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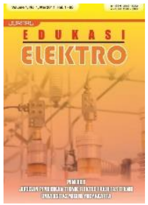

Electrical Energy Audit in Pratama Tapan Hospital

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Abstract— Hospitals, as large energy consumers, must adopt efficient energy-saving measures due to cost increases, regulations, and climate change concerns. In this study, an electrical energy audit was conducted at Pratama Tapan Hospital to identify energy-saving opportunities and recommend equipment replacements or technology upgrades. The primary objective was to determine the Energy Consumption Intensity (ECI) and analyze the potential for energy savings. The audit revealed an ECI value of 10.33 kWh/m²/year, highly efficient by ASEAN-USAID standards. However, 100% of rooms didn't meet the SNI 03-6197-2000 light intensity standard, causing discomfort. The study recommends installing specific light fixtures and adjusting lamp power to comply with the standard. These findings offer valuable insights for healthcare institutions striving to achieve sustainability goals.

Keywords: energy audit, energy efficiency, hospital, ECI, lighting.

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1 Introduction

Electrical energy has an important role in human life. Along with technology development, electricity is needed in various sectors such as education, government, agriculture, and health. Research [1] states that Indonesia is one of the countries with considerable use of electrical energy. This can cause an electrical energy crisis that will impact the environment, society, and economy. Therefore, an effort is needed to reduce electricity usage in all these sectors to overcome excess electrical energy.

Based on Indonesian policy ESDM No. 13 of 2012 regarding the saving of electricity consumption, all government office buildings, both services and services, must carry out energy management so that the electricity Energy Consumption Intensity (ECI) becomes organized and can achieve efficient use. One of the main strategies of energy management that can be done is energy conservation. Some methods are commonly applied in energy conservation, namely retrofitting, technology upgrades, and energy-saving behavior. An energy audit process in the energy conservation process is a calculation method to obtain energy consumption in one or more buildings [2]. Energy audits also aim to identify energy consumption and seek efforts to improve energy efficiency.

Several researchers have previously conducted many studies on energy audits, such as in industrial buildings [3, 4], Higher Education [5-7], Office [8], Apartment [9, 10], and Hospitals [11-13]. Based on these studies, it can be concluded that electrical energy audits must be carried out in buildings that have a high intensity of electrical energy usage. Therefore, based on Government Regulation No. 70 of 2009 Article 12, hospitals have large energy consumption and are included in the mandatory energy management or conservation category. Research [14, 15] stated that the high intensity of continuous energy use, such as inpatient rooms, lighting, medical devices, cooling systems, and air purifiers, causes high energy consumption in hospital buildings. The larger or taller the hospital building construction, the more energy is used to operate the facility.

Therefore, in this research, an electrical energy audit was conducted at Pratama Tapan Hospital, which is a type D hospital. The need for more lighting comfort in this hospital was found based on interviews and surveys. This is caused by several factors, such as if the weather is cloudy, intense lighting in the Hospital Building is very dim, especially in certain rooms that do not get direct light from the sun so that it can interfere with the comfort of work. From the survey, it was also found that the lack of use of air conditioners in this hospital. This can be seen from all inpatient rooms; only seven rooms are installed with Air Conditioners.

From these problems, the authors conducted energy audit case research at Pratama Tapan Hospital, Basa Ampek Balai Tapan sub-district, Pesisir Selatan district, and West Sumatra province. The Pesisir Selatan regional government manages this hospital with a land area of 40,000 m^2. Electricity source This hospital gets electricity from PLN, which comes from Tapan Diesel Power Plant (PLTD). PLTD is a power plant that still uses fossil energy, so it is one of the strong reasons for conducting an energy audit at Pratama Tapan Hospital. In addition, it was based on interviews with staff that this hospital has never undertaken an electrical energy audit. Therefore, an electrical energy audit in this hospital is the right thing to do.

The main objective of this research is to conduct an electrical energy audit of all rooms in the Primary Hospital to obtain the amount of electrical energy used, determine the Electricity Consumption Intensity (ECI), analyze opportunities for electrical energy savings, and make recommendations for replacing electrical equipment or upgrading technology that can be done at the Primary Hospital of Tapan. However, this upgraded technology will focus on lighting classification. As for air conditioning, it is difficult to do for several reasons, namely, the uneven installation of air conditioners in all inpatient rooms, and according to interviews conducted, the lack of air conditioning use may be due to social, cultural, or climate in the local area.

2 Methodology

2.1 Place and Time of Research

This research was conducted at Pratama Tapan Hospital. This hospital is located at Tapan-Padang Street, Basa Ampek Balai Tapan District, Pesisir Selatan Regency, West Sumatra Province. This hospital class is Type D. This hospital has a ward, mortuary, operating room, maternity clinic, laboratory, emergency room, and waiting room. The time used for data collection in this research was in April 2023 and used data from the previous year.

2.2 Research Design

The authors conducted an energy audit research design through two stages in this research. First, planning an initial audit to determine the current energy usage at the Pratama Tapan Hospital using the energy or electricity payment account method and second, preparing a detailed follow-up energy audit to obtain the results of whether the current energy use is included in the energy-efficient category adjusted to the ECI standard. The flowchart explains the stages of the research carried out can be seen in Figure 1.

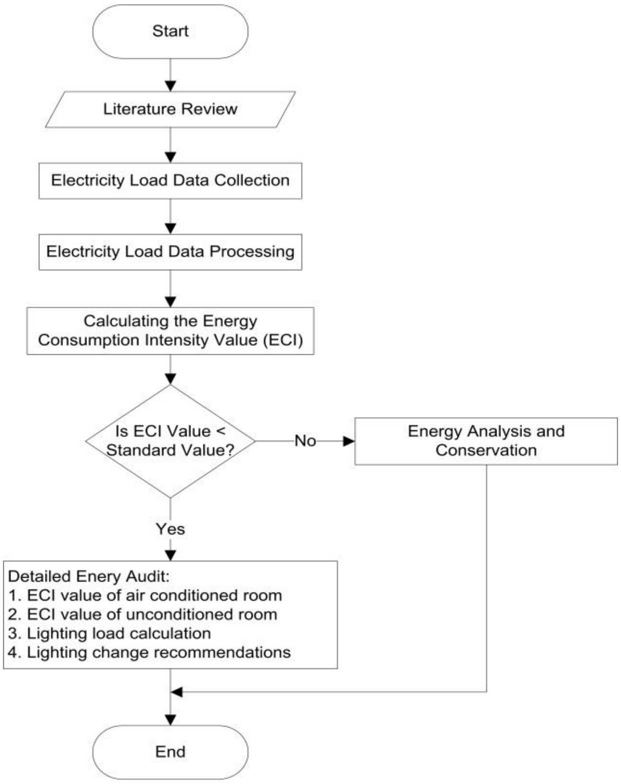

Fig. 1. Research flowchart

2.3 Data Collection Technique

In this research, the authors conducted two primary data collection techniques. The first is to make observations; observations in this research were carried out by looking at the lighting system, cooling, and the use of electrical energy in all work units or rooms in the Pratama Tapan Hospital. This observation aims to find out how the use of electrical energy works. The second primary data collection technique is interviews with the Engineering Manager and the Finance Department. This is done to determine when electrical energy is used with high and low needs and get results such as Energy Usage data, Electricity Bill Data, Room Data, and Measurement Data at Pratama Tapan Hospital. Secondary data such as building ECI standards, ECI air-conditioned rooms, and standardization of lighting strength in this research are taken from the standardization set by the government.

2.4 Data Analysis Technique

The data analysis technique in this research is based on the Energy Consumption Index (ECI). Electricity Energy Consumption Intensity (ECI) is an indicator that represents the energy used in a building or building in a certain period. This ECI standard has been applied in various ASEAN member countries and APEC member countries. [15]. After collecting data on all electrical energy components, it will be audited with the ECI standard. The ECI standard is to see how much energy conservation has been done by the Pratama Tapan Hospital Building. The unit used to represent ECI value is kWh/m^2/year. Or it can be formulated as equation (1) [5].

$$\text{ECI} = \frac{\text{Energy Consumption (kWh)}}{\text{Building Area (m}^2\text{)}} \quad (1)$$

According to a study conducted by ASEAN-USAID in 1992, the standard of ECI value in buildings can be seen in Table 1.

Table 1. Standard of ECI value in buildings

No	Building Type	ECI (kWh/m^2/year)
1	Office	240
2	Shopping Center	330
3	Hotel and Apartments	300
4	Hospital	380

Based on the Regulation of the Minister of Energy and Human Resources number 13 of 2012, the calculation value of the intensity of electrical energy consumption in a building can be divided into two parts: buildings using air conditioning and those without air conditioning. This can be seen in Table 2.

Table 2. ECI value for two parts of building [12]

Criteria	ECI (kWh/m^2/year)	
	With AC	*Without AC*
Highly Efficient	<8.5	<3.4
Efficient	8.5 - 14	3.4 – 5.6
Moderately Efficient	14 – 18.5	5.6 – 7.4
Wasteful	>18.5	>7.4

If the ECI value is lower than the lower limit, the building is said to be energy efficient. Hence, it needs to be maintained by carrying out activities and maintenance in accordance with the standard procedures set by the company. If the ECI value is between the lower limit and the reference, the building is said to be somewhat efficient, so it is necessary to improve performance by tuning up. If it is between the reference and the upper limit, then the building is somewhat wasteful, so it is necessary to make some changes.

These changes were obtained by analyzing energy-saving opportunities. Based on the results of the Energy Management Opportunity [16], several recommendations can be made to get electrical energy savings, namely:

a. Recommendations that are advisory in nature so that they do not use cost investment and do not change existing equipment. An example is turning off electrical equipment, such as lights and air conditioning, when unused.
b. Low-Cost Investment, this recommendation slightly changes the existing equipment as an example of installing a timer on the lighting automatically or installing a temperature sensor on the air conditioner so that it can regulate the existing temperature.
c. High-cost investment is to make changes and improvements to the existing system. Usually, these recommendations include installing power factor correction equipment and variable speed drives.

2.5 Light Intensity

Light intensity is the amount of light needed to illuminate a room. Light intensity must meet the Indonesian National Standard (SNI). The light intensity is measured using a Luxmeter. Calculating the light intensity in the room can be found using equation (2).

$$E = \frac{N \times \Phi \times LLF \times C_u \times n}{A} \quad (2)$$

Explanation:

E : Light intensity (Lux)
N : Number of light points
Φ : Lumen Value
LLF : Light Loss Factor (0.8)
C_u : Coefficient of Utilization (0.7)
n : Number of lights in one point
A : Number of lights in one point (m^2)

3 Results and Discussion

3.1 Results

Data on building/space area is obtained from the data collection. The Pratama Tapan Hospital building has a total area is 15.120,70 m2. The detailed information can be seen in Table 3.

Table 3. Data of building area

Load	Room Name	Area (m^2)
105 kVa	Treatment Room	9,670.5
	Mortuary Room	180
	Operation Room	150
	Maternity Clinic	1,440
	Laboratory	430.2
	Emergency Room	2,450
	Waiting Room	800
Total Area		15,120.70

The use of electrical energy in Tapan Primary Hospital is divided according to the classification of lighting, cooling/air conditioning, and health or other electronic equipment that requires electrical energy, which can be seen in Table 4.

Table 4. Electrical equipment for each room

No.	Room Name	Equipment	Quantity	Power (W) / Unit
1	Inpatient Room 1	Lamp	8	12
		AC	1	1920
2	Inpatient Room 2	Lamp	8	12
		AC	1	1920
3	Inpatient Room 3	Lamp	8	12
		AC	1	1920
4	Inpatient Room 4	Lamp	8	12
		AC	1	1920
5	Inpatient Room 5	Lamp	8	12
		AC	1	1920
6	Inpatient Room 6	Lamp	8	12
		AC	1	1920
7	Inpatient Room 7	Lamp	8	12
		AC	1	1920
8	Inpatient Room 8	Lamp	8	12
		Fan	1	50
9	Inpatient Room 9	Lamp	8	12
		Fan	1	50
10	Inpatient Room 10	Lamp	8	12
		Fan	1	50
11	Adult Guard Room	Lamp	1	12
		Fan	1	50
12	Child Guard Room	Lamp	2	12
		Fan	1	50
13	Radiology	Lamp	4	12
		AC	1	1920
		Mobile X-ray	1	3000
14	Radiology Guard Room	Lamp	2	12
15	Medical Records	Lamp	8	12
		Fan	1	50
16	Pediatric Clinic	Lamp	4	12
		AC	1	1170
17	Dental Clinic	Lamp	3	12
		AC	1	1170
		Dental Unit	1	1200
18	Internal Medicine Clinic	Lamp	4	12
		AC	1	1170

No.	Room Name	Equipment	Quantity	Power (W) / Unit
19	General Poly	Lamp	2	12
		AC	1	840
20	Surgery	Lamp	4	12
		AC	1	1170
21	Guard the Cashier	Lamp	4	12
		Fan	1	50
22	Operation	Lamp	3	12
		AC	2	1170
23	Operation Guard Room	Lamp	2	12
24	Obstetrics Clinic	Lamp	8	12
		AC	2	350
		Suction Pump	1	25
		UV lamp	1	26
25	Public Restroom	Lamp	2	12
26	Panel	Lamp	2	12
		Fan	1	50
27	Laundry	Lamp	2	12
28	Nutrition Room	Lamp	6	12
		Rice Cooker	1	1300
		Dispenser	1	250
		Blender	1	500
		Refrigerator	2	80
29	Gas chamber	Lamp	1	12
30	Nutrition Break Room	Lamp	2	12
		Fan	1	50
31	Emergency Room	Lamp	12	12
		AC	4	840
		Suction Pump	1	25
		Nebulizer	2	192
		Doppler	1	20
32	Pharmacies	Lamp	4	12
		AC	1	1170
33	Emergency Room	Lamp	1	12
34	Medicine Warehouse	Lamp	2	12
35	ICU	Lamp	2	12
		AC	1	840
		Suction Pump	1	25
36	Director's Room	Lamp	4	12
		AC	1	1920
37	Archive Room	Lamp	4	12
		AC	1	840
38	Head of Sub-Division Room	Lamp	4	12
		AC	2	840
		Computer	2	250
		Printer	2	12
39	Head of Service	Lamp	4	12
		Computer	3	250
		AC	1	1170
		Printer	1	12
40	Head of Support	Lamp	4	12
		Computer	3	250
		AC	2	840
		Printer	1	12
		Refrigerator	1	80
41	Mosque	Lamp	8	12
		AC	1	1920
42	The Hall	Lamp	10	12
		AC	3	1170
43	Supervisor	Lamp	1	12
		AC	1	350
44	Perinatology	Lamp	2	12
		AC	1	840
		Suction Pump	1	25
		Baby Incubator	2	680
		Icubator Transfor	1	176

No.	Room Name	Equipment	Quantity	Power (W) / Unit
		Blue Leght	1	180
		Infant warmer	1	35,6
		Baby Cpap	1	312
45	Resuscitation	Lamp	2	12
		AC	2	840
46	Accreditation	Lamp	4	12
		AC	1	1170
47	Head of Finance	Lamp	4	12
		AC	1	1170
		Computer	1	250
		Printer	1	12
		Refrigerator	1	80
48	Asset Room	Lamp	4	12
		AC	1	840
49	Mortuary Room	Lamp	2	12
50	Dressing Room	Lamp	2	12
51	CCSD	Lamp	3	12
		AC	1	340
		Strydy Autoclave	1	3100
		Fuji Elite Autoclave	1	1200
		Tuttnauer Autoclave	1	2200
		Shinva Autoclave	1	11000
52	VK	Lamp	10	12
		Duppler	1	20
		Suction Pump	1	25
		AC	3	840
		Anesthesia Machine	1	70
		Coolter machine	1	900
		Ventilator	1	110
53	VK Guard Room	Lamp	2	12
		Fan	1	50
54	TCM	Lamp	4	12
		AC	1	1170
55	Labor	Lamp	4	12
		Centrifuge	1	750
56	Medical Rehab	Lamp	2	12
		AC	1	840

Table 4 shows the results of checking electrical equipment in each room at Pratama Tapan Hospital. The type of lamp used already uses LED lights. The use of electrical equipment in each room varies based on needs. The air conditioner used is 2pk with 1,920 watts, 1.5pk with 1,170 watts, and 0.5pk with 340 watts.

Table 5. Power usage by classification

Classification	Power (Watt)
Lighting	5,469
Cooling/AC	37,730
Electronics	47,859

In Table 5, the highest power usage is in the electronics classification, while the most minor electrical energy usage is in the lighting classification. For the percentage of use can be seen in Figure 2, where 53% of the electronic classification supplies the most electrical energy users. While lighting is only about 6% of the overall supply of electrical energy users in Pratama Tapan Hospital.

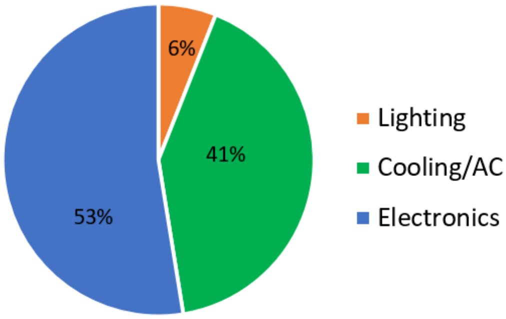

Fig. 2. Percentage of electric energy usage

The source of electrical energy for Pratama Tapan Hospital is supplied from PLN, with a power of 105,000 VA. At the same time, the total building area is 15,120.70 m^2 with a power tariff group (S-2 / L). Furthermore, kWh data used to conduct this energy audit is data on the use of installed or used electrical loads. Figure 3 shows energy consumption (kWh) per month in a year.

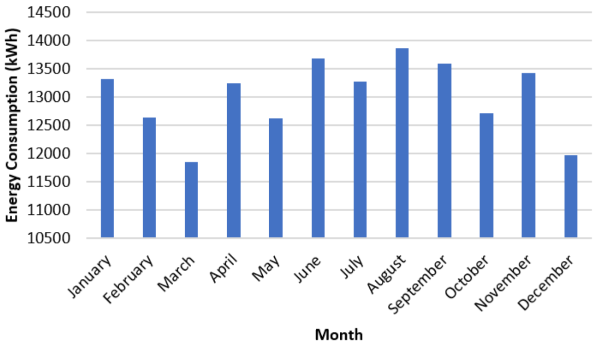

Fig. 3. Energy consumption in a year

From Figure 3, the use of electrical energy varies during the year. The lowest use of electrical energy in March amounted to 11,851 kWh, and the most extensive use in August amounted to 13,868 kWh. This occurs due to differences in the duration of use of electronic devices in the hospital.

3.2 Initial Energy Audit

Judging from the average electrical energy used in Pratama Tapan Hospital, the ECI value can be calculated. It is known that the total value of electrical energy consumption a year is 156,210.7 kWh, and the building area is 15,120.7 m^2. So that the ECI value is obtained from equation (1) by

$$\text{ECI} = \frac{156{,}210.7}{15{,}120.7} = 10.33\ \text{kWh/m}^2\text{/year} \quad (3)$$

The resulting ECI value is 10.33 kWh/m^2/year. Based on the standard ECI value from ASEAN-USAID, the use of electrical energy at the Pratama Tapan Hospital can be very efficient because it is very small compared to the standard value of 380.

Figure 4 presents the ECI value per month in January-December 2022. The lowest ECI value is in March, and the highest is in August. When viewed from the room-specific ECI value based on air-conditioned and non-air-conditioned rooms from Table 2, it can be said that the monthly ECI value is very efficient. Several possibilities can cause ECI values that are very small from this standard.

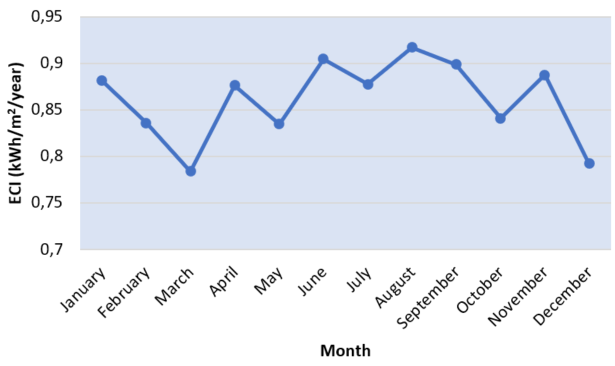

Fig. 4. ECI value in a year

Based on the results of interviews from the Pratama Tapan Hospital stated that first, low energy usage is due to room facilities that do not meet the standards, as seen in the ten inpatient rooms; 4 of them only use fans as air conditioners. Second is the low number of patients and inpatients, so the use of electrical energy is low. Third, low electrical energy usage can be caused because room facilities that have met the standards have yet to be used optimally. The use of health electronics in this hospital is not very significant. This is because the patients are not too crowded.

3.3 Detailed Energy Audit

a. ECI Value of Air-Conditioned Room

A detailed energy audit is carried out by calculating the ECI of air-conditioned rooms at Pratama Tapan Hospital based on the results of calculations with the effective energy use of electricity for one month or 26 working days, apart from the emergency room, which is full for one month. This measurement uses effective working time, which is 8 hours per day. Table 6 shows the ECI measurement value and criteria for each air-conditioned room in Pratama Tapan Hospital based on the standardization of the Minister of Energy and Mineral Resources Regulation No. 13 of 2012.

Table 6. ECI Value of air-conditioned room

No	Room Name	Area (m^2)	kWh / month	ECI / month	Criteria
1	Emergency Room	53.8	943.9	17.6	Moderately Efficient
2	ICU	16.0	184.9	11.6	Efficient
3	Perinatology	18.8	288.3	15.3	Moderately Efficient
4	Resuscitation	32.0	354.4	11.1	Efficient
5	Director	38.6	409.3	10.6	Efficient
6	Accreditation	24.4	253.3	10.4	Efficient
7	Head of Subdivision	22.3	409.9	18.4	Moderately Efficient
8	Head of Finance	34.4	324.5	9.4	Efficient
9	Head of Service	25.8	411.8	16.0	Moderately Efficient
10	Head of Support	28.4	467.7	16.9	Moderately Efficient
11	Mosque	48.0	419.3	8.7	Efficient
12	The Hall	96.0	755.0	7.9	Highly Efficient
13	Archive	16.0	184.7	11.5	Efficient
14	Assets	16.0	184.7	11.5	Efficient
15	Operation	28.0	494.2	17.7	Moderately Efficient
16	CCSD	6.0	95.1	15.8	Moderately Efficient
17	VK	67.5	783.1	11.6	Efficient
18	Obstetrics Clinic	24.0	176.2	7.3	Highly Efficient
19	Hospitalization	54.0	419.3	7.8	Highly Efficient
20	Radiology	27.8	487.3	17.5	Moderately Efficient
21	TCM	20.0	253.3	12.7	Efficient
22	Pharmacies	32.0	253.3	7.9	Highly Efficient
23	Internal Medicine Clinic	17.5	253.3	14.5	Moderately Efficient

No	Room Name	Area (m^2)	kWh / month	ECI / month	Criteria
24	Dental Clinic	16.6	306.7	18.5	Moderately Efficient
25	Surgery	16.6	253.3	15.3	Moderately Efficient
26	Medical Rehab	14.0	179.7	12.8	Efficient
27	Pediatric Clinic	16.6	253.4	15.3	Moderately Efficient
28	General Poly	14.0	179.7	12.8	Efficient
29	Supervisor's Room	8.6	75.3	8.7	Efficient

From Table 6, the ECI value for air-conditioned rooms in Pratama Tapan Hospital based on effective assumptions of electrical energy has varying criteria. However, the ECI value is still within the scope of efficiency. Therefore, this needs to be maintained by the Hospital so that Electric Energy savings can continue to be implemented.

b. Lighting Load Calculation

Measurement of lighting intensity at Pratama Tapan Hospital using a lux meter. Sampling lighting intensity data made measurements at each point in the workspace. Table 7 shows the results of the survey of lighting intensity measurements in each room along with comfort standards for workspaces based on the Directorate of Medical Support Services and Health Facilities of the Directorate General of Health Efforts of the Ministry of Health of the Republic of Indonesia in 2014 for Type D Hospitals.

Table 7. Results of light intensity measurement

No	Room Name	Lighting In		Temperature (°C)
		Measurement	*SNI*	
1	Inpatient Room 1	50	200	30.5
2	Inpatient Room 2	47	200	30.2
3	Inpatient Room 3	48	200	31.1
4	Inpatient Room 4	48	200	30.4
5	Inpatient Room 5	49	200	30.4
6	Inpatient Room 6	50	200	31.2
7	Inpatient Room 7	55	200	31.2
8	Inpatient Room 8	52	200	31.8
9	Inpatient Room 9	50	200	31.5
10	Inpatient Room 10	52	200	31.4
11	Adult Guard Room	192	200	30.7
12	Child Guard Room	68	100	30.6
13	Radiology	67	200	30.2
14	Radiology Guard Room	65	100	30.2
15	Medical Records	50	100	30.4
16	Pediatric Clinic	58	250	30.6
17	Dental Clinic	57	250	30.6
18	Internal Medicine Clinic	56	250	30.6
19	General Poly	54	250	31.7
20	Surgery	56	250	30.6
21	Guard the Cashier	59	100	30.2
22	Operation	51	500	31.7
23	Operation Guard Room	47	100	31.6
24	Obstetrics Clinic	50	200	31.6
25	Public Restroom	48	100	27.5
26	Panel	57	100	31.7
27	Laundry	58	100	31.4
28	Nutrition Room	53	100	31.3
29	Gas chamber	55	200	31.3
30	Nutrition Break Room	58	100	31.2
31	EMERGENCY ROOM	55	250	31.2
32	Pharmacies	52	200	31.0
33	Emergency Room	53	100	31.2
34	Medicine Warehouse	47	200	31.6
35	ICU	43	200	31.6
36	Director's Room	58	200	31.5

No	Room Name	Lighting In		Temperature (°C)
		Measurement	*SNI*	
37	Archive Room	64	100	31.6
38	Head of Sub-Division Room	58	200	31.6
39	Head of Service	50	200	31.6
40	Head of Support	58	200	31.6
41	Mosque	57	200	31.6
42	The Hall	46	100	31.6
43	Supervisor	58	200	31.3
44	Perinatology	54	500	30.5
45	Resuscitation	85	500	30.2
46	Accreditation	63	200	31.2
47	Head of Finance	54	200	30.8
48	Asset Room	77	100	30.6
49	Mortuary Room	68	100	30.5
50	Dressing Room	65	200	31.4
51	CCSD	54	200	31.5
52	VK	86	500	30.8
53	VK Guard Room	48	100	31.6
54	TCM	59	200	30.5
55	Labor	58	500	30.8
56	Medical Rehab	50	200	30.4

Based on the results of the lighting intensity measurements in Table 7, it is still not up to standard. This condition can be more efficient regarding energy use, but working comfort will be reduced. Because the results of the overall energy consumption of the building are still very efficient, adding lamp points to increase room lighting is still very possible, or replacing larger lamp power to meet lux standards for the room.

c. Lighting Change Recommendations

For light intensity data that has yet to meet the predetermined standards, it is necessary to change the number of lamp points and power used. The type of lamp used in each room is LED. The selection of lamps for lighting in this hospital is already said to be efficient. Given that LEDs are lamps with small energy consumption and long service life. But to improve the lighting of LED lamps used must be a larger wattage and an increase in the number of lamps so that the desired lighting standards are by Minister of Health Regulation No. 24 of 2016 standards. Table 8 shows the recommended lamp replacement and the lux value resulting from the lamp replacement.

Table 8. Results of lighting replacement recommendations

No	Room Name	Substitution Recommendation LED Light			Lux		
		13W	*19W*	*55W*	*LT**	*SNI*	*LR**
1	Inpatient Room 1	-	12	-	50	200	212.8
2	Inpatient Room 2	-	12	-	47	200	212.8
3	Inpatient Room 3	-	12	-	48	200	212.8
4	Inpatient Room 4	-	12	-	48	200	212.8
5	Inpatient Room 5	-	12	-	49	200	212.8
6	Inpatient Room 6	-	12	-	50	200	212.8
7	Inpatient Room 7	-	12	-	55	200	212.8
8	Inpatient Room 8	-	12	-	52	200	212.8
9	Inpatient Room 9	-	12	-	50	200	212.8
10	Inpatient Room 10	-	12	-	52	200	212.8
11	Adult Guard Room	2	-	-	192	200	218.4
12	Child Guard Room	2	-	-	68	100	107.0
13	Radiology	-	6	-	67	200	206.4
14	Radiology Guard Room	-	1	-	65	100	132.6
15	Medical Records	-	10	-	50	100	141.1
16	Pediatric Clinic	-	5	-	58	250	289.1
17	Dental Clinic	-	5	-	57	250	289.1
18	Internal Medicine Clinic	-	6	-	56	250	328.7
19	General Poly	-	4	-	54	250	273.6
20	Surgery	-	5	-	56	250	289.1

No	Room Name	Substitution Recommendation LED Light			Lux		
		13W	*19W*	*55W*	*LT**	*SNI*	*LR**
21	Guard the Cashier	4	-	-	59	100	210.0
22	Operation	-	-	6	51	500	594.0
23	Operation Guard Room	1	-	-	47	100	109.2
24	Obstetrics Clinic	8	-	-	50	200	218.4
25	Public Restroom	2	-	-	48	100	187.2
26	Panel		3	-	57	100	119.7
27	Laundry	2		-	58	100	145.6
28	Nutrition Room	-	6	-	53	100	112.0
29	Gas Chamber	-	4	-	55	200	240.0
30	Nutrition Break Room	2	-	-	58	100	172.4
31	Emergency Room	-	-	5	55	250	257.8
32	Pharmacies	-	7	-	52	200	209.5
33	Emergency Room	-	1	-	53	100	124.7
34	Medicine Warehouse	-	3	-	47	200	252.0
35	ICU	2	-	-	43	200	81.90
36	Director's Room	-	-	3	58	200	215.2
37	Archive Room	3	-	-	64	100	122.9
38	Head of Sub-Division Room	-	5	-	58	200	215.1
39	Head of Service	-	6	-	50	200	222.7
40	Head of Support	-	6	-	58	200	202.5
41	Mosque	-	11	-	57	200	219.5
42	The Hall	-	11	-	46	100	109.7
43	Supervisor	-	2	-	58	200	221.7
44	Perinatology	-	-	4	54	500	588.5
45	Resuscitation	-	-	6	85	500	519.7
46	Accreditation	-	-	2	63	200	227.6
47	Head of Finance	-	8	-	54	200	222.7
48	Asset Room	3	-	-	77	100	122.9
49	Mortuary Room	2	-	-	68	100	124.8
50	Dressing Room	2	-	-	65	200	218.4
51	CCSD	3	-	-	54	200	327.6
52	VK	-	-	13	86	500	533.9
53	VK Guard Room	1	-	-	48	100	109.2
54	TCM	-	5	-	59	200	239.4
55	Labor	-		4	58	500	525.0
56	Medical Rehab	-	3	-	50	200	205.2

* LT: Measured Lux
** LR: Recommended Lux

After obtaining the results in the form of recommendations by changing the number of light points (N) and lamp power in the lighting system at Pratama Tapan Hospital, the results of the calculation of lighting strength in each room are obtained using equation (2).

The calculation of lux value after lamp replacement is shown in Table 8, namely: Inpatient Room 1 - 7,

$$E\ (LR) = \frac{N \times \Phi \times LLF \times C_u \times n}{A} \quad (4)$$

$$E\ (LR) = \frac{12 \times 1.710 \times 0{,}8 \times 0{,}7 \times 1}{54}$$

$$E\ (LR) = \frac{11.491{,}2}{54} = 212{,}8 \text{ Lux}$$

After calculating the recommended lux value (LR) using recommendation data in the form of changing the number of lamp points (N) and lamp power, the results obtained in the form of an increase in lighting strength (Lux) are appropriate and have met the lighting standards of SNI 03-6197-2000 [16].

4 Conclusion

Based on the calculation of the use of electrical energy in the Pratama Tapan Hospital, amounting to 38,296 watts with the most significant energy use found in the cooling/air conditioning load of 53% and the lowest is the lighting load of 5% of the total calculated power. While the results of the use of electrical energy in the Primary Hospital based on the Energy Consumption Intensity (ECI) standard after the measurement is very efficient, which amounted to 10.33 kWh/m^2/year. Therefore, the hospital must maintain this condition so that the ECI value is always in a highly efficient position. The small value of Energy Consumption Intensity (ECI) is due to several factors, one of which is that the room facilities at the Pratama Tapan Hospital do not meet the standards.

The lighting system in the Pratama Tapan Hospital room still does not meet the Lux SNI standard stated in the SNI 03-6197-2000 standard, so it is necessary to change the number of lamp points (N) and power on the lamp so that the lighting strength in each room meets the minimum lighting.

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