JURNAL SOSIAL DAN TEKNOLOGI

Jurnal Sosial dan Teknologi (SOSTECH)
p-ISSN 2774-5147 | e-ISSN 2774-5155
Volume 4, Number 11, November 2024

An Analysis of Potential for Reducing Operational Costs Through The Use of LED Lighting in Indonesian Hotel

Aldo Gusti Rahman[1], Elsha Juliani[2], Burhanuddin Halimi[3]
Bandung Institute of Technology, Bandung, Indonesia
Email: 23223047@std.stei.itb.ac.id, 23221301@std.stei.itb.ac.id, burhan@std.stei.itb.ac.id

Abstract

Indonesia has significant tourism potential, which drives the growth of the hospitality industry and increasing energy needs. Large energy consumption in hotels, especially in lighting systems, leads to high operational costs and carbon emissions. This study aims to analyze the potential for reducing operational costs through the use of LED lighting at the Bumi Sawunggaling Hotel, Bandung. The methods used include field observation and energy consumption measurement using a Power Quality Analyzer (PQA) for one week, with data taken every 30 minutes. The results of the study show that the hotel's electrical energy consumption reaches 923.45 kWh per week at a cost of IDR 1,334,166. By replacing conventional lighting with LED, hotels can reduce energy consumption by up to 80%, which translates to operational cost savings of 30% or more. The conclusion of this study emphasizes that the application of LED technology not only provides financial benefits but also supports environmental sustainability. The implication of this study is the importance of adopting energy-saving technologies such as LEDs in the hospitality sector as a strategic step to reduce costs and carbon emissions and improve the hotel's reputation as an eco-friendly business, besides that it is very important for Hotel Bumi Sawunggaling to replace its conventional lighting with LED lights to achieve higher energy efficiency. LED lights are known for their superior energy efficiency compared to traditional incandescent lamps or CFL (Compact Fluorescent Lamp) lamps.

Keywords: electrical energy utilization, energy optimization, electrical equipment, building energy, electrical energy consumption

INTRODUCTION

The hospitality industry in Indonesia is experiencing significant growth, driven by its rich natural and cultural resources that attract both domestic and international tourists. (Mahendra, 2024; Ollivaud & Haxton, 2019). In 2022, Indonesia welcomed 5.89 million international tourists, generating foreign exchange earnings of USD 6.72 billion, while domestic tourist visits reached 734.86 million. (Irsyad & Mursyid, 2024). These figures rose in November 2023, with international tourist arrivals totaling 10.4 million and domestic visits reaching 749.11 million, highlighting the sector's importance in national economic development. This growth necessitates the provision of adequate and comfortable accommodations.

Energy efficiency in the hospitality industry is a growing global concern due to significant energy consumption related to guest comfort (Karvounidi et al., 2024). Globally, the hospitality sector is recognized as a major consumer of energy, with lighting systems

contributing substantially to total energy consumption. Amid economic and environmental pressures, the need for sustainable energy practices is critical to reducing the carbon footprint and operational costs in the industry.

In Indonesia, the rapid development of tourism has led to the expansion of the hospitality sector which increases energy demand. Factors such as obsolete lighting technology, lack of awareness of energy-efficient technology, and reliance on conventional lighting systems contribute to excessive electricity consumption. With about 30% of a hotel's energy use caused by lighting, an inefficient system directly affects operational costs and environmental sustainability.

Java, as one of Indonesia's premier tourist destinations, attracts 74.25% of the total domestic tourists. Consequently, the role of accommodations such as hotels is crucial in supporting the development of the tourism sector. The comfort of these accommodations is closely linked to the availability of electrical facilities, such as lighting, cooling systems, and other electrical equipment. Inefficient use of electrical energy can lead to increased operational costs, ultimately affecting hotel profitability.

The high energy consumption in hotels due to inefficient lighting systems leads to increased operating costs and greenhouse gas emissions, which negatively impacts profitability and sustainability. Conventional lighting, such as incandescent bulbs and CFLs, not only consumes more energy but also has a shorter lifespan, increasing maintenance costs and replacement needs. This inefficiency puts financial pressure on hotels, especially those targeting travelers on a budget.

Lighting, which accounts for approximately 30% of total energy consumption in hotels, is a primary focus for energy savings efforts. LED (Light Emitting Diode) lighting technology is considered an effective solution due to its significantly higher energy efficiency compared to incandescent or CFL (Compact Fluorescent Lamp) bulbs. Studies have shown that LEDs can reduce energy consumption by up to 80% while offering a much longer lifespan, ranging from 25,000 to 50,000 hours, which significantly decreases the frequency of replacements and reduces maintenance costs. (Baten et al., 2021; Elliott et al., 2019).

In Indonesia, the adoption of LED technology has been increasingly supported by government policies aimed at reducing energy consumption. As of 2019, approximately 52% of lighting in the country had transitioned to LED, reflecting a national commitment to energy efficiency. (Khayam et al., 2023; Sutopo et al., 2020). This trend is critical in sectors like hospitality, where energy consumption is high, and operational costs are a key concern.

The main variable in this study is the type of lighting technology used in the hotel, specifically comparing traditional lighting systems with LED (Light Emitting Diode) lighting. (Khan et al., 2015). LEDs offer significant advantages in terms of energy efficiency, with studies showing energy savings of up to 80% and a much longer lifespan than traditional lights. These LED technology variables are analyzed based on their impact on energy consumption and reduced operational costs.

With the Indonesian government focusing on reducing energy consumption and improving sustainability, there is an urgent need for the industrial sector, especially high-consumption sectors such as hospitality, to adopt energy-efficient technologies. The urgency

of this research lies in the provision of data that can be used as a guide for hotel managers to reduce operational costs and contribute to national energy-saving targets.

According to Ganandran et al., (2014) One quick way to save energy is to use energy-efficient electrical appliances, where lighting systems have great potential for energy savings. The project focuses on selected buildings on the Universiti Tenaga Nasional campus to design appropriate retrofit scenarios as well as calculate potential electricity savings, payback periods, and potential environmental benefits. In this project, energy savings and emission reductions were analyzed based on a comparison between the existing lighting system and the proposed LED retrofit. In this survey, the old lighting retrofit policy to energy-efficient LEDs started with 10% in the first year and continued until the entire system was replaced within 10 years. The analysis shows that the investment starts to be profitable after four years. Compared with CFLs, T5, and LEDs are more energy-efficient; A 100% retrofit to LEDs saves 44% energy with a 4.01-year return, while the T5 saves 22% with a 3.8-year return. Although the initial cost of LEDs is higher, the long-term savings are greater.

This study offers novelty compared to previous research by focusing on the application of LED lighting retrofits in the Indonesian hospitality sector, especially at Hotel Bumi Sawunggaling, Bandung, which has specific energy consumption patterns and lighting needs. In addition to examining energy savings, the study also analyzes the direct economic impact on hotel operating costs and environmental sustainability implications. By providing empirical data related to economic and environmental benefits in the short and long term, this study serves as a practical guide for hotel managers in Indonesia to optimize energy efficiency and support national sustainability targets through the adoption of LED technology.

This study aims to analyze the potential reduction in operational costs through the replacement of conventional lighting with LED technology at Hotel Bumi Sawunggaling, Bandung. Additionally, the study compares power consumption before and after the implementation of LEDs, considering the number, type, and distribution of lights in various hotel areas. The results are expected to provide practical guidance for hotel managers in enhancing energy efficiency, reducing operational costs, and supporting sustainability in energy management within the hospitality industry.

Furthermore, this study reviews recent literature on lighting technology in Indonesia, including a comprehensive review by (Khayam et al., 2023), which provides an overview of the current status of lighting technology implementation in Indonesia. This review is essential for placing the research within a broader context of energy efficiency in Indonesia's hospitality sector and supporting the adoption of LED technology as part of a long-term sustainability strategy. This review is essential for placing the research within a broader context of energy efficiency in Indonesia's hospitality. The findings of this study are expected to provide valuable insights for hotel managers in Indonesia and similar regions who want to improve energy efficiency. By adopting LED lighting, hotels can lower their electricity costs, reduce carbon emissions, and improve their sustainability profile. These benefits not only support profitability but also contribute to environmental conservation, in line with Indonesia's sustainable development goals.

RESEARCH METHODS

Research Stages

The methodology employed in this study follows the procedures illustrated in the accompanying figure.

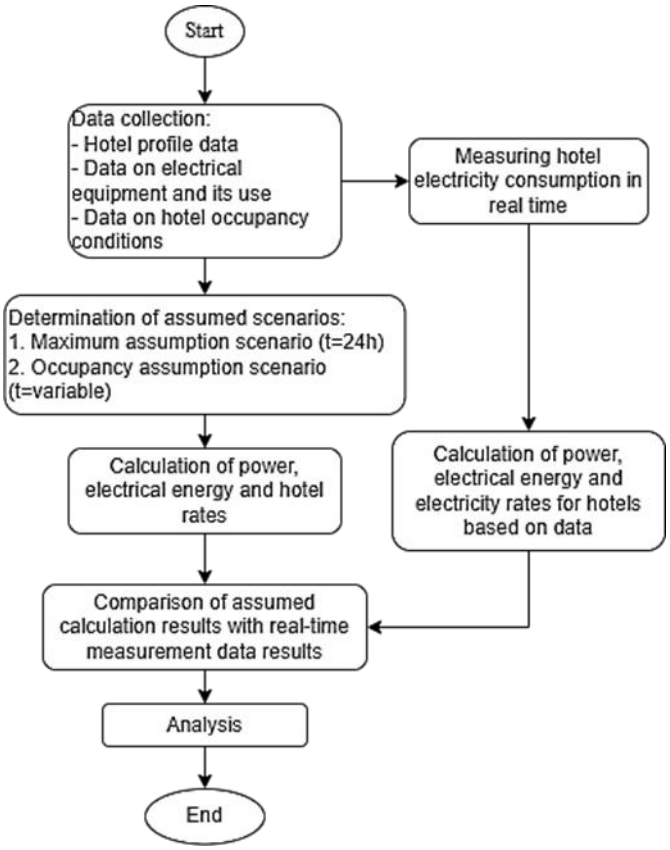

Figure 1. Research Stages

Data Collection

This research employed three distinct methods for data collection:

a. Initial data regarding the hotel building profile was gathered manually through direct field observations to assess the condition of hotel rooms and areas, as well as the electrical equipment in use.
b. A Power Quality Analyzer (PQA) was utilized to measure the hotel's electrical energy consumption in real-time, with data collected at 30-minute intervals over the course of one week.
c. Microsoft Excel was employed to process all collected data and derive research conclusions.

Hotel Description

The object of this study is the Bumi Sawunggaling Hotel, located at Jl. Sawunggaling, No. 13, Ex. Tamansari, District of Bandung Wetan, Bandung City, West Java Province, postal code 40116. The hotel comprises 22 rooms and 2 meeting rooms spread across three floors,

with specific details regarding room types and areas as follows.

Table 1. Room Types at Bumi Sawunggaling Hotel

No	Room Type	Lt 1	Lt 2	Lt 3	Lt 2+	Total
1	Superior Room	4	4	6		14
2	Deluxe Room				3	3
3	Deluxe Hot Water			4		4
4	Suite Room				2	1
5	Meeting Room	4				2

Table 1 provides information about the types of rooms available in Hotel Bumi Sawunggaling, Bandung. This table groups rooms by type and location on each floor of the hotel. There are several types of rooms, namely Superior Room, Deluxe Room, Deluxe Hot Water, and Suite Room, as well as Meeting Room. Each room type is spread over different floors and has a different number of rooms, according to the capacity and facilities offered by the hotel. This table is important for understanding the distribution of room types and hotel capacity, which will later affect the consumption of electrical energy in each hotel area.

Table 2. Size Of Each Hotel Area

No	Floor	Areas	Long (m)	Wide (m)	Total (m2)
1	1st Floor	Room 101	6.3	3.5	22.1
2		Room 102	6.3	3.5	22.1
3		Room 103	6.3	3.5	22.1
4		Room 104	6.3	3.5	22.1
5		Lobby	9.5	5.4	51.3
6		Siliwangi Meeting Room	7.5	6.5	48.8
7		Ganesha Gallery	5	4.5	22.5
8		Kafe - Outdoor	20.5	7.5	153.8
9		Kafe - Indoor	10.5	6	63.0
10		Parking Area	50	7	350.0
11	2nd Floor	Room 201	6.3	3.5	22.1
12		Room 202	6.3	3.5	22.1
13		Room 203	6.3	3.5	22.1
14		Room 204	5	3.5	17.5
15		Room 205	5	3.5	17.5
16		Room 206	5	3.5	17.5
17		Room 207	5	3.5	17.5
18		Room 208	3	3.5	10.5
19	2+ Floor	Room 401	7.8	6	46.8
20		Room 402	6.5	5	32.5
21		Room 403	5.6	5	28.0
22		Room 404	5.6	5	28.0
23	3rd Floor	Room 301	6.3	3.5	22.1
24		Room 302	6.3	3.5	22.1
25		Room 303	6.3	3.5	22.1
26		Room 304	5	3.5	17.5
27		Room 305	5	3.5	17.5
28		Room 306	5	3.5	17.5

No	Floor	Areas	Long (m)	Wide (m)	Total (m2)
Total hotel area (m2)				1178.1	

Table 2 shows the size of each area in Hotel Bumi Sawunggaling, including guest rooms, meeting rooms, lobby, café areas (indoor and outdoor), galleries, and parking areas. The information presented includes the length, width, and total area (in square meters) of each area of the hotel. This table serves to provide a complete overview of the area in the hotel, which is an important factor in the analysis of energy consumption. Larger areas tend to require more energy for lighting and cooling, so this data will help in calculating the overall energy consumption of the hotel.

To enhance the comfort of guests during their stay, Hotel Bumi Sawunggaling is equipped with various electrical appliances in each room and throughout the hotel premises. According to the data collected, lighting contributes to 30% of the total electricity consumption in the building. Therefore, optimizing lighting usage presents a significant opportunity for energy savings, which can effectively reduce the overall electricity consumption at Hotel Bumi Sawunggaling. The total electrical equipment power is seen in Fig.1.

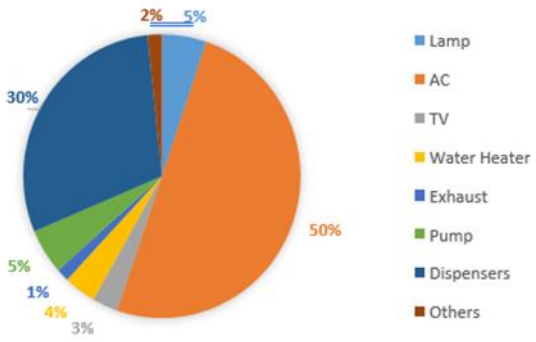

Figure 2. Distribution of Electrical Power Consumption Based on Type Of Electrical Equipment

Additionally, as depicted in Figure 3, the total power consumption for each hotel room/area indicates that Meeting Room 2 has the highest power usage, followed by the Suite Room and the pump. When the total power consumption for all room types is aggregated, considering the varying quantities of each type/room, the distribution of power consumption shifts. This change is illustrated in Figure 4, where the Superior room type emerges as the area with the highest total power consumption.

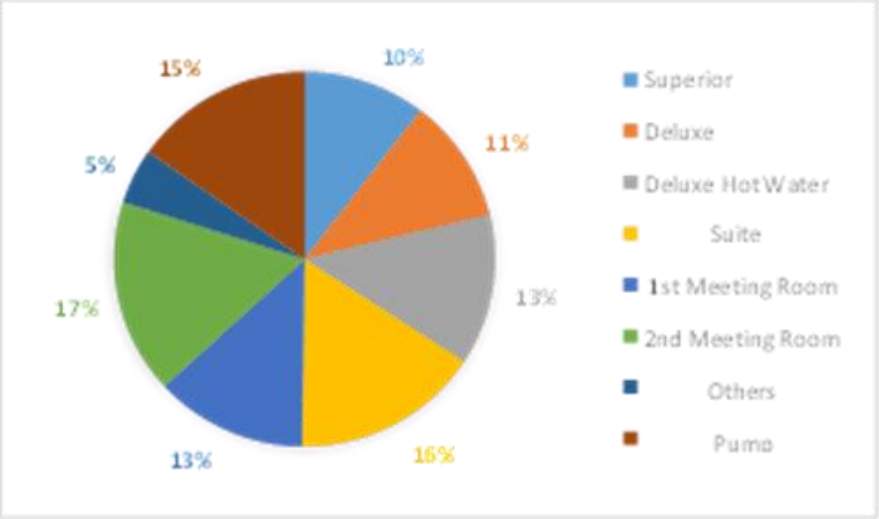

Figure 3. Distribution of Electrical Power Consumption Based on Area Type

RESULTS AND DISCUSSION

Measurement of Power Consumption and Electrical Energy in Realtime

The power consumption and electrical energy data for Hotel Bumi Sawunggaling were collected over a one-week period using a Power Quality Analyzer (PQA), with measurements recorded every 30 minutes. The results indicate that the average daily energy consumption during weekdays was approximately 111.21 kWh, while the average consumption increased to 159.55 kWh during weekends due to higher room occupancy. Figure 5 provides a graphical representation of the hotel's daily energy consumption patterns.

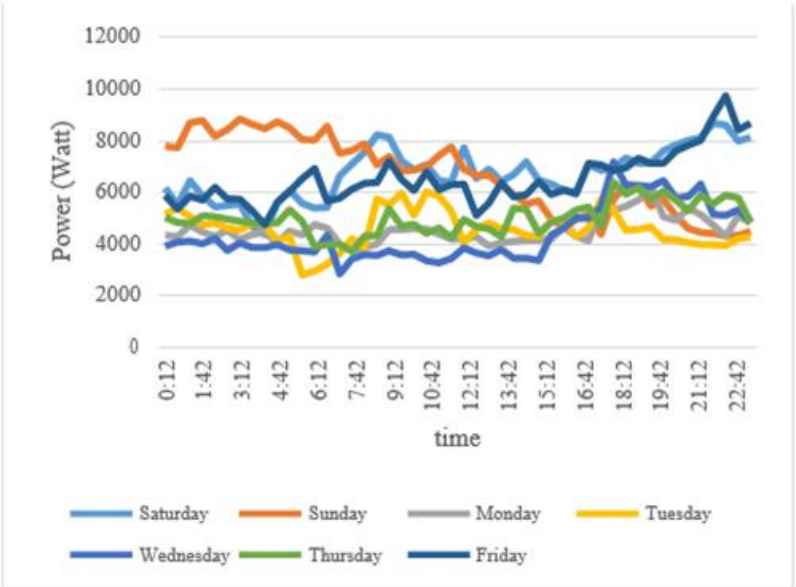

Figure 4. Graph of Hotel Electricity Consumption Per Day

The total energy consumption for the observed week was 923.45 kWh, incurring a total electricity cost of IDR 1,334,166. Based on the weekly consumption data, the estimated monthly energy cost is IDR 5,336,664, and the annual energy cost is projected to be IDR

64,039,166. These projections offer valuable insights for hotel management in developing energy-saving strategies.

Table 3. Total Hotel Room Occupancy

No	Day	Superior	Deluxe	Deluxe Hot Water	Suite	Total
1	Saturday	12	3	3	1	19
2	Sunday	2	0	1	0	3
3	Monday	1	0	3	1	5
4	Tuesday	1	0	0	0	1
5	Wednesday	3	0	2	0	5
6	Thursday	7	0	2	0	9
7	Friday	7	2	3	1	13

Using the hotel electricity consumption data depicted in Figure 5, the researchers calculated the average power consumption at various times throughout the day. This study employed three distinct averaging scenarios: a) the overall average power consumption over time; b) the average power consumption over time for weekdays (Monday, Tuesday, Wednesday, and Thursday); and c) the average power consumption over time for weekends (Friday, Saturday, and Sunday).

Figure 6 illustrates that power consumption is higher during weekends compared to weekdays. This observation is further supported by hotel room occupancy data, which shows a greater number of occupied rooms on weekends than on weekdays. This correlation suggests that increased occupancy rates during weekends lead to higher electricity consumption.

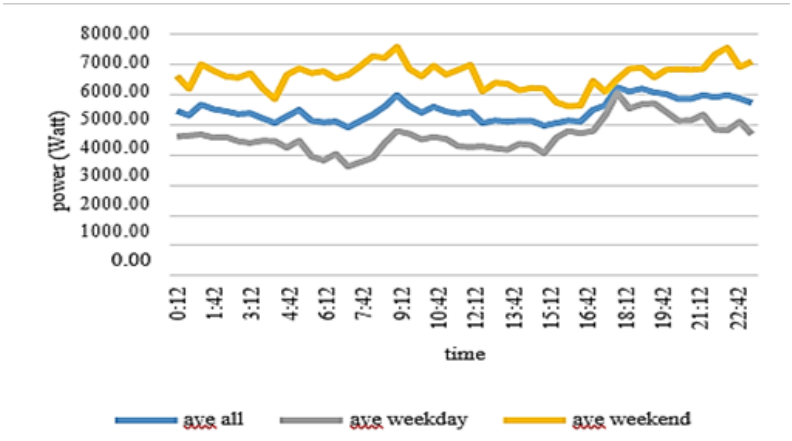

Figure 5. Graph of The Average Value of Hotel Power Per Time

Based on the hotel's electrical power consumption data presented in Figure 5, the total daily electrical energy consumption of the hotel is detailed in Table IV. According to PLN's basic electricity tariff, Hotel Bumi Sawunggaling, which operates within an electric power range of 6600 VA to 200 kVA, falls under the B2/TR tariff category. Consequently, the basic electricity tariff is IDR 1,444.70 per kWh (Zeghoudi et al., 2021). Table IV provides a breakdown of the total electrical power consumption for one week. By using this weekly tariff data, it is possible to estimate the electricity costs for one month and one year.

This analysis allows for a comprehensive understanding of the hotel's energy expenditure, facilitating better financial planning and energy management strategies. By projecting the weekly consumption data over longer periods, hotel management can anticipate future costs and identify potential areas for energy savings.

Table 4. Daily Hotel Electricity Rates

No	Day	Energy (kWh)	BaseTariff	Total tariff
1	Saturday	161.68	Rp1,444.70	Rp233,579.10
2	Sunday	160.09	Rp1,444.70	Rp231,282.02
3	Monday	109.33	Rp1,444.70	Rp157,949.05
4	Tuesday	110.16	Rp1,444.70	Rp159,148.15
5	Wednesday	105.32	Rp1,444.70	Rp152,155.80
6	Thursday	120.03	Rp1,444.70	Rp173,407.34
7	Friday	156.88	Rp1,444.70	Rp226,644.54
Total tariff 1 week				Rp1,334,166.00
Total tariff 1 month*				Rp5,336,664.01
Total tariff 1 year*				Rp64,039,166.14

Calculating Power and Electricity Energy Consumption Based on Assumed Scenarios

a. Scenario Assuming Maximum Electricity Consumption (duration of use for 24 hours)

In the maximum assumption scenario, it is presumed that all electrical equipment in the hotel operates at full capacity, with all rooms fully occupied and equipment running continuously for 24 hours. While this scenario is unlikely, it provides an upper limit for the hotel's power and electrical energy consumption.

Table V illustrates the maximum power and energy required by the hotel to meet its electricity needs across various room types and areas. According to this table, the maximum energy consumption the hotel can achieve in one day under these conditions is 1114.176 kWh. Table VI details the corresponding maximum electricity costs incurred by the hotel.

This scenario serves as a benchmark for understanding the upper limits of the hotel's energy requirements and costs, enabling better planning and management of energy resources. By knowing these limits, the hotel can implement strategies to optimize energy usage and reduce operational expenses.

Table 5. Power Consumption And Electric Energy Based On Area Type

No	Room Type	Power (kW)	Number	Duration on (h)	Energy @area (kWh)	Total Energy (kWh)
1	Superior	1.633	14	24	39.19	548.688
2	Deluxe	1.6914	3	24	40.594	121.7808
3	Deluxe Hot Water	2.0414	4	24	48.994	195.9744
4	Suite	2.511	1	24	60.264	60.264
5	1st Meeting Room	2.032	1	24	48.768	48.768
	2nd					

6	Meeting Room	2.63	1	24	63.12	63.12
7	Others	0.7492	1	24	17.981	17.9808
8	Pump	2.4	1	24	57.6	57.6
Total Energy Max		15.688				1114.176

Table 4. Electricity Price Rates Based On Room Type

No	Type Room	Power (kW)	Number	Tariff @room	Total Tariff
		1	2	3 = 1 x 24h x Rp 1,440.70	2 x 3
1	Superior	1.633	14	Rp56,463.91	Rp790,4 94.80
2	Deluxe	1.6914	3	Rp58,483.20	Rp175,4 49.60
3	Deluxe Hot Water	2.0414	4	Rp70,585.08	Rp282,3 40.32
4	Suite	2.511	1	Rp86,822.34	Rp86,822.34
5	1st Meeting Room	2.032	1	Rp70,260.06	Rp70,26 0.06
6	2nd Meeting Room	2.63	1	Rp90,936.98	Rp90,936.98
7	Others	0.7492	1	Rp25,904.94	Rp25,904.94
8	Pump	2.4	1	Rp82,984.32	Rp82,984.32
Total Maximal Tariff					Rp1,605,193.36

b. Assumed User Electricity Consumption Scenario (duration of usage adjusted to possible hotel occupants)

In this assumed scenario, the duration of use for each type of electrical equipment varies throughout the day, as detailed in Table VII. Using these durations, the predicted electrical energy consumption for each room/area type is calculated and presented in Table VIII, along with the corresponding electricity rates in Table IX.

At Hotel Bumi Sawunggaling, lighting accounts for 30% of the total electricity consumption. Transitioning to LED lighting could result in significant energy savings. LEDs have a much longer lifespan, often lasting up to 25 times longer than traditional bulbs, which reduces both maintenance costs and the frequency of replacements. Additionally, LEDs generate less heat, which can further decrease cooling costs in air-conditioned environments. (Martin et al., 2022).

The adoption of LED technology also enhances the overall guest experience. LEDs provide superior lighting quality with adjustable brightness and color temperatures, creating a more comfortable and aesthetically pleasing environment. This can improve guest satisfaction and potentially increase occupancy rates.

Moreover, the environmental benefits of LEDs are substantial. By reducing energy consumption, hotels can significantly lower their greenhouse gas emissions. This not only contributes to environmental conservation but also enhances the establishment's reputation as a responsible and eco-friendly entity.

In conclusion, integrating LED lighting in hotels and buildings is a practical and effective solution for reducing electricity consumption. It offers economic benefits through lower energy

and maintenance costs, improves guest comfort, and supports environmental sustainability. Therefore, it is highly recommended that establishments like Hotel Bumi Sawunggaling consider this transition as part of their energy management strategy.

Table 5. Assumed Duration Of Use Of Electrical Equipment By Hotel Residents

No	Equipment	Power (kW)	Duration (h)	Energy (kWh)
1	Lamp	2.411	14	33.754
2	AC	23.24	10	232.4
3	TV	1.38	6	8.28
4	Water Heater	1.75	2	3.5
5	Exhaust	0.682	24	16.368
6	Pump	2.4	6	14.4
7	Dispensers	13.8	1	13.8
8	Others	0.761	4	3.044

Table 6. Predicted Electric Energy Consumption Based On Room Type

No	Room Type	Number	Epre (kWh)	Total Epred(kWh)
1	Superior	14	15.52	217.28
2	Deluxe	3	16.869	50.607
3	Deluxe Hot Water	4	17.569	70.276
4	Suite	1	29.818	29.818
5	1st, 2nd Meeting Room	1	38.758	38.758
6	Others	1	28.7288	28.7288
Total		435.4678		

Table 7. Predicted Electricity Rates Based On Room Type

No	Room Type	Number	Epred (kWh)	Tariff @room	Total Tariff
1	Superior	14	15.52	Rp22,359.66	Rp313,035.30
2	Deluxe	3	16.869	Rp24,303.17	Rp72,909.50
3	Deluxe Hot Water	4	17.569	Rp25,311.66	Rp101,246.63
4	Suite	1	29.818	Rp42,958.79	Rp42,958.79
5	1st , 2nd Meeting Room	1	38.758	Rp55,838.65	Rp55,838.65
6	Others	1	28.729	Rp41,389.58	Rp41,389.58
Total					Rp627,378.46

Comparison of Measurement and Calculation Result

Based on the prediction results outlined in the assumption scenario in the previous section, and the real-time measurements of hotel electricity consumption, a comparison of the total electrical energy used and the corresponding electricity rates can be made, as illustrated in Figures 7 and 8. These results indicate that the predicted values for weekdays align more

closely with the real-time measurements compared to the predictions for weekends.

This comparison highlights the accuracy of the assumption scenario for weekdays, suggesting that the model used for predictions is more reliable during these days. The discrepancy observed during weekends may be attributed to variations in hotel occupancy and usage patterns, which are less predictable. Understanding these differences is crucial for improving the accuracy of future predictions and optimizing energy management strategies.

By refining the prediction models to account for these variations, hotels can better anticipate their energy needs and implement more effective cost-saving measures. This approach not only enhances operational efficiency but also supports sustainable energy practices.

A critical aspect of this study is the analysis of potential energy savings resulting from the adoption of LED lighting technology. Currently, lighting contributes approximately 30% of the hotel's total energy consumption, signifying a substantial opportunity for optimization. This section presents a comparison between energy consumption with conventional lighting and post-retrofit LED lighting. (Dotulong et al., 2021)(Partayasa et al., 2023) (Tanoto, 2023).

Table V illustrates the predicted reductions in energy consumption across different room types following the installation of LED lights. These predictions were based on both real-time measurements and assumptions about the power reduction offered by LEDs.

Table 8. Comparison of Lighting Energy Consumption Before and After LED Retrofit

Room Type	Energy Consumption (Pre-LED) (kWh)	Energy Consumption (Post-LED) (kWh)	Energy Savings (%)
Superior Room	39.19	7.84	80%
Deluxe Roo	40.59	8.12	80%
Suite Room	60.26	12.05	80%
Meeting Room 1	48.77	9.75	80%
Meeting Room 2	63.12	12.62	80%

The results clearly indicate that energy consumption for lighting can be reduced by up to 80% across all room types by replacing conventional lighting systems with LED technology. This is consistent with findings from the U.S. Department of Energy and the European Commission, which report that LED lighting can result in energy savings of 75-80% compared to incandescent and CFL lighting. (Elliott et al., 2019).

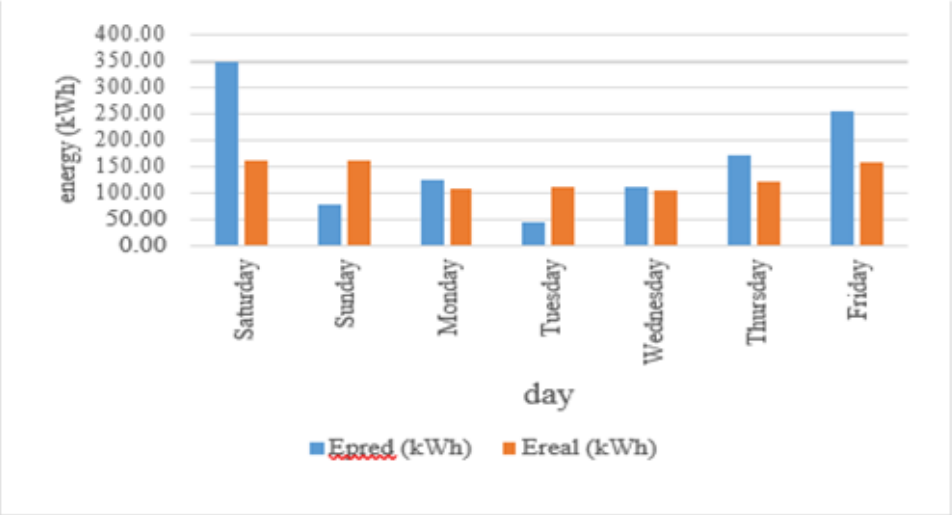

Fig. 6. Comparison of total predicted electrical energy consumption and real-time energy consumption in hotels

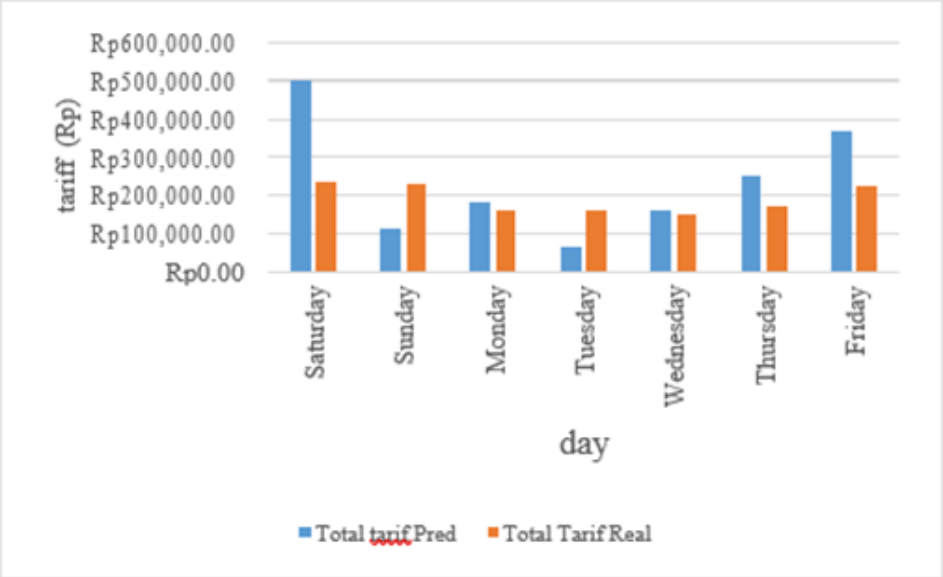

Fig 7. Comparison of Total Predicted Electrical Energy Consumption and Real-Time Energy Consumption in Hotels

Research Implications

This study shows that the use of LED lighting significantly reduces energy consumption at Hotel Bumi Sawunggaling, which has a direct impact on reducing operational costs. The results of observations and calculations carried out for one week showed that there was a real difference between energy consumption before and after the implementation of LED technology. Here are some of the implications of this study:

1. **Reduced Hotel Operating Costs**

The implementation of LED lighting contributes to savings in electricity costs of up to 30% or more, as shown in the results of the study. These savings can increase hotel profit margins, especially in the highly competitive hospitality sector. Hotel managers can take advantage of these cost reductions for more effective allocation of funds, such as upgrading guest amenities or investing in other eco-friendly technologies.

2. Support for Sustainability and Social Responsibility

By reducing energy consumption and carbon emissions, the hotel supports environmental sustainability and enhances its reputation as a socially responsible business. This is not only important for consumers who are increasingly environmentally conscious, but it can also attract tourists who prefer sustainable accommodation. These implications can help hotels build a positive eco-friendly image in the eyes of the public and increase guest loyalty.

3. Effectiveness in Maintenance and Management

In addition to reducing energy consumption, LED lighting has a longer lifespan compared to conventional lights. This means that hotels can reduce the frequency of lamp replacement and maintenance costs. This effectiveness in maintenance management allows hotels to allocate labor to other, more productive tasks and reduce operational costs related to facility maintenance.

4. Potential for Energy Saving Policies in the Hospitality Industry

The findings of this study can also be the basis for the formulation of energy-saving policies in the hospitality industry, especially in Indonesia. The Ministry of Tourism and related agencies can consider the results of this research in developing programs or incentives to support the application of energy-saving technology in other hotels. These implications are important to encourage the widespread adoption of sustainable technologies in support of national targets for energy consumption reduction.

5. A Guide for Hotel Managers in the Implementation of Energy-Efficient Technology

This research can serve as a guide for hotel managers in planning and implementing energy-efficient technologies in their spaces. Energy consumption data before and after LED implementation provides a clear example of the financial and environmental benefits. Other hotels can use these results as a benchmark to estimate the energy savings they can achieve and plan similar measures to improve energy efficiency.

CONCLUSION

This research shows the results of measurements and calculations based on assumptions about electrical energy consumption at a hotel, namely the Bumi Sawunggaling Hotel, which is a type of 1-star hotel in the city of Bandung. Based on real-time measurement results, the average electrical energy consumption required for weekdays and weekends is 111.21 kWh and 159.55 kWh, respectively.

The total electrical energy for one week of observation at the hotel is 923.45 kWh with a total tariff of IDR 1,334,166,- which needs to be spent for one week, IDR 5,336,664,- for one month, and IDR 64,039166,- for one year. Based on relevant research and articles, it is imperative that Hotel Bumi Sawunggaling replaces its conventional lighting with LED lights to achieve higher energy efficiency. LED lights are known for their superior energy efficiency compared to traditional incandescent or CFL (Compact Fluorescent Lamp) bulbs.

LED lights convert a significant portion of electrical energy into light, whereas conventional bulbs tend to convert most of the electrical energy into heat. This means that using LED lights can significantly reduce energy consumption. According to various sources, LED lights can save up to 80-90% of energy compared to incandescent bulbs. Moreover, LED lights have a longer lifespan, ranging from 25,000 to 50,000 hours, which means the frequency of bulb replacement and maintenance costs can be significantly reduced. With high energy efficiency and a long lifespan, the use of LED lights at Hotel Bumi Sawunggaling can reduce electricity costs by 30% or more. Therefore, replacing conventional lighting with LED lights at Hotel Bumi Sawunggaling will not only reduce operational costs but also support sustainability and environmental friendliness.

DAFTAR PUSTAKA

Baten, M. Z., Alam, S., Sikder, B., & Aziz, A. (2021). III-Nitride Light-Emitting Devices. *Photonics*, *8*(10), 430.

Dotulong, B. K., Rumbayan, M., & Tumaliang, H. (2021). *Analisis Audit Energi di Hotel Quality Manado*.

Elliott, C., Yamada, M., Penning, J., Schober, S., & Lee, K. (2019). *Energy Savings Forecast Of Solid-State Lighting in General Illumination Applications*. Navigant Consulting, Inc., Washington, DC (United States).

Ganandran, G. S. B., Mahlia, T. M. I., Ong, H. C., Rismanchi, B., & Chong, W. T. (2014). Cost-Benefit Analysis and Emission Reduction of Energy Efficient Lighting At The Universiti Tenaga Nasional. *The Scientific World Journal*, *2014*(1), 745894.

Irsyad, M., & Mursyid, A. Y. (2024). Da'wah Management in Halal Tourism Development: Implementing Pentahelix Synergy And The ACES 3.0 Framework. *Jurnal Ilmu Dakwah*, *44*(1), 93–114.

Karvounidi, M. D., Alexandropoulou, A. P., & Fousteris, A. E. (2024). Towards Sustainable Hospitality: Enhancing Energy Efficiency in Hotels. *International Research Journal of Economics And Management Studies IRJEMS*, *3*(6).

Khan, T. Q., Bodrogi, P., Vinh, Q. T., & Winkler, H. (2015). *LED Lighting: Technology And Perception*. John Wiley & Sons.

Khayam, U., Zaeni, A., Banjar-Nahor, K. M., Hamdani, D., Sinisuka, N. I., Dupuis, P., Zissis, G., & Canale, L. (2023). Status of Lighting Technology Application in Indonesia. *Sustainability*, *15*(7), 6283.

Mahendra, D. (2024). The Impact of Tourism on The Preservation and Transformation of Cultural Identity in Bali, Indonesia. *Studies In Social Science & Humanities*, *3*(6), 34–41.

Martin, A., Agusta, D. R., & Simangunsong, N. (2022). Audit Energi Sistem Tata Cahaya dan Tata Udara Lantai 2 & 3 pada Bangunan Gedung Toko Buku di Pekanbaru. *Turbo: Jurnal Program Studi Teknik Mesin*, *11*(2).

Ollivaud, P., & Haxton, P. (2019). *Making The Most of Tourism in Indonesia to Promote Sustainable Regional Development*.

Partayasa, I. K. A., Mahendra, I. M. A., & Juniastra, I. M. (2023). Analisis Penghematan Energi Listrik dalam Mewujudkan Konsep Green Solar Panel pada Industri Perhotelan di Bali. Studi Kasus di Bvlgari Hotel And Resort Bali. *Jurnal Ilmiah Vastuwidya*, *6*(2), 79–87.

Sutopo, W., Mardikaningsih, I. S., Zakaria, R., & Ali, A. (2020). A Model To Improve The Implementation Standards of Street Lighting Based on Solar Energy: A Case Study. *Energies*, *13*(3), 630.

Tanoto, Y. (2023). Pengelolaan Energi Berkelanjutan di Hotel. in *Pengelolaan Energi Berkelanjutan di Hotel*. Zahir Publishing.

Zeghoudi, A., Bendaoud, A., Canale, L., Tilmatine, A., & Slimani, H. (2021). Determination of Power Factor and Harmonic Distortion of AC/DC LED Driver. *2021 IEEE International Conference on Environment and Electrical Engineering and 2021 IEEE Industrial and Commercial Power Systems Europe (EEEIC/I&CPS Europe)*, 1–6.