ENERGY AUDITING IN KOLEJ MAWAR, UNIVERSITI TEKNOLOGI MARA SHAH ALAM

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ABSTRACT

The global warming arouse the awareness of the public in the energy saving. New energy saving technology is appearing and developing rapidly, at the same time energy regeneration or alternative technology are developing in large scale. Basically energy problem can be classified into the following solution in general: energy saving, energy searching and energy recycling. Energy saving is defined as the differences between actual energy intensity and anticipated intensity. This project presents the system equipment efficiency at Kolej Mawar, Univesiti Teknologi Mara Shah Alam using Matrix Energy Saving (MES-30) equipment with autotransformer. The energy usage is determined from the historical data and walkthrough audit. Opportunity for improving the energy consumption were identified and evaluated. The economic analysis was carried out to determine the payback period.

Keywords: Energy saving, energy intensity, energy consumption, payback period

1.0 INTRODUCTION

As Malaysia moves towards a developed country status in 2020, our energy requirement will be very intensive. As it is, presently almost half of the energy consumption in the country is in the industrial, residential and commercial sectors. The commercial and residential building in Malaysia account for about 13% of total energy consumption and 48% of the country's electricity consumption. Hence there is a strong need to apply energy efficiency strategies in lowering the building's energy consumption. MS 1525:2001 Code of Practice on Energy Efficiency and used of Renewable Energy for Non Residential Building was developed to provide the best practice in energy efficiency for building [3].

Nowadays, Tenaga Nasional Berhad (TNB) and other Non Government Organization (NGO) has started to promoted energy efficiency technologies in the country. The body encourages consumer to invest their money wisely in energy efficiency appliances and equipment. The shift from the supply side to demand side by utilities has been implemented to save energy. Demand Side Management (DSM) is developed to improve the efficiency of electricity usage.

Beside this, recent advancement and technology in electrical product have increased the opportunity to cut the energy cost. Universiti Teknologi Mara Shah Alam has spent RM 17,956,881.71 electricity bill for one year in 2008. The total cost includes the entire university except Building Science and Technology. All data was taken from the main intake 33kV beside UiTM Hotel. Because of this, consciousness arises from management to reduce costs incurred. The project was carried out in the ten-storey building Kolej Mawar, Universiti Teknologi Mara Shah Alam which can accommodate around 1000 students. It's provided 498 rooms for use by students for accommodation. Each room can accommodate 2 students, while electrical facilities are provided with 2 numbers fluorescent lighting 1 x 36W, 1 ceiling fan and 4 numbers 13A switch socket outlet. This project was undertaken to assess whether it can increase energy efficiency and save energy consumption. It includes improving the efficiency of electrical systems in the building.

3.0 METHODOLOGY

This project presents the improving system equipment efficiency at Kolej Mawar, Universiti Teknologi Mara Shah Alam. It used Matrix Energy Saving (MES-30) equipment concept autotransformer. This project involves some procedure and relevant techniques towards achieving the project outcome. Project consists of data collection, installation, testing and analyzing the latest data.

A. Data preparation

Sample data before the installation of energy saving tools available from installing a FlukeView Power Quality Anlyzer. This meter is installed on every level in Kolej Mawar. Meter installation period will last for a week and has been set once every 1 hour reading for a more accurate reading. This includes the voltage, current, power and power factor. Results of data obtained are analyzed and identified for maximum voltage, maximum current, maximum power and power factor.

B. Installation

MES-30 is installed on every level in the hostel room raiser. Electrical source is connected through Matrix Energy Saving (MES-30) before connected to the output load. All three phase electrical source are connected to the Matrix Energy Saving (MES-30) before the output is connected to the load. Figure 1(a) shows the schematic diagram of where equipment is installed.

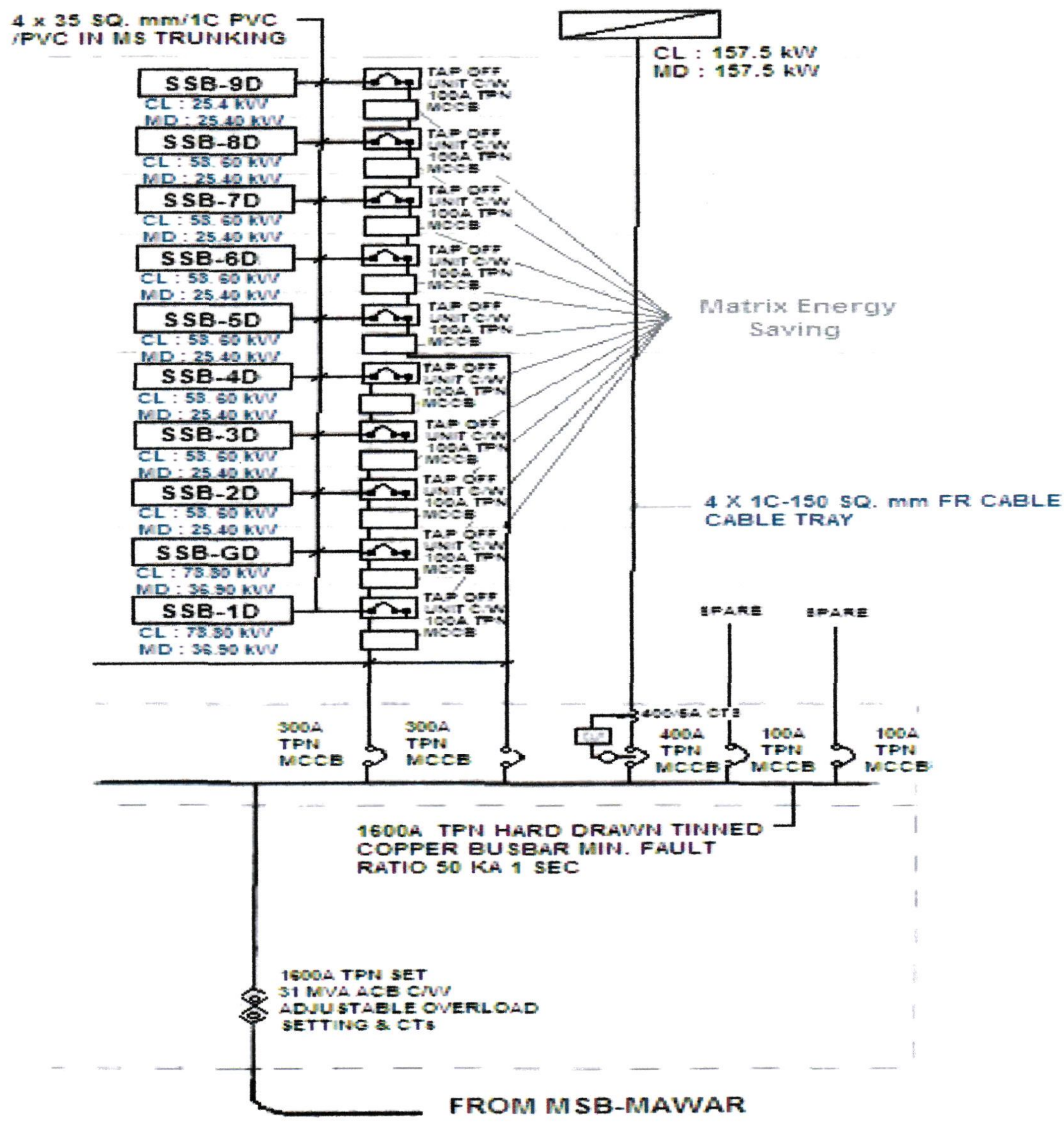

Figure 1(a): Schematic diagram of where equipment is installed.

C. Testing

After installation completed, the equipment was tested for its effectiveness. Equipment is fully tested before it is left in operation. It is monitored by technicians assigned. All data on voltage, current, power and power factor recorded.

D. Analyze data outcome

After the project is completed and submitted to the Universiti Teknologi Mara Shah Alam, once more FlukeView Power Quality Analyzer was installed. This allows the latest data recorded and analyzed. Meter is installed for a week and recorded every 1 hour. It is installed at all levels Kolej Mawar, Universiti Teknologi Mara Shah Alam. All information was downloaded in the computer. Information obtained and compared scheduled. Information based on the analysis results before and after the installation of equipment savings. Figure 1(b) chart below shows the flowchart work done to complete this project.

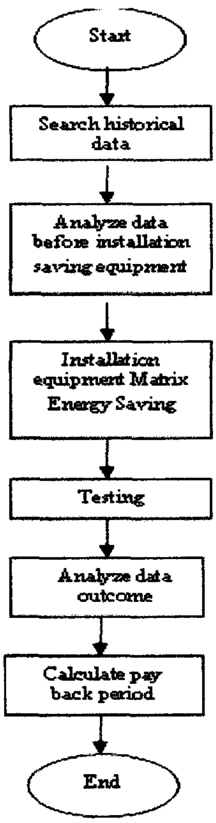

Figure 1(b): Flowchart work progress.

4.0 AUTOTRANSFORMER

This project uses basic autotransformer concept. An autotransformer is an electrical transformer with only one winding. The winding has at least three electrical connection points called taps. The voltage source and the load are each connected to two taps. One tap at the end of the winding is a common connection to both circuits (source and load). Each tap corresponds to a different source or load voltage. In an autotransformer a portion of the same winding acts as part of both the primary and secondary winding [1]. A common winding as show in Figure 2 is mounded on a core and the secondary is taken from a tap on the winding.

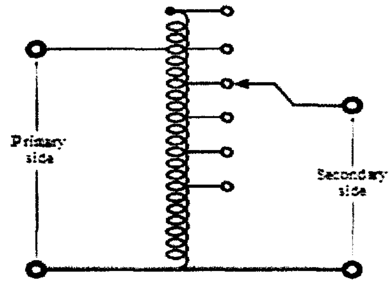

Figure 2: Common winding autotransformer.

Since all the turns link the same flux in the transformer core,

$$\frac{V1}{V2} = \frac{N1}{N2} = a$$

For ampere turn balance the parameter that uses is

$$\frac{I1}{I2} = \frac{1}{a}$$

The advantages of an autotransformer connect are lower leakage reaction, lower losses, lower exciting current, increased kVA rating and variable output voltage when a sliding contact is used for the secondary. The disadvantage is the direct connection between the primary and secondary sides.

5.0 RESULT AND DISCUSSION

The result can be divided into three part. The first part involved determination of parameter for 10 storey building Kolej Mawar, Universiti Teknologi Mara Shah Alam. Second part is cost installation of energy saving equipment and lastly calculation of payback period.

5.1 DETERMINATION OF PARAMETER FOR 10 STOREY BUILDING KOLEJ MAWAR

After installation, all data before and after the project is analyzed to assess whether this effect is positive or otherwise. This data is obtained based on studies and audits conducted over the project.

Table 1(a) below shows the measurement parameters, monthly total power and energy consumption when the time peak electricity usage before energy saving. This table is for before energy saving. Besides that, Table 1 (b) shows the results after the installation of equipment savings. While Table 2 (a) and 2 (b) shows changes in power and power factor for 24 hours before and after the installation of energy saving equipment.

Direct/Disconnect Mode											
Level	DB NO	IR	IY	IB	VR	VY	VB	PF	Hours	Total Power/Monthly (kW)	Total Energy/Monthly(kWh)
G	DB-GF	24	37	36	236.74	241.25	244.63	0.85	24	615	14760
1	DB-1F	26	13	36	240.09	241.94	245.77	0.92	24	492	11808
2	DB-2F	25	22	17	239.24	243.29	247.26	0.87	24	393	9432
3	DB-3F	33	17	17	239.55	244.27	245.74	0.95	24	453	10872
4	DB-4F	26	17	22	236.77	239.58	243.32	0.90	24	408	9792
5	DB-5F	16	26	14	238.71	240.91	244.79	0.95	24	402	9648
6	DB-6F	18	16	20	237.26	240.31	240.58	0.88	24	345	8280
7	DB-7F	22	18	21	240.26	243.09	246.39	0.87	24	369	8856
8	DB-8F	16	27	16	239.23	242.73	246.05	0.91	24	354	8496
9	DB-9F	20	15	24	238.38	241.48	244.47	0.82	24	417	10008
									Total	**4248**	**101925**

Table 1(a): Monthly total power and energy consumption when the time peak electricity usage before MES-30 installation

Energy Saving Mode											
Level	DB NO	IR	IY	IB	VR	VY	VB	PF	Hours	Total Power/Monthly (kW)	Total Energy/Monthly(kWh)
G	DB-GF	18	18	17	208.48	211.05	210.00	0.90	24	297	7128
1	DB-1F	14	16	21	209.82	212.54	209.86	0.93	24	297	7128
2	DB-2F	25	23	19	210.74	213.61	210.24	0.95	24	384	9216
3	DB-3F	15	13	19	207.80	211.60	207.60	0.91	24	192	4608
4	DB-4F	17	20	18	210.54	213.17	211.02	0.95	24	282	6768
5	DB-5F	16	21	11	210.75	206.80	210.40	0.94	24	270	6480
6	DB-6F	18	13	19	209.39	206.50	209.23	0.95	24	294	7056
7	DB-7F	16	17	10	209.81	206.47	208.39	0.93	24	255	6120
8	DB-8F	21	13	11	209.62	206.58	208.32	0.95	24	273	6552
9	DB-9F	21	13	18	212.71	209.52	211.47	0.87	24	291	6984
									Total	**2835**	**68040**

Table 1(b): Monthly total power and energy consumption when the time peak electricity usage after MES-30 installation

Table 1 (a) and 1 (b) shows the monthly total power and energy consumption when the time peak electricity usage before and after energy saving. Total energy per month before the energy saving is 101,925 kWh. While after the installation of energy saving equipment, these figures decreased to 68,040 kWh. From Table 1(a) and 1(b), the device can save electricity by 31%.

Direct/Disconnect Mode																				
Level	G		1		2		3		4		5		6		7		8		9	
Time	kW	PF	kW	PF	kW	PF	kW	PF	kW	PF	kW	PF	kW	PF	kW	PF	kW	PF	kW	PF
1.00 AM	20.3	0.85	14.6	0.93	11.2	0.87	9.4	0.86	10.8	0.88	12.1	0.91	9.8	0.87	10.3	0.86	10.5	0.88	14	0.82
2.00 AM	17.8	0.83	11.1	0.93	10	0.88	8.3	0.87	8.3	0.89	8.6	0.89	8.3	0.87	8.9	0.86	8.2	0.87	12.3	0.82
3.00 AM	17.3	0.83	8.8	0.93	8.8	0.87	8.2	0.86	7.4	0.89	8.2	0.88	7.5	0.88	8.5	0.86	7.8	0.87	11.6	0.81
4.00 AM	15.3	0.8	8.2	0.93	8.4	0.9	7.7	0.87	7.3	0.89	7.3	0.88	7.2	0.88	8.7	0.87	7.4	0.87	11.6	0.81
5.00 AM	14	0.78	13	0.92	9.7	0.92	15.7	0.95	13.1	0.95	13.2	0.95	9.4	0.9	10.7	0.9	11.9	0.91	12.6	0.82
6.00 AM	13.4	0.79	12	0.89	8.2	0.88	8	0.86	7.7	0.87	8.2	0.89	8.8	0.88	8	0.85	7.9	0.87	11.7	0.8
7.00 AM	13.3	0.78	11.5	0.89	8.1	0.88	7.7	0.87	8.1	0.89	6.5	0.93	9.9	0.88	7	0.9	6.1	0.92	12	0.82
8.00 AM	7.2	0.87	7.4	0.83	8	0.87	6.3	0.92	6.1	0.91	7.3	0.93	8.2	0.87	6.3	0.95	6.9	0.95	13.2	0.83
9.00 AM	4.6	0.8	5.7	0.79	6.7	0.89	4.6	0.92	2.9	0.87	3.9	0.94	4	0.93	5	0.94	5.1	0.94	9.5	0.78
10.00 AM	5	0.81	5.1	0.77	6.2	0.82	3.6	0.91	2.4	0.83	3.9	0.93	3.3	0.9	4.5	0.94	2.1	0.86	10.4	0.77
11.00 AM	3.8	0.74	5.5	0.79	5.2	0.83	3.9	0.9	2.6	0.83	4	0.93	2.8	0.85	2.1	0.84	2.4	0.9	8.3	0.71
12.00 AM	4.3	0.76	5.3	0.8	5.1	0.83	4.8	0.92	2.2	0.8	2.9	0.86	2.8	0.86	2.8	0.89	2.7	0.92	9.1	0.73
1.00 PM	4.5	0.81	5.6	0.84	5.9	0.88	4.1	0.91	4.7	0.94	2.9	0.86	3.9	0.91	5.9	0.94	4.7	0.96	6.7	0.82
2.00 PM	5.2	0.82	7.7	0.87	5.1	0.87	3.5	0.91	3.4	0.91	3.8	0.91	3.6	0.91	5.2	0.95	4.8	0.96	7.2	0.87
3.00 PM	5.5	0.84	8.8	0.89	8.1	0.92	3.2	0.89	2.7	0.89	5.1	0.82	3.3	0.9	3.6	0.91	2.3	0.9	6.2	0.84
4.00 PM	4.7	0.82	8.4	0.87	5.3	0.87	4.3	0.92	2.7	0.89	5.3	0.82	5.5	0.94	2.7	0.89	2.1	0.88	6.1	0.82
5.00 PM	5.2	0.82	8.8	0.88	6.5	0.88	3.7	0.92	6.7	0.95	5.4	0.88	5.4	0.93	3	0.9	3.8	0.84	6.5	0.84
6.00 PM	11	0.76	11.5	0.88	6.6	0.87	8.1	0.95	6.5	0.85	6.5	0.9	5.1	0.9	5.2	0.95	5.9	0.91	7.9	0.88
7.00 PM	16.1	0.84	12	0.86	11.4	0.89	11.5	0.91	12	0.88	8.6	0.88	10	0.9	7.9	0.87	8.2	0.88	11.9	0.89
8.00 PM	18.3	0.83	11.1	0.9	9.9	0.84	10.7	0.83	9.3	0.82	9.6	0.85	9.4	0.85	9.2	0.84	9	0.86	13.4	0.85
9.00 PM	17.8	0.83	13.5	0.91	10.7	0.85	10.4	0.84	11.5	0.85	9.7	0.85	9.4	0.85	8.6	0.83	9.3	0.85	13.8	0.87
10.00 PM	19.6	0.84	16.4	0.92	11.2	0.84	11.4	0.85	10.9	0.85	12	0.87	12	0.88	9.4	0.84	9.5	0.86	13	0.86
11.00 PM	19.9	0.85	15.9	0.92	13.2	0.87	11.4	0.86	11.5	0.85	11.6	0.88	11.2	0.88	12.4	0.87	10.9	0.87	13.4	0.85
12.00 PM	20.5	0.84	13.8	0.92	11.5	0.86	13.1	0.88	13.6	0.9	10.6	0.88	11.5	0.88	10.3	0.85	10.7	0.88	13	0.87
Average Power/Day	11.858		10.070		8.375		7.65		7.266		7.383		7.179		6.925		6.675		10.641	

Total Power/Day	84.025 kW
Total Power/Month	2.521 MW
Energy (Monthly)KWh	60.498 MWh
Cost (Monthly)RM	RM 17,423.42

Table 2(a): Measurement power and power factor before MES-30 installation

Energy Saving Mode																				
Level	G		1		2		3		4		5		6		7		8		9	
Time	kW	PF	kW	PF	kW	PF	kW	PF	kW	PF	kW	PF	kW	PF	kW	PF	kW	PF	kW	PF
1.00 AM	7.8	0.86	8.1	0.92	9.5	0.92	5	0.89	8.5	0.94	7	0.93	7.7	0.94	7.4	0.92	8.7	0.95	9.7	0.87
2.00 AM	7.6	0.86	7.3	0.91	8.1	0.92	4.3	0.89	7.2	0.94	6.6	0.92	6.8	0.93	6.3	0.91	6.5	0.95	8.2	0.86
3.00 AM	7.4	0.84	6.6	0.91	7.6	0.93	4.1	0.87	6.2	0.93	6.1	0.93	5.9	0.92	5.9	0.92	6.2	0.93	7.5	0.85
4.00 AM	7	0.84	6.2	0.91	6.9	0.92	3.9	0.87	6	0.94	5.7	0.92	5.6	0.92	5.8	0.91	5.9	0.92	7	0.84
5.00 AM	7.1	0.84	6.1	0.91	6.3	0.92	3.8	0.87	5.9	0.93	5.6	0.92	5.5	0.92	5.2	0.91	5.6	0.92	6.7	0.83
6.00 AM	7	0.84	6.1	0.91	6.1	0.92	3.8	0.87	6.5	0.95	5.6	0.92	5.7	0.92	4.9	0.91	5.7	0.92	6.6	0.83
7.00 AM	5.2	0.85	6.6	0.92	6.9	0.92	4.9	0.91	7.3	0.95	5.9	0.94	8.5	0.95	6.8	0.97	6	0.93	7.3	0.85
8.00 AM	4.2	0.9	6.4	0.92	8.8	0.94	3.9	0.92	6.8	0.96	5	0.94	7.1	0.95	4.4	0.95	6.8	0.98	5.8	0.92
9.00 AM	2.5	0.86	3.9	0.95	5.7	0.91	2.5	0.89	4.7	0.95	5.4	0.96	4	0.94	3.7	0.95	3.8	0.96	5.5	0.92
10.00 AM	2	0.82	4	0.94	6.4	0.93	1.8	0.84	4.2	0.94	4.4	0.95	3.3	0.93	3.5	0.94	3.9	0.96	4.6	0.91
11.00 AM	1.7	0.78	2	0.85	4.8	0.91	1.4	0.79	2.9	0.91	3.8	0.94	5.2	0.94	4	0.95	3.2	0.95	4.5	0.9
12.00 AM	2.1	0.82	2	0.84	4.3	0.89	1.6	0.79	4.5	0.94	4.1	0.95	3.9	0.92	3.2	0.93	3.7	0.95	4.1	0.89
1.00 PM	2.7	0.86	4	0.94	4.7	0.91	2	0.84	4.8	0.95	4	0.95	3.6	0.92	3.4	0.94	3.2	0.93	4.4	0.9
2.00 PM	2.7	0.87	2.6	0.9	4.6	0.91	1.6	0.81	4.1	0.93	3.7	0.94	3.7	0.92	4.7	0.96	3.1	0.94	4.8	0.92
3.00 PM	2.4	0.83	3.1	0.93	6	0.93	2.1	0.86	4.3	0.94	3.9	0.95	3.7	0.92	3.4	0.94	3.2	0.94	4.4	0.91
4.00 PM	2.4	0.84	3.4	0.93	5.8	0.93	2.1	0.85	5.1	0.95	5.5	0.95	3.3	0.92	2.6	0.94	2.6	0.92	3.5	0.89
5.00 PM	3.1	0.87	5.2	0.91	5.3	0.92	2.1	0.85	5.1	0.94	5.8	0.95	3.4	0.93	2.8	0.92	3.2	0.94	4.2	0.9
6.00 PM	7.1	0.82	6.2	0.9	6.2	0.92	2.8	0.87	6.5	0.94	5.6	0.93	3.6	0.93	3.8	0.94	6	0.94	5	0.9
7.00 PM	8.2	0.86	7.2	0.91	8.5	0.92	5.8	0.9	7.8	0.91	6.7	0.92	6.6	0.92	8	0.93	7.5	0.93	9.6	0.95
8.00 PM	9.9	0.9	8.5	0.91	9.2	0.91	5.3	0.87	8.9	0.91	8.5	0.93	8.4	0.92	6.4	0.9	7.2	0.92	7.5	0.83
9.00 PM	8.6	0.86	9.9	0.93	9.8	0.92	5	0.87	9.4	0.95	8.4	0.94	8.4	0.93	6.4	0.9	7.8	0.93	7.8	0.83
10.00 PM	8.4	0.86	8.4	0.9	9.8	0.92	5.4	0.87	8.7	0.91	7.2	0.92	8.8	0.94	6.9	0.9	7.1	0.91	7.7	0.84
11.00 PM	8.4	0.86	8.6	0.9	12.8	0.95	6.4	0.91	9.1	0.92	8.6	0.93	8.2	0.93	7.6	0.91	8	0.93	8.7	0.86
12.00 PM	8.4	0.87	8.4	0.91	9.9	0.92	5.7	0.89	8.7	0.92	9	0.94	9.8	0.95	8.5	0.93	9.1	0.95	9.4	0.87
Average Power/Day	5.579		5.867		7.25		3.638		6.383		5.921		5.863		5.233		5.583		6.438	

Total Power/Day	58.004 kW
Total Power/Month	1.740 MW
Energy (Monthly)KWh	41.762 MWh
Cost (Monthly)RM	RM 12,027.74

Table 2(b): Measurement power and power factor after MES-30 installation

Before the installation of energy saving equipment in Kolej Mawar, Universiti Teknologi Mara Shah Alam liable to pay the cost of electric bills of RM 17,423.42 per month only at the college. This amount can be found in Table 2 (a). Actions of management conduct this project; the cost of electric bills can be reduced to RM 12,027.74 per month. Universiti Teknologi Mara Shah Alam can save as much as RM 5,395.68 per month. Table 2 (b) shows the measurement after energy saving. Figure 3(a) shows differences before and after energy saving mode according to every level and Figure 3(b) shows number of power consumption used in Kolej Mawar daily.

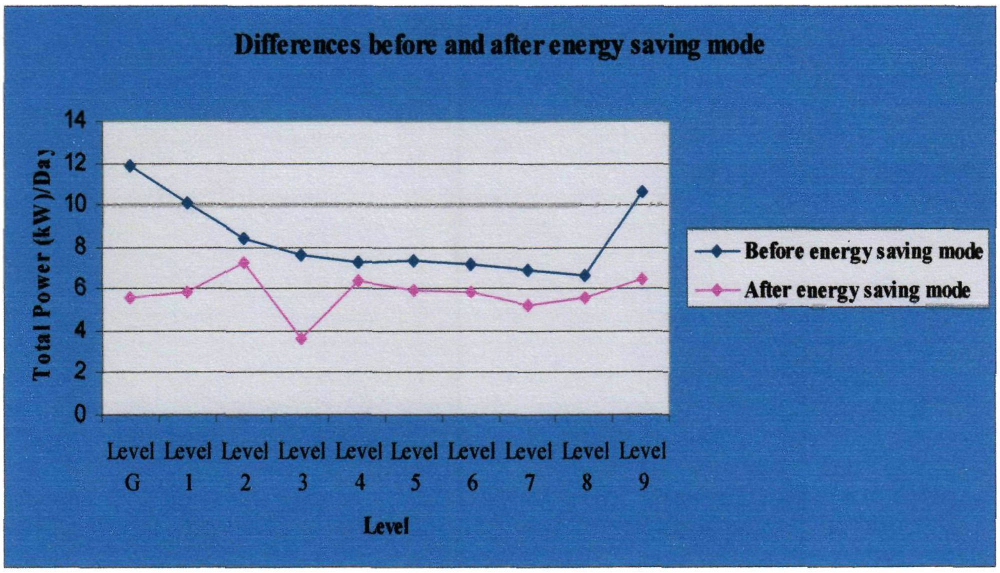

Figure 3(a): Differences before and after energy saving mode according to every level

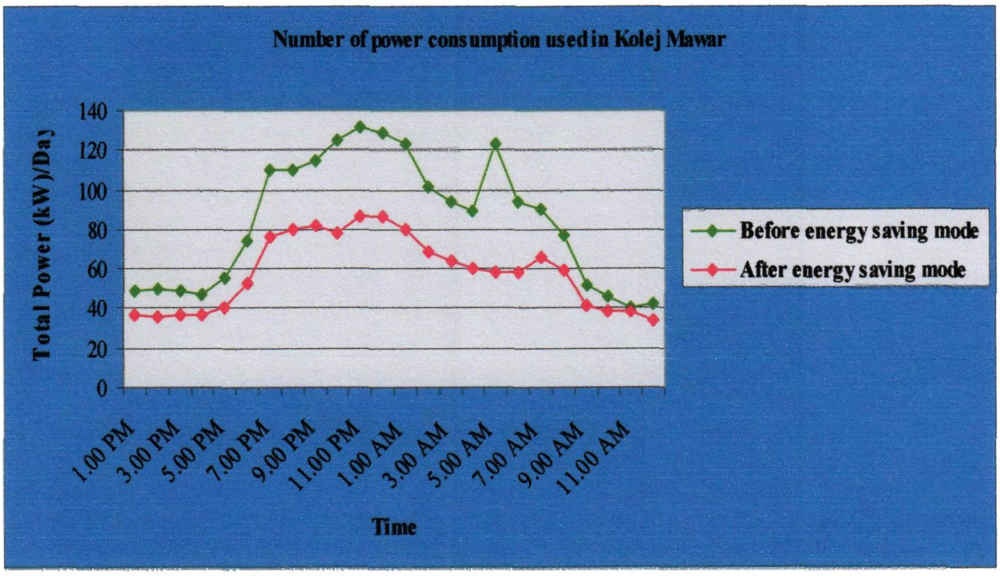

Figure 3(b): The number of power consumption used in Kolej Mawar

5.2 COST INSTALLATION OF ENERGY SAVING EQUIPMENT

Cost of these devices depends on the KVA rating of which RM495 per KVA. This includes the cost for installation, testing and commissioning.

Cost is providing by Matrix Energy Saving (M) Sdn Bhd to Universiti Teknologi Mara Shah Alam. Table 3 shows the total cost including installation, testing and commissioning energy saving equipment.

NO	LOCATION	DESCRIPTION	QTY	UNIT PRICE (RM)	AMOUNT (RM)
1	GROUND FLOOR	54KVA,415V,50Hz	1	26,730.00	26,730.00
2	1st FLOOR	33KVA,415V,50Hz	1	16,335.00	16,335.00
3	2nd FLOOR TO 9th FLOOR	30KVA,415V,50Hz	8	14,850.00	118,800.00
				TOTAL	161,865.00

Table 3: Total cost including installation, testing and commissioning energy saving equipment

5.3 CALCULATION OF PAYBACK PERIOD

Each investment must have run value and period of return of capital benefit. In this project, each investment is calculated and re-evaluated its effectiveness. Period of return of capital is taken into account because it involves high costs and ensures a project that benefits in accordance with the investment that has been issued. Calculation below shows the returns back the capital invested for this project.

Payback period calculation:

Monthly electricity bill saving = RM 5,395.68
Annually electricity bill saving = RM 64,748.16
Total cost of Energy Saving system =
RM 161,865.00
The payback period =
RM 161,865.00/ RM 64,748.16 = 2.5 years

From Table 2 (a) and 2 (b) found the total cost per month electricity bill before savings equals to RM 17,423.42 and after saving it declined to RM 12,027.74. Of these, total monthly electricity bill that can be saved equals to RM 5,395.68. While the total annual electricity bill can be saved is RM 5,395.68 x 12 year's equivalent to RM 64,748.16.In determining the payback period, the overall cost taken into account equals to RM 161,865.00. These costs include the cost of the entire project. The total cost of this can be found in Table 3. After that, the payback period is calculated based on formula; Total cost of energy saving system divided by annually electricity bill saving. The investment that is invested can be gained as a result after 2.5 years energy saving equipment is used in Kolej Mawar.

6.0 CONCLUSION

Based on the project conducted, the conclusions can be made is based on data obtained before and after the Energy Saving Matrix (MES-30) was used. Results obtained showed a positive development. Energy Saving Matrix (MES-30) saved electricity by 31%. Before installation Matrix Energy Saving (MES-30), the cost of electricity bills paid in Kolej Mawar of RM 17,423.42 per month. Costs can be reduced to RM 12,027.74 per month after the product is installed. Universiti Teknologi Mara Shah Alam can save as much as RM 5,395.68 per month. Within a year can be saved RM67,748.16. Cost of maintenance is free maintenance. The product warranties are 3 years and the lifetime 15 years. Besides the returns of capital could be recovered within two and a half years after it began operating. It can be concluded that MES-30 can save energy consumption thus reduce the overall electricity bill.

7.0 RECOMMENDATION FOR FUTURE DEVELOPMENT

There is various energy saving products in the market. Their principles are different and they have different energy saving function in the different operating states. The charge of electric power can be reducing through improving power quality. In Kolej Mawar UiTM, 55% of electricity are used for lighting systems. Therefore, the Unit Tenaga, Bahagian Pengurusan Fasiliti, Universiti Teknologi Mara Shah Alam plans to conduct other projects in the future which can help save energy consumption.

7.1 ENERGY SAVING LIGHTING

There are many other energy saving lighting choose like T5, T6 or LED. For next project, Unit Tenaga choose try to install the LED light at Kolej Mawar. The LED lighting is one of the energy saving light that produces high output, long life span and solid state light at high efficiency. Apart from that, it also conserves up to 90% energy and electricity consumption. LED also has the power factor that is about 0.89. All the products are more energy efficient than incandescent and most halogen light sources and is fast approaching the efficiency of fluorescents. The products contain no mercury and no harmful ultraviolet (UV) rays or infrared heat that contained in the light beams. The operating at voltages as low as 3.5 VDC, the life span at least 10 times longer than a typical light source, thus reducing or even eliminating ongoing maintenance costs and periodic revamping expense. Compare with the other energy saving lighting LED have many advantages. Some of the advantages are it has the higher light output that is it has the higher flux per LED. The operating hours for the LED lighting is up to 100,000 hours compared to 1,000 to 2,000 hours for a typical incandescent bulb. LED also lighting that low heat and does not affect room temperature. It is also an environmental soundness because it is based on solid state LED technology. This product contains no Mercury thereby avoiding potential health hazards [7].

7.2 REFLECTED LIGHT CASING (RLC)

Reflected lighting casing is one of the ways that can be used to emit the maximum light possible. It is used to prevent light reflected in the appropriate place without occur without wastage. RLC should be installed in new collage in UiTM.

7.3 DIMMING CONTROL

Apart from the use of technology in LED lighting system, dimming control is another alternative to save on electricity usage. Electronic dimmer ballast for fluorescent lamp is also common. It has a high frequency inverter that is transmits electronic electric power to fluorescent lamp by controlling voltage and frequency. On the other hand, dimmer for compact fluorescent lamp (CFL) has been also produced. It reduces voltage by adjusting voltage waveform by electronic circuit that it still producing approximate sine wave, which can adjust high intensity effectively.

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