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THE IMPLEMENTATION OF SOLAR PHOTOVOLTAIC INSTALLATION ON THE ROOFTOP OF UTHM BUILDINGS

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Abstract:
Renewable energy has become one of the largest sources to produce electricity consumption in our daily use, most notably energy from the sun. Malaysia receives enough energy from the sun to generate a noteworthy amount of electricity. Malaysia can tap this incredible potential energy initiative. The Malaysian government wants total electricity to come from renewable energy sources. However, Malaysians still do not prefer to use the renewable energy sources for energy consumption in daily life. Ironically, even UTHM does not play a role as a public university in implementing the government's intention to uplift the renewable energy industry. This study was conducted to investigate the total area (number?) of selected buildings that could possibly install the Solar PV panel towards the diffusion of the sun's irradiation. For this study, there are three phases conducted. The first phase is gaining data on electricity consumption; the second phase is fieldwork; and lastly is design phase. All these three phases were conducted in order to achieve the objectives of implementation and installation of Solar PV for UTHM buildings. The outcome of this study is the proposed design of energy consumption from Solar PV panels for UTHM buildings.

Keywords *:* Solar Photovoltaic Panel; Rooftop; Costing.

1.0 INTRODUCTION

Nowadays, the construction sector has been recognized as one of the sectors that contribute some of the pollution to the environment. The construction of conventional mega power plants is essential to maintaining human business and operations, while energy is needed for fuel, and construction processes, both of which affect the environment. This cannot be stopped completely because it is interdependent and requires the inevitability to meet the demands of the human population. However, the balance between these two sectors can be achieved by creating sustainable development through utilization of renewable energy. Sustainable development is the integration of economic viability, social equity and environmental conservation. With the intention of achieving sustainable development, the construction sector must play an important role in gaining and implementing green technology as an initiative to safeguard the environment (Ying, et al., 2013). One of the green technologies that can be used is installing Solar Photovoltaic panels on the rooftop of current buildings that will help achieve sustainability in both the energy sector and the construction sector. In order to become one of the pioneer public universities in implementing the Government's intention to uplift the renewable energy industry, Universiti Tun Hussein Onn Malaysia (UTHM) needs an initiative to play the role of an Engineering and Technology University that implements the renewable energy system especially on electric sources. This research was held at UTHM main campus at Parit Raja, Batu Pahat, Johor.

1.1 Objectives of study

There are two objectives of the study in the implementation of Solar Photovoltaic Panel installation on the rooftop of UTHM buildings. The two objectives are: i) to develop a procedure process for Solar Photovoltaic Panel installation and their energy consumption towards the implementation and

management of the Solar Photovoltaic Panel for UTHM buildings; and ii) to propose a design of energy consumption from Solar Photovoltaic Panel used for UTHM buildings.

1.2 Scope of study

The study was conducted on selected rooftop buildings inside Universiti Tun Hussein Onn Malaysia (UTHM) main campus. The study will be based on the roof orientation in order to get the best solar radiation towards it surface. This research is to analyze and design the electric consumption by how the area needed from the rooftop of building. The parameters required in the scope of study are:-

1. The data on electricity consumption of the selected buildings through electricity supply from the government was collected at "Pusat Pengurusan Hartabina (PPH)". The purpose is to make it as a benchmark to design the maximum electricity consumption using Solar PV that will be implemented to the rooftop area later; and
2. This study requires the total costing for developing Solar PV panel on rooftop of the buildings.

2.0 LITERATURE REVIEW

Renewable Energy Policy and Action Plan under the 10th Malaysia Plan demonstrate the government's further interest into RE. The objective has been raised to 985MW by 2015, amounting to 5.5% of Malaysia's electricity generation mix compared to the previous 5% (Fayaz et al., 2011). The Sustainable Energy Development Authority (SEDA) was set up when the Renewable Energy Act 2011 and Sustainable Energy Development Authority Act 2011 [Act 726] were passed to replace the Special Committee on Renewable Energy (SCORE) permanently (Fayaz et al., 2011). Feed-in-Tariff (FiT) was introduced under these two acts which allows RE investors to enjoy premium tariff payback rate per unit energy generated by selling to Tenaga Nasional Berhad (TNB) (Khor, C. S., & Lalchand, 2014).

Table 1: Summary of impacts by Malaysian Renewable Energy technologies

Types of energy technology	**Negative Impact**
Hydro	1) Alter migrating birds' flight path 2) Electromagnetic interference for radio signals 3) Consequential noise from rotating blades 4) Eyesore to the landscape
Wind	1) Native population displacement 2) Soil erosion 3) Reduced agricultural land 4) Ecosystem disturbance
Biomass	1) Fuel source uncertain and requires land for waste production 2) Facility requires sizeable amount of land and water 3) Affect surrounding biodiversity 4) Emission of greenhouse gases such as deadly methane and CO_2
Solar Power Plant	1) Requires sizeable amount of land 2) Poses environmental hazards if the production process is not handled appropriately
Solar BIPV	1) Poses environmental hazards if the production process is not handled appropriately

(Adapted from Ahmad et al., 2014)

Table 2: Summary of Malaysian Renewable Energy technologies in comparison

Types	Hydro	Wind	Biomass	Solar Power Plant	Solar BIPV
Source	Limited	Limited	Limited	Abundant	Abundant
Cost per kWh	Low	High	High	High	High
CAPEX	Extremely High	Low	High	High	High
OPEX	High	Average	Low	Low	Low
Land requirements	Extremely High	Low	High	High	Low
FiT category	Inclusive	Not Listed	Inclusive	Inclusive	Inclusive

(Adapted from Ahmad & Tahar, 2014)

3.0 METHODOLOGY

This study is conducted at four selected buildings. The selection factor is based on the large area available in the building. The largest building is FPTV, second largest is FKAAS building, the third largest is FSKTM building and lastly the smallest is FPTP building. All these buildings have their own meter reader to show consumption of electricity provided by "Tenaga Nasional Berhad" (TNB). There are two phases of methodology required to perform this research.

The first stage of methodology for this research is interviewing session with Electrical Engineer and Civil Engineer from "Pejabat Pengurusan Hartabina UTHM". This session is for getting all the information about electricity consumption and the area of rooftop provided by the buildings. The information gained is total electricity by kWh per month and per annum used by all four buildings. Other than that is the total cost required to pay TNB monthly and annually. Other than that, all four buildings' drawings and plans were given in order to design based on the rooftop area provided.

The second stage is the design process, which is required to differentiate between electricity consumption by Solar PV panel and electricity provided by TNB. A calculation was made to differentiate between the two sources of electricity. The calculation on how many Solar PV panel and its energy consumption is based on the possible areas at the rooftops of the buildings.

4.0 ANALYSIS AND FINDINGS

Table 3: Electricity consumption and cost price provided by TNB

	AVERAGE ELECTRIC CONSUMPTION (kWh) / month	AVERAGE COST PRICE (RM) / month	TOTAL PRICE PAID TO TNB (RM) / year	TOTAL ROOF AREA (M2)
FPTV	346,607.87	126,511.87	1,557,429.00	5,252.31
FKAAS	223,933.37	81,735.68	980,390.00	4,623.73
FSKTM	90,138.51	32,900.56	557,492.00	1,466.28
FPTP	69,280.67	25,287.44	318,413.00	1,764.88

Table 4: Shows Solar PV panel energy consumption by provided area

	PV AREA / Panel (M2)	TOTAL PV PANEL BY TOTAL AREA (UNIT)	ELECTRIC CONSUMPTION / PV Panel unit (Watt)	TOTAL PV GENERATED (Watt)
FPTV	0.54	9,727	100.00	972,650.00
FKAAS	0.54	8,562	100.00	856,245.37
FSKTM	0.54	2,715	100.00	271,533.33
FPTP	0.54	3,268	100.00	326,829.63

Table 5: Shows total of Solar PV energy consumption towards TNB

	TOTAL PV GENERATED (kWh)	TOTAL PV GENERATED (kWh) / day	TOTAL PV GENERATED (kWh) / month	% PV CONSUMPTION TOWARDS TNB
FPTV	972.65	6,808.55	204,256.50	58.93
FKAAS	856.25	5,993.72	179,811.53	80.30
FSKTM	271.53	1,900.73	57,022.00	63.26
FPTP	326.83	2,287.81	68,634.22	99.07

Table 6: Differences by Solar PV panel costing towards total price paid to TNB within a year

	TOTAL PV COST INSTALLATION (RM)	TOTAL PRICE PAID TO TNB (RM/YEAR)
FPTV	2,917,950.00	1,557,429.00
FKAAS	2,568,736.11	980,390.00
FSKTM	814,600.00	557,492.00
FPTP	980,488.89	318,413.00

For the electricity consumption by solar PV panel, 100Watt was taken as a benchmark to calculate the total PV generated. This is due to 100Watt being the reference minimum Wattage from one solar PV panel. Electricity consumption by one solar PV panel sized 0.6m x 0.9m can produce up to a maximum of 340Watt per hour and the minimum is 100Watt. The maximum 340Watt produced by one Solar PV panel can only be achieved during peak hours, which is from 12pm to 2pm average in Parit Raja, Batu Pahat with up to 26^0C temperature (GlobalSolarAtlas.info).

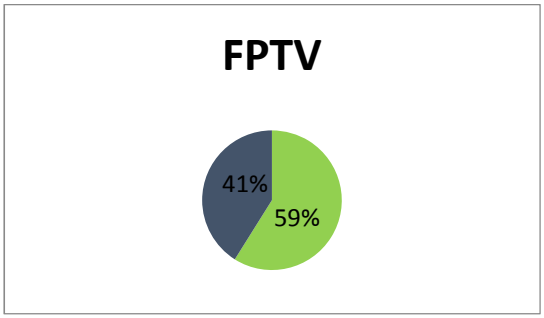

Figure 1

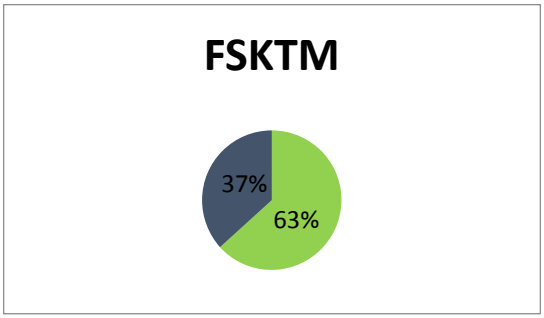

Figure 2

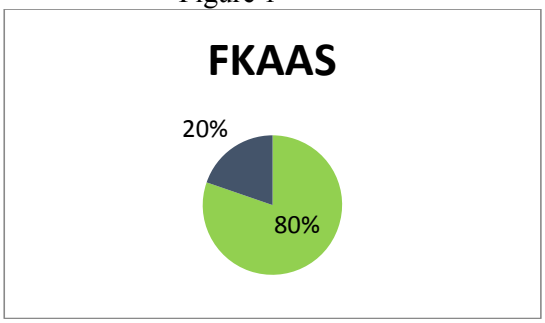

Figure 3

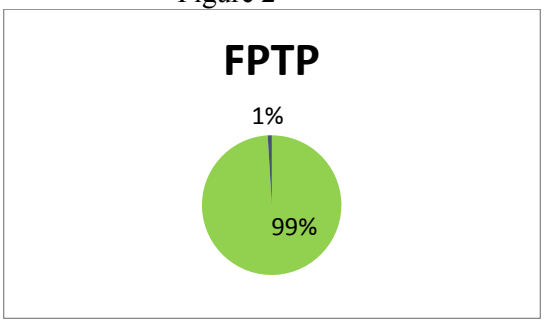

Figure 4

Figure 1 – 4 as above shows % of PV electricity consumption against TNB electricity supply

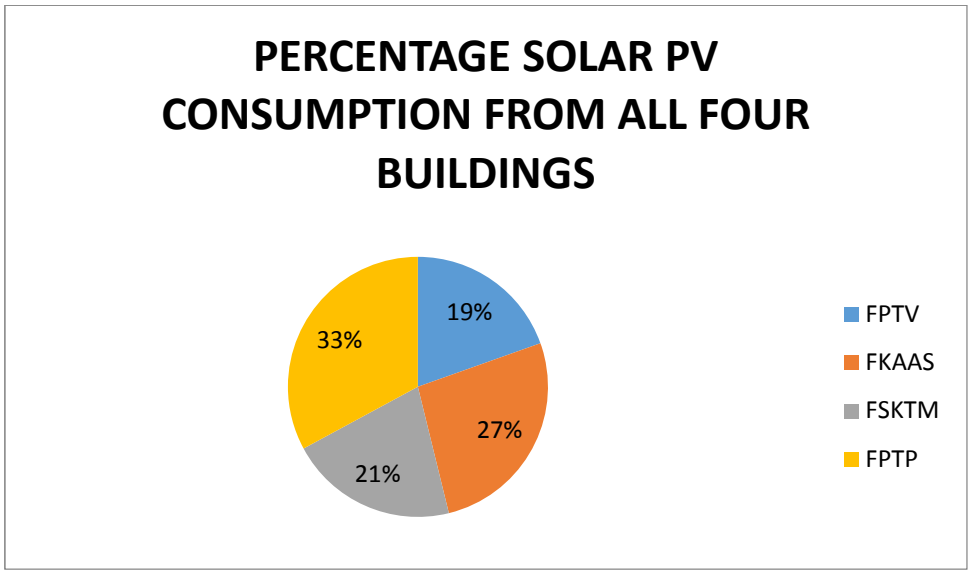

Figure 5: Percentage of Solar PV panels' electricity consumption by all four buildings study

5.0 CONCLUSION

The study has achieved the objectives that are set earlier in this study. The methodologies of the study were followed during the execution of this study. The results were obtained through a very detailed and specific process.

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