ELECTRICITY AND LIGHTING AUDITS AT THE BONO PEKANBARU HOTEL

TUGAS AKHIR

Diajukan Sebagai Salah Satu Syarat untuk Memperoleh Gelar Sarjana Teknik
pada Program Studi Teknik Elektro Fakultas Sains Dan Teknologi

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PROGRAM STUDI TEKNIK ELEKTRO
FAKULTAS SAINS DAN TEKNOLOGI
UNIVERSITAS ISLAM NEGERI SULTAN SYARIF KASIM RIAU
PEKANBARU
2023

LEMBAR PERSETUJUAN

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Electricity and Lighting Audits at The Bono Pekanbaru Hotel

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Abstract— Electrical energy is one of the primary sources of energy support in our lives, which is very important in the operation of the hospitality industry, especially in using electronic equipment and air conditioning lighting. Many devices that require electrical energy to operate make energy consumption increase. Therefore, efforts to prevent waste of electricity use need to be made through energy audits as well as energy savings opportunities by performing calculations of Energy Consumption Intensity (IKE) values based on historical data of electrical consumption and performing measurements of light intensity on the lighting system available at The Bono Pekanbaru Hotel. Some rooms still exceed the set IKE value, which can be categorized as wasteful energy. It is necessary to do so energy-saving opportunities while on the lighting system based on the measurement of the light intensity carried out in each room, many rooms that do not meet the lighting standards and the basis of the visual still experience evaporation. This requires an energy audit and a lighting audit. On the important lighting system made, upgrade technology with the change of type and power of lighting on lighting will create energy savings in the use of electricity at the Hotel the Bono Pekanbaru and create a bright and comfortable room. Change the currently installed lights into LED lights so that the lighting system available in each room meets the SNI lighting standard 03-6197-2000.

Keywords: energy audit, electricity, IKE, lighting

1 Introduction

Electricity is an energy often used to assist in every human activity. Electricity plays a significant role, one of which is to activate electronic equipment. According to the Ministry of Energy and Mineral Resources (ESDM), electricity consumption per capita in Indonesia by 2022 will have reached 1,173 kilowatt-hours (kWh). Electricity consumption has increased by 4.45% from 2021 to 1.123 kWh. This shows that electricity consumption is increasing every year [1].

The Indonesian government is striving for energy efficiency to reduce the use of the remaining fossil energy reserves. The government's efforts to improve energy efficiency involve using energy conservation methods commonly used in factories, industrial buildings, households, and commercial buildings. One is on commercial buildings such as public service buildings, shopping centers, and hotels [2].

At the hotel building, we use lighting tools to save energy. Our central lighting system utilizes natural light from dawn to daylight and cuts down on artificial lighting from lamps, reducing our electricity usage. Our electric energy efficiency depends on the electricity used, the installed equipment, and monthly or yearly electricity consumption [3]. On energy conservation, several things can be done to improve efficiency: conducting energy-saving behavior, retrofitting, and upgrade technology [4].

Energy conservation is a highly systematic, scheduled, and integrated step to preserve energy resources. Energy conservation is a method used to calculate the energy consumption of a building or more buildings, the so-called audit process. If power use on electricity is inefficient, it causes high electricity consumption and increases electricity costs. This is why it is important to conduct an energy audit [5][6].

Research related to energy audits and lighting audits has been carried out in various sectors, including energy auditing and the measurement of light intensity on the lighting systems in hotels [7]

dan [8], energy audit and lighting audit on buildings [6] and [9], Energy audits and recommendations for changing lights on lighting systems [10][11].

Audits at hotels are significant because they are one of the commercial places that are generally used with colossal electricity consumption. In the world of hospitality, energy consumes the most critical things in its operation, such as lighting systems, lifts, cooling systems (AC), pumps, and heaters. The Hotel Bono Pekanbaru is a four-star hotel with complete facilities and rooms. The hotel has a building area of 5000 m^2 and has 16 floors with a total of 145 rooms and 11 versatile rooms.

Based on the electricity consumption data at the Bono Hotel in 2022, it shows huge monthly energy usage. In addition to the lighting system, based on the observation and survey results carried out, it still looks weak. In an interview with the hotel's technician, Bono said that the lights in the hotel did not appear bright and still used CFL (Compact Fluorescent Lamp) and TL (Tubular Lamp). The measurements, which showed the results of the intensity of death present in each room at the hotel building, proved this. The Bono Pekanbaru is still re-dup and needs to meet the lighting standard SNI 03-6197-2000.

Based on the problems that occurred at the hotel, the purpose of this research is to identify the value of energy consumption intensity (IKE), socialize related treatment of refrigerants and electricity consumption, and make recommendations for the replacement of environmentally friendly lamps or LED lamps that meet the standards and efficiency of the lighting system at the Bono Pekanbaru Hotel.

2 Methods

The outcome of the study is shown in Figure 1. The method used in this study is direct observation and energy auditing, with the following stages: 1) collect and calculate total monthly energy consumption data for 2022 based on historical data, 2) calculate the energy consumption intensity, or IKE value, that is available in each room of the Bono Pekanbaru Hotel, 3) calculate and analyze the energy savings opportunities available at Hotel The Bono Pekanbaru, 4) measure the light intensity (lux) in every room of Hotel The Bono Pekanbaru, and 5) calculate the recommended lighting points and change the type and power of the lighting in each room of Hotel the Bono Pekanbaru according to the SNI standard 03-6197-2000.

Energy auditing is a method of evaluating energy use by identifying opportunities for savings and providing recommendations to improve efficiency for users of energy sources in the context of energy conservation [12]. An energy audit aims to see how the amount of energy consumption in a building can be calculated by energy consumption intensity (IKE), which is a calculation obtained from the result of the distribution between the total electricity use in each period and the area of the building. According to the Energy and Mineral Resources Ministry's Energy Efficiency Guidelines, there are many aspects that are emphasized in several types of buildings that are needed to support energy savings, namely office buildings, hospitals, commercial buildings such as malls and shopping centers, apartments, educational buildings, and hotels. It is a hotel that has characteristics 1) 24-hour working hours, 2) it is divided into several categories, namely 5 stars, 4 stars, 3 stars, 2 stars, and 1 star, which are differentiated based on the number of rooms and standard of facilities, 3) it functions as a transit hotel, city hotel, and/or holiday hotel, 4) there is a bathroom in every room, 5) floor areas are divided according to public areas, limited areas, and service areas, and 6) safety and comfort are our top priorities [13].

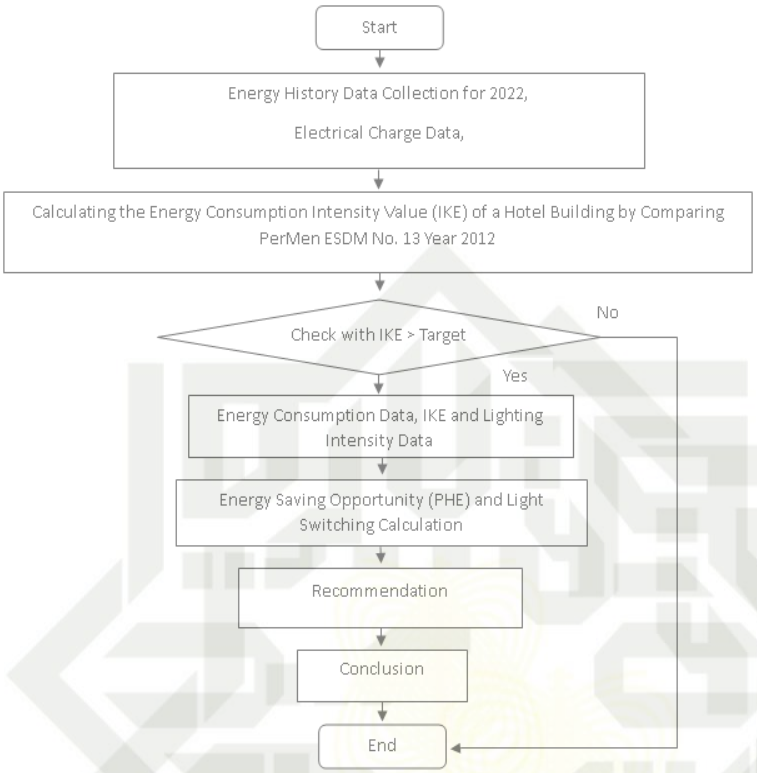

Fig. 1. Research flowchart

2.1 Energy Audit

An energy audit is a process of evaluating energy conservation and identifying energy-saving opportunities, along with recommendations to improve energy efficiency in a building. Energy audits are usually carried out by a party or person whose expert, non-partisan, and objective nature is commonly known as the auditor. The purpose of the audit is to verify that the equipment or energy use is running in accordance with existing standards and regulations and that its use has been approved [14][15].

2.2 Early Energy Audit

Audits are carried out by measuring productivity and savings in electricity consumption and looking at savings opportunities. The initial energy audits included several activities, namely the construction and documentation of buildings, the installation of lighting on each floor of the building, the use of electrical power, and the size of reserve power **[16].**

2.3 Detailed Energy Audit

A detailed audit is an advanced stage of the initial energy audit and analyzes the use of the last few years and then performs research by performing detailed calculations so that you can identify the waste of electricity and find solutions, such as more detailed energy savings opportunities, and obtain the savings value that is then used to present detailed report data and find recommendations and how to apply them [17][18].

2.4 Energy Use Intensity (IKE)

IKE is the result of the consumption of electric energy at a certain time by a large unit in the building. IKE (energy consumption intensity) calculation of a building [19],

$$IKE = \frac{\text{Total Energy Consumption (kWh)}}{\text{Wide (m}^2\text{)}} \quad (1)$$

The values obtained from the calculation of the electricity IKE are used as a benchmark to group the type of electricity consumption used in the building, whether it is the same as the existing standard or not. The calculation of the energy consumption intensity in the building is obtained from the SNI standard by dividing the use and duration of electricity use by a broad unit. What can be calculated [19]:

a. Energy consumption per year (kWh/year).
b. Large detail of the building (m^2).
c. Energy Consumption Intensity (IKE) in Buildings (kWh/m^2/year).
d. Cost of energy use.

According to a study conducted by ASEAN-USAID in 1987, the value of energy consumption intensity for accommodation or hospitality is 300 kWh/m^2/year [20]. Based on the minimum requirements for IKE values on buildings in Indonesia that were set by the Ministry of National Education in 2004 [21].

Table 1. Standard IKE [12]

Category	AC Room (kWh/m^2/month)	Non-AC Room (kWh/m^2/month)
Very Efficient	< 8,5	< 3.4
Efficient	8.5 s/d 14	3.4 s/d 5.6
Sufficiently Efficient	14 s/d 18.5	5.6 s/d 7.4
Wasteful	> 18.5	> 7.4

2.5 Energy Saving Opportunities (PHE)

Energy Saving Opportunity (PHE) is the method performed in the energy audit when the value of the energy consumption intensity measured exceeds the standard value that has been specified. In the audit method performed, the value of total energy consumption was obtained using the IKE formula and the area of the building [22].

2.6 Lighting System

An audit is performed on the lighting system to know the standard and level of attack in a room. [22]. Saving the use of electric energy on the lighting system described in the ESDM policy of the Republic of Indonesia No. 13 Year 2012 on energy savings in Article 4 Paragraph 1 Letter B by doing the following [23]:

a. Use the light according to its intended use and do not waste energy.
b. Reducing the use of accessory lights (decorative lights).
c. Use of ballast in TL lamps.
d. Adjust the maximum electric power in the lighting system [6].

Table 2. Lighting standard

Room	Power	Minimum Lux
Parking Area	4 Watt/m^2	100 Lux
Room on the Stairs	4 Watt/m^2	150 Lux
Archive Warehouse	6 Watt/m^2	150 Lux
Meeting Room	12 Watt/m^2	300 Lux
Office	12 Watt/m^2	350 Lux
Reception Room	13 Watt/m^2	300 Lux

e. Grouping the switches according to their utilization and use.

f. When not in use, the light should be turned off.
g. The use of a lamp housing to have a good light reflection.
h. Install smart switches at any place using time settings and light sensors.
i. Using sunlight as the source of lighting during the day by opening curtains or windows.
j. Cleaning dirty lamps and the armature (lamp housing).

3 Result and Discussion

3.1 Equipment and Use of Electricity in Every Room of the Bono Hotel Pekanbaru

Table 3. Use of equipment and power in each room

Room Name	Equipment	Quantity	Power
Deluxe	5 Watt Lamp	7	35 W
	AC 1,5 PK	1	400 W
	Minibar	1	35 W
	TV 30'Inch	1	52 W
	Water Heater	1	650 W
Executive	5 Watt Lamp	7	35 W
	AC 1,5 PK	1	400 W
	Minibar	1	35 W
	TV 30'Inch	1	52 W
	Water Heater	1	650 W
Junior Suite	5 Watt Lamp	10	35 W
	AC 2 PK	1	400 W
	Minibar	1	35 W
	TV 30'Inch	1	52 W
	Water Heater	1	650 W
Presiden Suite	5 Watt Lamp	14	35 W
	AC 2 PK	2	400 W
	Minibar	1	35 W
	TV 30'Inch	2	52 W
	Water Heater	1	650 W
Front Office	Computer	5	200 W
	AC 5 PK	5	5000 W
	12 Watt Lamp	40	12 W
Kitchen	Oven	1	350 W
	Under C.Chiller	2	250 W
	Washing Machine	1	350 W
	Mixer	1	210 W
	AC 1,5 PK	1	400 W
	T18 Lamp	8	18 W
HRD Office	Computer	5	200 W
	AC 2 PK	1	720 W
	12 Watt Lamp	6	12 W
Engineering Office	Computer	2	200 W
	AC 2 PK	1	720 W
	T18 Lamp	2	18 W
	Dispenser	1	190 W
Marketing Office	Computer	4	200 W
	AC 5 PK	1	5000 W
	12 Watt Lamp	4	12 W

Room Name	Equipment	Quantity	Power
Corridor	3 Watt Lamp	22	3 W
	12 Watt Lamp	22	12 W
	Exhaust	3	1000 W
Talang M.1	12 Watt Lamp	25	12 W
	Sound	1	200 W
	AC 5 PK	1	5000 W
Talang M.2	12 Watt Lamp	25	12 W
	Sound	1	200 W
	AC 5 PK	1	5000 W
Talang M.3	12 Watt Lamp	25	12 W
	Sound	1	200 W
	AC 5 PK	1	5000 W
Talang M.4	12 Watt Lamp	25	12 W
	Sound	1	200 W
	AC 5 PK	1	5000 W
Talang M.5	12 Watt Lamp	25	12 W
	Sound	1	200 W
	AC 5 PK	1	5000 W
Akit 1	12 Watt Lamp	10	12 W
	Sound	1	200 W
	AC 5 PK	2	5000 W
Akit 2	12 Watt Lamp	10	12 W
	Sound	1	200 W
	AC 5 PK	2	5000 W
Akit 3	12 Watt Lamp	10	12 W
	Sound	1	200 W
	AC 5 PK	2	5000 W
Akit45.1	12 Watt Lamp	35	12 W
	Sound	1	1000 W
	AC 5 PK	4	5000 W
Akit45.2	12 Watt Lamp	35	12 W
	Sound	1	1000 W
	AC 5 PK	4	5000 W
Sakai	T18 Lamp	25	18 W
	15 Watt Lamp	16	15 W
	Chandelier	4	150 W
	Sound	1	3000 W
	AC 5 PK	8	5000 W
Toilet	12 Watt Lamp	3	12 W
Canteen	T18 Lamp	4	18 W
	Dispenser	1	190 W
	AC 2 PK	1	720 W
Restaurant	AC 5 PK	3	5000 W
	12 Watt Lamp	41	12 W
Pool	Circulation Pump	1	200 W
	Refrigerator	1	150 W
	12 Watt Lamp	21	12 W
	5 Watt Lamp	18	5 W
Bar/Cafe	TV 40 Inch	1	50 W
	Coffe Machine	1	200 W
	Under C.Chiller	2	150 W
	Incandescent Lamps	20	12 W

Room Name	Equipment	Quantity	Power
	Sound	1	1000 W
	Dispenser	1	190 W
	AC 2 PK	1	720 W

Each room in the hotel uses different electronic equipment according to the needs of the room. This resulted in the need for electricity, and the electricity consumption in each room was different. This can be seen in Table 4.

Table 4. Usage of kWh per-room

Room Name	Consumption (kWh/month)	Wide (m^2)
Deluxe	773.52	25
Executive	773.52	28
Junior Suite	994.62	48
Presiden Suite	1514.34	104
Front Office	19065.6	1500
Kitchen	473.58	180
HRD Office	483.84	144
Engineering Office	363.42	144
Marketing Office	1578.96	144
Corridor	11037.6	200
Talang M.1	396	60
Talang M.2	396	60
Talang M.3	396	60
Talang M.4	396	60
Talang M.5	396	60
Akit 1	728.64	100
Akit 2	728.64	100
Akit 3	728.64	100
Akit45.1	1542.24	625
Akit45.2	1542.24	625
Sakai	1465.2	625
Toilet	25.92	35
Canteen	265.14	121
Restaurant	4182.84	1500
Pool	186.84	1500
Bar/Café	405	1500

Based on the results of the audit and the calculation of electricity usage (kWh) that was carried out, there are differences in each room. A large use of electricity occurs in lodging rooms; this is caused by excessive use that does not suit the needs of every visitor who comes to stay overnight. In addition, the corridors also show large electricity usage (kWh) due to the heat source found in each corridor, which is on for 24 hours. Whereas in lodging rooms, the large use of electricity is caused using air conditioners, water heaters, and lights. However, the current research and calculations only focus on the system and the intensity of the lighting in each room.

3.2 Calculation of Energy Consumption Intensity (IKE)

The calculation of energy consumption intensity is done by adding up the monthly kWh usage and dividing it by the area of the building. Example:

Deluxe Room kWh consumption = 773.52 kWh

Wide = 25 m2

Then obtained using the IKE formula equation (1), namely:

$$\text{IKE} = \frac{\text{Total Energy Consumption (kWh)}}{\text{Wide (m}^2\text{)}}$$

$$IKE = \frac{773.52\ kWh}{25\ m^2}$$

$$IKE = 30.94\ kWh/m^2/month$$

The following is the result of calculating the energy consumption intensity (IKE) of The Bono Hotel in each room:

Table 5. Energy consumption intensity (IKE) of each room

Room Name	IKE (kWh/m^2/month	Standard (kWh/m^2/month)	Room Type	Category
Deluxe	30.94	14	AC	Wasteful
Executive	27.62	14	AC	Wasteful
Junior Suite	20.72	14	AC	Wasteful
Presiden Suite	14.56	14	AC	Sufficiently Efficient
Front Office	12.71	14	AC	Efficient
Kitchen	2.63	5.6	Non-AC	Very Efficient
HRD Office	3.36	14	AC	Very Efficient
Engineering Office	2.52	14	AC	Very Efficient
Marketing Office	10.96	14	AC	Efficient
Corridor	50.58	14	AC	Wasteful
Talang M.1	6.6	14	AC	Very Efficient
Talang M.2	6.6	14	AC	Very Efficient
Talang M.3	6.6	14	AC	Very Efficient
Talang M.4	6.6	14	AC	Very Efficient
Talang M.5	6.6	14	AC	Very Efficient
Akit 1	7.28	14	AC	Very Efficient
Akit 2	7.28	14	AC	Very Efficient
Akit 3	7.28	14	AC	Very Efficient
Akit45.1	2.46	14	AC	Very Efficient
Akit45.2	2.46	14	AC	Very Efficient
Sakai	2.34	14	AC	Very Efficient
Toilet	0.74	5.6	Non-AC	Very Efficient
Canteen	2.19	14	AC	Very Efficient
Restaurant	2.78	14	AC	Very Efficient
Pool	0.12	5.6	Non-AC	Very Efficient
Bar/Cafe	0.27	14	AC	Very Efficient

Based on the results of the energy consumption intensity (IKE) calculations carried out, there are several rooms that fall into the category of efficient and wasteful use of electricity. The IKE calculation results obtained show that the lodging room exceeds the existing IKE standard, which causes it to enter the category of waste electrical energy.

Through interviews that researchers conducted with the hotel before the pandemic hit, an increase in hotel guest arrivals occurred in the mid- to late-year range. In the same way as the use of rooms, multipurpose rooms or ballrooms at the hotel have also experienced an increase in their use, so by increasing the use of rooms, the use of electrical energy at Hotel the Bono Pekanbaru will increase, but in 2022, the arrival of guests has not increased because it is still in a transitional period. from pandemic to endemic. These results can be seen in Table 5.

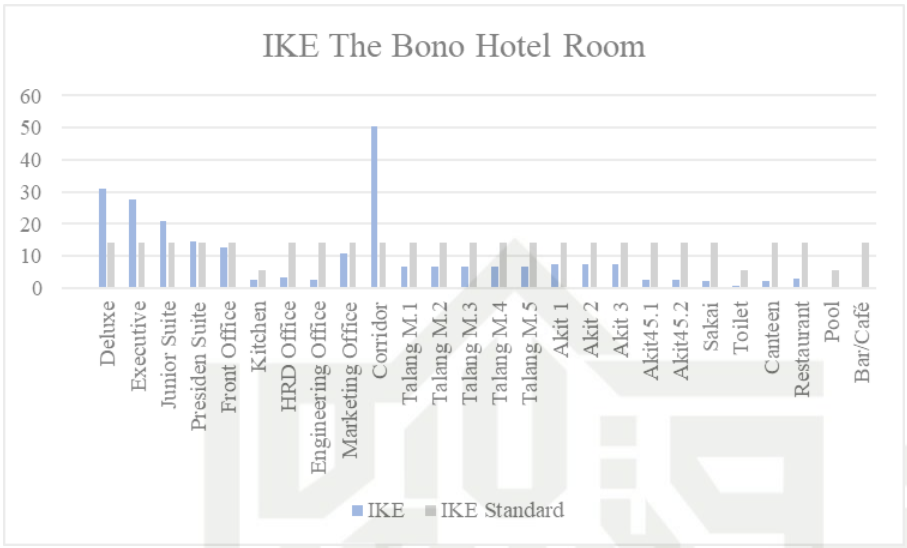

Fig. 2. Graph of room energy consumption intensity at the Bono Pekanbaru Hotel

Based on Figure 2, the graph shows that the deluxe, executive, junior suite, presidential suite, and corridor rooms experienced an increase in the energy consumption intensity (IKE) value, which exceeded the set IKE standard.

3.3 Energy Saving Opportunities (PHE)

The thing to do to get the saving value on energy-saving opportunities is to calculate the comparison or difference between the current energy consumption intensity value and the target energy consumption intention value. To find the PHE value at the Bono Pekanbaru Hotel, it can be seen in the Table 6.

Table 6. Value of energy saving opportunity (PHE) for each room

Room Name	IKE (kWh/m^2/month)	Standard (kWh/m^2/month)	PHE Target Value (kWh/m2/month)
Deluxe	30.94	14	16.94
Executive	27.62	14	13.62
Junior Suite	20.72	14	6.72
Presiden Suite	14.56	14	0.56
Front Office	12.71	14	There is no
Kitchen	2.63	5.6	There is no
HRD Office	3.36	14	There is no
Engineering Office	2.52	14	There is no
Marketing Office	10.96	14	There is no
Corridor	55.18	14	36.58
Talang M.1	6.6	14	There is no
Talang M.2	6.6	14	There is no
Talang M.3	6.6	14	There is no
Talang M.4	6.6	14	There is no
Talang M.5	6.6	14	There is no
Akit 1	7.28	14	There is no
Akit 2	7.28	14	There is no
Akit 3	7.28	14	There is no
Akit45.1	2.46	14	There is no
Akit45.2	2.46	14	There is no
Sakai	2.34	14	There is no
Toilet	0.74	5.6	There is no
Canteen	2.19	14	There is no
Restaurant	2.78	14	There is no
Pool	0.12	5.6	There is no

Room Name	IKE (kWh/m^2/month)	Standard (kWh/m^2/month)	PHE Target Value (kWh/m2/month)
Bar/Cafe	0.27	14	There is no

Based on the calculation of the Energy Saving Opportunity (PHE) performed, the value of the opportunity can be achieved in the deluxe rooms, executive suites, junior suites, presidential suites, and corridors with targeted energy-efficient opportunities in the efficient category.

3.4 Room Lighting Hotel the Bono Pekanbaru

a. Use Of Lights in Every Room in the Lighting System of The Bono Hotel

Table 7. Use of lights in every room

Room Name	Lamp Type	Quantity	Daya (Watt)
Deluxe	CFL	7	5 Watt
Executive	CFL	7	5 Watt
Junior Suite	CFL	10	5 Watt
Presiden Suite	CFL	14	5 Watt
Front Office	CFL	40	12 Watt
Kitchen	T18	8	18 Watt
HRD Office	CFL	6	12 Watt
Engineering Office	T18	2	18 Watt
Marketing Office	CFL	4	12 Watt
Corridor	CFL	22	3 Watt
	CFL	22	12 Watt
Talang M.1	CFL	25	12 Watt
Talang M.2	CFL	25	12 Watt
Talang M.3	CFL	25	12 Watt
Talang M.4	CFL	25	12 Watt
Talang M.5	CFL	25	12 Watt
Akit 1	CFL	10	12 Watt
Akit 2	CFL	10	12 Watt
Akit 3	CFL	10	12 Watt
Akit45.1	CFL	35	12 Watt
Akit45.2	CFL	35	12 Watt
Sakai	CHANDELIER	4	150 Watt
	T18	25	18 Watt
	CFL	6	15 Watt
Toilet	CFL	3	12 Watt
Canteen	T18	4	18 Watt
Restaurant	CFL	41	12 Watt
Pool	CFL	21	12 Watt
	CFL	18	5 Watt
Bar/Cafe	INCANDESCENT	20	12 Watt

The pattern of electricity consumption and usage in each room according to their respective uses has an impact on the building lighting system.

b. Comparison of Lighting Systems for Each Room of the Bono Hotel Pekanbaru

Table 8. Comparison of measurements and lighting system standards

Room Name	Lighting (Lux)		Description Fulfills
	Measurement	Standard	
Deluxe	90	150	No
Executive	89	150	No
Junior Suite	107	150	No
President Suite	109	150	No
Front Office	282	350	No
Kitchen	52	200	No
HRD Office	260	350	No
Engineering Office	263	350	No

Room Name	Lighting (Lux)		Description Fulfills
	Measurement	Standard	
Marketing Office	285	350	No
Corridor	39	100	No
Talang M.1	90	200	No
Talang M.2	91	200	No
Talang M.3	90	200	No
Talang M.4	90	200	No
Talang M.5	90	200	No
Akit 1	92	200	No
Akit 2	90	200	No
Akit 3	91	200	No
Akit45.1	98	200	No
Akit45.2	98	200	No
Sakai	102	200	No
Toilet	100	250	No
Canteen	52	200	No
Restaurant	107	200	No
Pool	160	200	No
Bar/Cafe	92	200	No

Based on an audit that has been carried out on the lighting system at the Bono Pekanbaru Hotel, measurement results have been obtained, which can be seen in Table 8. The lighting system in the hotel rooms does not meet SNI 03-6197-2000 standards [24]. There are still many rooms that look dark even though the lights are on. This is because the rooms in the hotel still use non-LED lamps, which are not environmentally friendly because the power of the lamps is small and not in accordance with the room they are illuminating. So, it is necessary to replace and install energy-saving lamps and good lighting using LED lights. It can be seen in Table 11. Recommendations for replacing lamps in the lighting system at the Bono Hotel Pekanbaru.

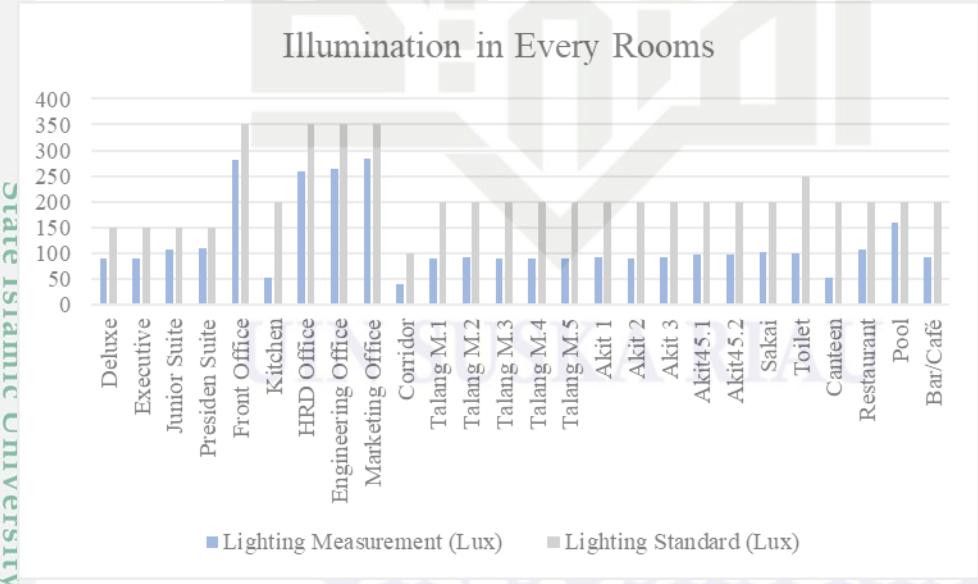

Fig. 3. Bono hotel room lighting comparison graph

Based on Figure 3, Shows a comparison graph of the lighting system with the SNI 03-6197-2000 standard found at The Bono Hotel. The graph shows a significant difference in that the light intensity in each room still does not meet the existing standards, so it is necessary to replace the lights.

c. Replacement of Lamps in Lighting Systems According to SNI 03-6197-2000 Standards

Table 9. Lighting system lamp upgrade recommendations

Room Name	LED Lamp Upgrade Recommendations (pcs)		SNI Standard
	13W	19W	
Deluxe	6		150
Executive	7		150
Junior Suite	11		150
Presiden Suite	24		150
Front Office		410	350
Kitchen		29	200
HRD Office		40	350
Engineering Office		40	350
Marketing Office		40	350
Corridor	31		100
Talang M.1		10	200
Talang M.2		10	200
Talang M.3		10	200
Talang M.4		10	200
Talang M.5		10	200
Akit 1		16	200
Akit 2		16	200
Akit 3		16	200
Akit45.1		99	200
Akit45.2		99	200
Sakai		99	200
Toilet	12		250
Canteen	31		200
Restaurant		233	200
Pool		233	200
Bar/Cafe		233	200

After obtaining the results in the form of recommendations for changing the type and power of the lights in the lighting system of The Bono Pekanbaru Hotel, the results of calculating the light intensity in each room of The Bono Pekanbaru Hotel are as follows.

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

Explanation:
E = Lux Value
N = Amount of Light Points
Φ = Lumens Value
LLF = Light Loss Factor (0,8)
Cu = Coefficient of Utilization (0,7)
n = Number of Lights in One Point
A = Room Area

The calculations after upgrading the lamp are, example in Deluxe Room:

$$E = \frac{N \times \Phi \times LLF \times Cu \times n}{A}$$

$$= \frac{6 \times 1400 \times 0,8 \times 0,7 \times 1}{25}$$

$$= \frac{4704}{25}$$

$$= 188,16 \text{ Lux}$$

So, the calculation results for each room are as follows:

Table 10. Results of the upgrade of lamps in the lighting system

Room Name	Before Upgrade (Lux)	After Upgrade (Lux)	SNI Standard (Lux)
Deluxe	90	188	150
Executive	89	196	150
Junior Suite	107	179	150
Presiden Suite	109	180	150
Front Office	282	352	350
Kitchen	52	207	200
HRD Office	260	357	350
Engineering Office	263	357	350
Marketing Office	285	357	350
Corridor	39	121	100
Talang M.1	90	214	200
Talang M.2	91	214	200
Talang M.3	90	214	200
Talang M.4	90	214	200
Talang M.5	90	214	200
Akit 1	92	206	200
Akit 2	90	206	200
Akit 3	91	206	200
Akit45.1	98	204	200
Akit45.2	98	204	200
Sakai	102	204	200
Toilet	100	268	250
Canteen	52	200	200
Restaurant	107	200	200
Pool	160	200	200
Bar/Cafe	92	200	200

After the results were obtained in the form of recommendations in the form of changing the type and power of lamps in the lighting system of The Bono Hotel Pekanbaru, the results were obtained in the form of an appropriate increase in light intensity and had met the lighting standards of SNI 03-6197-2000 [24].

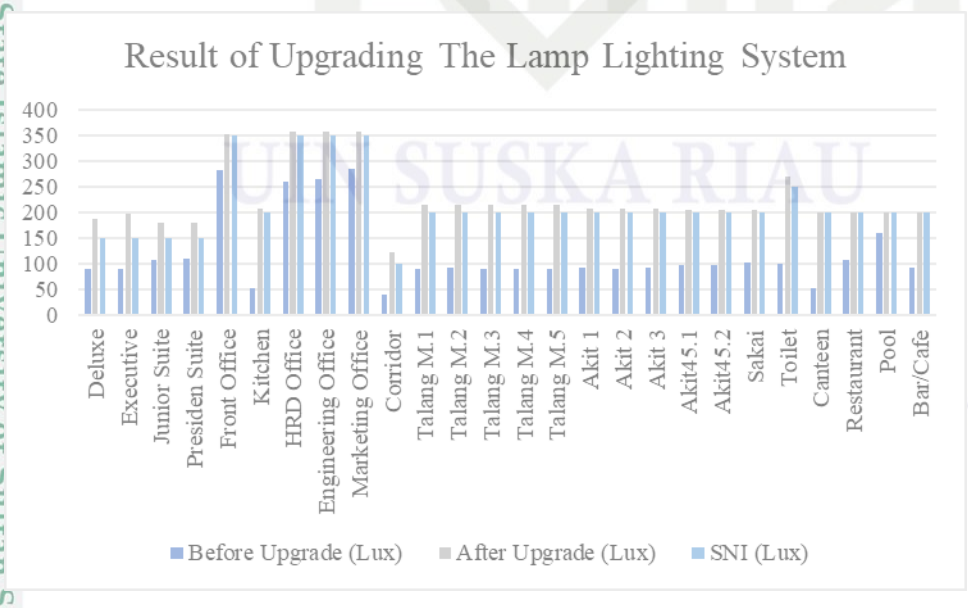

Fig. 4. Comparison graph of lighting before and after lamp replacement

After replacing the light bulbs in the lighting system found in the inn rooms, the graph in Figure 4. Shows the increase in light intensity in the deluxe, executive, junior suite, and president suite rooms. The increase in light intensity has met the minimum standard of lux that has been set. Whereas in the rooms at The Bono Pekanbaru Hotel, after the replacement of the lights, there was an increase in the value of lighting intensity (lux), which has met the SNI 03-6197-2000 standard of lighting intensity in each room.

d. Energy Consumption Intensity (IKE) After Lamp Upgrade

After upgrading the lights in the lighting system, the amount of electricity usage is obtained in the Table 11.

Table 11. Use of kWh and IKE after upgrade of lamps in the lighting system

Room Name	Consumption (kWh/month)	IKE	IKE Standard	Room Type	Category
Deluxe	801.9	32.07	14	AC	Wasteful
Executive	810.48	28.94	14	AC	Wasteful
Junior Suite	1056	22	14	AC	Wasteful
Presiden Suite	1677.06	16.12	14	AC	Sufficiently Efficient
Front Office	23861.4	15.90	14	AC	Sufficiently Efficient
Kitchen	583.47	3.2	5.6	Non-AC	Very Efficient
HRD Office	669.6	4.65	14	AC	Very Efficient
Engineering Office	558.9	3.88	14	AC	Very Efficient
Marketing Office	1771.2	12.3	14	AC	Efficient
Corridor	11065.98	55.32	14	AC	Wasteful
Talang M.1	388.08	6.46	14	AC	Very Efficient
Talang M.2	388.08	6.46	14	AC	Very Efficient
Talang M.3	388.08	6.46	14	AC	Very Efficient
Talang M.4	388.08	6.46	14	AC	Very Efficient
Talang M.5	388.08	6.46	14	AC	Very Efficient
Akit 1	741.88	7.41	14	AC	Very Efficient
Akit 2	741.88	7.41	14	AC	Very Efficient
Akit 3	741.88	7.41	14	AC	Very Efficient
Akit45.1	1647.43	2.63	14	AC	Very Efficient
Akit45.2	1647.43	2.63	14	AC	Very Efficient
Sakai	1395.43	2.23	14	AC	Very Efficient
Toilet	112.32	3.2	5.6	Non-AC	Very Efficient
Canteen	354.51	2.92	14	AC	Very Efficient
Restaurant	5245.29	3.49	14	AC	Very Efficient
Pool	1289.79	0.85	5.6	Non-AC	Very Efficient
Bar/Cafe	1033.05	0.68	14	AC	Very Efficient

Based on Table 11, Shows that the use of electrical energy has increased compared to before the change to LED lights in the lighting system in each room. However, there are several rooms that have experienced a decrease in electricity usage (kWh), such as the Talang Mamak 1 to Talang Mamak 5 rooms. After obtaining the total energy use in each room, the Energy Consumption Intensity (IKE) calculation is performed.

The calculation of energy consumption intensity is done by adding up the monthly kWh usage and dividing it by the area of the building. For example, the following:

Deluxe Room kWh consumption = 801.9 kWh

Wide = 25 m^2

Then obtained using the IKE formula equation (1) namely:

$$IKE = \frac{\text{Total Energy Consumption (kWh)}}{\text{Wide } (m^2)}$$

$$IKE = \frac{801.9 \text{ kWh}}{25 \text{ m}^2}$$

$$IKE = 32.07 \text{ kWh/m}^2\text{/month}$$

Based on the results of the calculation of the energy consumption intensity (IKE) obtained based on Table 11, It shows that after changing the lamp to an LED lamp, the results of the IKE value in each room show the same category as before the lamp was replaced, so that it does not cause excessive use. soared all over the room. Rooms that exceed IKE standards are in the deluxe, executive, junior suite, and corridor rooms in the extravagant category, while the front office and presidential suite are in the quite efficient category. However, in the lighting system, after changing the lights, it shows that the light intensity in each room meets SNI 03-6197-2000 standards.

As for energy conservation, which is carried out to reduce the use of electrical energy and achieve the desired energy savings in the efficient category in the deluxe, executive, junior suite, presidential suite, and corridor rooms, it is necessary to carry out energy conservation with energy-saving behavior. The energy-saving behaviors that are carried out are:

1) In commercial buildings, when using electronic equipment that is not in use, you should turn it off.
2) Change the settings on the computer to be in standby mode when not in use.
3) Unplug cables on electronic equipment from the wall socket when not in use or use a smart power strip for all electronic equipment.
4) Incessantly conduct important training on how to save energy for employees and outreach to visitors who come.

4 Conclusions

Based on the results of the measurements and calculations carried out, it is concluded that the size of the Energy Consumption Intensity (IKE) in office rooms, versatile spaces, swimming pools, restaurants, canteens, cafes/bars, and toilets at The Bono Hotel Pekanbaru is still in the efficient category, but there are some rooms that are still in the category of quite efficient, such as the accommodation room with the type of presidential suite. In the deluxe, executive, junior suite and corridor rooms, the IKE value in the apartment is still significant, exceeds the set IKE standard, and is in the wasteful category. Energy consumption intensity (IKE) exceeds the standards set by the Minister of Energy and Mineral Resources Regulation No. 13 of 2012, it is necessary to make energy-saving opportunities to reach the efficient category, so it is required to save energy by providing awareness and outreach about energy-saving behaviors. Meanwhile, the lighting system in every room of the hotel building still does not meet the lux standard set out in the SNI 03-6197-2000 standard, so the intensity in each room still looks dim. For each room to have comfort during activities as well as excellent intensity and meet standards, it is necessary to make a change (a technology upgrade) to this type of lighting with LEDs because these types of lamps produce good and bright lighting and are environmentally friendly and so that the level of lighting in each room meets minimum lux lighting standards set.

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JURNAL EDUKASI ELEKTRO
ISSN: 2548-8252 (Printed)
ISSN: 2548-8260 (Online)

Letter of Acceptance
(LoA)

Dear Muhammad Fiqri Ramadhan & Zulfatri Aini
(Universitas Islam Negeri Sultan Syarif Kasim Riau, Riau, Indonesia)

With this letter, it's our pleasure to inform you that your papers:

ID : 62785
Title : Electricity and Lighting Audits at the Bono Pekanbaru Hotel
Corresponding Author : Muhammad Fiqri Ramadhan

Has been **ACCEPTED** for publication in Jurnal Edukasi Elektro (JEE) in Vol. 07, No. 02, November 2023.

Congratulation! Thank you very much for contributing to JEE.

Sincerely,

Dr. phil. Didik Hariyanto, M.T.
Editor in Chief