Implementation of 10% Cutting Movement in Building a Lighting System on Postgraduate Diponegoro University

by Jaka Windarta

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Implementation of 10% Cutting Movement in Building a Lighting System on Postgraduate Diponegoro University

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Abstract. Until now, the need for energy continues to increase while the energy source is running low. Therefore, the Government issued various policies to conserve resources and improve the efficiency of energy utilization. One is through energy conservation programs in all sectors of life, called the 10% Cutting Movement. The program is promoted in the hope that people can reduce energy consumption up to 10% of daily energy use as well as in the academic environment. This research aims to implement a 10% cutting movement in lighting system in Diponegoro University postgraduate building and find out how much savings can be achieved. The implementation is carried out purely and modified by following existing standards. Pure implementation is done by setting a target of 10% savings on the overall energy consumption of the lighting system. While modification implementation is done by determining the 10% savings target, then adjusting the lamp usage hours. The savings obtained from the pure implementation amounted to 1.91 MWh / year, whereas in modifications implementation results obtained in the amount of 1.99 MWh / year. The savings from both methods is bigger than the specified savings target.

1. Introduction

Indonesia is a country with abundant energy resource potential. However, the source of energy in Indonesia has not been fully utilized to meet the needs of its citizens. While most of the available energy sources come from fossils, which are decreasing.

The government issued several policies to conserve energy resources, one through energy conservation contained in Regulation No. 70 of 2009 (1). Energy conservation is an act of using energy efficiently and rationally (8). This policy is expected to apply to all energy resources. According to Pramonohadi, savings opportunities from the implementation of energy conservation when applied to all sectors can achieve 10% - 35%. The savings that are easy to do can provide savings opportunities up to 10-15%, while savings by issuing several investments able to achieve up to 30% (8).

The government saw the opportunity and implement in the cut 10% energy conservation movement. This program appeared in 2012 and was introduced in 2016. This program aims to encourage awareness and increase responsibility for using energy efficiently in our daily lives. In 2017 this program campaigned in several cities such as Denpasar, Balikpapan, and Makassar. The program also provides education to the community that by reducing 10% of energy consumption from daily

energy use, the energy savings can be used to supply the electricity in other areas were still lacking the electrification ratio. The 10% considered as the number of savings may be achieved with the lowest investment (2). The target of this movement covers all sectors, such as household, industrial, business and social.

According to EECHI, in 2012, the construction sector absorbs up to 40% of the world's energy resources and responsible for up to 50% of total energy expenditure (3). The energy consumption came primarily from the cooling system and followed by the lighting system in the second place (4).

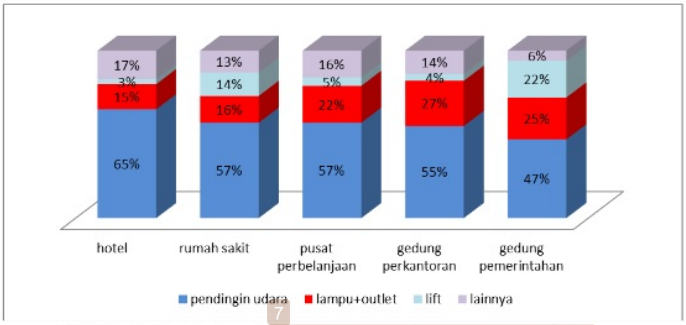


Figure 1. Illustration of Energy Consumption in Building Sector

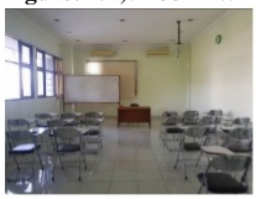
The postgraduate building is one of the building sectors that is expected to play an active role in energy conservation activities in the 10% cut movement. Some implementations conducted by guides savings provided by the Ministry of Energy and Mineral Resources include turning off lights when not in use, use energy-saving lamps, and reducing the use of incandescent light bulbs and clean the lights regularly. Hopefully, by implementing this action will reduce energy consumption so that the cost of energy use is also decreasing.

2. Methods

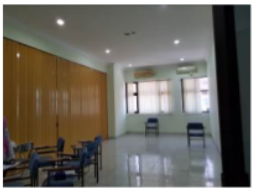
This research uses eight lecture room samples (figure 2) in Building A Diponegoro University Postgraduate School that operates Monday - Saturday at 8:00 a.m. to 4:00 p.m. with 197 kVA power subscribe from PLN (S2 tariff).



Figure. 2. a). Room 2.01 b). Room 2.02 c). Room 2.03



d). Room 3.01 e). Room 3.02 f). Room 4.01


g). Room 4.02


h). Room 5.01

The implementation of the 10% cut movement was observed using 2 methods as follows:

a. Pure implementation
   Observations were done on the electricity consumption of the lighting system in all eight samples room. After obtaining the total electricity consumption, then calculating the savings target of 10% of the total consumption.
b. Modified implementation
   Savings in this method still use the target of saving 10% by setting the hours of lamp use.
   After both methods were calculated and analyzed, then compared to the amount of savings that can be obtained. Some of the rooms that observed in this study are as follows.

3. Result and Discussion

3.1. *Energy Consumption*

The research was preceded by calculating the lighting system energy consumption from the research object. The results of observations and calculations of energy consumption in the lighting system of the 8 rooms samples are shown in the following table.

Table 1. Existing Energy Consumption

No	Room	Lamp Power (W)	Number of CFL Lights	Energy Consumption (Wh)
1	2.01	18	6	864
2	2.02	18	6	864
3	2.03	18	8	864
4	3.01	18	8	1152
5	3.02	18	8	1152
6	4.01	18	8	1152
7	4.02	18	8	1152
8	5.01	18	8	1152
1 year energy consumption (Wh/year)				2.405.376
Energy consumption costs (Rp/year)				2.164.838.400

From table 1, it can be stated that the energy consumption from eight rooms for one year is 2.4 MWh or equal to Rp 2.164.838.400,- (900 Rp/kWh) (5). After obtaining energy consumption for one year, then a 10% cut target calculation is carried out at 240 kWh. To get savings according to the target, it is necessary to measure the intensity of lighting in each room.

Measurements were made to determine how much of natural light received by each room. Measurements were made using a lux meter at measurement points that have been determined by SNI 16-7062-2004 (6).

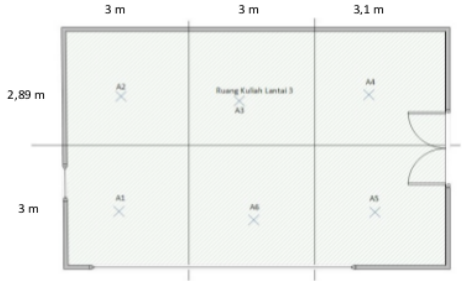


Figure 3. Determination of Point Measurement on Room 3.01

Figure 1 shows how to determine the measurement points according to applicable standards. SNI 16-7062-2004 states that for a room area of 10-100 m2, the measurement point lies in the intersection of horizontal and vertical lines in every 3m of the area of the room. For example, the measuring point A1 is drawn 1.5 m length from the left wall, 1.5 m length from the right, up and down points. The measurement results presented in the following table.

Table 2. Measurement of Light Intensity On Natural Lighting

Room	Room Size (m^2)	Time	A1 (lux)	A2 (lux)	A3 (lux)	A4 (lux)	A5 (lux)	A6 (lux)
2.01	56,9572	09.56	17,9	37,5	63,4	132,4	38,2	22,3
2.02	34,0252	10.18	6	0,07	0,5	0,4	0,6	0,5
2.03	32,3162	10.38	0	0	0	0	0	0
3.01	53,599	08.30	324*	123	125	113	175	258*
3.02	45,3102	09.22	27,8	93,5	36	17,4	18	30
4.01	52,8879	10.53	462*	205	199	152	221	403*
4.02	41,8	11.15	34,1	76,3	220	231	64	30
5.01	52,8879	11.30	898*	793*	456*	322*	472*	724*

The * sign is a light intensity measurement results in accordance with SNI 03-6197-2000

The measurement results in table 2 show that there are still several measurement points that do not meet the minimum standard of 250 lux (7).

3.2. Pure Implementation

Using the results in table 2, the reduction amount of light usage at some point that had at least 250 lux light intensity (7). The lamps usage in rooms 4.01 and 5.01 were reduced, where two lamps in room 4.01 were not used, while in room 5.01 all lights are turned off during operating hours because it is assumed that natural lighting is still able to light up the room and still comply with the minimum standards recommended. Calculation of energy consumption after reducing the number of lamps, as shown in the following table.

Table 3. Energy Consumption After Reducing the Number of Lamps

storey	Room	Power (W)	Number of CFL Lamp	Energy consumption (Wh)
2	2.01	18	6	864
2	2.02	18	6	864
2	2.03	18	6	864

3	3.01	18	6	864
3	3.02	18	8	1152
4	4.01	18	6	864
4	4.02	18	8	1152
5	5.01	18	0	0
Total energy consumption (Wh/year)				1.907.712
Total price of energy consumption (Rp/year)				1.716.940.800

Table 3 shows that the savings from pure implementation amounted to 1,908 MWh/year or Rp 1.716.940.800,-. The savings more than 87.4% from the target.

3.3. Modifications Implementation

In this method, the clock setting lamps made to obtain savings target. Based on table 2, rooms 3.01 and 4.01 have two measurement points, which are still getting natural lighting at 08.00-12.00 so that the use of lamps at that point will only take place at 12.00-16.00.

Table 4. Energy Consumption After Setting The On-Time

Room	Time of use 8a.m. – 4p.m.	Time of use 12a.m.- 4p.m.	Energy consumption (Wh)
2.01	6		864
2.02	6		864
2.03	6		864
3.01	6	2	1008
3.02	8		1152
4.01	6	2	1008
4.02	8		1152
5.01	0		0
Total energy consumption (Wh/year)			1.990.656
Total price of energy consumption (Rp/year)			1.791.590.400

The savings obtained from the setting of the lamps usage that reached 1.99 MWh, slightly greater than the pure implementation method or Rp 74.649.600,-.

The calculation results then compared between the pure implementation method and the modification implementation method for one year from 8 room samples that shown in the following table.

Table 5. Comparison of energy savings

Savings target (kWh/year)	Pure implementation (kWh/year)	Modified implementation (kWh/year)
240,538	1.907,712	1.990,656

From the table above shows that after the implementation of the 10% cut movement with a savings target of 240.538 kWh/year, the results exceeded the target. In the pure implementation method where the savings achieved by reducing the number of lamps earned savings of up to 87.4% more than the target or saved up to Rp 1.716.940.800,-/year. While the modification implementation where the savings achieved by adjusting the lamp timer to get savings of up to 87.9%, or about Rp 1.791.590.400,-/year.

4. Conclusion

In this paper, we try to implement the 10% Cutting Movement in a simple way but still meet the applicable standards. In the pure implementation method obtained savings up to 1.908 MWh / year, while in the modification's implementation obtained savings of up to 1.99 MWh / year.

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