Benefits of Electrical Energy Efficiency in Office

Driaskoro Budi Sidharta[1,*], Slamet Prasetyo Sutrisno[1], Firmansyah Abdullah Rosanto[1], Paulina M Latuheru[1], Febriansyah[1]

[1]Politeknik Transportasi Sungai Danau dan Penyeberangan Palembang: Palembang
[*]Email : budi.driaskoro@gmail.com

Abstract.
It is necessary to make various efforts to save energy usage by each party. Inland Water and Ferries Transport Polytechnic of Palembang as part of the Indoneia government is trying to find ways to use electrical energy. The use of motion sensors, wireless switches, window film, controlling room temperature is one of the efforts to save electrical energy use. The parameters assessed are the Energy Consumption Intensity and the amount of budget savings obtained by making these energy savings. The research was carried out by comparing Energy Consumption Intensity, room temperature before and after the savings measures and the amount of electrical budget spent. The Teknika Laboratory of Inland Water and Ferries Transport Polytechnic of Palembang is classified as very efficient, the use of window film is able to reduce room temperature by 1,28^{0}C and is able to save the budget by 1,059%.
Keywords: Electrical energy, budget, energy Consumption Intensity.

1 Introduction

Energy saving in buildings is crucial since their consumption is raising continuously, particularly in developed countries (Sadeghian, et al. 2021). Energy efficiency decreases the amount of electricity wasted, which decreases the quantity of fossil fuels burned and, ultimately, lowers the total amount of pollutants produced by power plants. (American Council for an Energy-Efficient Economy 2018). Inland Water and Ferries Transport Polytechnic of Palembang is an official school under the Indonesia Ministry of Transportation that stands on an area of 20 hectares with several supporting facilities such as administrative buildings, lecture buildings, student dormitories, polyclinics, official houses and laboratory buildings. These buildings utilize electrical energy for lighting and air conditioning purposes, especially Air Conditioners. The large use of electrical energy contributes to the utilization of large energy sources and results in the accelerated depletion of energy sources and environmental damage. In reviewing the energy usage of different building sectors, office buildings stand among the most energy-consuming (Luewarasirikul 2015). In addition to this, the use of electrical energy for offices is related to the use of the state budget to pay for the use of electricity. A wide assortment of arrangements for climate alter relief have been executed universally and these arrangements have gotten to be one of the most concern (Stankuniene 2021).

P. M. Latuheru et al. (eds.), *Proceedings of the International Conference of Inland Water and Ferries Transport Polytechnic of Palembang on Technology and Environment (IWPOSPA-T&E 2023)*, Advances in Engineering Research 236,
https://doi.org/10.2991/978-94-6463-484-6_19

The Indonesia government through the Ministry of Energy and Mineral Resources established the Regulation of the Minister of Energy and Mineral Resources of the Republic of Indonesia No. 13 of 2013 in order to regulate the saving of electrical energy use in state buildings. In addition, saving the use of electricity in state buildings will be in line with the efficiency efforts of the state budget. To support the reduction of energy consumption in the Inland Water and Ferries Transport Polytechnic of Palembang environment, simulations need to be carried out to find potential energy savings that might be done. The electrical energy consumption variable associated with using air conditioners and lamps has an impact on the energy consumption intensity (Purnami, Arianti and Setiawan 2022). The usage of electrical sources from the improvident category can be made more efficient by using LED lighting and reducing the usage of air conditioners (Basyarach and Wardani 2020). The electricity usage in office building could effect to use of financial budgets in this case budget of the Inland Water and Ferries Transport Polytechnic of Palembang.

To determine energy consumption in office building could use energy audit method. Energy Audit could is the procedure for evaluating a factory's or building's energy usage and finding ways to reduce it (Meliala, Fitriani and Taufiq 2022) and an energy audit is a method used to calculate energy consumption in buildings and how to save it (Djamaludin, Poekoel and Rumbayan 2018). Energy Consumption Intensity is the amount of energy used in a building per conditioned area per month or per year (Biantoro and Permana 2017) meanwhile the comparison of energy consumption and unit area of a building (Meliala, Fitriani and Taufiq 2022).

2 Research Methodology

The intention of this research is to reduce the amount of electricity used by office lighting and air conditioning systems. This research was done by 1) studying electrical consumption in Teknika Laboratory which one of office building of Inland Water and Ferries Transport Polytechnic of Palembang, 2) studying effects of controlling usage of lighting and air conditioner electrical energy.

1) Collecting Initial Data on Electricity Consumption.

Electricity consumption at the Teknika Laboratory will be measured using a digital KWH Meter. The data was taken is electricity consumption before and after implementing the electricity saving strategy which will be taken every day

2) Taking room temperature, room air humidity and room area

A comfort study room temperature will create comfortable room conditions for the users that has a room temperature of 22.8 – 25.8^{0}C and humidity of 70% (Istiningrum, et al. 2017) and humans can work in comfortable conditions if they are in a room with a temperature of 20-26^{0}C and air humidity of 40-60% (Muttaqi and D 2019).

3) Implementation of Reducing Electrical Energy Consumption

a) Reduction of Air Conditioner workload
The room cooling load is influenced by several factors, namely the external cooling load, which is in the form of heat on the room walls, window glass,

doors, roof and floor of the room as well as heat generated by indoor equipment. (Ridhuan and Rifai 2013). Reducing the cooling load by covering all the room windows throughout by sun blocking window film with cutting up to 80% of heat. A 1°C or 2°C increase in room air temperature can reduce cooling energy consumption by more than 13% and 26% (Hamzah and Asniawaty 2017)

b) Restrictions on the use of lights
Restrictions on the use of lights are aimed at reducing electrical energy consumption but without reducing the comfort of laboratory users. These efforts were done by 1) Controlling the usage of the toilet light, a light switch was equipped with a motion sensor and timer so that it can limit the use of lights in the toilet 2) All rooms in teknika laboratory were equipped with smart light switches that can be turned off and on all electronic devices via an application on a cellphone.

3 Discussion

Carry out a comparative calculation of Energy Consumption Intensity
Based on the observations results of monthly electricity consumption in the Teknika Laboratory building, it can be concluded that the Energy Consumption Intensity is still categorized as very efficient. The Energy Consumption Intensity for the period August 2023 and September 2023 is 3.74 and 2.39 as shown in below table

Table 1. Energy Consumption

Period	Power Consumption (KWh/Month)	Building Area (m^2)	Energy Consumption Intensity	Category
August	1604	400	3,74	extremely efficient
September	1026		2,39	extremely efficient

A building's energy efficiency level category is determined in the Regulation of the Minister of Energy and Mineral Resources of the Republic of Indonesia No. 13 of 2013 as follow :

Table 2. Electrical Consumption Criteria

Criteria	Office Building with Air Conditioner (KwH/m^2/month)	Office Building without Air Conditioner (KwH/m^2/month)
extremely efficient	< 8,5	< 3,4
efficient	8,5 - 14	3,4 – 5,6
quiet efficient	14 – 18,5	5,6 – 7,4
improvident	>18,5	> 7,4

The opportunity to save energy is achieved by utilizing several equipment, namely:

a) Usage sun blocking window film with cutting up to 80% in the debriefing room (one of Teknika Laboartory room)
b) Usage of Automatic Motion Sensor Switches in the toilets of the Teknika Laboratory Building
c) WiFi based light switches in each room
d) Controlling room temperature by setting the Air Conditioner temperature at 18^0C

Table 3. Room temperature and hunidity

Period	Room Temperature (^{0}C)			Humidity Average (%)		
	Min	Max	aver-age	Min	Max	Average
August	23,7	28	25,51	48%	71%	55,08%
Septem-ber	22,9	26	24,23	45%	60%	53,94%

In terms of room temperature, it was found that using window film was able to reduce the increase in room temperature by 1,28^{0}C. By doing these savings opportunities, electricity usage savings of 578 KWh a month are achieved. From a financial aspect, this has succeeded in reducing costs by Indonesian Rupiah (IDR). 982,328.34 which a cost of IDR 1,699.53 per kWh every month. This savings is 1.059% when compared to the average cost of electricity consumption bills each month.

4 Conclusion

Based on usage sun blocking window film with cutting up to 80% can reduce the room temperature by 1.28^{0}C. Controlling and reducing the electricity consumption in office building could be done by usage WiFi based light switches, Automatic Motion Sensor Switches in some rooms such as in toilet and sun blocking window film. It could save the budget of office each period.

References

1. Djamaludin, Fikri P, Vecky C Poekoel, and Meita Rumbayan. "Energy Audit of Sam Ratulangi University Rectorate Building, Manado." *Jurnal Teknik Elektro dan Komputer* 7, no. 4 (2018).
2. American Council for an Energy-Efficient Economy. "The Health Impacts of Avoiding Power Plant Pollution with Energy Efficiency." 2018.

3. Basyarach, Niken Adriaty , and Ayusta Lukita Wardani. "Analysis of Usage and Efforts to Achieve Energy Efficiency in Surabaya Office Buildings." *SEMINAR NASIONAL KONSORSIUM UNTAG Indonesia ke-2.* Surabaya, 2020. 280.
4. Biantoro, Agung Wahyudi, and Dadang S Permana. "Energy Audit Analysis for Achieving Energy Efficiency in the AB Building, Tangerang Regency, Banten." *Jurnal Teknik Mesin* 6, no. 2 (2017).
5. Hamzah, Baharuddin , and Asniawaty. "Lecture Room Design that is Comfortable and Energy Saving." *Prosiding 2017© Seminar Ilmiah Nasional Sains Dan Teknologi Ke-3.* Gowa - Sulawesi Selatan, 2017. 54.
6. Istiningrum, Demi Tria , Rr Leidy Arumintia , Muhamad Mukhlisin, and Mochammad Rochadi Tri . "Study of Thermal Comfort of Lecture Rooms in School Building C, 2nd Floor, Semarang State Polytechnic." *Wahana TEKNIK SIPIL* 22, no. 1 (2017).
7. Luewarasirikul, Narun . "A Study of Electrical Energy Saving in Office." *7th World Conference on Educational Sciences.* Athens,, 2015.
8. Meliala, Selamat, Fitriani, and Taufiq. "Analysis of Electrical Energy Consumption in the Sawang District Head Office Using Matlab Gui." *Jurnal Teknologi Terapan and Sains 4.0* 3, no. 1 (2022).
9. Muttaqi, Ahmad Saifuddin, and Adil Mushaithir D. "Application of the Space Health Concept: Relation to Temperature and Humidity, Air Quality and Conductivity of Material Types." *Seminar Karya & Pameran Arsitektur Indonesia 2019.* Yogyakarta: Universitas Islam Indonesia, 2019. 434-448.
10. Purnami, Ndaru Atmi , Refni Arianti, and Paulus Setiawan. "Analysis of Energy Consumption Intensity at the Institute of Technology Diplomacy (ITDA) in Yogyakarta." *AVITEC* 4, no. 2 (2022).
11. Ridhuan, Kemas , and Andi Rifai. "Analysis of Cooling Load Requirements and Power of AC Cooling Devices for Campus Hall 2 UM Metro." *TURBO* 2, no. 2 (2013).
12. Sadeghian, Omid , et al. "A comprehensive review on energy saving options and saving potential in low voltage electricity distribution networks: Building and public lighting." *Sustainable Cities and Society 72*, 2021.
13. Stankuniene, Gintare. "Energy Saving in Households: A Systematic Literature Review." *European Journal of Interdisciplinary Studies* 13, no. 1 (2021).