Audit Energi pada Dinas Tenaga Kerja dan Transmigrasi Kabupaten Manokwari
(Energy Audit at the Manpower and Transmigration Office of Manokwari Regency)

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ABSTRACT

Electrical energy is a fundamental necessity that is vital in supporting various activities, including in the industrial, business, and office sectors. Along with the rapid growth of these sectors, electrical energy consumption has significantly increased. However, this increase is frequently accompanied by energy waste due to a lack of public awareness regarding the importance of energy efficiency. Therefore, an energy audit is necessary to evaluate the efficiency of electricity usage, such as at the Department of Manpower and Transmigration (*Disnakertrans*) Building of Manokwari Regency, West Papua Province. This study aims to calculate the Energy Use Intensity (EUI/ *IKE*) and formulate recommendations for Energy Saving Opportunities (ESO/ *PHE*) to reduce electrical energy consumption in the building. The results showed that the total electrical energy consumption based on load groups reached 4,074.78 kWh/month. Based on these results, the monthly EUI value obtained was 4.88 kWh/m²/month. This value indicates that the electrical energy consumption at the Manokwari Regency *Disnakertrans* Building is classified as highly efficient.

ABSTRAK

Energi listrik adalah jenis energi yang paling sesuai dan nyaman bagi manusia modern karena dapat dengan mudah diubah menjadi energi lain, seperti untuk keperluan pendinginan, penerangan, dan lain sebagainya. Hampir semua aktivitas manusia didukung oleh adanya energi listrik. Dengan pertumbuhan industri dan bisnis yang semakin pesat, penggunaan energi listrik pun meningkat. Namun, pemborosan energi listrik sering terjadi karena kurangnya kesadaran masyarakat dalam menghemat energi listrik. Dinas Tenaga Kerja Dan Transmigrasi Kabupaten Manokwari terletak di Jalan Percetakan Negara Kabupaten Manokwari Provinsi Papua Barat. Penelitian ini akan dilakukan perhitungan Intensitas Konsumsi Energi (IKE) dan juga rekomendasi Peluang Hemat Energi (PHE) yang dapat diterapkan dan diharapkan dapat mengurangi konsumsi energi listrik pada gedung tersebut. Konsumsi energi listrik berdasarkan kelompok beban pada gedung ini yaitu sebesar 4.074,78 kWh/bulan dan didapatkan nilai IKE bulanannya yaitu sebesar 4,88 kWh/m²/bulan untuk Gedung Disnakertrans Kabupaten Manokwari tergolong sangat efisien.

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1. INTRODUCTION

The demand for electrical energy continues to increase along with the growth of office operational activities, including in government agency facilities. Good energy management is a necessity to avoid budget waste while maintaining the reliability of the electricity supply. One of the initial steps in energy management is through an energy audit. An energy audit is a process of evaluating energy utilization to determine usage profiles and find opportunities for energy savings without compromising comfort.

The standard commonly used to measure the level of energy use efficiency in a building is the Electrical Energy Consumption Intensity. EEC is the ratio between total electrical energy consumption in a certain period and the conditioned building area. By knowing the ECC value, a building can be classified as to whether its usage is wasteful or efficient according to applicable standards.

The Department of Manpower and Transmigration of Manokwari Regency is one of the local government institutions responsible for providing essential public services. The office building operates continuously using various electrical loads to support administrative functions and public service activities. However, the building's electricity consumption has never been comprehensively evaluated using standardized energy audit procedures. Consequently, it remains unclear whether the current level of energy consumption is efficient or whether there are hidden sources of energy waste. Such an evaluation is essential to minimize unnecessary operational expenditures resulting from uncontrolled electricity usage.

This research is focused on the Manpower and Transmigration Office building of Manokwari Regency. As a public service center, this building uses various electronic equipment such as air conditioners (AC), lighting, and computer devices that operate routinely. Therefore, this study aims to determine the level of electricity consumption efficiency through the calculation of EEC and to analyze the Energy Saving Opportunities that can be implemented in the building.

2. METHOD

This study employed a descriptive quantitative approach conducted at the Department of Manpower and Transmigration Office Building in Manokwari Regency, Indonesia. The primary objective of this research was to evaluate the efficiency of electrical energy consumption from all electrical loads operating routinely within the building.

Based on the research framework, data were collected through three main methods: field observations and building area measurements, direct measurements of electrical loads including air conditioning (AC), lighting, and office equipment, and secondary data in the form of PLN monthly electricity bills from September 2023 to October 2025.

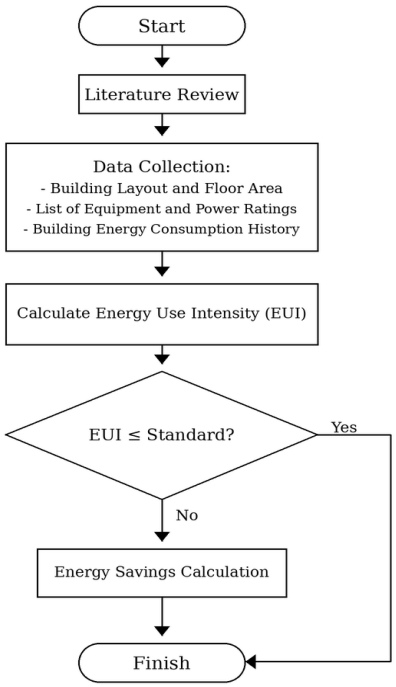
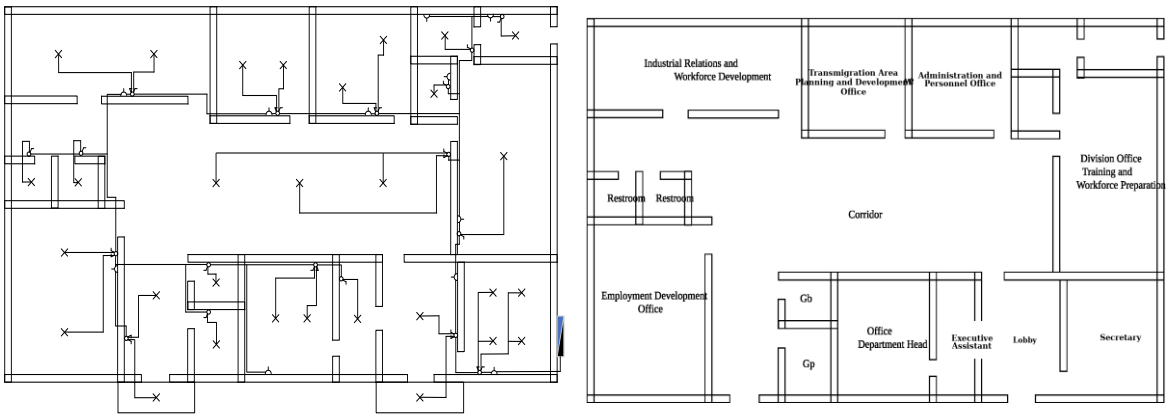


Figure 1. Single Line Manpower and Transmigration Office organizational chart



(a) (b)

Figure 2. (a) Single Line Diagram Manpower and Transmigration Office organizational chart and (b) Office floor plan

As an initial step toward understanding the building's electrical system comprehensively, the electrical power distribution network was first identified and mapped. The building, which has a total floor area of 834,58 m². relies on a power supply configuration and distribution of electrical loads across its distribution panels as illustrated in the Single Line Diagram (SLD), shown in Figure 2. The SLD serves as an essential technical reference for understanding the building's electrical infrastructure and for determining appropriate measurement points to ensure safe and accurate electrical load assessments throughout the energy audit process.

To evaluate the electrical energy performance of the building, the total electrical energy consumption is calculated based on the active power measurements over a specific operating period, as formulated in Equation (1)

$$kWh = Number\ of\ unit\ x\ \frac{Power\ (W)\ x\ Hour(jam)}{1000}) \quad (1)$$

Furthermore, the Energy Use Intensity —which serves as the primary indicator to measure the efficiency of electrical energy utilization within the building—is determined by dividing the total monthly electrical energy consumption Emonthly by the total conditioned floor area of the building A total . The monthly IKE formula is expressed as follows:

$$IKE\ Bulanan = \frac{Energy\ used\ per\ month\ (kWh)}{Building\ Area\ (m^2)} \quad (2)$$

In addition to evaluating the current energy performance, potential energy conservation opportunities are analyzed to optimize energy usage and reduce operational expenses. The percentage of cost savings resulting from the implementation of energy-saving measures is calculated using the following formula.

$$Percent\ Saving \text{ per month} = \Delta E\ (kWh) \times Electricity\ Tariff\ (Rp/kWh) \quad (3)$$

3. RESULT AND DISCUSSION

This section presents the results of the energy audit conducted at the Department of Manpower and Transmigration (Disnakertrans) Office Building in Manokwari Regency. The discussion covers the building's electricity consumption profile, the Energy Use Intensity (EUI) analysis, and the identified Energy Saving Opportunities (ESOs) to improve energy efficiency and reduce electricity costs.

3.1. Electricity Consumption Measurement Data for The Disnakertrans Building

This measurement data was obtained from measuring electrical energy consumption for one week during effective working hours at the Manpower and Transmigration Office Building of Manokwari Regency. The data was collected starting from Tuesday, October 22, 2024, until Monday, October 28, 2024. The data was measured from 07:30 AM to 04:30 PM. The measurement results data can be seen in Table 4.3 below.

Table 1.Electrical Energy Consumption Measurement Data Of The Manpower And Transmigration Office Organizational Building

Hour	kWh Meter Display						
	Tuesday	**Wednesday**	**Thursday**	**Friday**	**Saturday**	**Sunday**	**Monday**
7.30	112.694,63	112.809,85	112.962.84	113.051,93	113.166.84	113.212.45	113.314.33
8.30	112.702,05	112.815,90	112.971,89	113.054,09	113.167.23	113.212.97	113.318.23
9.30	112.710,22	112.817,44	112.977,87	113.061,21	113.167.89	113.213.34	113.321.67
10.30	112.718.71	112.82021	112.981,91	113.065,41	113.168.57	113.213.87	113.325.10
11.30	112.725.67	112.822,90	112.984,66	113.071,40	113.168.96	113.214.30	113.328.81
12.30	112.730.35	112.825,76	112.991,83	113.076,71	113.169.04	113.214.99	113.332.72
13.30	112.734.15	112.828,05	112.993,53	113.080,47	113.169.11	113.215.30	113.338.39
14.30	112.739.03	112.830,92	112.995,56	113.083,28	113.170.25	113.216.23	113.34144
15.30	112.743.01	112.832,47	112.996,99	113.086,87	113.170.75	113.216.88	113.342.03
16.30	112.745.94	112.834,56	112.998,08	113.091,37	113.171.15	113.217.50	113.342.99

As shown in Table 1, the highest electricity consumption at the Department of Manpower and Transmigration (Disnakertrans) Office Building in Manokwari Regency occurred in October 2023, reaching 8,545 kWh, while the lowest consumption was recorded in February 2025 at 1,890 kWh. Based on interviews with Disnakertrans staff, the significant increase in electricity consumption in October 2023 was attributed to a large-scale employee recruitment process, which required intensive use of office electronic equipment for preparing recommendation letters and administrative documents. In addition, several official activities conducted during that period also involved extensive use of electrical equipment. As illustrated in the graph, electricity consumption from November 2023 to September 2025 showed only minor fluctuations, indicating a relatively stable pattern of energy use throughout the observation period

3.2. Calculation of Energy Consumption Intensity (ECI)

Based on measurements obtained by the author using Google Earth, the total floor area of the Department of Manpower and Transmigration (Disnakertrans) Office Building in Manokwari Regency was 834.58 m². The building's average monthly electricity consumption was 4,074.78 kWh. Based on these data, the monthly Energy Use Intensity (EUI) was calculated using the following equation is 4,88 kWh/m²/month.

Based on the calculation, the monthly Energy Use Intensity (EUI) of the Department of Manpower and Transmigration (Disnakertrans) Office Building in Manokwari Regency was 4.88 kWh/m²/month. According to the Energy Conservation Implementation Guidelines (Table 2.2), this EUI value classifies the building as Very Efficient, indicating that its electricity consumption is within the recommended energy efficiency standard.

3.2.1. Energy Saving Opportunities (ESO)

Based on the calculated monthly and annual Energy Use Intensity (EUI) values and their comparison with the ASEAN–USAID (1992) standards and the Energy Conservation Implementation Guidelines, the Department of Manpower and Transmigration (Disnakertrans) Office Building in Manokwari Regency is classified as Very Efficient in terms of electricity consumption. Therefore, increasing the building's installed electrical capacity is not recommended.

Although the building demonstrates excellent energy performance, several Energy Saving Opportunities (ESOs) are recommended to further optimize electricity consumption:

1. Limit office lighting operation to 8 hours per day, corresponding to official working hours, and switch off lighting after office hours.
2. Reduce restroom lighting operation to only when required, with a maximum operating time of approximately 2 hours per day.
3. Operate only one air-conditioning (AC) unit in each room when occupancy is low, while the second AC unit should be used only during periods of high occupancy.
4. Restrict the operating time of office electrical equipment, except for CCTV systems and refrigerators, to a maximum of 8 hours per day in accordance with office working hours

3.2.2. Percent Saving

After estimating the potential energy savings based on the proposed recommendations, the percentage of energy savings was calculated using the estimated monthly and annual energy savings. The calculation was based on the applicable electricity tariff for the Disnakertrans Office Building, which falls under the P-1/TR tariff category with a rate of IDR 1,699.53 per kWh. The percentage of energy savings was calculated using the following equation is Rp. 1.903.864,49 and per year is Rp. 22.846.373,90.

Based on the calculation results, the estimated electricity cost savings are IDR 1,903,864.49 per month and IDR 22,846,373.90 per year. These results indicate that implementing the proposed Energy Saving Opportunities (ESOs) can significantly reduce the building's electricity expenditure while maintaining its operational performance and occupant comfort.

4. CONCLUSION

Based on the results of the energy audit, it can be concluded that the electricity consumption pattern of the Department of Manpower and Transmigration (Disnakertrans) Office Building in Manokwari Regency exhibited operational fluctuations, with the highest electricity consumption recorded in October 2023 (8,545 kWh) and the lowest in March 2024 (1,951 kWh). Overall, the building's electricity consumption remained relatively stable throughout the observation period from September 2023 to October 2025.

The calculated Energy Use Intensity (EUI) was 4.88 kWh/m²/month, which is classified as Very Efficient according to the Energy Conservation Implementation Guidelines. A comparison with the ASEAN–USAID (1992) benchmark and the applicable national standards confirmed that the building meets the required energy efficiency criteria. Therefore, the existing electrical system capacity is considered sufficient, and no increase in the installed electrical capacity is required in the near future. The identified Energy Saving Opportunities (ESOs) are expected to further optimize electricity consumption, maintain the building's high level of energy efficiency, and reduce operational electricity costs in a sustainable manner.

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