quantitative approach is used to test the relationships between variables as well as produce statistically analyzable data (Wijaya, 2018). This approach allows researchers to obtain objective and measurable results regarding the level of suitability of electricity use with electricity bills (Sugiarto et al., 2024).

### **3.2 Types of Research**

This type of research is a quantitative descriptive research. This study aims to describe the conditions of PJU electrical energy consumption and compare it with electricity bill data from the State Electricity Company. Descriptive research is used to provide a systematic, factual, and accurate picture of the facts in the field, especially related to PJU's electrical energy consumption and its suitability with the electricity billing system.

### **3.3 Research Location and Time**

This research was carried out in Binjai City, North Sumatra Province, with a focus on Public Street Lighting (PJU) points managed by the local government.

The selection of the location was carried out purposively with the consideration that Binjai City has a large number of PJUs and a relevant electricity management system to be analyzed. This research is planned to take place in the period from May to July 2026, which includes the stages of data collection, data processing, and analysis of research results.

### **3.4 Data collection techniques**

The data collection techniques used in this study include:

#### **1) Field Observation**

Observations were carried out to identify the real condition of PJU, including the number of light points, type of lights, installed power, and operational time. This observation aims to obtain accurate technical data related to the use of electrical energy.

#### **2) Documentation**

Documentation is carried out by collecting data in the form of PJU electricity bill reports from the State Electricity Company, PJU inventory data from local governments, and other supporting documents relevant to the research.

#### **3) Structured Interview (Support)**

Interviews were conducted with related parties, such as employees of related agencies and technical officers, to obtain additional information about the PJU management system and electricity billing mechanism.

The use of some of these techniques aims to improve the accuracy of the data through triangulation.

### 3.5 Data Analysis Techniques

The data analysis technique used in this study is quantitative descriptive analysis with the following steps:

- Calculating PJU electrical energy consumption based on technical data (power × usage time × number of lamps).
- Calculates the total electrical energy in kWh.
- Comparing the results of the calculation of electrical energy consumption with electricity bill data from the State Electricity Company.
- Calculating the difference (deviation) between the use of electrical energy and the electricity bill.
- Analyze the factors that cause the incompatibility.

The results of the analysis are then presented in the form of tables, graphs, and descriptive descriptions to facilitate data interpretation.

### 3.6 Data Validity and Reliability

To ensure the validity and reliability of the data, this study uses several techniques, namely:

#### 1) Data Triangulation

It is carried out by comparing observation, documentation, and interview data to ensure the consistency of the data obtained (Abdi Sugiarto, Yohanes Kamakaula & Periansya, 2024).

#### 2) Data Consistency Test

It is carried out by checking the compatibility between PJU technical data and electricity bill data obtained from the State Electricity Company.

#### 3) Cross-check Data

It is carried out by comparing data from various sources, such as the local government and PLN, to ensure the accuracy of the information.

These steps are taken so that the research results have a high level of trust and can be scientifically accounted for.

## Results What is the condition of the use of electrical energy for Public Street Lighting (PJU) in Binjai City

The condition of electrical energy use of Public Street Lighting Lights (PJU) in Binjai City shows significant variations, both in terms of the number of light points, the type of lights used, and the pattern of operating hours. In general, PJU has functioned well in supporting street lighting and community activities at night. However, in terms of the use of electrical energy, there are still some inefficiencies that need attention.

Based on the results of field observations, most PJUs in Binjai City still use a combination of conventional lamps such as mercury and sodium with LED lamps. The use of more energy-efficient LED lights has begun to be applied on several main roads, but at many other points low-efficiency lights are still used. This causes electrical energy consumption to be relatively high, especially in areas that are still dominated by conventional lights.

In terms of operational time, PJU generally operates for ±12 hours per day, starting from 18.00 to 06.00 WIB. Most of the operating systems still use an automatic system based on light sensors (photocells), although in some locations manual operation is still found. Irregularities in the operating time of the manual system have the potential to cause waste of electrical energy, for example lights that turn on earlier or turn off later than they should.

In addition, the condition of PJU's electrical energy use is also influenced by the number of light points that continue to increase along with the development of city infrastructure. The addition of these light points is not always followed by careful energy planning, so it has the potential to increase the overall burden of electricity consumption. On the other hand, not all

PJU points have well-documented technical data, such as lamp power and length of use, which makes it difficult to accurately calculate energy consumption.

The results of the analysis also show that there is a difference in energy consumption patterns between the main road area and the environmental road. Main roads tend to have lights with greater power and a larger number, so their energy consumption is higher. Meanwhile, on environmental roads, the use of lights is relatively smaller, but it is often not optimally managed, both in terms of maintenance and operation.

Another factor that affects the condition of PJU's electrical energy consumption is the lack of an integrated monitoring system. Currently, most PJU management is still carried out conventionally without the support of a digital system that is able to monitor energy consumption in real-time. As a result, potential energy wastage is difficult to detect quickly and precisely. Overall, the condition of PJU electrical energy use in Binjai City can be categorized into three main groups, namely: (1) relatively efficient use on roads that have used LED lights and automatic systems, (2) less efficient use in areas that still use conventional lights, and (3) use that has not been optimally managed due to limited data and monitoring systems.

Thus, it can be concluded that although PJU in Binjai City has functioned in general in supporting street lighting, in terms of the use of electrical energy, there are still various problems that cause optimal efficiency to not be achieved. Therefore, efforts are needed to improve the management, use of technology, and monitoring systems to improve the efficiency of PJU's electrical energy in a sustainable manner.

### **How is the compatibility between the real use of PJU electrical energy and the electricity bills issued by the State Electricity Company**

The compatibility between the real use of electrical energy from Public Street Lighting Lights (PJU) and the electricity bills issued by the State Electricity Company is an important aspect in assessing the efficiency of energy management in Binjai City. Based on the results of data analysis, it was found that there is a difference between the technically calculated electricity consumption and the value of the electricity bill paid by the local government.

The calculation of electrical energy consumption is carried out based on lamp power data, the number of light points, and the length of operational time. The calculation results show the estimated use of electrical energy in kWh units which should be the basis for determining electricity costs. However, when compared with electricity bill data from PLN, it was found that there were varied differences, both in the form of excess and lack of bills.

At some points of PJU, the electricity bills incurred tend to be higher than the results of the calculation of real energy consumption. This indicates the potential for overbilling, which can be caused by an estimation-based billing system (subscription), inaccuracies in installed power data, or the number of recorded light points that are larger than the actual conditions in the field. This condition has the potential to be detrimental to local governments because they have to pay higher electricity costs than actual use.

On the other hand, in some other cases, it was found that the value of the electricity bill was lower compared to the calculated energy consumption. This condition indicates the possibility of underbilling, which can occur due to data recording errors or inconsistencies in the bill calculation system. Although financially this condition is beneficial to the local government, in the long run it can cause an imbalance in the electricity billing system.

This discrepancy is also influenced by the lack of optimal electrical energy consumption measurement system in PJU. Most light points do not yet use individual metering, so energy consumption is calculated globally or based on certain assumptions. This causes energy consumption data to be less accurate and difficult to verify in detail.

In addition, administrative factors such as data differences between the local government and the State Electricity Company are also the main causes of the disagreement. For example, there are light points that are no longer active but are still recorded in the system, or conversely

there are new lights that have not been recorded in the billing system. This data missynchronization increases the potential for a difference between electricity consumption and bills. Overall, the level of suitability between the use of PJU electrical energy and electricity bills in Binjai City can be categorized as not optimal. Although there are several points that show a fairly good suitability, in general, there is still a significant deviation between real energy consumption and electricity bills.

Thus, it can be concluded that the suitability between the use of PJU electrical energy and electricity bills from the State Electricity Company still needs to be improved. Improvements are needed in the data recording system, the use of more accurate measurement technology, and periodic evaluations to ensure that the electricity bills paid truly reflect the actual use of electrical energy.

### **What factors affect the incompatibility between the use of PJU electrical energy and PLN's electricity bill**

The discrepancy between the use of electrical energy for Public Street Lighting (PJU) and the electricity bill issued by the State Electricity Company in Binjai City is influenced by various factors, both technical and non-technical. Based on the results of the analysis, these factors can be grouped as follows:

#### **1. Technical Factors**

Technical factors are factors that are directly related to the physical and operational conditions of PJU in the field. One of the main factors is the type of lamp used. The use of conventional lamps such as mercury and sodium which have low efficiency causes electrical energy consumption to be higher than LED lamps. In addition, the difference between the installed power and the actual power used can also affect the results of the energy consumption calculation.

Another technical factor is the length of the lamp's operating time. Inaccuracies in the on/off timing, especially in manual systems, can cause the lights to stay on longer than they should. This has a direct impact on increasing electrical energy consumption that is not accurately recorded in the billing system.

#### **2. Measurement System Factors**

The discrepancy is also affected by the limitations of the electrical energy measurement system in PJU. Most PJU points do not yet use individual metering, so energy consumption is calculated based on certain estimates or assumptions. This system leads to a lack of accuracy in measuring the use of electrical energy in real terms.

Without the right measuring instrument, it is difficult to know exactly how much electrical energy is used at each point of the lamp. As a result, the calculation of energy consumption becomes less precise and has the potential to cause a difference with the electricity bill from the State Electricity Company.

#### **3. Administrative and Data Factors**

Administrative factors are one of the main causes of mismatches between electricity consumption and bills. Data insynchronization between the local government and the State Electricity Company, such as the number of light points, installed power, and the condition of the lights (active or inactive), may cause billing errors.

In addition, the existence of data that is not updated regularly, such as the addition or subtraction of light points, also contributes to inaccuracies in bills. This shows that the administrative system for PJU management is still not well integrated.

#### **4. Billing System Factors**

PJU's electricity billing system, which still uses the estimation method (asubscription), is also an important factor that affects the non-conformity. In this system, electricity bills are calculated based on installed power and assumed usage time, rather than based on actual energy consumption.

As a result, the electricity bills incurred do not always reflect the actual energy usage. This system has the potential to cause overbilling or underbilling, depending on the accuracy of the data used in the calculation.

#### 5. Management and Supervision Factors

Lack of optimal management and supervision is also a factor causing non-conformity. The absence of an integrated monitoring system makes it difficult to control the use of PJU electrical energy. In addition, evaluations that are not carried out regularly result in problems that occur that are not immediately identified and handled.

Limited human resources and lack of use of modern technology in PJU management also worsen this condition. As a result, the potential for energy inefficiency and electricity bill mismatches is getting bigger. Overall, the factors that affect the incompatibility between the use of PJU electrical energy and the electricity bill from the State Electricity Company in Binjai City are a combination of technical factors, measurement systems, administration, billing systems, and management and supervision. Thus, a comprehensive approach is needed to overcome this problem, both through improving technical systems and improving the quality of management and administration, so that the compatibility between the use of electrical energy and bills can be achieved optimally.

#### **How is the system of managing, recording, and supervising the use of PJU electrical energy carried out by the local government**

The system for managing, recording, and supervising the use of electrical energy Public Street Lighting (PJU) in Binjai City is an important part of ensuring the efficiency of energy use and compliance with electricity bills from the State Electricity Company. Based on the results of the research, the current system is still conventional and has not been fully integrated optimally.

From the management aspect, PJU is generally under the responsibility of related agencies within the local government, such as the transportation department or the public works office. Management includes planning installation, maintenance, and replacement of damaged lights. However, in practice, management is still more focused on operational aspects (repair and installation) than on managing electrical energy consumption efficiently.

From the aspect of recording, data related to PJU such as the number of light points, type of lights, installed power, and installation location are still not fully documented and integrated in one accurate database system. The recording carried out is still manual or partial, so it has the potential to cause data inconsistency between conditions in the field and administrative data. This has a direct impact on inaccuracies in the calculation of electrical energy consumption and electricity bills.

In addition, the absence of a digital system or information technology-based application that is able to monitor the condition of PJU in real-time is an obstacle in the management process. As a result, information related to malfunctioning lights, changes in the number of light points, and changes in power cannot be detected quickly and accurately.

From the aspect of supervision, monitoring activities on the use of PJU electrical energy are still not carried out optimally. Supervision is mostly carried out reactively, namely based on community reports related to lights that are out or have problems, rather than through a planned and continuous monitoring system. This makes it difficult to identify potential waste of electrical energy and bill mismatches early on.

In addition, coordination between the local government and the State Electricity Company in terms of data synchronization also needs to be improved. Data differences between the two parties are often the main cause of mismatches between electrical energy consumption and electricity bills.

Other factors that affect the management and supervision system are the limitation of human resources and the lack of use of modern technology, such as smart lighting systems or

the Internet of Things (IoT). In fact, the use of this technology can help in monitoring electrical energy consumption more accurately and efficiently. Overall, the system for managing, recording, and supervising the use of PJU electrical energy in Binjai City can be categorized as not optimal. The existing system is still manual, less integrated, and not supported by adequate technology. Thus, improvement efforts are needed which include the development of an integrated PJU database system, increased coordination with the State Electricity Company, and the application of digital-based monitoring technology. These measures are expected to increase the effectiveness of PJU management and supervision, so that the use of electrical energy becomes more efficient and in accordance with the bills paid.

### **How can efforts be made to improve the efficiency of the use of electrical energy and the suitability between PJU electricity consumption and bills**

Efforts to improve the efficiency of the use of electrical energy and the suitability between the use and electricity bills of Public Street Lighting (PJU) in Binjai City need to be carried out comprehensively through improvements in technical, administrative, and managerial aspects. Based on the results of the analysis in this study, some recommendations that can be applied are as follows:

#### **1. Use of Energy-Saving Lighting Technology**

One of the main steps that can be taken is to replace conventional lights (mercury and sodium) with LED lights that are more energy-efficient and have a longer lifespan. The use of LED lights has been proven to be able to significantly reduce electrical energy consumption, so that it can reduce the burden of electricity bills from the State Electricity Company.

#### **2. Implementation of Meterization and Monitoring System**

To improve the accuracy of electrical energy consumption measurements, it is necessary to install a metering system on the PJU network, both in groups and individually. In addition, the application of technology-based monitoring systems such as smart lighting or the Internet of Things (IoT) can help in monitoring energy use in real-time. With this system, potential energy waste can be immediately detected and acted upon.

#### **3. Improvement of Data Collection and Administration System**

Local governments need to build an integrated and always updated PJU database system. Data such as the number of light points, type of light, installed power, and operational conditions must be accurately documented. Data synchronization with the State Electricity Company also needs to be done periodically to avoid data differences that can cause bill mismatches.

#### **4. Periodic Energy Evaluation and Audit**

The implementation of regular energy audits is very important to evaluate the efficiency level of PJU's electricity use. Through this audit, it can be known the amount of real energy consumption, potential savings, and factors that cause mismatches between electricity consumption and bills. The results of the audit can be the basis for more appropriate policymaking.

#### **5. Improvement of Management and Supervision System**

It is necessary to strengthen the PJU management and supervision system through the implementation of more structured energy management. Supervision is not only carried out reactively, but also preventively by utilizing monitoring technology. In addition, increasing the capacity of human resources in PJU management is also an important factor in supporting the effectiveness of the system.

#### **6. Preparation of Technical Policies and Standards**

Local governments need to develop policies and technical standards related to PJU management, including standards for the use of energy-efficient lights, operating systems, and recording and reporting procedures. This policy can be a guideline in ensuring that PJU management is carried out efficiently and sustainably (Abdi Sugiarto et al., 2023).

Efforts to improve efficiency and conformity between the use of electrical energy and PJU electricity bills in Binjai City require an integrated approach between technology, management, and policies. With the implementation of these recommendations, it is hoped that the management of PJU can become more efficient, transparent, and accountable, and be able to reduce the potential for waste of regional budgets due to non-conformity of electricity bills from the State Electricity Company.

## **Conclusion**

Based on the results of the study regarding the evaluation of the suitability of the use of electrical energy of Public Street Lighting Lights (PJU) to the electricity bills of the State Electricity Company in Binjai City, several things can be concluded as follows:

1. The use of PJU electrical energy in Binjai City shows significant variations, both in terms of the type of lights, the number of light points, and the operational system. Some regions have used more efficient lights such as LEDs, but there are still many points that use conventional lights with relatively high energy consumption. In addition, an operating system that is not fully automated also has the potential to cause waste of electrical energy.
2. The results of the study show that the compatibility between the real use of electrical energy and the electricity bill from the State Electricity Company is still not optimal. There is a difference between technically calculated energy consumption and the value of electricity bills, which indicates the potential for overbilling and underbilling.
3. The discrepancy is influenced by various factors, including technical factors (type of lights and operational time), measurement system factors (lack of meterization), administrative factors (data insynchronization), estimation-based billing systems, and weak management and supervision systems.
4. The PJU management, recording, and supervision system in Binjai City is still conventional and has not been optimally integrated. Inaccurate data recording and lack of technology-based monitoring systems cause control of the use of electrical energy to be less effective.
5. Efforts to improve efficiency and conformity can be carried out through the use of energy-saving lights (LEDs), the implementation of digital metering and monitoring systems, improvements to the data collection system, the implementation of periodic energy audits, and the strengthening of PJU management and management policies.

## **Suggestions**

Based on the results of the research, some suggestions that can be given are as follows:

1. Local governments are advised to gradually replace conventional lights with LED lights to improve the efficiency of electrical energy use.
2. It is necessary to implement a metering system and digital-based monitoring technology (smart lighting) to obtain more accurate and real-time electrical energy consumption data.
3. Local governments need to build an integrated PJU database system and synchronize data periodically with the State Electricity Company to avoid discrepancies in electricity bills.
4. It is recommended to conduct regular energy audits to evaluate the efficiency of electricity use and identify potential energy waste.
5. Local governments need to improve the PJU management and supervision system through the formulation of clear policies and technical standards, as well as increasing the capacity of human resources in the field of energy management.

Thus, it is hoped that the management of PJU electrical energy in Binjai City can be more efficient, transparent, and accountable, so that it can support regional budget savings and the sustainability of the use of electrical energy in the long term.

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