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Analysis of Impact on the Use of Lighting Lamps against Efficiency and Impact on the Environment

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Abstract:- The increasingly deficited oil fuel condition further triggers the government to promote energy consumption efficiency. In an effort to improve efficiency of energy various efforts are made one of them is by creating light energy saving lighting. Lights with LED type bulb components are one of the light energy saving lighting products. In addition to the problem of energy efficiency problems caused by the electrical component is the lamp waste that can damage and harm the environment. Lighting waste is one of the waste that is categorized into non-organic group, i.e. the waste that cannot be degradable in the wild, the use of illumination lamps donate a waste as much as 2% per day. This research is done by observation and analysis method with the aim to know the potential efficiency of the use of lighting types and the potential of recycling waste lamps so that it can be re-made. Using a field survey approach and calculation method of the amount of energy efficiency gained by using lighting lamps and analyzed from the technical aspects and environmental aspects. Based on the calculation of technical aspects is derived that the use of LED lamps have a potential efficiency of 16% compared to the use of conventional lighting other lamps. From this aspect of LED lighting has the potential to be recycled and re-loaded.

Keywords:- *Efesiensi, LED, Inorganic Waste, Recycling, Illumination Light.*

I. INTRODUCTION (*HEADING 1*)

The deficit of fossil fuels is a common problem faced by the general world and the Indonesian Government in particular. It also affects the electrical energy deficit. Various solutions are done by the Government to anticipate these problems in order to provide continuity of service to meet the needs of electrical energy. These conditions trigger the state electricity Company (PLN) or the private-owned power plant to perform the efficiency in the use of electricity. To practice the electrical energy deficit issue of various energy Hemet products produced by the manufacturer. One of the energy-saving products is light lighting.

Electrical problems are not only limited to energy deficit and blackout problems, problems that are currently concern is the garbage problem generated by the electrical products one of them is the trash bulb that is not used Thus giving a negative impact to the environment. The trash or waste produced from the lighting includes the category of waste an organic that is harmful and cannot be degradable in the wild. Waste management in Indonesia is governed by law No 18 year 2008, aims to improve public health and environmental quality and to make waste as a resource [1]. As for the various types of garbage and the amount of waste production produced by the public can be seen in table 1.

Types of Waste	Number of million tonnes/year	Percentage (%)
Kitchen waste	22,4	58%
Plastic waste	5,4	14%
Paper waste	3,6	9%
Wood Waste	2,3	6%
Glass Waste	1,4	4%
Rubber/Leather Waste	0,7	2%
Fabric Waste	0,7	2%
Metal Waste	0,7	2%
Sand Debris	0,7	2%
Other Waste	0,5	1%
Total	38,5	100%

Table 1:- Data Statistics Amount of Waste Production
Source: Environmental Agency

Referring to the research conducted by Anisah S. and Darma A showed data that the type of Light Emiting Diode (LED) is still a product of energy saving lamps and environmentally friendly products. So that this type of LED light is precisely used as lighting [2].

Based on the background so it is considered necessary to create a study to examine and produce a lighting product that is energy efficient based green technology and environmentally friendly, with the aim to produce Emergency lamp product design based green tecologists as alternative energy and solutions from the electrical energy deficit from PLN and aims to reduce the production of waste so as to reduce environmental pollution.

II. LITERATURE REVIEW

A. Recycling Technology

Garbage or also commonly known as waste that has negative impact on the environment has been a big concern whether it is national and international as a chest seen on YouTube with URL https://youtu.be/wxMK48UAVAY [3]. While nationally in Indonesia, the legal basis for waste management is regulated and contained in the Law of the

Republic of Indonesia number 18 year 2008 about waste management [1]. Government regulation No. 81 year 2012 on household waste management and garbage type household waste [4]. Regulation of the Minister of Environment Republic of Indonesia number 13 year 2012 about the guidelines on the implementation of Reduce, and Reuse and Recycle through garbage banks. Policies on energy efficiency are also regulated in the Law of the Republic of Indonesia number 30 year 2007 about energy [5].

Referring to the research that has been done by Ika Wahyuning lighting bulbs can be cataloged in the type of garbage K3 is a type of garbage that is dangerous and difficult to break in the free environment [6]. Based on the characteristics of environmentally friendly technology (TRL) can be categorized:

- Included for all transition technologies that will be environmentally sound technology.
- All flow of life of material, energy and water in the production system and consumption.
- Covers overall spectrum starting from the basic technology of production system and consumption up to the overall integrated technology where environmental technology is the technology of production and consumption for itself.
- Includes closed system technology where the target is zero waste and reduced use of significant resources and environmental technology. That generates fewer emissions, considering the technological development in ecological context and Social.

Fig 1:- Lighting Lamp Waste

B. Waste Management Legal Basis

Legal basic tapping that discusses waste management is as follows:

- Law of Republic of Indonesia No. 18 year 2008 Concerning Waste Management.
- Law of Republic of Indonesia No. 30 year 2007 Concerning Energy.
- Government Regulation No. 81 year 2012 Concerning Household Waste Management and Garbage Type Household Waste.
- Regulation of the Minister of Environment Republic of Indonesia No. 13 year 2012 Concerning Guidelines on the Implementation of Reduce, and Reuse and Recycle Through Trash Bank.
- Regulation of the Minister of Environment Republic of Indonesia No 7 year 2011 No 1 year 2013 Concerning Guidelines for Implementing the Adipura Program.

Energy policy according to Law No. 30 of 2007 about energy, National energy policy is a policy of energy management based on principles of fairness, sustainability, and environmental insight for the creation of autonomy and energy resistance. National. Renewable energy sources are the source of energy generated from sustainable energy resources if managed properly, such as geothermal, wind, bioenergy, sunlight, flow and water fall, and the movement and temperature difference of the sea layer. Energy policy according to Law No. 30 year 2007 about energy.

The national energy policy consists of:

- The main policy includes:
  - ✓ Energy availability for national needs;
  - ✓ Priority energy development;
  - ✓ Utilization of national energy resources; National Energy reserves.
- Supporting policy includes:
  - ✓ Conservation and energy diversification;
  - ✓ Environment and safety;
  - ✓ Price, subsidies and energy incentives;
  - ✓ Infrastructure, community access and energy industry;
  - ✓ Energy research and development; and
  - ✓ Institutional and funding.

C. Electrical Energy

The energy of an object is a measure of the ability of the object to do business. Energy unit is Joule. Electric energy is the final energy needed for electrical appliances to move the motor, lighting, heating, cooling or to move back a mechanical equipment to produce another form of energy. Power unit = Joule/second is often referred to as Watt. Energy units can also be expressed in Waat, i.e. Watt-hours or Wh

1 Wh = 1 J/s x 3600 s = 3600 J
1 KWh = 1000 Wh = 3600 kJ

Lights are a source of illumination when we do. The higher the focus required of an activity, the brighter the light that we need. Similarly, the lower the focus of an activity, the more dim the light that we need. Currently, there is no sensor technology that can work to feel high-low the activity of one/several people in a room. The lamp itself, produced with the concept of one light power. It is not dynamic to be able to produce some bright levels of light. With such a lamp condition, we are not able to change it. However, we can change/regulate lighting techniques in a room to streamline power consumption by using multiple lights inside. To know or identify where and how much energy is used in lighting systems (various types of illumination lamps), it is necessary to observe and or measure directly on the different types of illumination lamps. The use of different types of illumination lamps will also produce a large different power generated, load

characteristics are needed for the power system and the influence of the loading can be analyzed properly, the analysis is included in determining the initial circumstances that will be projected in planning to use the load can be more effective.

➢ *Power*

Each load definitely has the power, this power is generated by the load when connected with the supply, as well as the lamp. Lamps can produce light because he consumes a certain amount of power according to the standard of each-each manufacturer of the lamp. The power is usually included in each product, but this power can also be obtained by directly measuring the respective lights.

➢ *Electrical Expenses*

Broadly, the load can be classified into, household load, commercial load, and industrial load. Load characteristics arise due to the power consumption of the magnitude of change over time. The large load of each specific interval varies as needed by electricity or consumer consumption, about the electricity sale price provided by PLN, the electricity tariff for household customers is differentiated into three, R1, R2 and R3. In electricity costs there are two types of costs, namely cost of load and usage. The cost of load is the fee to be paid per month for each 1000 VA connection (1kVA). While the usage fee is the cost for every 1kWh of electricity used. Specifically for the R1 group is known the term block consisting of block I-III. The goal is to save electricity consumption. Load characteristics in need so that the power system and the thermos effect of the loading can be analyzed properly. The analysis is included in determining the initial state that will be at project in subsequent planning to allow users with load characteristics to be effective. Broadly, the load can be classified as follows:

HOUSEHOLD: THE VALUE OF SOME OF THESE HOUSEHOLD BURDEN FACTORS IS: DEMAND FACTOR IS 70-100%. THE DIVERSITIES FACTOR IS 1.2-1.3 AND THE LOAD IS 10-15%.
COMMERCIAL: GENERALLY DEMAND FACTOR IS 90-100%. THE DIVERSITY FACTOR IS 1.1-1.2 AND THE LOAD FACTOR IS 25-30%.
INDUSTRY: FOR LARGE-SCALE INDUSTRIES DEMANDNYA 70-80% FACTOR AND LOAD FACTOR 60-65%.

➢ *Lighting Lamp*

Lighting lamps have different characters, with attention to the required power and the level of exposure produced, (Sukisno, Wardani 2011), in general the lamp can be classified into three types:

- *Fluorescent lamps (incandescence);*

Light is produced by the filament of the tungsten material (melting point > 2200 °c) which is glowing due to heat. This lamp efficacy is low, only 8-10% of energy becomes light. The rest is wasted as hot. In general the lamp.

Fig 2:- Fluorescent Lamps

The incandescent lamp has a yellowish light that creates a warm, romantic, and intimate ambience. Large-watt incandescent lamps are more efficient than low-wattage. For example a 100 W (120 V) lamp generates 1750 lumens, while two 50 W (120 V) lamps will only produce 1280 lumens. Incandescent lamps have a variety of types, among them clear bulb, argenta lamp, superlux lamp, opaque bulb, candle-shaped bulb, luster lamp, halogen lamp.

- *Lamps Fluorescence*

These lamps are usually referred to as fluorescent lamps. However, the world of the lamp industry is known as TL lamp. Now there is a new type of fluorescent light, some light producers refer to this light as SL and PL lamps. The normal fluorescent light is white while the SL and PL lamps In addition to white also have a yellow and white color type bluish. Advantages of using fluorescence lamps: efficacy (lumens per watt) high. Durable (longevity), up to 20,000 hours (assuming the old starting 3 hours each service). The more often in life-turn off, the age is getting shorter. The shape of the lamp extends to a wider area with diffuse light. For lighting that does not want to be banyangan, fluorescent lamps are better than incandescent lamps.

Fig 3:- Lamps Fluorescence

- *LED Lamps*

LED lamps are made of semiconductor material that will only permit the electric current to flow in one direction and not in the opposite direction. LED chips generally have a relatively low broken voltage. The characteristic of LED chips in general is the same as the characteristic diode that only requires a certain voltage to be able to operate. But when given a voltage that is too large, the LED will be damaged even though the voltage given is advanced voltage. The purpose of this study is: knowing the characters produced by LEDS are made. Know the effect of

using LED on indoor lighting. Comparing the performance of LED lights and incandescent lamps, TL, and LHE (energy saving lamp) by observing the resulting power (P) and light intensity (Lux) values. Creating a more simple, easy-to-understand and lightweight LED lighting arrangement.

Fig 4:- LED Lamps

The light on the LEDS is the electromagnetic energy emitted in the viewable spectrum section. The visible light is the result of a combination of lengths – different wavelengths of visible energy, the eye reacts looking at the length – the wavelength of electromagnetic energy in the area between the ultra violet and infra red radiation. Light is formed from the result of electron movement in an atom. In an atom, electrons move into an orbit surrounding an atomic nucleus. Electrons in different orbits have different amounts of energy. Electrons that move from orbit with higher energy levels to orbit with lower energy levels need to release their energy. This energy released is a form of photons resulting in light. The greater the energy released, the greater the energy contained in the photons. Where do we know a product has good quality. Of course the test results were done. It also applies to LEDS. Before the marketed lights – LED lights through the testing phase, to ensure the quality. The testing phase is called cholinergic process. On LEDS There are four things that must be proved through the binning process, namely color consistency, colour rendering, lifetime, and efficacy (amount of light per power) expressed in units of lumen per watt (LPW). The cholinergic function is to ensure that each LED generated meets that standard.

III. METHODOLOGY

The research carried out in the year with the main purpose of research in the form of studies is centered on the study of the potential and source of raw materials waste lighting produced by the community. For smooth implementation and can obtain good data need to be done research phase of the system by doing the following:

1. Library Research, which is collecting data that has to do with the writing of the thesis by reading the material and text books standard, e-book, internet, related journals, and scientific works.
2. Observation method (observation), which is observing directly to the object that has been selected.
3. Analysis method.

IV. RESULT AND DISCUSSION

❖ *Technical Facet Analysis*

Based on the results of studies and calculations conducted on the community using LED illumination lights have the potential to perform efficiency of the use of electrical energy such as the calculation result as follows:

Data collection is done to get information by conducting live interviews and in field observations.

No	Lamp Type	Power capacity (in Watt)	Amount
1	TL/Neon	14 Watt	5 pcs
2	TL/Neon	18 Watt	6 pcs
3	TL/Neon	24 Watt	3 pcs

Table 2:- Lighting Usage

From the table data above to replace the type of lamp with energy-efficient lamps then required a comparison value between the lumen and the intesity of light from the lamp used with the lamp to be replaced so the lumen comparison value of some Light type can be seen in table 3. Where in the table it states that the lumen value of the LED light has a higher intensity than the other type of lamp.

No	Incandescent Lamp Power	Fluorescent Lamp Power	LED Lamp Power	Lumen
1	40 watt	9 Watt	7 watt	450
2	60 watt	14 Watt	9 watt	800
3	75 watt	19 Watt	12 watt	1100
4	100 watt	24 Watt	14 watt	1600

Table 3:- Large Lumen Lighting Lamps

No	Types of Lamp	Capacity (in Watt)	Amount
1	LED Lamp	9 Watt	5 pcs
2	LED Lamp	12 Watt	6 pcs
3	LED Lamp	14 Watt	3 pcs

Table 4:- Energy-Efficient Lamp Types Replaced

From the data in the table above, we can specify the value P, V, and I

1. Power calculation
2. Voltage calculation
3. Current calculation
4. Load calculation

A. Calculation of lamp usage of TL type lighting

a. Power calculation on TL lamps

From the data in table 2 can be seen that the value of power has been determined by the manufacturing of 14 Watts, 18 watts. 24 Watt.

1. Voltage calculation on lamp Tlvoltage Calculation in the research was taken from the specified source voltage of 220 Volt
2. Current calculation

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From table 2 can be analyzed the current value contained in each lamp are:

- On the lamp 14 Watt:

$$I = \frac{14\ \text{Watt}}{220\ V} = 0{,}06\ \text{A}$$

- On the lamp 18 Watt:

$$I = \frac{18\ \text{Watt}}{220\ V} = 0{,}08\ \text{A}$$

- On the lamp 24 Watt

$$I = \frac{24\ \text{Watt}}{220\ V} = 0{,}1\ \text{A}$$

B. Electricity burden calculation on the use of TL lamps

- On the lamp TL 14 Watt

KWH Wearer electrical = power Tool Energy x long usage (in hours) KWH lamp usage in a day= 14 Watts x 10 hours x 30 days= 4200 WH = 4.2 kWH

Then the cost of electricity a month for the use of lamps 14 Watt is:
Electricity fee = Usage (kWH) x TDL
Electricity fee = 4.2 x 1,034 = Rp. 4.342
Total cost = number of lamps used x electricity fee
Total cost = 4 x 4,343 = Rp. 17,373

- On the lamp TL 18 Watt

KWH Wearer electrical = power Tool Energy x long usage (in hours) KWH lamp usage in a day= 18 Watts x 6 hours x 30 days = 3240 WH = 3.2 kWH

Then the cost of electricity a month for the use of lamps 14 Watt is:
Electricity fee = Usage (kWH) x TDL
Electricity fee = 3.2 x 1,034 = Rp. 3.308
Total cost = number of lamps used x electricity fee
Total cost = 6 x 4,343 = Rp. 19,848

- On the lamp TL 24 Watt

KWH electrocuter = power of electrical appliance x long usage (in hours)
KWH lamp usage in a day = 24 Watts x 6 hours x 30 days = 4320 WH = 4.3 KWH

Then the cost of electricity a month for the use of lamp 24 Watt is:
Electricity fee = Usage (kWH) x TDL
Electricity fee = 4.3 x 1,034 = Rp. 4.446
Total cost = number of lamps used x electricity fee
Total cost = 3 x 4,446 = Rp. 13,338

The Total load of electrical feeding on the TL lamps in kWH is:
Rp. 17.373 + Rp. 19,848 + Rp. 13,338 = Rp. 50,559

No	Types of Lamp	Current Used	1 Month Load Usage
01	Lamp TL 14 W (5 pcs)	0,3 A	Rp. 17.373
02	Lamp TL 18 W (6 pcs)	0,48 A	Rp. 19.848
03	Lamp TL 24 W (3 pcs)	0,3 A	Rp.13.338
04	**Total**	**1,01 A**	**Rp. 50.559**

Table 5:- Speakers Load Consumption in 1 Month on TL Lamps

C. Efficiency Calculation of LED Lamp

a. Power Calculation on LED Lamp

From the data in table 4 can be seen that the value of power has been determined by the manufacturing of 9 watts, 12 watts. 14 Watts.

3. Voltage calculation on LED light

Calculation of voltage in the research is taken from the specified source voltage of 220 Volt.

4. Current calculation

From table 4 can be analyzed the current value contained in each lamp is:

- On the lamp LED 9 Watt:

$$I = \frac{9\ \text{Watt}}{220\ V} = 0{,}04\ \text{A}$$

- On the lamp LED 12 Watt:

$$I = \frac{12\ \text{Watt}}{220\ V} = 0{,}05\ \text{A}$$

- On the lamp LED 14 Watt

$$I = \frac{14\ \text{Watt}}{220\ V} = 0{,}06\ \text{A}$$

b. Calculation of electrical charges on the use of LED lamps

- On the lamp LED 9 Watt

KWH electrocuter = power of electrical appliance x long usage (in hours)
KWH lamp usage in a day = 9 Watts x 10 hours x 30 days = 2700 WH = 2.7 kWH

Then the electricity cost a month for the use of lamp 9 Watt is:
Electricity fee = Usage (kWH) x TDL
Electricity fee = 2.7 x 1,034 = Rp. 2,791
Total cost = number of lamps used x electricity fee
Total cost = 4 x 2,791 = Rp. 11,164

- On the lamp LED 12 Watt

KWH electrocuter = power of electrical appliance x long usage (in hours)
KWH lamp usage in a day = 12 Watts x 6 hours x 30 days = 2,160 WH = 2.1 kWH

Then the cost of electricity a month for the use of 12 Watt lamps is:
Electricity fee = Usage (kWH) x TDL
Electricity fee = 2.1 x 1,034 = Rp. 2.171
Total cost = number of lamps used x electricity fee
Total cost = 6 x 2,171 = Rp. 13,026

- On the lamp LED 14 Watt

KWH electrocuter = power of electrical appliance x long usage (in hours)
KWH lamp usage in a day = 14 Watts x 6 hours x 30 days = 2520 WH = 2.5 kWH

Then the cost of electricity a month for the use of lamps 14 Watt is:
Electricity fee = Usage (kWH) x TDL
Electricity fee = 2.5 x 1,034 = Rp. 2,585
Total cost = number of lamps used x electricity fee
Total cost = 3 x 2,585 = Rp. 7,755

The Total load of electrical feeding on the TL lamps in kWH is:
Rp. 11.164 + Rp. 13,026 + Rp. 7,755 = Rp. 31,945

No	Types of Lamp	Current Used	1 Month Load Usage
01	Lamp LED 9 W (5 pcs)	0,2 A	Rp. 17.373
02	Lamp LED 12 W (6 pcs)	0,3 A	Rp. 19.848
03	Lamp LED 14 W (3 pcs)	0,18 A	Rp.13.338
05	**Total**	**0,68 A**	**Rp. 31.945**

Table 6:- Speakers Load Usage in 1 Month on LED Lamp

Field Implementation

After conducting data analysis, the implementation of direct to the field by replacing the lamp used by the partner with energy saving lamp with LED type, and subsequently done comparison of electricity monthly payment amount with Before and after replacing.

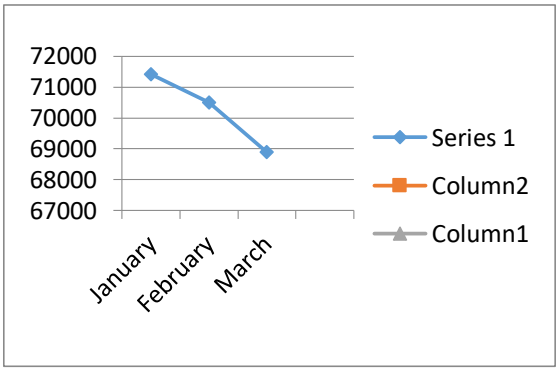

Fig 5:- Electric Account Monthly Payment before Lamp Replacement

From the figure of 5 charts above can be seen that the electricity load payment varies each month, this is due to the use of unstable electrical loads.

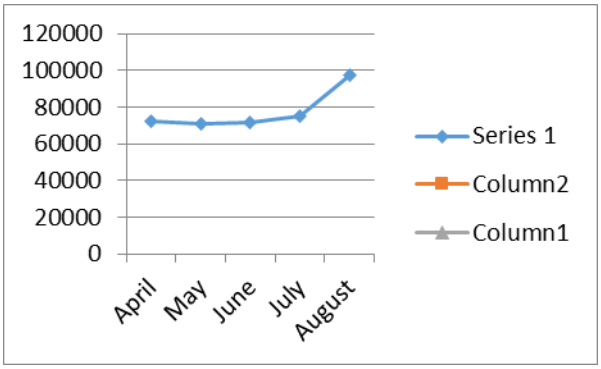

Fig 6:- Monthly Electricity Payment Account after Lamp Replacement

From chart 6 can be seen that there is increase in the payment after changing the lamp due to the addition of the burden for daily use and also the revocation of electricity subsidy from PLN.

❖ *Analysis of Environmental Impact*

Based on the results of field observations on the use of lighting lamps in the home community can be seen the impact of its environment as follows:

- The waste produced by the lighting of the TL type and LED is a solid material that can be categorized into non-organic waste types that can damage the environment and cannot be degradable in the wild.
- The use of energy saving lamps as an alternative source of light peril improved because people still think the price of energy saving lamps tend to be more expensive than other conventional lamps.
- The duration of use of a longer LED energy saving lamp compared to the use of conventional lamps can support the reduction of waste or waste caused by the illumination light.

Lamp waste has a role of 2% in the disposal of the amount of non organic waste. Based on the results of technical studies of LED lamps waste has the potential to be done recycling, this is intended by components that are owned by a remade and re-opened through Reuse and Recycle so as to produce recycled products Green-based technology.

V. CONCLUSION

From the research results can be concluded that:

- The use of LED lighting types can improve the savings and efficiency of the use of electrical energy compared to using other conventional lighting lamps.
- The use of LED lighting types can have a positive impact on these things because the LED illumination light can be recycled after use.

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