

## Performance evaluation on electricity consumption of Humanities and Social Science Faculties in Mahidol University, Thailand

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### Abstract

The electrical energy is very important both in the present as well as in the future world because it is the age of technology, where we use electrical power as the main power in all operations of life. This is particularly true in the case of Thailand because electrical energy is very important to Thai's life style and business. This research is performed with aims to 1) analyze the used of electricity consumption of Humanities and Social Science Faculties in Mahidol University, Thailand based on criteria of Eco - Index for fiscal 2012 - 2014; 2) comparative statistical analysis of the average electricity consumption and average electricity used in each year of the event; 3) comparative statistical analysis of the average electricity consumption per area and average electricity used in each year of the event; 4) comparative statistical analysis of the average electricity consumption per head and average electricity used in each year of the event.

**Keywords:** performance, evaluation, electrical consumption

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### 1. Introduction

Energy supply is becoming a major concern globally as a result of increased needs and changes in lifestyles. This particularly holds true for electrical energy. The electrical energy is very important in the present world as well as in the future. It can be seen that this present world and modern society is the age of technology. We necessarily use electrical power as the main power in all operations of life such as use of computer and electronics technology. This is being true especially in Thailand as it is in the tropical zone with very hot weather all year through. Therefore air conditioning is widely used in Thailand to get relief from the hot weather. From the statistical analysis of electricity consumption in Thailand, there is an increasing trend in the amount of electricity consumption per year.

The electricity energy is important to Thailand because of the electrification of Thai's lifestyle and business, which is increasing its consumption day by day. In case of the maintenance of energy production, such as repairing the gas pipelines, the electricity consumer needs to be of concern of the power outage or insufficiency of energy as a result of its maintenance. So the government has promoted the policies to reduce electricity consumption. The budgetary support made by the government is to modify the power consumption device, so as to reduce its consumptions through introduction of public relations campaign to the private sector and the general public for promoting the reduction in usage of electricity.

Mahidol University has a substation to receive and purchase electricity power from Provincial Electricity Authority at voltage 115 kV (115,000 volts) and transform the energy to the university system at voltage 22 kV (22,000 volts) and then distribute electricity power to the university departments. The size of the power station can afford size 10/15 MVA and the record of electricity power used in this station is at the maximum power of 11.78 MVA. With the installation of this power substation, there can be adequate transmission of power for the University.

Mahidol University is a renowned education institution in Thailand. There are 14 social sciences faculties in Mahidol University. The management and usage of electricity is based on the criteria of Eco-Index worldwide, which is used as the leading sustainability tool for apparel and more. For the purpose of this research, it is necessary to note the use of the various segments for comparative analysis of electricity usage to performance management. This research aims to evaluate the usage of electricity. The research consists of 4 objectives and the research information will be collected from 14 social sciences faculties in fiscal year 2012-2014. The objectives of the study are 1) to compare the electricity usage of each of the faculties; 2) to compare the usage of electricity of each year, 3) to compare electricity usage per area and 4) to compare electricity usage per person of most tasks. This output will serve as guidelines and define the criterion of the efficiency of electricity use in the next year [1].

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## 2. Methods

This research is carried out so as to find out the amount of electricity consumption in Mahidol University by collecting data from 14 faculties by collecting and keeping information about electricity consumption based on the eco index criteria of Mahidol University from 3 previous years (Year 2012-14) and months period between October–September in a year, for example: [2]

Year 2012: from October 2011 – September 2012

Year 2013: from October 2012 – September 2013

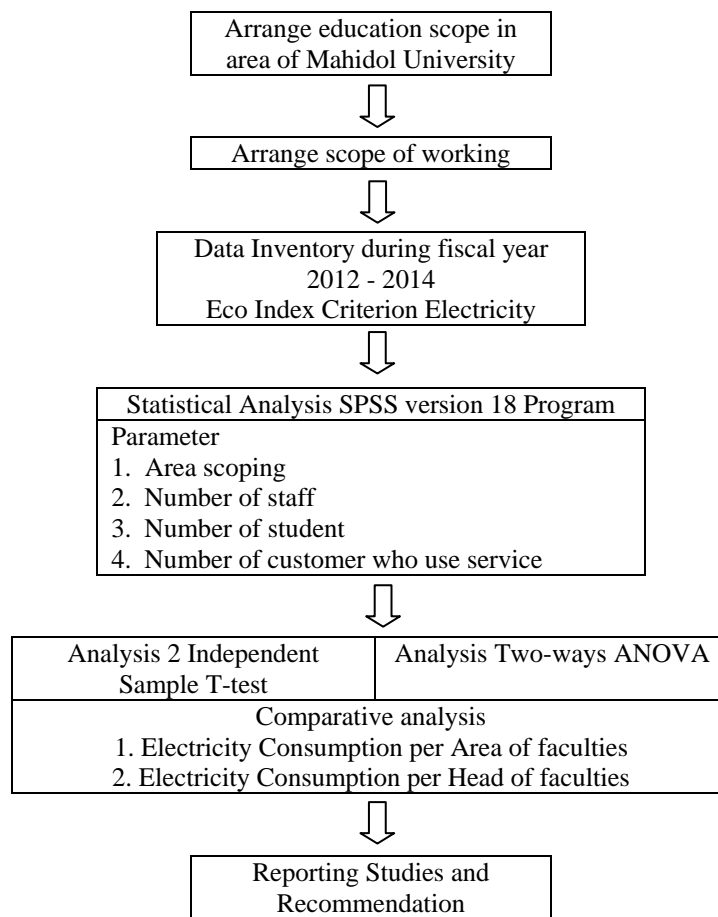
Year 2014: from October 2013 – September 2014

Secondary information: General information are composed of the scope of the area, quantity of electricity consumption by each faculties such as Financial department to presenting the number of people, number of staff, students and medical service, information broadcasted, researching strategy and plan of Mahidol University. The collected data is analyzed by using SPSS version 18 for quantitative analysis and statistical results. The findings are categorized into different group information such as

sized area, number of students, staff and service users [3].

Therefore, in this study a total of 14 faculties are selected in terms of Eco Index criteria selection. The following are the faculties as: 1. Faculty of Liberal Arts (LA) 2. Faculty of Social Sciences and Humanities (SH) 3. Institute of Human Right and Peace Studies (IHRP) 4. College of Management (CM) 5. College of Music (MS) 6. International College (IC) 7. Ratchasuda College (RC) 8. College of Religions Studies (CR) 9. Contemplative Education Center (CE) 10. Institute for innovative Learning (IL) 11. Asean Institute for Health Development (AD) 12. Institute for Population and Social Research (IPSR) 13. Research Institute for Languages and Cultures of Asia (LC) 14. National Institute for Child and Family Development (CF).

The collection from targeted group was done from the receipt of electric usage (kilowatt-hour (kWh) during October 2012 – September of 2013 for one year and subsequent collection for three years.



**Figure 1** Conceptual framework research

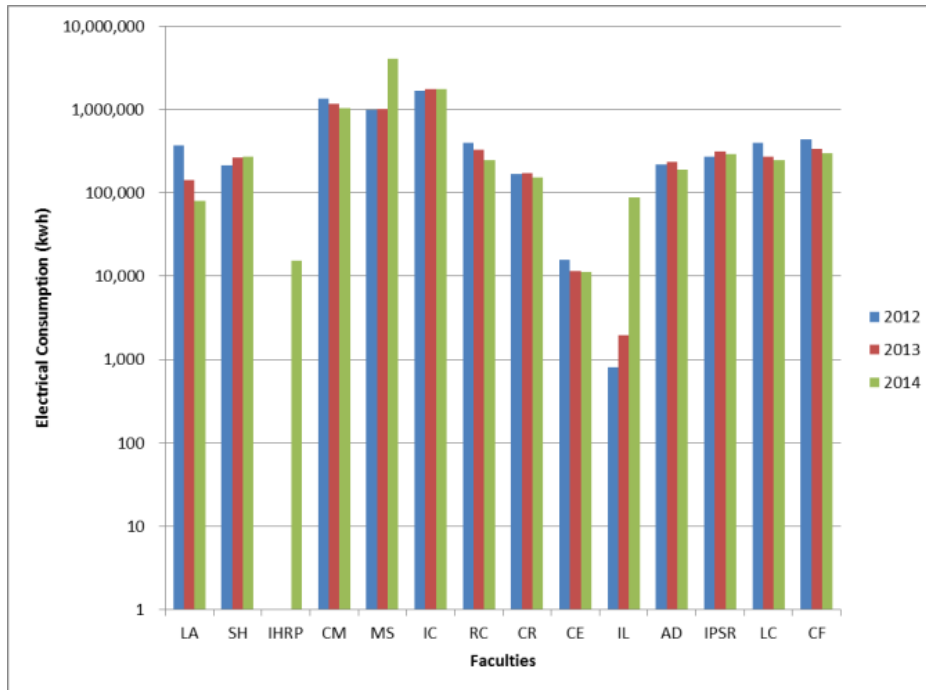


Figure 2 The electricity consumption of 14 faculties under the eco-index during fiscal year 2012 - 2014

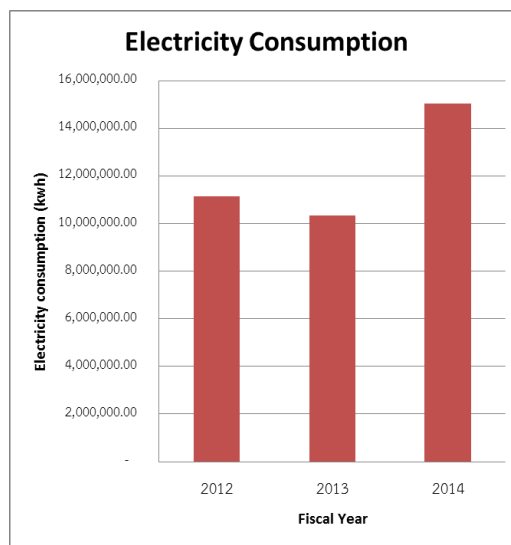


Figure 3 The electricity consumption during the fiscal year 2012 - 2014

**3. Results and discussion**

The findings of the study are analyzed and the result is shown in the following Figure 2.

From Figure 2, it can be seen that during the fiscal year 2012 - 2014, the total electricity consumption in the College of Music (MS.) is the maximum usage of electrical power total 10,471,128.99 units. Especially in 2014 MS. used the electricity 7,025,223.10 unit that was an increase of 302 percent from year 2013. While Contemplative Education Center (CE.) is the faculty with the least usage of electrical power total 66,685 units. It is important to note that some other faculties have continuous reductions tendency in electrical

usage due to good management. However some others faculties have high tendency to use electrical power such as MS. due to having more students and activities than others faculties.

Figure 3 shows the total electricity consumption during the fiscal year 2012 - 2014 of the 13 faculties of Mahidol University. From the above figure, it can be seen that in 2012, the total electricity consumption of the 13 faculties reached 11,143,950.54 units of the whole except IHRP. (No information is collected because of the relocation). In 2013, the total consumption was 10,351,529.26 units and in 2014, the total electricity consumption was 15,036,945.47

units. The average use of electricity during these three years is 12,177,475.09 units.

### 3.1 Electricity consumption

Below gives the statistical analysis of electricity used by each faculty of Humanities and Social Science of Mahidol University.

Each has an average consumption of electricity during the years. Different P-value < 0.0009 when tested found out that MS, IC and CM have the no mean difference. MS with an average of more than 10 another faculties (CF, RC, LC, IPSR, SH, AD, LA, CR, IL, CE) IC, CM, CF, RC, LC, IPSR, SH, AD have no mean difference. IC with an average of more than 4 another faculties (LA, CR, IL, CE) CM, CF, RC, LC, IPSR, SH, AD, LA, CR, IL, CE have no mean difference and  $F2 = 0.629$  with the group being categorized with the primary mission of providing academic instruction in the social sciences. The average amount of electricity consumption each year is no different at P-value = 0.541

### 3.2 Electricity consumption per area

The area analysis of electricity consumption of faculties is grouped with the mission of teaching provided by the social sciences during the academic years; the results is shown as follows 1. LA has 6,740 square meters 2. SH has 13,840 square meters 3. IHRP has 990 square meters 4. CM has 9,786.47 square meters 5. MS has 30,585.65 square meters 6. IC has 32,063.10 square meters 7. RC has 54,112 square meters 8. CR has 33,789.60 square meters 9. CE has 405 square meters 10. IL has 886 square meters 11. AD has 7,726.58 square meters 12. IPSR has 10,746 square meters 13. LC has 24,870 square meters 14. CF has 15,208 square meters. The electricity consumption per area can be seen from the table given below [4, 5, 6].

$$\text{The electricity consumption per area} \\ = \text{The use electricity} / \text{area size}$$

Each faculty has an average consumption of electricity during the year. Different P-value < 0.0009

when tested in couples founded out that CM, MS and IC have no mean difference. CM with an average of more than 10 another faculties (IL, CE, LA, AD, IPSR, CF, IHRP, LC, RC, CR) MS, IC, IL, CE, LA, AD, IPSR, CF, IHRP, LC, RC, and CR have no mean difference and  $F2 = 0.870$  with the group being categorized with the primary mission of providing academic instruction in the social sciences. The average amount of electricity consumption each year is no different at P-value = 0.432.

### 3.3 Electricity consumption per head

The results of electricity consumption by faculty personnel, student and users, which is grouped with the mission of teaching provided by the social sciences during the academic years is given as follows: 1) LA in year 2012 has 631 persons, year 2013 has 645 persons and year 2014 has 659 persons 2) SH in year 2012 has 968 persons, year 2013 has 1,149 persons and year 2014 has 1069 persons 3) IHRP in year 2012 has 127 persons, year 2013 has 114 persons and year 2014 has 109 persons 4) CM in year 2012 has 1,378 persons, year 2013 has 1,531 persons and year 2014 has 1,530 persons 5) MS in year 2012 has 1,535 persons, year 2013 has 1,589 persons and year 2014 has 1,561 persons 6) IC in year 2012 has 3,703 persons, year 2013 has 3,880 persons and year 2014 has 3,821 persons 7) RC in year 2012 has 396 persons, year 2013 has 394 persons and year 2014 has 374 persons 8) CR in year 2012 has 383 persons, year 2013 has 397 persons and year 2014 has 399 persons 9) CE in year 2012 has 51 persons, year 2013 has 52 persons and year 2014 has 47 persons 10) IL in year 2012 has 73 persons, year 2013 has 75 persons and year 2014 has 82 persons 11) AD in year 2012 has 173 persons, year 2013 has 153 persons and year 2014 has 164 persons 12) IPSR in year 2012 has 208 persons, year 2013 has 210 persons and year 2014 has 152 persons 13) LC in year 2012 has 337 persons,

**Table 1** Power consumption of each of HUMANITIES and SOCIAL SCIENCE faculties

Faculties	Electricity consumption (kwh)			
	year 2012	year 2013	year 2014	Total
LA	638,739.00	244,490.00	138,863.40	1,022,092.40
SH	370,852.88	457,042.80	463,568.19	1,291,463.87
IHRP	-	-	26,205.05	26,205.05
CM	2,333,742.00	2,004,354.00	1,775,390.00	6,113,486.00
MS	1,698,479.89	1,747,426.00	7,025,223.10	10,471,128.99
IC	2,841,404.00	3,034,016.50	2,984,824.00	8,860,244.50
RC	674,967.99	565,379.99	428,058.54	1,668,406.52
CR	286,020.10	294,166.09	263,105.99	843,292.18
CE	27,155.00	19,978.00	19,552.00	66,685.00
IL	1,376.00	3,357.88	153,062.20	157,796.08
AD	379,723.00	407,312.00	321,904.00	1,108,939.00
IPSR	464,438.68	531,900.00	504,340.00	1,500,678.68
LC	674,752.00	468,116.00	420,549.00	1,563,417.00
CF	752,300.00	573,990.00	512,300.00	1,838,590.00
<b>TOTAL</b>	<b>11,143,950.54</b>	<b>10,351,529.26</b>	<b>15,036,945.47</b>	<b>36,532,425.27</b>

**Table 2** Electricity consumption per area of HUMANITIES and SOCIAL SCIENCE faculties

Faculties	Electricity consumption per area (kwh/m <sup>2</sup> )			
	year 2012	year 2013	year 2014	Total
LA	94.76	36.27	20.60	151.64
SH	26.79	33.02	33.49	93.31
IHRP	-	-	26.46	26.46
CM	238.46	204.80	181.41	624.68
MS	55.53	57.13	229.69	342.35
IC	88.61	94.62	93.09	276.33
RC	12.47	10.44	7.91	30.83
CR	8.46	8.70	7.78	24.95
CE	67.04	49.32	48.27	164.65
IL	1.55	3.78	172.75	178.09
AD	49.14	52.71	41.66	143.52
IPSR	43.21	49.49	46.93	139.65
LC	27.13	18.82	16.90	62.86
CF	49.46	37.74	33.68	120.89
<b>TOTAL</b>	<b>762.68</b>	<b>656.91</b>	<b>960.68</b>	<b>2,380.28</b>

**Table 3** Consumption per person of each segment group with the mission of teaching provided by the social science in the academic years 2012-2014

Faculties	Electricity consumption per head (kwh/h)			
	year 2012	year 2013	year 2014	Total
LA	1,012.26	379.05	210.71	1,602.03
SH	383.11	397.77	433.64	1,214.53
IHRP	-	-	240.41	240.41
CM	1,693.57	1,309.17	1,160.38	4,163.13
MS	1,106.50	1,099.70	4,500.46	6,706.66
IC	767.32	780.35	781.16	2,328.84
RC	1,704.46	1,434.97	1,144.54	4,283.98
CR	746.78	740.97	659.41	2,147.17
CE	532.45	384.19	416.00	1,332.64
IL	18.84	44.77	1,866.61	1,930.23
AD	2,194.93	2,662.16	1,962.82	6,819.92
IPSR	2,232.87	2,532.85	3,318.02	8,083.76
LC	2,002.23	1,449.27	1,592.98	5,044.49
CF	4,791.71	2,913.65	2,978.48	10,683.86
<b>TOTAL</b>	<b>19,187.08</b>	<b>16,128.93</b>	<b>21,265.69</b>	<b>56,581.71</b>

year 2013 has 323 persons and year 2014 has 264 persons 14) CF in year 2012 has 157 persons, year 2013 has 197 persons and year 2014 has 172 persons. The electricity consumption per head can be seen from the table given under [4, 5, 6]:

$$\text{The electricity consumption per head} \\ = \frac{\text{The use electricity}}{\text{The number of head}}$$

From the above table, we can see the average consumption of electricity by each person during the year. Different P-value < 0.0009 were found when tested incouples. It is also found out that CF, IPSR, AD, MS, LC, RC, and CM have no mean difference. CF with an average of more than 6 another faculties IPSR, AD, MS, LC, RC, CM, IC, CR, IL, LA have no mean difference. IPSR with an average of more than CE and IHRP, AD, MS, LC, RC, CM, IC, CR, IL,

LA, CE, and IHRP have no mean difference and F2 = 0.869 where the group has been categorized with the primary mission of providing academic instruction in the social sciences. The average amount of electricity consumption per head each year is no different at P-value = 0.432

#### 4. Conclusions

This research studies can be adopted for Performance Evaluation on Electricity Consumption of Humanities and Social Science Faculties in Mahidol University, Thailand. The Humanities and Social Science Faculties in Mahidol University should have continuous evaluation of carbon footprint every year so that the data can be compared and also changes in Electricity Consumption. In addition, there should be evaluation covering all activities of Electricity Consumption with regard to other factors

such as Air conditioning. In order to know real evaluation of electricity consumption, the different faculties are grouped with the mission of providing academic instruction in the social sciences of Mahidol University. The amount of electricity consumption varies on the number of people and the context in which the work process operation is carried out. The consumption of electricity is affected by the organization's policies and the steps or measures of implementation of the work process. However, the study showed that the usage of the electricity consumption is not significant. The results showed that there is no difference from the previous year with regard to the operations associated with the usage of electricity. However, since the offices of the university are expanding with the increase in population of the university, the electricity capacity stored for the university may be not sufficient in the future years. As a result, it is considered necessary for the university to make a constructive plan so as to support the growth of operations in the following years for sustainable electric power usage in the university. For the reformation of this plan, there should be measures to reduce electricity consumption. There should be campaign to promote renewable energy performance such as installing solar systems for electricity etc. Lastly, it is necessary to have a supportive budget for long term construction, operations and the encouragement and support from all the faculties of the university.

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