Buletin Profesi Insinyur 8(2) (2025) 065–072
http://dx.doi.org/10.20527/bpi.v8i2.297
ISSN 2654-5926

Electricity Consumption Analysis and Energy-Saving Opportunities in Student Dormitories through Energy Audit

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Inefficient energy use can lead to waste, which negatively impacts both the economy and the environment. Energy efficiency in dormitories can be achieved through energy audits, an essential evaluation process to identify building energy performance and potential savings in electricity consumption. This study employed field observation method through the collection of building physical data, historical electricity consumption records, and interviews. The Tanah Laut dormitory consists of 16 rooms with 2 floors (±392 m² per floor). Measurement results show energy consumption of 14.611 kWh/day or 336.128 kWh/month. The supervisor's room recorded the highest consumption at 16,43 kWh/bulan, while the terrace had the lowest at 3,6 kWh/bulan. The total monthly energy consumption reached 336,128 kWh, with an IKE value of 5.14, categorized as efficient according to the Ministry of Energy and Mineral Resources Regulation No. 13 of 2012. The proposed energy-saving strategies include: (1) no-cost: educating residents on efficient energy use behavior to control the number and duration of appliance usage; and (2) medium-cost: replacing fluorescent lamps with LEDs (potential savings of ±75%) and installing motion sensors in corridors, kitchens, and bathrooms.

Keywords: energy consumption, energy audit, IKE, energy efficiency

Submitted: November 26, 2025
Revised: December 1, 2025
Accepted: December 18, 2025
Published: December 20, 2025

Introduction

Indonesia, ranked as the fourth most populous country globally, faces significant challenges when it comes to managing energy consumption, particularly in residential settings like student dormitories. These dormitories are vital spaces where students live, study, and engage in social activities, making the management of their energy consumption particularly important. Inefficient energy usage in such environments can lead to considerable waste, affecting both the economy and the environment. Given their importance as accommodation for students during their academic pursuits, effective energy management in dormitories becomes critical.

Energy audits are a fundamental process to assess the energy performance of buildings and identify areas where consumption can be reduced. Studies, such as the one by Nugrahadi et al., (2023), highlight the importance of energy conservation and examining savings on the consumer side to mitigate unnecessary electricity use. This is espIKEally relevant for student dormitories, where the energy needs of a large and diverse group of residents can vary significantly. Adi & Trihadiningrum, (2021) further note that managing both energy use and electronic waste in student housing is key to achieving sustainability. In this context, energy audits provide essential data on energy consumption patterns and the potential for improvement. For instance, energy audits conducted at Universitas Muhammadiyah Yogyakarta revealed that, although energy use was within an efficient range, regular monitoring is necessary to prevent future waste (Ningrum et al., 2019).

While energy audits have traditionally been used in large buildings like hospitals, newer methods involving structured measuring instruments and evaluation techniques have proven effective in assessing the intensity and quality of electricity consumption. Recent studies have demonstrated how these audits can provide clear data to support recommendations for improving energy efficiency (Hakim et al., 2023). (Dewi et al., (2025) was conducted audit at the Vyatra I Dormitory Building of PEM Akamigas to identify potential energy savings. The audit analyzed energy consumption, voltage and current profiles, harmonics, lighting, and air conditioning systems. Results showed an annual energy consumption of 159,044 kWh, accounting for 9.17% of total campus energy use. The building's Energy Consumption Intensity (IKE) increased

Cara mensitasi artikel ini:
Ansyah F.R., Adha M., Syafii R., Aqli Z., Jefriadi, & Waskito, A. (2025) Electricity Consumption Analysis and Energy-Saving Opportunities in Student Dormitories Through Energy Audit. *Buletin Profesi Insinyur, 8*(2), 065–072

from 135.02 kWh/m²/year (2021) to 159.2 kWh/m²/year (2023), exceeding the office building benchmark of 102 kWh/m²/year.

Indonesian office building in 2018 showed that systematic energy assessment can identify major energy users and reveal significant savings potential. The audit found that by optimizing electrical, lighting, and air-conditioning systems, the building could reduce its energy use by about 30.45%, equivalent to IDR 29 million per year (Hamdani et al., 2023). A study on energy auditing at the Aston Manado Hotel demonstrated inefficient areas and potential savings. The audit revealed that guest corridors were highly efficient (IKE < 8.5), while engineering and HR offices were moderately efficient (IKE 8.5–14). However, some areas, such as the receptionist room, exceeded the IKE standard of 18.5 and were categorized as wasteful. The study suggested replacing TL and CFL lamps with LED lighting and upgrading computers from 250-watt units to 65-watt energy-efficient models to reduce energy consumption (Darise et al., 2023). A campus building energy audit study applied the Energy Consumption Intensity (IKE) method to assess energy efficiency and identify saving opportunities. The results showed that Labtek V and Labtek VI had IKE values of 38.01 and 16.75, meaning both buildings were not yet energy efficient. The study recommended improvements in lighting, cooling, and equipment use, estimating potential energy savings of 6.70% (Faniama et al., 2024). Similarly, energy audits in residential areas like Batam have pinpointed systems, such as air conditioning, as the largest contributors to energy use and suggested solutions like enhancing home insulation (Nugrahadi et al., 2023). These findings could provide valuable insights for dormitory managers, local governments, and other stakeholders looking to promote energy sustainability.

Through comprehensive energy audits, dormitories can receive tailored recommendations to reduce the environmental impact of their energy consumption. This process can also support broader efforts to mitigate climate change by reducing carbon footprints. Moreover, improving energy efficiency in student housing doesn't just address environmental concerns—it enhances the overall quality of life for residents (Saputra et al., 2022). The importance of energy audits at the Tanah Laut student dormitory in Banjarbaru goes beyond efficiency; it addresses wider social and environmental issues, making it a crucial step in managing Indonesia's energy resources effectively.

Method

The energy audit process begins with an initial data collection phase, where essential information about the building is gathered. This includes the building layout, which helps understand the spatial energy flow, as well as historical electricity usage data, such as monthly electricity bills, to observe consumption trends over time. Additionally, occupancy patterns are examined, as the number of residents and their energy use habits significantly influence the building's energy consumption and is calculated bu Equation 1. From this data, the Energy Consumption Intensity (IKE) is calculated by Equation 2 (Darise et al., 2023), which helps assess the building's energy efficiency. The ICI is a key metric used to compare energy usage relative to the size of the building or the number of occupants, offering a clear indication of whether the building is operating efficiently or if there is room for improvement.

Next, a comprehensive analysis is conducted to understand the building's energy requirements. During this stage, data is collected to assess the overall energy demand. This research forms the foundation for a detailed understanding of how energy is being used and where the building's energy needs are the highest, allowing for a more targeted approach in the subsequent steps of the audit. Once the energy usage data is gathered, the audit proceeds to measuring the electricity intensity of individual room within the building compare with existing regulations .

Following this, Energy Saving Opportunities (ESOs) are identified based on the Energy Consumption Intensity (IKE) calculated earlier. If the IKE value is found to be within or below the existing regulations, the need for a detailed audit may be reduced, and the process can be considered complete. However, if the IKE exceeds acceptable levels, the audit will proceed to the next phase of identifying and exploring potential energy-saving measures. This includes evaluating building systems and practices to identify areas where energy efficiency can be improved, such as optimizing lighting.

The next step involves a thorough analysis of the ESO by comparing the potential savings with the costs required to implement the necessary changes such as replacing old lighting with energy-efficient options. Additionally, the feasibility of these measures is evaluated to ensure that the implementation of energy-saving solutions does not negatively affect the comfort of dormitory residents. Balancing energy efficiency with maintaining a comfortable living environment is key to the success of the energy audit process.

Finally, the audit concludes once the IKE value is reduced to meet or fall below the predefined target. A comprehensive report is then prepared, summarizing the audit findings, the implemented energy-saving measures, and their corresponding benefits. This provides recommendations for further improvements, outlines the financial and environmental benefits of the energy-saving measures, and serves as a roadmap for ongoing energy management. The audit not only helps reduce energy consumption but also supports broader sustainability goals by mitigating the environmental impact of the dormitory's energy usage.

$$\text{Energy (kWh)} = \frac{\text{Power (W)} \times \text{Duration (h)}}{1000} \qquad (1)$$

$$IKE = \frac{\text{Total Enery Comsumption (kWh/month)}}{\text{Area of Building (m}^2\text{)}} \quad (2)$$

Results And Discussion

Building's energy consumption

The energy audit for the Tanah Laut Dormitory was carried out to assess the building's energy performance and identify areas for improvement. The dormitory, a two-story building, houses 16 rooms, each designed to accommodate students and facilitate both academic and social activities. Each floor covers a total area of 392 m², giving the building a combined floor area of 784 m². The dormitory operates on a prepaid electricity subscription, which allows for the tracking of energy usage in real-time. To ensure accurate measurement of energy consumption, the audit was conducted between 11:00 AM and 1:00 PM WITA. A HIOKI digital power meter was employed to measure the energy usage directly from the circuit breaker panels, while a lux meter was used to assess the lighting intensity within the building. The measured electrical energy consumption during this period was found to be 14.611 kWh per day, which amounts to 336.128 kWh per month.

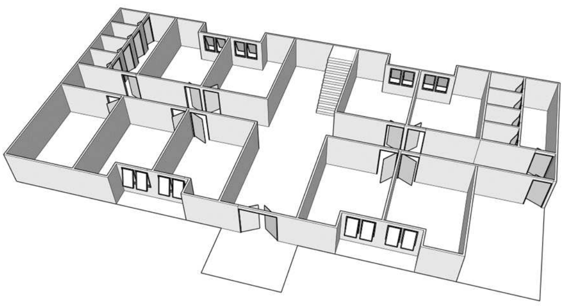

Figure 1 Floor 1 of the Tanah Laut Dormitory

The design of Floor 1 of the Tanah Laut Dormitory (Figure 1) is symmetrical, with a total building depth of 28 meters and a width of 14 meters. The front section of the building houses the main rooms and serves as the primary access point, with an entrance leading directly into a central corridor that divides the building horizontally into two sections. On the left side of the building, a spacious kitchen area is located, providing easy access to the surrounding rooms. This arrangement allows residents to cook without disturbing the main corridor, offering convenience and privacy. The design of the dormitory rooms along both sides of the building ensures adequate natural lighting and ventilation through large windows.

At the rear right corner of the building, shared sanitation facilities, including bathrooms and toilets, are strategically placed for easy access by all residents, ensuring convenience without compromising privacy. The right front side of the building features a parking area for residents' vehicles, making it easily accessible to the residents. The central corridor, running from the front to the back of the building, facilitates smooth circulation, connecting the rooms, kitchen, and sanitation facilities. In terms of lighting, lamps are installed in each room and key common areas, ensuring consistent and adequate lighting throughout the building. A staircase in the middle of the floor provides access to the second floor, which accommodates additional rooms for more residents.

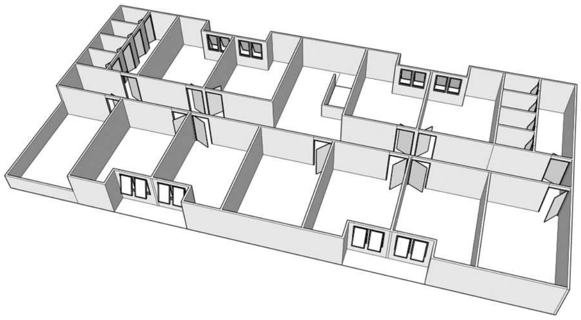

Figure 2 Floor 2 of the Tanah Laut Dormitory

Floor 2 of the Tanah Laut Dormitory (Figure 2) is designed similarly to the first floor, with a total length of 28 meters and a width of 14 meters. The layout is functional, with a central corridor providing access to all rooms. A staircase from the first floor leads to this level, further facilitating circulation throughout the building. On the left side of the second floor, there is a designated clothes drying area, providing a shared facility for the residents to dry their laundry. This area is separated from the main living spaces to ensure that laundry activities do not disturb residents' daily routines.

The rooms on the second floor are arranged along both sides of the corridor, maintaining a consistent layout. Each room is equipped with windows, ensuring that there is adequate natural lighting and ventilation, which enhances the overall comfort and livability of the space. At the rear right corner of the second floor, there are shared sanitation facilities, including bathrooms and toilets, similarly positioned to optimize accessibility and efficiency for the residents. Additionally, this floor includes a multipurpose hall located at the right front side of the building. The hall is designed as a communal space for various activities, meetings, and social events, fostering a sense of community and engagement among the dormitory residents.

The overall design of the Tanah Laut Dormitory maximizes functionality and ensures that the building's energy use can be easily monitored and improved. The audit and data collected during this process will help inform future efforts to reduce energy consumption and enhance the building's sustainability, supporting the broader goals of energy efficiency and environmental responsibility within student housing.

The Figure 3 illustrates the distribution of space across various rooms in the Tanah Laut Dormitory floor plan. The largest area is dedicated to the dormitory rooms, each measuring 24 m², emphasizing the building's primary function as student accommodation.

 ISSN 2654-5926

Shared facilities, such as the mosque, supervisor room, and parking area, have balanced sizes, each occupying 18 m², which support activities such as worship, supervision, and parking needs for the residents. See Figure 4 as the sample of some areas in dormitory.

The connecting corridor or hallway spans 12.2 m², ensuring smooth circulation for residents. The kitchen is placed with an area of 12.6 m², which is adequate for communal cooking activities. Meanwhile, the front terrace, measuring 9 m², functions as a transitional space between the outdoor and indoor areas of the dormitory.

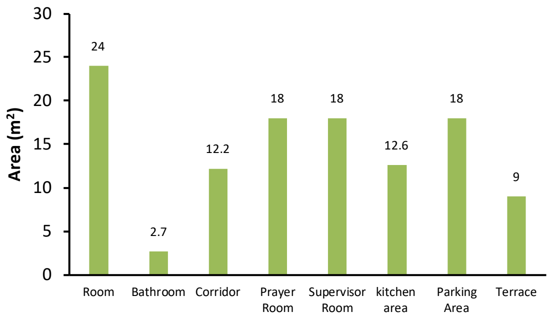

Figure 3 Floor 1 of the Tanah Laut Dormitory

On the other hand, the bathroom occupies the smallest area at 2.7 m², but the presence of multiple bathrooms ensures that sanitation needs are met. Therefore, the distribution of room sizes highlights a priority on the primary function of residence, while also maintaining a balance between supporting facilities, worship, supervision, and resident comfort.

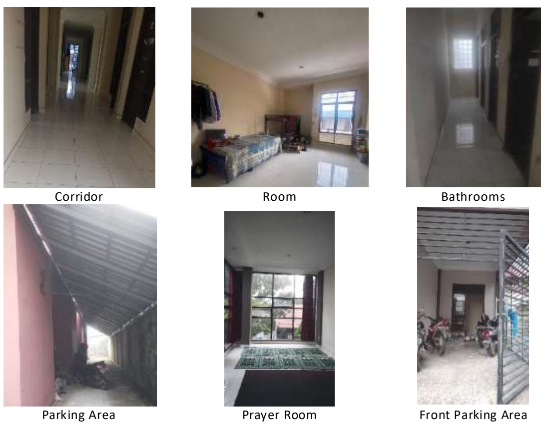

Figure 4 Areas of Dormitory Building

Electricity Usage and Energy Profile

The table below shows the electricity usage for several appliances in Room 1, detailing power consumption, usage duration, and daily and monthly energy consumption. This data includes various appliances such as a rice cooker, mobile phone charger, and laptop charger, each with different power ratings and usage times. The table provides an overview of the total power used by each device, as well as an estimate of energy consumption in kWh per day and per month.

The Figure 5 and 6 illustrates the daily (kWh) and monthly (kWh) electricity consumption at the Tanah Laut Student Dormitory Banjarbaru based on room usage. From the Figure 4, there is a significant variation in energy consumption across rooms. Room 8 records the highest electricity consumption, reaching 1.35 kWh/day, followed by Room 8 with 1.35 kWh/day and Room 9 with 1.23 kWh/day. Other rooms, such as Room 1, Room 4, and Room 13, also show relatively high energy consumption, approximately 1 kWh/day. Conversely, Room 2, 3 and Room 15 record very low energy consumption, only about 0.04 kWh/day each. Outside the bedrooms, areas such as the prayer room (mushola), bathroom, and parking lot demonstrate lower usage, each ranging only between 0.2–0.7 kWh/day. The terrace also records minimal electricity usage, with consumption around 0.12 kWh/day.

When examined on Figure 5, Room 13 the largest contributor with 26.74 kWh/month, followed by Room 8 with 26.33 kWh/month and Room 9 with 24.83 kWh/month. Other rooms with significant monthly consumption include Room 1 (23.22 kWh/month) and Room 12 (20.93 kWh/month).

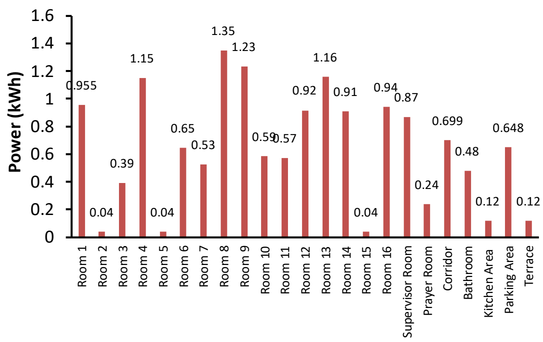

Figure 5 electricity usage per day

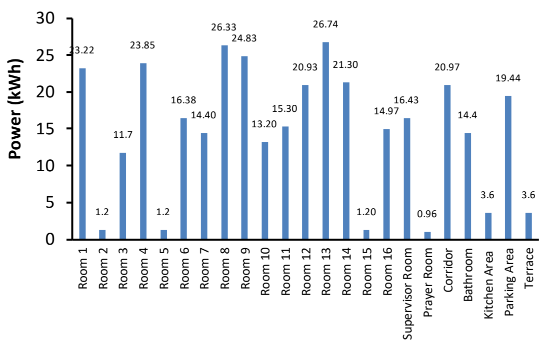

Figure 6 electricity usage per month

On the other hand, the Prayer Room, Parking Lot, Kitchen and Terrace show very low usage, with monthly averages below 5 kWh, indicating efficient electricity use in these areas. The consumption pattern suggests that sleeping rooms, espIKEally Room 8, 9 and Room 13, dominate both daily and monthly energy use. This can be attributed to a higher number of occupants or more intensive use of electrical devices in these rooms, which aligns with the primary factors influencing energy consumption variations across rooms—namely, the combination of room occupancy and behavior in operating electrical devices (device usage time, duration, and efficiency) (Bedir, 2017). In contrast, shared areas such as the Prayer Room, Bathroom, and Parking Lot display more efficient electricity consumption.

The Figure 7 illustrates the monthly costs of electricity consumption at the Tanah Laut Student Dormitory Banjarbaru, with a tariff of Rp 1,444.7 per kWh. The room with the highest cost is Room 13, recording a monthly expense of Rp 38,624, followed by Room 8 with Rp 38,032, and Room 9 with Rp 35,872. These high costs correspond to the significant energy consumption in these rooms, indicating more intensive use of electronic devices.

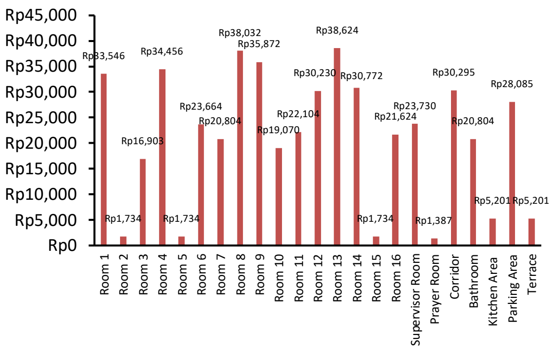

Figure 7 Electricity cost per month

Meanwhile, rooms such as Room 1 (Rp 33,546), Room 4 (Rp 34,456), and Room 14 (Rp 30,722) incur lower yet still substantial costs. On the other hand, Prayer Room, Kitchen, and Terrace record very low costs, ranging between Rp 1,387 and Rp 5,201, reflecting more efficient energy usage in these areas. Similarly, rooms with consistently low consumption, such as Room 2, 3, and 15, record comparable costs of around Rp 1,734.

Overall, this pattern demonstrates that rooms with higher energy consumption result in significantly higher electricity expenses, while shared areas and rooms with more efficient energy use record much lower costs.

Energy Consumption Intensity (IKE)

The Tabel 1 presents data on the Energy Consumption Intensity (IKE) in various rooms within a building. IKE is calculated by comparing annual energy consumption with the floor area of each room (Equation 1), providing an overview of the energy efficiency utilized in each space.

Table 1 IKE various rooms of building

Name	Area (m^2)	Monthly (kWh)	Annualy (kWh)	IKE (kWh/m^2/year)	IKE (kWh/m^2/bulan)
Room	384	256,73	3080,79	8,02	0,7
Bathroom	32,4	14,4	172,8	5,33	0,4
Corridor	97,6	20,97	251,64	2,58	0,2
Prayer Room	18	0,96	11,52	0,64	0,1
Supervisor Room	18	16,43	197,106	10,95	0,9
kitchen area	12,6	3,6	43,2	3,43	0,3
Parking Area	18	19,44	233,28	12,96	1,1
Terrace	9	3,6	43,2	4,80	0,4
Building	**784**	**336,128**	**4033,536**	**5,14**	0,4

In general, rooms with higher energy consumption tend to have higher IKE values. For instance, the Dormitory Room records significant monthly energy use, amounting to 256.73 kWh, resulting in an IKE of 8.02. This indicates that despite the relatively large floor area of the room (384 m²), the energy use per square meter remains relatively high. In contrast, the Prayer Room, with a much smaller floor area (18 m²) and a monthly consumption of only 0.96 kWh, records a very low IKE of 0.64.

On the other hand, rooms such as the Supervisor's Room show the highest IKE value at 10.95, indicating that although its floor area is smaller (18 m²), the energy consumption is very high, likely related to the presence of electrical devices within the space. Overall, the building has an IKE of 5.14, calculated from the total annual energy consumption compared with the total building area. This provides an indication of energy efficiency at the building level. Smaller and more spIKEfic rooms, such as the Kitchen and Parking Area, display lower IKE values of 3.34 and 12.96, respectively, reflecting differences in energy use depending on the function of each space.

Comparison with Existing Regulations

Ministerial Regulation of Energy and Mineral Resources (Permen ESDM) No. 13 of 2012 establishes energy efficiency criteria based on the magnitude of Energy Consumption Intensity (IKE) of electricity in buildings(ESDM, 2012) as seen in Table 2. These criteria are divided into four categories: very efficient, efficient, moderately efficient, and wasteful, applicable to both air-conditioned and non-air-conditioned rooms

Table 2 IKE Based on ESDM Decree No.13/2012

Criteria	Room with AC (kWh/m^2/bln)	Room Non AC (kWh/m^2/bln)
Very Efficient	IKE < 8,5	IKE < 3,4
Efficient	8,5 ≤ IKE ≤ 14	3,4 ≤ IKE ≤ 5,6
Fairly Efficient	14 < IKE ≤ 18,5	5,6 < IKE ≤ 7,4
Inefficient	IKE > 18,5	IKE > 7,4

Based on research conducted by ASEAN–USAID in 1987 and published in 1992, target values for Electrical Energy Consumption Intensity (IKE) were established(Hakim et al., 2023) as seen in Table 3.

Table 3 IKE based on ASEAN-USAID

Building	Target IKE (kWh/m² per tahun)
Office Building	240
Shopping Center	330
Hotel/Apartment	300
Hospital	380

Table 4 IKE comparation on ESDM Decree No.13/2012

Name	Area (m²)	Monthly (kWh)	IKE (kWh/m²/bulan)	ESDM Decree No.13/2012
Room	384	256,73	0,7	Very Efficient
Bathroom	32,4	14,4	0,4	Very Efficient
Corridor	97,6	20,97	0,2	Very Efficient
Prayer Room	18	0,96	0,1	Very Efficient
Supervisor Room	18	16,43	0,9	Very Efficient
kitchen area	12,6	3,6	0,3	Very Efficient
Parking Area	18	19,44	1,1	Very Efficient
Terrace	9	3,6	0,4	Very Efficient
Building	**784**	**336,128**	0,4	Very Efficient

Based on the energy consumption data across various rooms in the building (Table 4), it is evident that each room demonstrates very good energy efficiency. A dormitory room with an area of 384 m² records a monthly energy consumption of 256.73 kWh, resulting in an IKE of 0.7 kWh/m²/month, which falls into the "very efficient" category. The bathroom, with an area of 32.4 m², consumes 14.4 kWh per month, yielding an IKE of 0.4 kWh/m²/month, while the corridor with an area of 97.6 m² consumes only 20.97 kWh per month with an IKE of 0.2 kWh/m²/month, both indicating low energy usage. The prayer room, with an area of 18 m², uses 0.96 kWh per month (IKE 0.1), while the supervisor's room, also 18 m², consumes 16.43 kWh per month (IKE 0.9), both categorized as very efficient. The kitchen, with an area of 12.6 m², consumes 3.6 kWh per month (IKE 0.3), while the parking lot, 18 m², records 19.44 kWh per month (IKE 1.1), and the terrace, 9 m², consumes 3.6 kWh per month (IKE 0.4); all are considered very efficient. Overall, the building, with a total area of 784 m², has a total monthly energy consumption of 336.128 kWh, resulting in an IKE of 0.4 kWh/m²/month. This indicates that energy management throughout the building has been carried out optimally and is in accordance with the criteria set out in Ministerial Regulation of Energy and Mineral Resources (Permen ESDM) No. 13/2012.

Lighting Intensity

The results of lighting intensity measurements in several rooms using a lux meter, compared with the SNI 6197:2011 standard (Table 5), reveal non-compliance in most rooms. In the dormitory room with an area of 24 m², the average measured light intensity was 62.5 lux, far below the required standard of 250 lux. A similar condition was observed in the hall, with an area of 18 m², which recorded only 20.83 lux, whereas the minimum standard is 150 lux. This indicates that the quality of natural or artificial lighting in both rooms is inadequate, potentially causing visual discomfort and reducing occupant productivity.

Table 5. lighting intensity in some areas

Ruangan	Luas (m²)	Hasil Lux (lux/m²) Rata-rata	Berdasarkan SNI 6197:2011
Room	24	62,5	250
Corridor	7,2	52,08	60
Bathroom	2,7	138,88	250
Hall	18	20,83	150
Supervisor Room	18	79,16	250

Meanwhile, the corridor with an area of 7.2 m² showed a light intensity of 52.08 lux, which is close to the SNI standard of 60 lux, although still slightly below. This condition is relatively acceptable; however, further improvements in lighting are needed to meet the standard. In the bathroom/WC, with an area of 2.7 m², the measured intensity was 138.88 lux, still far below the 250 lux standard. Low light intensity in this room could reduce comfort and user safety.

In contrast, the supervisor's room, with an area of 18 m², recorded a light intensity of 79.16 lux compared with the standard of 250 lux. This is also considered very low, indicating non-compliance with the standard and potentially disrupting monitoring activities that require optimal lighting.

In general, the measurement results show that most rooms still fall below the lighting standards set by SNI 6197:2011. Therefore, improvements are needed, such as increasing lamp intensity, using energy-efficient lamps with higher lumen output, or optimizing natural lighting. This finding aligns with previous studies indicating that illumination intensity in rooms is influenced by window size, orientation, and distance from the light source, which can lead to variations in energy consumption for lighting between rooms. As a result, rooms with higher illumination intensity tend to have higher electricity costs (Kim et al., 2019). Improving lighting to meet standards will support comfort, safety, and the health of building occupants.

Energy Saving Opportunities (ESOs)

Based on the data on energy consumption and Energy Consumption Intensity (IKE) across various rooms in the building, several opportunities for further energy savings can be identified. Although all rooms already fall into the "Very Efficient" category according to Ministerial Regulation of Energy and Mineral Resources (Permen ESDM) No. 13/2012, strategic measures are still required to further optimize energy use.

The potential for energy savings in the building can be classified into two categories: no-cost and medium-cost measures. For the no-cost category, savings can be achieved without additional investment, for example, by regulating the operating hours of lamps and electrical equipment so that they are only turned on when truly needed. This scheduling should be communicated to all dormitory residents to ensure shared understanding. Socialization can be carried out through regular meetings and informational campaigns on each electrical appliance. Studies have found that the use of stickers as reminders can improve behavior by up to 20.74% and persist over a long period (Shearer et al., 2017). Although the study was more focused on food waste management, this approach can be adapted for energy-saving campaigns in the dormitory.

Second, the application of a zoning lighting system in dormitory rooms and the supervisor's room is also effective, allowing occupants to switch on reading lights, task lights, or general lighting as needed, thereby avoiding excessive energy use. Moreover, savings can also be achieved through management of electrical equipment use in rooms with relatively high IKE, such as the supervisor's room and parking area, by arranging alternating usage.

Third, routine maintenance such as cleaning reflectors, fixtures, and ventilation will improve lighting intensity without increasing electrical load. Studies indicate that integrating reflective materials can reduce lighting energy consumption by more than 36% (Cai et al., 2025). Often unnoticed, dirt that disrupts reflector performance can be a significant contributor to poor lighting efficiency.

Meanwhile, for the medium-cost category, energy savings can be achieved through moderate investment. The first step is replacing conventional lamps with energy-efficient LED lamps that provide better illumination. Studies report that the use of LEDs for lighting can reduce electricity costs by up to 60% (Apridzal, 2018). In this case, the dormitory rooms still do not meet the minimum illumination requirement for bedrooms, which is 120–250 lux (Badan Standardisasi Nasional, 2000). With a dormitory bedroom area of 24 m², it is recommended to install two 13-Watt LED lamps, producing approximately 3,060 lumens and 127.5 lux, thus meeting the standard. Bathrooms and kitchens must achieve 250 lux, requiring two 12-Watt LED lamps.

Second, installing motion sensors or timers in corridors, bathrooms, and the hall is also a strategic measure, as lights will only turn on when there is activity. This is supported by studies showing that the combination of LED use with smart controls and effective load management significantly increases energy efficiency compared to simply replacing lamps with LEDs alone (Rohman et al., 2019).

Third, optimizing natural lighting through the addition of openings, windows, or transparent roofing (Bedir, 2017) also represents a medium-term solution that can reduce reliance on artificial lighting during the daytime.

Conclusion

Energy audit by field observation is conducted on Tanah Laut Dormitory and the results show energy consumption of 14.611 kWh/day or 336.128 kWh/month. The supervisor's room recorded the highest consumption at 16,43 kWh/bulan, while the terrace had the lowest at 3,6 kWh/bulan. The total monthly energy consumption reached 336,128 kWh, with an IKE value of 5.14, categorized as efficient according to the Ministry of Energy and Mineral Resources Regulation No. 13 of 2012.

- For the no-cost category, savings can be achieved without additional investment, Regulating the operating hours of lamps and electrical, Zoning lighting system in dormitory (occupants switch on reading lights, task lights, or general lighting as needed, thereby avoiding excessive energy use), and Routine maintenance such as cleaning reflectors,
- For the medium-cost category, savings can be achieved moderate investment Replacing conventional lamps to LED lamps, installing motion sensors or timers in corridors, bathrooms, and the hall, and optimizing natural lighting through the addition of openings, windows, or transparent roofing.

This study has several limitations that should be considered when interpreting the results. The energy-use data were primarily obtained through interviews with dormitory occupants rather than direct measurement, which may reduce the accuracy of the estimated consumption and overlook variations in actual appliance usage. In addition, the observation period did not include continuous or long-term monitoring, limiting the ability to capture daily or seasonal fluctuations in energy behavior. Furthermore, the study did not evaluate the potential integration of renewable energy technologies. Future research should therefore incorporate comprehensive metering for each electrical appliance or room and adopt real-time monitoring to produce more reliable data. It is also recommended that subsequent studies assess the feasibility of renewable energy solutions to support a more sustainable energy management strategy for the dormitory.

Acknowledgment

This research was financially supported by Lambung Mangkurat University Research Grant year 2025 with grant number 2372/UN8.2/PG/2025.

References

Adi, M. A., & Trihadiningrum, Y. (2021). Pengelolaan Limbah Elektronik Di Asrama Mahasiswa Di Kota Surabaya. *Jurnal Teknik Its*, *9*(2). https://doi.org/10.12962/j23373539.v9i2.54987

Apridzal, H. (2018). Analisis Ekonomi Penggunaan Lampu Led Sebagai Alternatif Pengganti Lampu Konvensional Pada Pju Di Kota Pontianak. *Journal of Electrical Engineering, Energy, and Information Technology (J3EIT)*, *6*(1).

Badan Standardisasi Nasional. (2000). Sni 03-6197-2000 Energi Pada Sistem Pencahayaan. In *BSN*.

Bedir, M. (2017). Occupant behavior and energy consumption in dwellings: An analysis of behavioral models and actual energy consumption in the dutch housing stock. In *Architecture and the Built Environment*.

https://doi.org/10.59490/abe.2017.16.1876

Cai, W., Li, S., Zha, L., He, J., Zhang, J., & Bao, H. (2025). Significantly enhanced energy efficiency through reflective materials integration in plant factories with artificial light. *Applied Energy*, *377*(PC), 124587. https://doi.org/10.1016/j.apenergy.2024.124587

Darise, R. J., Maluegha, B. L., & Rembet, M. E. (2023). Audit Energi Konsumsi Listrik Di Hotel Aston Manado Tahun 2023. *Jurnal Tekno Mesin*, *9*(2), 131–138. https://doi.org/10.35793/jtm.v9i2.51995

Dewi, A. K., M, M. Z. Z., & Wardhana, A. S. (2025). Audit Energi sebagai Wujud Penghematan Energi Listrik di Asrama Vyatra 1 Politeknik Energi dan Mineral Akamigas Cepu Energy. *J-Dinamika*, *10*(2), 266–274.

ESDM. (2012). Peraturan Menteri Energi Dan Sumber Daya Mineral Republik Indonesia Nomor 13 Tahun 2012 Tentang Penghematan Pemakaian Tenaga Listrik Dengan. *Berita Negara Republik Indonesia No. 556, 2012*, *151*(2), 10-17 ENERGI DAN SUMBER DAYA MINERAL REPUBLIK INDO. https://peraturan.bpk.go.id/Home/Details/142561/permen-esdm-no-13-tahun-2012

Faniama, V., Hanadi, H., Christian, H., Tomoyahu, S., Pradipta, J., Haq, I. N., & Leksono, E. (2024). Energy Audit Based on Energy Consumption Intensity for Energy Conservation in University Buildings. *Jurnal Otomasi Kontrol Dan Instrumentasi*, *16*(1), 53–67. https://doi.org/10.5614/joki.2024.16.1.6

Hakim, M. F., Hermawan, A., Kurniawan, F., & Habsari, K. M. (2023). Audit Energi dan Rekomendasi Penghematan Energi Listrik di Gedung Rumah Sakit. *Elposys: Jurnal Sistem Kelistrikan*, *10*(2), 136–141. https://doi.org/10.33795/elposys.v10i2.2522

Hamdani, C. N., Dewi, A. K., Wardhana, A. S., Utama, P. A., Yudanto, R. C., & Swandaru, C. F. P. (2023). Audit Energi Pada Bangunan Gedung – Studi Kasus Pada Gedung Perkantoran. *JTT (Jurnal Teknologi Terapan)*, *9*(1), 1. https://doi.org/10.31884/jtt.v9i1.391

Kim, S., Song, Y., Sung, Y., & Seo, D. (2019). Development of a Consecutive Occupancy Estimation Framework for Improving the Energy Demand Prediction Performance of Building Energy Modeling Tools. *Energies*, *12*(3), 433. https://doi.org/10.3390/en12030433

Ningrum, D. Y., Chamim, A. N. N., Syahputra, R., & Jamaaluddin, J. (2019). Report of Energy Audit in Building F1, F3, F4, and G6 of Universitas Muhammadiyah Yogyakarta. *Journal of Electrical Technology UMY*, *3*(2), 61–68. https://doi.org/10.18196/jet.3255

Nugrahadi, R., Farizky, M. D. A., Dewantari, T. N., Karnoto, K., & Zahra, A. A. (2023). Analisis Pencahayaan Dan Peluang Penghematan Energi Listrik Di Gedung Rektorat Universitas Katolik Soegijapranata. *Transient Jurnal Ilmiah Teknik Elektro*, *12*(4), 149–158. https://doi.org/10.14710/transient.v12i4.149-158

Rohman, F., Nurhadi, N., Gumono, G., Purwanto, R. E., & Suryani, D. (2019). Penerapan Sistem Kontrol Penerangan Nirkabel Untuk Pengaturan Dan Penghematan Lampu Pada Aplikasi Smart Home. *Jurnal Eltek*, *17*(1), 30. https://doi.org/10.33795/eltek.v17i1.138

Saputra, K. A. K., Subroto, B., Rahman, A. F., & Saraswati, E. (2022). Eco-Efficiency and Energy Audit to Improve Environmental Performance: An Empirical Study of Hotels in Bali-Indonesia. *International Journal of Energy Economics and Policy*, *12*(6), 175–182. https://doi.org/10.32479/ijeep.13565

Shearer, L., Gatersleben, B., Morse, S., Smyth, M., & Hunt, S. (2017). A problem unstuck ? Evaluating the effectiveness of sticker prompts for encouraging household food waste recycling behaviour. *Waste Management*, *60*, 164–172. https://doi.org/10.1016/j.wasman.2016.09.036