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Study of Energy Efficiency Opportunities in UTHM

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Abstract**—**Sustainable energy usage has been recognized as one of the important measure to increase the competitiveness of the nation globally. Many strong emphases were given in the Ninth Malaysia Plan (RMK9) to improve energy efficient especially to government buildings. With this in view, a project to investigate the potential of energy saving in selected building in Universiti Tun Hussein Onn Malaysia (UTHM) was carried out. In this project, a case study involving electric energy consumption of the academic staff office building was conducted. The scope of the study include to identify energy consumption in a selected building, to study energy saving opportunities, to analyse cost investment in term of economic and to identify users attitude with respect to energy usage. The MS1525:2001, Malaysian Standard -Code of practice on energy efficiency and use of renewable energy for non-residential buildings was used as reference. Several energy efficient measures were considered and their merits and priority were compared. Improving human behavior can reduce energy consumption by 6% while technical measure can reduce energy consumption by 44%. Two economic analysis evaluation methods were applied; they are the payback period method and net present value method.

Keywords**—**office building, energy, efficiency, economic analyses

I. Introduction

TODAY trend shows that electrical energy is the lifeblood of our style of living. It is difficult to survive without electric energy, air conditioning, lighting, television, computer, heater, fan and others. As all fossil fuels such as coal, oil and gas are depleting and will disappear in the future. It is predicted that, based on the current electrical consumption, gas and oil will only be available for the next 40 to 60 years, and coal will only be available for another few hundred years[1]-[4]. Therefore, it is necessary to increase the efficiency of electric energy usage in order to lengthen these resources availability. As Malaysia moves towards the status of a developed nation in 2020, our energy requirement will become more intensive [5]. The building sector is among the major energy consumers in the country[6]. According to MS1525 standard, recommended building energy index (BEI) is 135 kwh/ m²/ yr[7]. Almost all of the buildings in Malaysia do not meet this standard. Fig. 1 shown present three buildings achieved recommended standard building energy index in Malaysia [8], [9].

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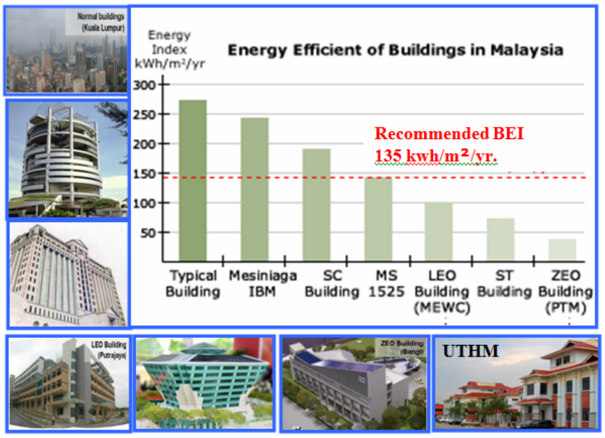

Fig. 1 Energy efficient of building in Malaysia

Rapid growth of Universiti Tun Huseein Onn Malaysia (UTHM) leads to an increase of electrical energy usage. It is expected that UTHM will expand six times greater than current condition. Hence, it is crucial to study on the efficiency of the electrical energy usage. The objective of this project is to investigate the potential of energy saving in selected buildings in UTHM. This project is aim to reduce electrical energy consumption in selected buildings designated as at Block C15, C16 and C17 at UTHM.

II. Cooling Load

Cooling load is the amount of heat energy to remove from a space by the HVAC equipment to maintain the indoor design temperature. There are two types of cooling loads; sensible cooling load and latent cooling load. The sensible cooling load refers to the dry bulb temperature of the building and the latent cooling load refers to the wet bulb temperature of the building.

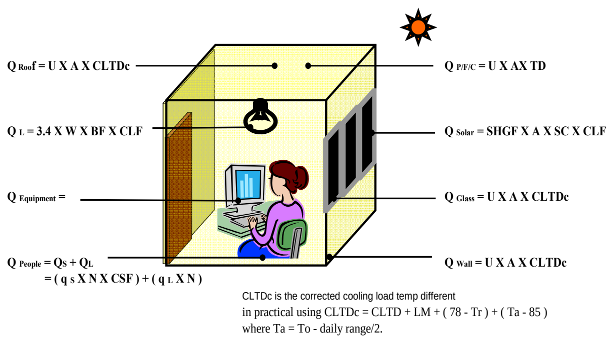

Fig. 2 Heat gain components into an enclosed space

Many factors influence the cooling load; they are windows, doors, skylights, walls, partitions, ceilings, roofs, floors, open crawl space, air infiltration, people, equipment, process and appliances [10]. Fig. 2 shown illusion factor which influence to cooling load estimation.

III. Methodology

In order to achieve this project, several techniques and measures have been selected and describe in process flow shown as Fig. 3.

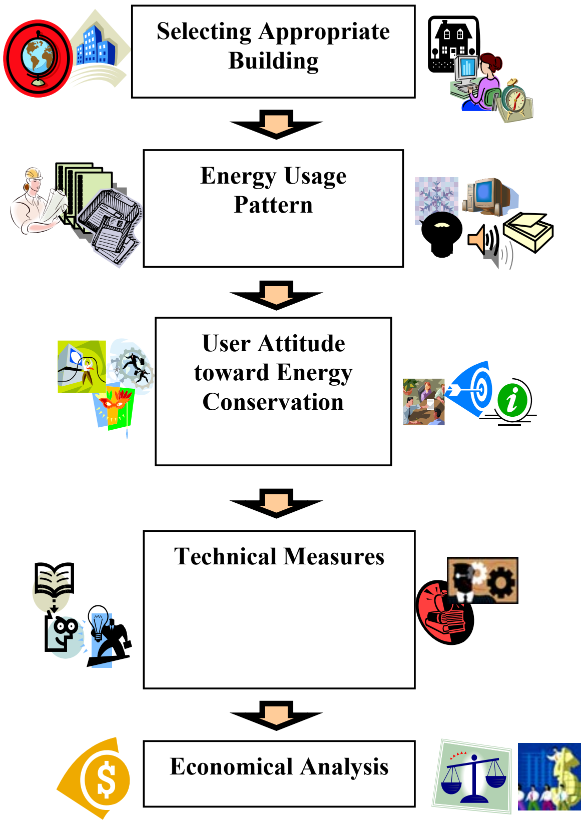

Fig. 3 Process flow of methodology of study.

A. The Selected Building

The buildings selected located in main campus of UTHM, Parit Raja, Batu Pahat, Johor, at 2° toward North and 103° toward East. The blocks are two stories building and designed to house 210 people for an academician office. Office hour starts at 8.00 am and ends at 5.00 pm, 8 working hours.. Total floor area of the building is 2172 m² and total number 126 rooms to cater up to 210 lecturers. Table I shows the details of the office building characteristics.

B. Electric Energy Consumption Pattern

The trend of electric was studied by analyzing actual electric consumption based on the electric bills issued by Tenaga Nasioanal Berhad (TNB).

TABLE I
PHYSICAL CHARACTERISTICS OF THE BUILDING

Component	Description
Wall	4 inches common brick
	+ 2 inches insulation
U-value	0.111 BTU/h.ft².°F
B Group no.	
Roof	Single pitch roof
Slope roof	45°.
R value	0.06
Thickness	1 inch
U-value	0.06 BTU/h.ft².°F
Glazing	Single Glass
Thickness	¼ inches
Light blinds / dark curtain	
Shading coefficient,	0.67
People	210 persons
Lighting	325W/m2
Type of lighting	
Fluorescent Tube 36 watt	
Down light 13 watt	
Equipment	Desktop PC or Notebook PC
	Small laser or Bubble jet printer
	Other small equipment
Ventilation rate	7.5 L/S/person
Infiltration rate	0.2 ach
HVAC system	Split unit air condition
TOSHIBA INVERTA	
Outdoor Unit	RAS-3M23YACV
Indoor Unit	RAS-M10YKCV
	RAS-M13YKCV
	RAS-M16YKCV
CARRIER	
Outdoor Unit	38HDT036
Indoor Unit	40GKX048

C. Estimation of Electric Energy Consumption

The electric consumption for air conditioning portion that has been considered includes air conditioning of office rooms and air conditioning of lobby area. Electric consumption for lighting consists of office room lighting, passageway lighting, walkway lighting, lobby lighting, building lighting, toilet lighting, stair lighting, compound lighting and landscape lighting. While electric consumption for other office equipments include desktop computer, laptop computer, copier, printer, battery charger, hand phone charger, coffee maker and other small equipments.

D. Users Behavioral Study

User attitudes towards electrical energy usage were conducted by means of questionnaires. The survey was conducted via questionnaires and interviewing the users.

IV. Technical Saving Countermeasure

A. Improving Physical Properties of Building Components

Cooling load can further be reduced by considering improvement in building physical properties such as solar gain coefficient for glass, insulation for wall and roof. Shading Coefficient (SC) is the ability of glazing to block the sun's radiant heat. The SC is the ratio of solar heat gain of a window compared to single-pane 1/8" clear glass. The lower the SC, the lower the solar heat gains through the window. Therefore, this measure suggested using low shading coefficient ratio.

TABLE II
PERFORMANCE OF CLEAR GLASS WITH AND WITHOUT WINDOW FILMS

Glazing Type	Shading Coefficient	Solar Heat Gain Coefficient	Visible Light Transmittance
Single-pane ¼" glazing			
Clear glass	1.00	0.86	90%
Clear with tinted film	0.50	0.43	48%
Clear with reflective film	0.29	0.25	15%
Clear with spectrally selective film	0.51	0.44	69%
Double-pane ¼" glazing			
Clear glass	0.87	0.75	81%
Clear with tinted film	0.56	0.48	43%
Clear with reflective film	0.42	0.36	16%
Clear with spectrally selective film	0.58	0.50	62%

From Table II, comparison between clear glass (SC=1.0) and tinted glass (SC=0.5) prove that by improving glazing, it is possible to reduce electric energy consumption. The total cooling load for tinted glass was lower compared to clear glass.

B. Air Condition Temperature Control Setting

Air condition temperature setting point is one of the factors that contribute to total cooling load and electric energy. The lower temperature setting cause higher cooling load and higher temperature setting cause lower cooling load. Therefore, it was suggested to set the air condition temperature at higher level within the recommended range. According to the MS 1525:2001 standards, there is a standard for indoor design condition for office building as listed below [9].

- Recommended dry bulb temperature 23 – 26 ºC
- Minimum dry bulb temperature 22 º C
- Recommended relative humidity 60 % – 70 %
- Minimum relative humidity 55 %

C. Reconsidering Low Occupant Area

Investigation on the office buildings found that the lobby area which is fully air conditioned but least occupied. This is considered as a waste when nobody utilizes this area. Users use this area just to walk through to clock in, restroom, food centre and to get to their offices. It takes less than one minute to walk through this area. Therefore, it is suggested not to provide air condition to this area.

D. Relamping

Relamping is the action taken to reduce the number of lamps required in certain area. Some number of lamps were removed when the luminance levels were above the levels as recommended by the MS 1525:2001 standards which is Malaysia official standard issued by SIRIM [9].

E. Improving the Efficiency Of Lighting Systems

Lighting for a typical office building represents on the average 18.4% of the total electrical energy use. There are varieties of simple and inexpensive measures to improve the efficiency of lighting systems. These measures include the use of energy-efficient lighting lamps and ballasts and the addition of reflective devices.

Energy consumption saving (kwh)
= (Old watt – New watt) x No of Lamps
x Operating Duration (1)

Electric cost saving (RM)
= Energy Consumption Saving
x Cost of Energy (2)

F. The Use of Occupant Sensors Switch Lamp for Washroom

Occupant sensors are switching devices that respond to the presence and absence of user. The system consists of a motion detector, an electronic control unit, and a controllable switch. Manual on / automatic off occupant sensors suggested an alternate compliance option to high efficacy lighting. Manual on / automatic-off occupant sensors automatically turn lights off if an occupant forgets to turn them off when a room is unoccupied.

G. The Use of Solar Power Lamp at Suitable Area

There are 18 units of 80 watts landscape lamp and 42 units of 13 watts wall lamp at this office building. These lamps function as a decoration lamp and placed outdoor. These lamps are switched on at night only.

Energy consumption saving (kwh)
= Bulb watt x No of Lamps xOperatingDuration (3)

V. Economics Analysis

Two evaluation methods were used and described, which are the net present value analysis method and the payback period analysis method, which are widely used in economic analysis. The Payback Period defined as the length of time required to recover an initial investment through cash flows generated by the investment [11]. The Payback Period gives the level of profitability of an investment in relation to time. The shorter the period is the better the investment opportunity. The Payback Period is a tool that is easy to use and understand, but it has its limitations. Payback period analysis does not address the time value of money, nor does it go beyond the recovery of the initial investment.

$$\text{Payback Period} = \frac{\text{Investment}}{\text{cash flow (year)}} \quad (4)$$

While net present value defined as the sum of the present values of the annual cash flows minus the initial investment [11]. Cash flows discounted or adjusted by incorporating the uncertainty and time value of money. This method is one of the most robust financial evaluation tools to estimate the value of an investment. The formula to calculate the NPV is as follow and simplified in mathematical terms:

$$\text{NPV} = \text{inital investment} + \sum_{t=1}^{t=\text{end of project}} \frac{(\text{Cash flow at Year } t)}{(1+r)^{\wedge}t} \quad (5)$$

Where: r = interest rate.
t = year of investment.

Initial investment cash flow is negative while the cash flows for the following years are generally positive. The investment to be consider economical when the net present value has to be positive or at worst zero. The higher the net present value is the more economically are the measures.

VI. Result And Discussion

A. Trend of electric energy

The total annual electric bill for UTHM was RM 3,728,230.77 and average monthly electric bill was RM 310,685.90. However, the monthly electric consumption was not consistent. The difference was attributed to the intensity of electric consumption during the semester term, semester break, holidays, convocation and others. The highest electrical consumption was RM 404,931.88, which was the beginning of session. The least amount was as low as RM 238,448.34. This discrepancy was due to few factors such as increase in electric tariff, beginning of semester, convocation and discount tariff rate offer by TNB. Normally electric energy consumption trend was high at beginning of semester and low at the end of semester.

B. Estimation of electric energy consumption

Table 4.3 shows the breakdown of the estimated electric consumption according to air condition, lighting and other equipment. Electric consumption for air conditioning was the highest (74.5%), followed by electric for lighting (18.4%) and other office equipment is the lower percent (7.1%) [12].

TABLE III
BREAKDOWN OF ESTIMATED ENERGY CONSUMPTION FOR OFFICE BUILDING

Equipment	Energy Usage (kwh)	Monthly Cost (RM)	Percent (%)
Air Conditioning	42444.00	12223.87	74.5%
Lighting	10487.81	3020.49	18.4%
Office Equipment	4032.00	1161.22	7.1%
Total	56963.81	16405.58	100.00%

C. Users behavior pattern

Users spend more than 3 hours working in the room daily. Only three users utilize their office room less than 5 hours per day. Majority of them spend between 5 to 9 hours daily working in their room. It can be concluded that, on the average, a user spend 88% of the working hours (8 hours) in his or her room. Hence, on the average, the room was not occupied for 1 hour per day. Eighteen persons switched off the light when they go out for more than 30 minutes and twenty-eight persons for more than 1 hour. The good practice is that all of the users switch off their room lights at the end of the day work.

Five users switched off the air conditioner when they are not in their rooms for less than 1. The good practice is that all of the users switch off their air conditioner when they return home. The energy wasted as a result of occupants not switching off their room lights and air conditioners when leaving their room for greater than 1 hour is calculated as below.

Waste = 1 hour x 6 lamps x 36 watts
x 24 days x RM0.288 kwh
= RM1.50 per month per user per room.

Assuming each office room having 6 fluorescent tubes with 36 watts, 24 working days per month and electric bill rate is RM0.288 per kwh. The same method is applied to estimate waste caused by air conditioning system. Calculation showed that 32184 watts or RM9.30 is wasted per month per room.

Based on current energy consumption trend in office building, there are many rooms to improve energy consumption. Proposal of electric energy saving opportunity is categorized into the two, one is saving opportunity by improving users' behaviors and another one is saving opportunity by means of technical measures.

Improving measures users' behaviors, effective programs make building users aware of energy consumption and saving. Increasing general awareness of energy use can be accomplished by training, poster campaigns, published, tip, guideline, fair and others. Provide information on organizational and individual energy saving practice to all office building users. Develop attractive and informative posters, bulletin boards, seminar, that discuss energy consumption and energy saving. Publish information on energy use, environmental impacts, and energy-saving options geared towards a general audience on the organization's web site or intranet site. Conduct energy fair oriented towards users with information on energy saving activities and products. Provide information on the energy performance of equipment or processes that employees regularly use as part of their jobs. For example, most employees probably do not know how much energy their computers use during the day and how much that costs the organization when it is on, but not in use. Develop scorecards develop charts and graphics that illustrate energy performance across department in organization or compare it between departments. Make comparison to a national standard and world standard. Gain top management support to improved energy awareness. Increasing the awareness of managers can help to build support for energy management initiatives.

D.Results of improving window shading coefficient

Windows affect the interior lighting, interior and exterior aesthetics, energy efficiency and user comfort. Right window choices can result in significant energy savings to office building. The building was installed with clear glazing which cause heat gain to office building. Cooling load by using clear glass (SC = 1) was 1139465.32 Btu/hr. Meanwhile cooling load by using tinted glass (SC = 0.5) is 957755.52 Btu/hr. This result showed 181710 Btu/hr was reduced when replacing clear glass to tinted glass. Total cooling load reduction was about 13% and possible saving in electric energy consumption around RM1589 per month. Several quotations were collected from local supplier to replace from clear glass to tinted glass. Average quotation price to replace the window glass is RM5 per ft square. Therefore, total cost to replace 4270 ft square window glass is RM21350.

E. Results of higher internal design temperature

Table IV shows estimated cooling load reading according to time and temperature setting. The result showed total cooling load was reduced about 6153638.4 Btu/hr per month when design temperature setting was changed from 70 °F to 77 °F. This reduced the cooling load by 5.7%, which translate into potential saving in electric energy consumption around RM697 per month with near zero cost.

TABLE IV
TABLE OF ENERGY CONSUMPTION ACCORDING TO TEMPERATURE SETTING

Room	*COOLING LOAD (BTU/H)*									
Temp. set	8.00 AM	9.00 AM	10.00 AM	11.00 AM	12.00 PM	1.00 PM	2.00 PM	3.00 PM	4.00 PM	5.00 PM
70 ° F	466480.49	477666.41	480442.11	477188.44	470152.57	461611.04	464677.27	474619.03	485663.49	490470.38
71 ° F	462817.61	474003.53	476779.23	473525.56	466489.69	457948.16	461014.39	470956.15	482000.61	486807.50
72 ° F	459154.73	470340.65	473116.35	469862.68	462826.81	454285.28	457351.51	467293.27	478337.73	483144.62
73 ° F	455491.85	466677.77	469453.47	466199.80	459163.93	450622.40	453688.63	463630.39	474674.85	479481.74
74 ° F	451828.97	463014.89	465790.59	462536.92	455501.05	446959.52	450025.75	459967.51	471011.97	475818.86
75 ° F	448166.09	459352.01	462127.71	458874.04	451838.17	443296.64	446362.87	456304.63	467349.09	472155.98
76 ° F	444503.21	455689.13	458464.83	455211.16	448175.29	439633.76	442699.99	452641.75	463686.21	468493.10
77 ° F	440840.33	452026.25	454801.95	451548.28	444512.41	435970.88	439037.11	448978.87	460023.33	464830.22

F. Results of reconsidering not to air condition low occupancy area

The energy consumption to air conditioning lobby areas was 10987 kwh per month. Assuming electric tariff of RM0.288 per kwh, total cost to air conditioning lobby areas is RM3164. This figure i.e. RM3164 could be easily saved by not having air condition in low occupant area such as lobby and passageway. However, some investment is needed to convert this lobby area to become open lobby area which is naturally ventilated. Estimation cost is about RM20000 to remove some glass door and glass window.

G.Results of relamping

According to MS 1525:2001, the luminance level for office was between 300 to 400 lux. Several offices were select as a sample office to collect data for luminance level. Basically, each of the office room was provided with 6 units of florescent lamp. From Fig. 4 it is found that the present level of luminance was above the maximum standard. Reading of actual luminance level was 443 lux, which was 43 lux above the maximum level. In other word it is 10.7 % above the maximum level. As a conservation measure, it was suggested to reduce the number of lamps from 6 units to 4 units. There is energy saving potential when reducing 6 units florescent lamp to 4 unit florescent lamp per room. The block consists of 126 rooms therefore a reduction of 252 units of florescent lamp was possible when 4 units of florescent per room were implemented. A total of 1741 kwh per month of electric energy was saved. Saving amount in term of money value is RM501 per month.

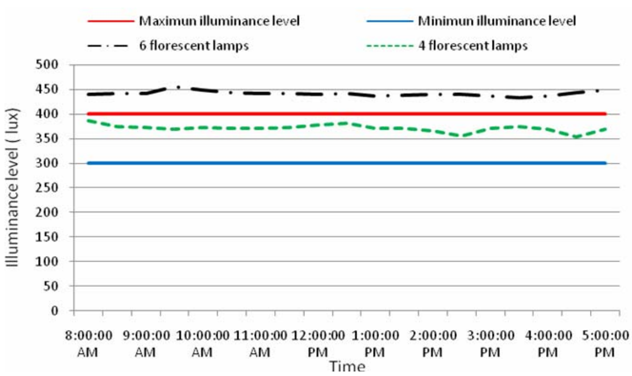

Fig. 4 Reading of luminance level at office building

H.Results of improving the efficiency of lighting systems

There are 254 pieces of T12 type florescent lamp consuming 36 watts of power. As an energy conservation measure, fluorescent lamps T8 type with the power of 32 watts was suggested to replace the T12 fluorescent lamp type. It can be replaced gradually whenever the old lamps burned out. Assuming electric tariff of RM0.288 per kwh, it is possible to save electric energy consumption around RM56 per month. Calculation methods for energy and cost saving are showed as below.

Energy consumption saving
= (36 -32) watts x 254 lamps
x 8 hour per day x 24 day per month.
= 195 kwh per month.
Electric cost saving
= 195 kwh x RM 0.288
= RM 56 per month

I. Results of sensor switch lamp

Saving from implementing occupant sensors switch lamp measure is quite difficult to calculate, whereby it is difficult to estimate how long a given lamp is left on when a room is unoccupied. However several lamps are always found on during non-office hour and non working day. Total number of lamp for washrooms is 120 units florescent lamp. Therefore, occupant sensors switch lamp can contribute in saving energy of 2488 kwh per month by just considering saving for non office hour and non working day, which amount to RM 716 per month. Cost estimation of implementing the measures can reach RM6000 including to remove florescent lamp to compact florescent lamp.

J. Results of using solar lamp for external purposes

Monthly electric energy consumption of lamps for external purpose is 571 kwh or equivalent to RM 164 per month. Estimation cost to replace present lamps to solar power lamps is RM 8000. Actual cost is depending on current technologies available and labor cost for electric contractor. Total saving is RM 164 per month.

K. Economics analysis

Economics analysis of proposed measures as discuss in this study is evaluated by using equation (4) and equation (5) as stated before. The Payback period is calculated by using equation (4), where by this equation is based on the initial cost and yearly return. All the value using this equation is positive and the result of the economics analysis is positive. Smaller result showed better result compare to bigger result. Below is the example of calculation of payback period based on measure 1.

Measure 1.

Payback Period

Initial cost = RM 21350

Yearly return = RM 19068.

$$\text{Payback period} = \frac{\text{Initial cost}}{\text{Yearly return}} = \frac{\text{RM } 21350}{\text{RM } 19068} = 1.12$$

From this calculation the payback period for this measure is about 1.12 or equal near to fourteen months. This investment is considered a good investment where by the initial cost is recovered in less than fourteen months.

Economics analysis by net present value is using equation (5). This equation is based on the initial cost, yearly return or yearly cash flow and yearly interest rate. Initial cost is considered as negative cash flow because it is spending money at beginning of investment year. Yearly return is considered positive cash flow whereby receiving money at end of the years. Result of net present value might be positive or negative. Positive value means it is a good investment.

Net Present Value

Initial cost = -RM 21359

Interest rate, r = 10 %

Yearly return = RM 19068

At 1st year,

$$\text{Net Present Value} = \text{Initial cost} + \frac{\text{Cash flow at } 1^{st} \text{ year}}{(1+r)^1}$$

$$= -\text{RM } 21359 + \frac{\text{RM } 19068}{(1+0.1)^1}$$

$$= -\text{RM } 4015$$

Net present value for the first year investment showed negative result. Repeat for the following year until getting positive result.

At 2nd year,

$$\text{Net Present Value} = \text{Initial cost} + \frac{\text{Cash flow at } 1^{st} \text{ year}}{(1+r)^1} + \frac{\text{Cash flow at } 2^{nd} \text{ year}}{(1+r)}$$

$$= -\text{RM } 21359 + \frac{\text{RM } 19068}{(1+0.1)^1} + \frac{\text{RM19068}}{(1+0.1)^2}$$

$$= \text{RM } 11743$$

This proposed measure showed a good investment after two year investment. At the end of the 2nd year, amount of cash flow is RM 11743. Repeat same method to calculate payback period and net present value for others measures and the results are showed as table below by assuming interest rate is 10 % per year.

Table V shows the payback period for the proposed energy efficient measures, where the lowest payback period is measures number 2 and the highest payback period is measure number 5.

TABLE V
RESULT OF PAYBACK PERIOD AND NET PRESENT VALUE ANALYSIS

Items	Measure 1	Measure 2	Measure 3	Measure 4	Measure 5	Measure 6	Measure 7
Initial cost	21350	0	20000	1500	29986	6000	8000
Monthly saving	1589	697	3164	501	457	716	164
Yearly saving	19068	8364	37968	6012	5484	8592	1968
PP	**1.12**	**0.00**	**0.53**	**0.25**	**5.47**	**0.70**	**4.07**
NPV 1st year	-4015	**7604**	**14516**	**3965**	-25001	**1811**	-6211
NPV 2nd year	**11743**	14516	45895	8934	-20468	8912	-4584
NPV 3rd year	26069	20800	74421	13451	-16348	15367	-3106
NPV 4th year	39093	26513	100353	17557	-12602	21235	-1762
NPV 5th year	50933	31706	123929	21290	-9197	26570	-540
NPV 6th year	61696	36427	145361	24684	-6102	31420	**571**
NPV 7th year	71481	40719	164844	27769	-3288	35829	1581
NPV 8th year	80376	44621	182556	30574	-729	39838	2499
NPV 9th year	88463	48168	198659	33123	**1596**	43482	3334
NPV 10th year	95815	51393	213297	35441	3711	46794	4093

Five out of seven of the proposed measures of energy efficient in building are economically viable and practical as they involved in return on investment within 2 years. Measures 5 and 7 incurred in a much longer payback period; i.e. 4 – 9 years, but they are still worth considering. Table VI shown the comparison of investment priority between payback period and net present value method

TABLE IV
COMPARISON OF INVESTMENT PRIORITY BETWEEN PAYBACK PERIOD AND NET PRESENT VALUE METHOD

NO	MEASURES	INVESTMENT PRIORITY BY PAYBACK PERIOD	INVESTMENT PRIORITY BY NET PRESENT VALUE
1	IMPROVE WINDOW GLAZING SHADING COEFFICIENT	5	5
2	AIR CONDITION TEMPERATURE SETTING CONTROL	**1**	**2**
3	RECONSIDERING LOW OCCUPANT AREA	**3**	**1**
4	RELAMPING	**2**	**3**
5	IMPROVE THE EFFICIENCY OF LIGHTING SYSTEMS	7	7
6	INTRODUCE OCCUPANT SENSORS SWITCH LAMP	4	4
7	INTRODUCE SOLAR POWER LAMP AT SUITABLE AREA	6	6

VII. CONCLUSION

The electric energy consumption can be reduced by several proposed measures. There are by improving user attitude towards the electric energy consumption through awareness, and technical improvement. Improving human behavior is possible to be reduced energy consumption by 6% and technical improvement could be reduced by energy consumption 44%. By implementing the measures, energy consumption index can be reduced to 142 kwh/m²/year. Five investment priorities to reduce electric energy consumption, there are by improving window glazing shading coefficient, setting air conditioner, temperature control, reconsidering low occupant area, relamping or delamping and introduce occupant sensors switch lamp.

VIII. RECOMMENDATIONS

Based on the results of the present study, several recommendations are consider for further works. There are; indicated energy star labels, maintenance of the building, maximize penetration of daylight, promote the use of low energy equipment and implement energy management system.

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