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AUDIT ENERGY AS A STUDY ON THE IMPLEMENTATION OF ENERGY MANAGEMENT TO IMPROVE THE EFFICIENCY OF ELECTRICITY USAGE AT FALETEHAN UNIVERSITY

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Abstract. The Government through the Ministry of Energy and Mineral Resources and PT Perusahaan Listrik Negara (PLN Persero) have decided to increase the basic electricity tariff as of July 1, 2022. This certainly impacts the operational costs in the provision of education at Faletehan University. With this increase in operational costs, efforts to improve the efficiency of electricity usage are needed, one of which is through the implementation of energy management in managing electricity usage at Faletehan University. Energy management itself is an integrated activity carried out by an institution to control energy consumption in order to achieve effective and efficient energy utilization to produce maximum output through structured and economical technical measures to minimize energy consumption, as stipulated in Regulation of the Minister of Energy and Mineral Resources of the Republic of Indonesia No. 14 of 2012. Based on this, research related to the implementation of energy management as an effort to improve the efficiency of electricity usage is needed, with the research location at Faletehan University. This research aims to identify where and how much energy is used by Faletehan University and what steps can be taken to conserve energy as an effort to improve the efficiency of electricity usage at Faletehan University.

Keywords: Energy Management, Energy Audit, Energy Conservation.

1. INTRODUCTION

With the increasing electricity basic tariff rates implemented by the government through the Ministry of Energy and Mineral Resources and PT Perusahaan Listrik Negara (PLN Persero) over the years, this has led to a rise in operational costs in the provision of education by Faletehan University.

One effort to mitigate the increase in operational costs is through the implementation of energy management in managing electricity usage as a cost-saving measure. Energy management implementation is conducted as a means of conserving electricity usage, commonly known as energy conservation.

Based on the above description, research related to the implementation of energy management as an effort to improve the efficiency of electricity usage in the environment of Faletehan University is necessary. This research aims to determine the potential for efficiency in electricity usage at Faletehan University so that energy costs can be minimized as much as possible.

According to the Regulation of the Minister of Energy and Mineral Resources of the Republic of Indonesia, energy management is described as an integrated activity to control energy consumption in order to achieve effective and efficient energy utilization to produce maximum output through

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structured and economical technical measures to minimize the consumption of raw materials and supporting materials.

Energy management is an integrated program planned and implemented systematically to utilize energy resources effectively and efficiently by conducting planning, recording, monitoring, and continuous evaluation without compromising the quality of production/services.

The purpose of energy management is resource conservation, climate protection, and cost savings. For consumers, energy management makes it easier to access energy according to what and when they need it.

The implementation of energy management begins with the energy audit process. Energy audit is an activity to identify where and how much energy is used, as well as what steps can be taken to conserve energy in an energy-consuming facility. Energy audit activities range from simple data surveys to detailed analysis and testing of existing data, designed to generate new data. Through an energy audit, we can obtain a snapshot of energy usage in a building, including information about the types, amounts of energy used, energy equipment, energy intensity, and other relevant data. Subsequently, based on the data obtained, the Electrical Building Energy Consumption Intensity (IKE) can be calculated. This is done to determine whether energy usage in a particular area is still categorized as efficient or not.

2. RESEARCH METHODS

Research Tools and Materials

This research is conducted quantitatively. The study investigates historical energy data that occurred at Faletehan University in the previous year. Based on the historical energy consumption data obtained, calculations of electricity consumption intensity will be performed, followed by an analysis of the results obtained from the calculations. Subsequently, an analysis will also be conducted on the energy audit parameters obtained through measurement results.

This research will be conducted from December 2022 to May 2023 at Faletehan University, Kramatwatu District, Serang Regency. In this research, two types of data are required, namely primary data and secondary data.

The primary data needed for this research includes measurements of electricity consumption intensity, room temperature and humidity measurements, measurements of room lighting intensity, and measurements of power quality.

The secondary data in this research is the electricity energy cost data incurred by Faletehan University in the previous year. This data is obtained from the Household Management Department at Faletehan University.

The data processing required for this research involves calculating the intensity of electricity energy used at Faletehan University. The calculation of energy consumption intensity is determined by the National Standardization Agency, as outlined in the Energy Audit Procedure for Buildings, SNI 03-6196-2000. Specific energy consumption per floor area with and without air conditioning is determined as follows:

a. If the percentage comparison of the floor area using AC to the total floor area of the building is less than 10%, then the building is classified as not using AC, and the energy consumption per floor area can be calculated using Equation 1.

Energy Consumption Intensity 1 = Total Energy Consumption / Total Floor Area Equation 1…

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b. If the percentage of floor area using air conditioning (AC) compared to the total floor area of the building is more than 90%, then the building is considered to be a building that uses AC, and the energy consumption per floor area using AC can be seen in Equation 2

Energy Consumption Intensity 2 = Total Energy Consumption / Total Floor Area Equation 2…

In calculating ECI, the total KWh per room and per building will be divided by the area's total. The output of the calculation will provide descriptions based on the Standard ECI Value in Building Structures as shown in Table 1.

Table 1. The Standart Energy Consumption Intensity for Building Structures

Criteria	The Room With Air Conditioning (kWh/m2/month)	The Room Without Air Conditioning (kWh/m2/month)
Highly Efficient	4,17 – 7,92	-
Efficient	7,92 – 12, 08	-
Sufficiently Efficient	12,08 – 14,58	0,84 – 1,67
Tend to be Inefficient	14,58 – 19,17	1,67 – 2,50
Inefficient	19,17 – 23,75	2,50 – 3,34
Highly Inefficient	23,75 – 37,5	3,34 – 4,17

To obtain energy saving opportunities, further data collection on the electricity utilization conditions at Faletehan University is necessary. Therefore, primary data collection is required. In this energy audit, primary data collection involves measuring the actual power usage of electrical equipment in Building I Campus of Faletehan University.
Primary data collection is conducted to reinforce the initial hypothesis in the secondary data calculations related to Energy Consumption Intensity (ECI). The primary data collected are as follows:

1. Building Area Data Collection
2. Number of Students of Faletehan University Data Collection
3. Total KWh/m2 Data Collection for Each Building
4. Asset data for each building (lights, AC units, computers, printers, projectors, etc.)
5. Measurement of Light Intensity (Lux) per room per faculty/unit
6. Power Quality at the Sample Panel of Building

The obtained primary data is processed into Energy Consumption Intensity (ECI) data, light intensity (Lux), specific energy consumption (SEC), and power quality data.
In the analysis of light intensity (Lux), a Lux Meter tool is used. Measurements are taken at a normal position (above the work desk) with varying distances between the tool and the light source. The results of the measurements will be compared with the SNI 6197 Year 2011 Standard on Energy Conservation in Lighting Systems. There are two categories in the index of measurement results: Compliant with Standards and Below Standards, adjusted to the SNI standard.

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Table 2. Standard Lighting Levels (Educational Institutions and Offices) SNI 6197 Year 2011

Building Function	Lighting Level (Lux)
Classroom	350
Library	300
Faculty Room	300
Corridor	100
Lobby	350
Laboratory	500
Meeting Room	300
Activity Room	300
Cafeteria Or Pantry	200
Parking Area	100
Emergency Staircase	150
Computer Room	350
Restroom	250
Auditorium	500

3. RESULTS AND DISCUSSION

Here is the summary of electric energy consumption at Faletehan University Campus from 2018 to 2023.

Table 2. Summary of Electric Energy Consumption

No	Year	Total Cost
1	2018	12.389.753
2	2019	12.658.638
3	2020	14.743.732
4	2021	15.684.339
5	2022	18.864.869
6	2023	19.432.237

In Table 3, the data shows the total cost from the year 2018 to 2023. Every year, Faletehan University Campus experiences an increase in electricity bill. This is accompanied by the addition of new buildings each year.
To determine the ECI value, data on the building area for each faculty is required. The calculated ECI per year can be converted into ECI per month using Table 1.

Table 3. Energy Consumption Intencity of I Building

Year	ECI EachYear (kWh/m2)	Average IKE Each Month (kWh/m2)	Criteria
2022	145,35	12,11	Sufficiently Efficient
2023	162,12	13,51	Sufficiently Efficient

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In the lighting system of the Faculty of Science and Technology building at Faletehan University, measurements (Lux) have been conducted in every room from the basement to the 3rd floor. Measurements were taken using a Digital Lux Meter positioned on the work desk approximately 1.5 meters below the light. Various types of lamps were used, such as 36 Watt TL, 18 Watt TL, CFL, and 12 Watt LED. Additionally, measurements were taken during working hours between 08:00-16:00 WIB.
Based on the actual Lux measurements conducted during daylight with external light present, the utilization of natural light is highly beneficial in building design, especially for saving artificial lighting resources, particularly for buildings operating during daytime. Besides this potential natural light, other considerations should be taken into account.

In the Faculty of Science and Technology building at Faletehan University, there are ventilation fins with a good lighting system, resulting in overall dominant light intensity meeting the standards. This may be due to not all energy-consuming equipment being operational and academic activities being suspended due to the COVID-19 pandemic.

From the comparison table of light intensity above, it can be observed that some rooms meet the SNI standards. However, some other rooms are still below the standard, influenced by factors such as the condition of the lamps (on or off), room size, wall color, lumens, lamp power, and the influence of external light. Since some measurement results do not meet the standards, it is advisable to make improvements to meet the standards and save more energy.

4. CONCLUSION

Based on the results of observations in the electricity consumption at Faletehan University Campus, there has been an increase in electricity bill over the past 5 years, with the addition of supporting facilities and several new buildings. The highest increase occurred in 2023, where the electricity bill rose to almost Rp 20,000,000 or experienced an increase of around 15.49%, with the addition of 2 new building accounts.
The energy consumption intensity is already within the criteria of being sufficiently efficient, with an ECI value of 162,12 kWh/m2 in 2023.

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