

# A Study on Energy Efficiency in UTHM Buildings

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## Abstract

Energy efficiency is an important aspect in sustainable design which produces the same amount of goods or service with less energy usage. Therefore, the factor of electrical utilities usage is crucial for saving energy. Currently, Universiti Tun Hussein Onn Malaysia (UTHM) has provided a large number of facilities to the students and staff. Most energy system embedded to those facilities are lighting and air-conditioning utilities, thus it is important to introduce ways to improve the efficiency of the utilities usage of the UTHM buildings. The objectives of this study are to identify the energy consumption of the UTHM buildings and to analyse the utility energy saving for the economical aspect. This study is focused on air-conditioning and lighting utilities energy efficiency. The locations of the study are lecturer's room (Block D1), classrooms (G3 Building) and Tun Fatimah College Residential (KKTF) at UTHM. Energy consumptions were measured by using field observation which was measured by the utilities rate of power. In this study, the lighting and air conditioning for one month energy consumption were determined. It was found that the highest amount of energy consumption was the G3 Building which is RM44979.22 per month, followed by KKTF with RM9873.34 per month and the lowest consumption is Block D1 with the amount of RM5240.81 per month. In this study, there are also ways to promote energy saving by using green product such as the 8-Watt Compact fluorescent light (CFL) which uses less energy and able to save energy as much as 1237kW/year but its 40Watt. It also gives a short pay back only in 6 months in return of investment. Subsequently, this result will minimize the energy consumption in building and further enhance energy saving on electrical utilities.

**Keywords:** energy efficiency; energy consumption; electrical utilities; air conditioning and lighting; energy saving.

## 1. Introduction

Malaysia is going to experience a considerable rise in energy prices especially the industry and business sectors. There are searching for energy saving solutions in order to counter the possibility of sharply rising overheads. By saving energy, Malaysia and every other country in the world will save a lot of money and as well as have a beneficial impact on the environment by reducing carbon emissions significantly. The most rapidly reacting businesses, aiming to protect profits by reducing their energy consumption and related bills, were hotels and owners of commercial buildings that already had large electricity bills. Energy-efficient lighting, air-conditioning and refrigeration represented the majority of the energy saving projects which Malaysian companies adopted. The increase in energy prices is a reality for Malaysia, but also for many other countries all over the world. Switching to energy saving solutions is the answer for reducing costs and for preserving the environment [1]–[3].

The abundant of energy resources can produce global warming and climate change which mostly because human activities [4]. The ones to contribute high demand energy are from educational institutes that have a large of facilities provided to students and staff.

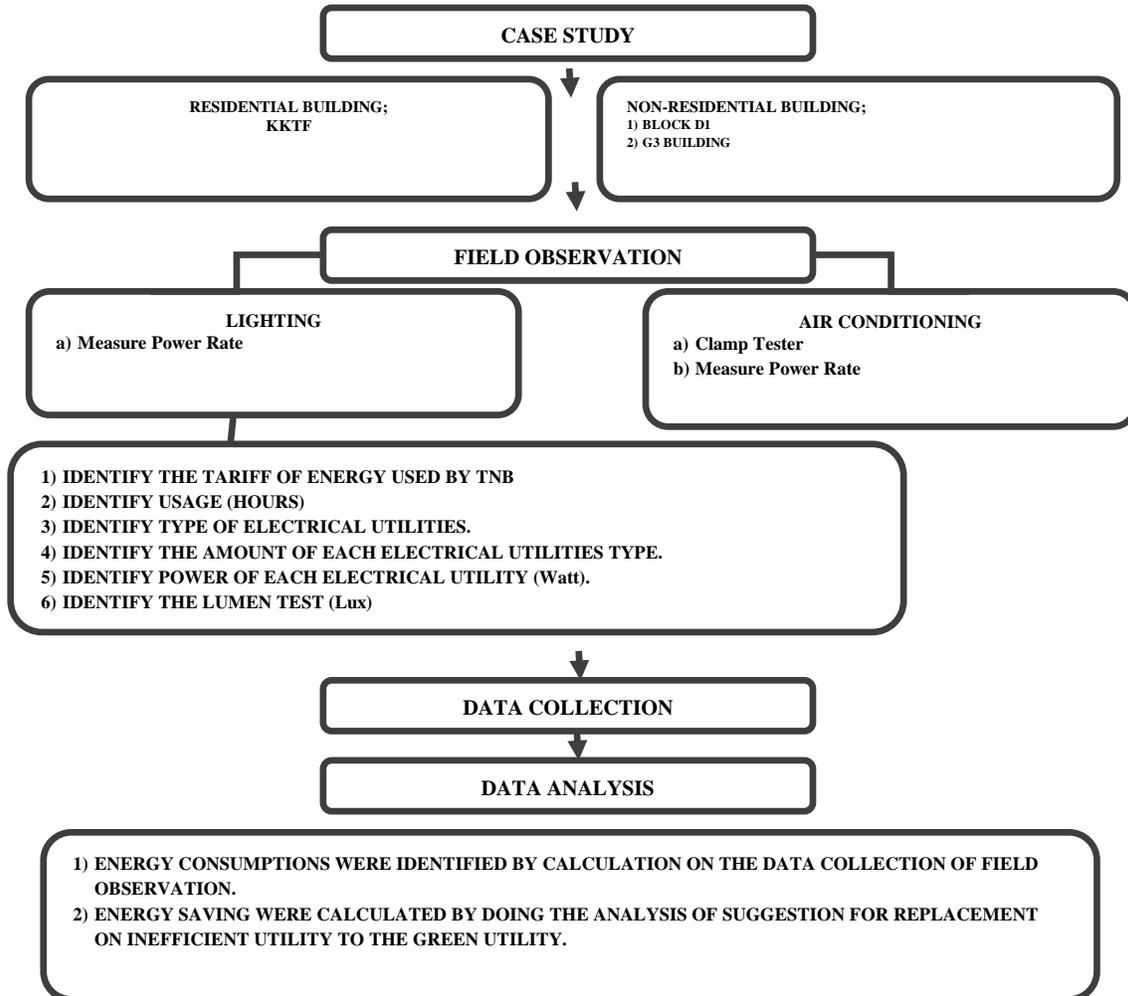
University Tun Hussein Onn Malaysia is one of the 20 public universities in Malaysia where most growths with their new developments. Mostly the energy consumption more to air-conditioning and lighting systems which also contribute the high energy consumption among all facilities provided[5].

## 2. Objective and Scope

The objectives of the study is to identify the energy consumption in UTHM Buildings and analyse energy saving at UTHM Building in economical aspect. And The scope of study is limited to the energy efficiency on electrical utilities only for air conditioning and lighting where the locations of the study are lecturer's room (Block D1), classroom (G3 Building) and Tun Fatimah College Residential (KKTF).

### 3. Research Methods

The study was conducted by field observation to the lecturer’ room (Block D1), classroom (G3 Building) and Tun Fatimah College Residential (KKTF), UTHM. The data was collected through the site observation and some methods have to conduct a test on electrical utilities used in the building (Fig. 1).



**Fig. 1 Field Observation Steps**



**Fig. 2. Apparatus and data collection Activities**

#### 4. Data Analysis And Study Result

The selections for this kind of buildings are to comparing the amount of energy consumption in one month for lighting and air conditioning in the buildings.

The energy consumption in a month can be calculated by using formula in Eq (1);

$$\text{Energy consumption} = \text{Wattage in kW} \times \text{Hours} \times \text{Days in month use (kW/ Month)}$$

The electricity bill can be calculated by using formula in Eq (2);

$$\text{Electricity bill} = \text{Energy consumption} \times \text{Tariff for electricity bill. (RM kW/Month)}$$

The tariff for electricity bill is 0.288cent kWh for UTHM which stated for commercial building.

The formula use in measuring the Watt by Clamp Tester in Eq (3);

$$\text{Wattage} = \text{Ampere (A)} \times \text{Volts (W)}$$

Fig. 4. Lighting Consumption in One Month, shows the amount electricity bill for three buildings in the lighting uses in one month. It can be seen that, the highest consumption are contributed by KKTF with the amount bill of RM9, 873.34 per month, followed by G3 Building with RM3, 170.64 per month and the lower consumption is Block D1 with RM1, 063.80 per month respectively . The factors which influenced the consumptions are the rate of energy produced by the lights, period of light use and the number of occupancies in the buildings.

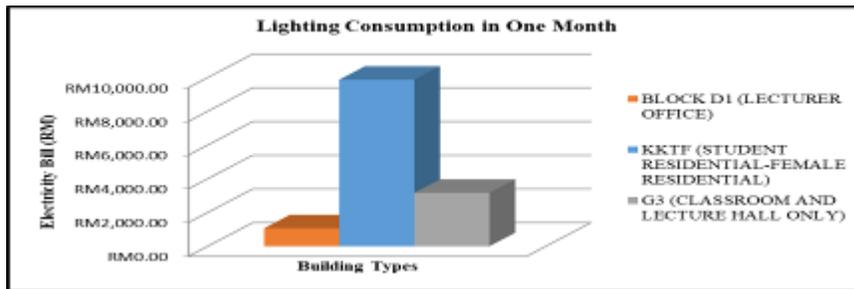


Fig. 3. Lighting Consumption in One Month

Based on Fig. 5, shows that G3 Building has the highest energy consumption for air conditioning with the amount of RM41808.58 per month. Meanwhile for Block D1 is RM4177.01 per month. There has a huge different amount of air conditioning consumption because the air conditioning systems applied to these buildings are also different. Furthermore, in Block D1, the split units air conditioning and variable refrigerant volume systems (VRV) are applied into the building and for G3 building the centralized air conditioning system is applied to produce the air conditioning in the building

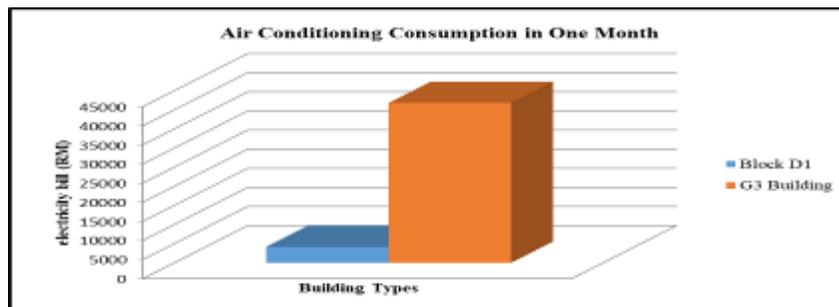


Fig. 4. Air Conditioning Consumption in One Month

## 5. Result and Discussion

Based on Fig. 6, G3 building mostly has a high percentage of 75 percent with the amount of RM44979.22 per month, followed by KKTF 16 percent with the amount of RM9873.34 per month and the lowest consumption is Block D1 only 9 percent with the amount of RM5240.81 per month. It shows air conditioning contribute the highest consumptions for G3 building.

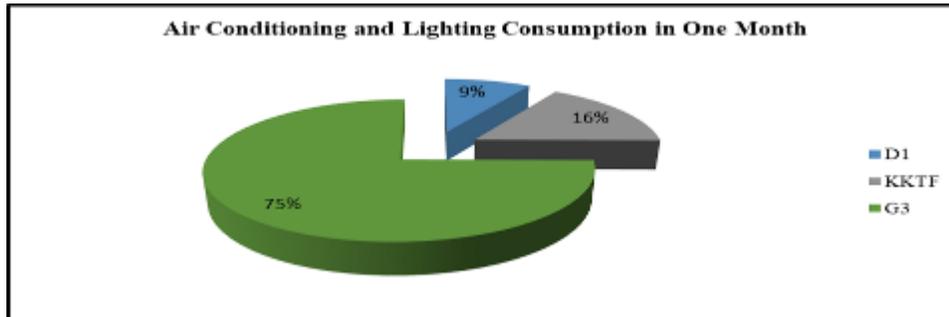


Fig. 5. Air Conditioning and Lighting Consumption in One Month

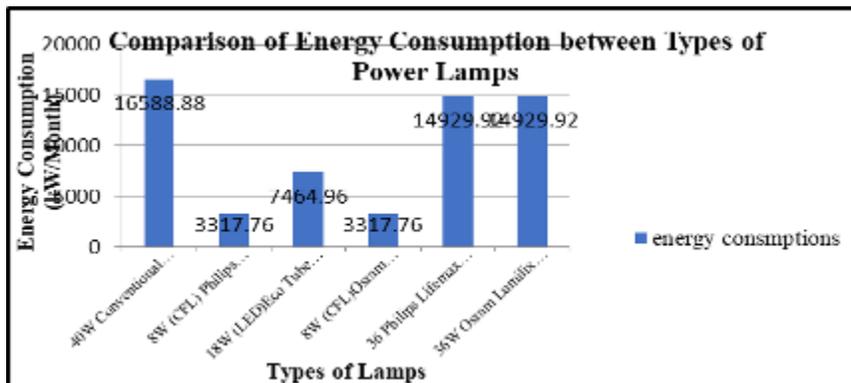


Fig. 6. Graph of Comparison between Types of Power Lamps

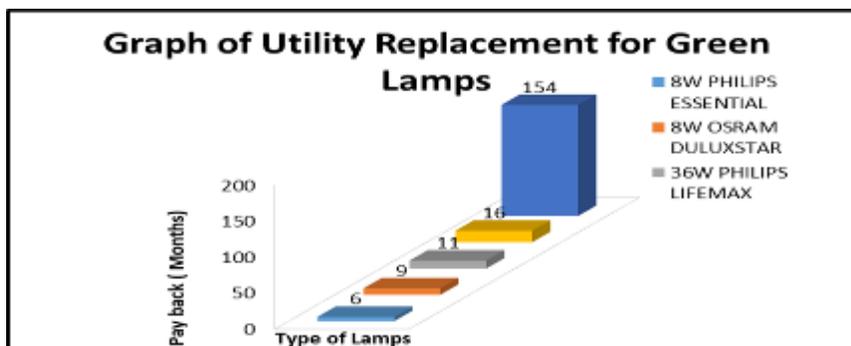


Fig. 7. Graph of Utility Replacement for Green Lamps

Based on Fig. 7, the 40W of conventional lamp produces the highest energy consumptions with amount 16588.88kW/Month meanwhile 8W of Philips Essential and Osram Duluxstar produce 3317.76kW/Month. Moreover, it can be seen that the green product can produce the less energy but also produce the same amount of quality as conventional lamp.

As in Fig. 8, the Philips Essential Lamp produce the less power than 8watt however, it can produce as much as ordinary fluorescent lamp 40watt. From the energy consumption, it shows that the energy saving could be obtained 13271

kW/year by making replacement to Philips Essential Lamp. Meanwhile, the price of this product is more expensive than ordinary fluorescent lamps because it has been released to the markets. For the returns of the investment, the pay back to invest of this product without including its installation cost is within 6 months only, which is really efficient product to use.

## 6. DISCUSSION

Based on findings, G3 Building has the highest energy consumption with the amount of RM44979.22 per month, followed by KKTF with RM9873.34 per month and the lowest consumption is Block D1 with the amount of RM5240.81 per month.

In Block D1, it proves that Variable Refrigerant Volume (VRV) system with 62 % more efficient which is less energy consumption rather than split units. This is because the system uses newest R-410a VRV system. According to the literature review, the newest R-410a VRV system with the highest efficiency achieved energy savings of 30% to 40% compared to the chillers, but an older R-22 VRF system showed little or no savings compared to the chillers. The VRF system savings are due to their high part-load efficiency capacity [6]

In G3 building, the central systems are mostly suitable applied for commercial and educational building which needs cold air to accommodating the large spaces. For this system, it usually required much more electricity bill because it has motors that is used for the supply and returns fans [7]. So, the way to reduce energy consumption for motors are used variable speed motor which can be an inverter to the motor to control the power use in motors. The intelligent inverter constantly adjusts compressor rotation speed to provide optimum performance at all times. This extremely precise operation enables quick cooling while reducing power consumption compared to conventional non-inverter units [7]–[9].

In lighting consumptions, the highest energy consumption was produced by KKTF where from the observation; the usages of the lightings are uncontrollable because the occupant switches on the lights exceed their needs. From here, it is known that human behaviour will affects the energy consumptions of the building they occupied.

In the analysis for energy saving, proving green products could reduce the energy consumption by its low power that is required and usage of less energy. Although the price of this product were more expensive than incandescent lamps but the effect is more to the usage of less energy that can be determined in short term. Compact fluorescent light (CFL) uses about 75% less energy than standard incandescent bulbs and lasts up to 10 times longer [10]

## 7. CONCLUSION

### 1. Energy consumption in UTHM Buildings.

From the findings, the type of air conditioning, lighting and time usage were considered to identify the energy consumption in Block D1, G3 Building and KKTF. G3 Building has the highest energy consumption with the amount of RM44979.22 per month, followed by KKTF with RM9873.34 per month and the lowest energy consumption is Block D1 with the amount of RM5240.81 per month.

For recommendation, a power meter must be required for each building to make it easier to conduct inspection and the energy usage can be controlled at the same time. Besides, this research will continue to help to identify other electrical appliances in future and the research can be more effective to study about the human behaviour of using electrical appliance in a building.

### 2. Energy Saving at UTHM Building in Economical Aspect

The finding for this analysis shows that cost for green products is really expensive but the product would require less energy which can give a good effect to the energy performance of the building. For the future research, the cost maintenance and installation could be studied to know how it supports life cycle cost for the product.

Lastly, this research can benefit UTHM especially when the university is now going to establish the green campus concept. It also can contribute on how to solve the abundant price of the electricity bill in UTHM and meanwhile support with the government's aim to minimize impact of global warming

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