



UNIVERSITI TEKNIKAL MALAYSIA MELAKA

**ANALYSIS OF THE FACTOR AFFECTING THE
CONSUMPTION OF ENERGY AND ENERGY TRENDS IN
FACTORY 2 FTK, USING STATISTICAL METHOD**

This report is submitted in accordance with the requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor of Electrical Engineering Technology (Industrial Power) with Honours.

by

ELWEELEE BIN ELAIN

B071410081

920414-12-5025

FACULTY OF ENGINEERING TECHNOLOGY

2017

BORANG PENGESAHAN STATUS LAPORAN PROJEK SARJANA MUDA

TAJUK: Analysis of the Factor Affecting The Consumption of Energy and Energy Trends in Factory 2 FTK, using Statistical Method

SESI PENGAJIAN: 2017/2018 semester 1

Saya **ELWEELEE BIN ELAIN**

mengaku membenarkan Laporan PSM ini disimpan di Perpustakaan Universiti Teknikal Malaysia Melaka (UTeM) dengan syarat-syarat kegunaan seperti berikut:

1. Laporan PSM adalah hak milik Universiti Teknikal Malaysia Melaka dan penulis.
2. Perpustakaan Universiti Teknikal Malaysia Melaka dibenarkan membuat salinan untuk tujuan pengajian sahaja dengan izin penulis.
3. Perpustakaan dibenarkan membuat salinan laporan PSM ini sebagai bahan pertukaran antara institusi pengajian tinggi.
4. ****Sila tandakan (✓)**

SULIT

(Mengandungi maklumat yang berdarjah keselamatan atau kepentingan Malaysia sebagaimana yang termaktub dalam AKTA RAHSIA RASMI 1972)

TERHAD

(Mengandungi maklumat TERHAD yang telah ditentukan oleh organisasi/badan di mana penyelidikan dijalankan)

TIDAK TERHAD

Disahkan oleh:

Alamat Tetap:

Cop Rasmi:

Peti surat 606,

89808, Beaufort

Sabah.

Tarikh: 08 December 2017

Tarikh: _____

**** Jika Laporan PSM ini SULIT atau TERHAD, sila lampirkan surat daripada pihak berkuasa/organisasi berkenaan dengan menyatakan sekali sebab dan tempoh laporan PSM ini perlu dikelaskan sebagai SULIT atau TERHAD.**

DECLARATION

I hereby, declared this report entitled “Analysis of the factor Affecting the consumption of energy and energy trends in factory 2 FTK, using statistical method” is the results of my own research except as cited in references.

Signature :

Author's Name : ELWEELEE BIN ELAIN

Date : 08/12/2017

APPROVAL

This report is submitted to the Faculty of Engineering Technology of UTeM as a partial fulfillment of the requirements for the degree of Bachelor of Electrical Engineering Technology (Industrial Power) with Honours. The member of the supervisory is as follow:

.....

(Project Supervisor)

ABSTRAK

FTK pada masa kini, FTK menekankan kepentingan kecekapan tenaga adalah penting untuk mengurangkan kos elektrik dan menguruskan penggunaan elektrik dengan cekap. Dalam kajian ini, faktor penggunaan tenaga akan dianalisis di Kilang 2, FTK UTeM. Beberapa faktor akan dibincangkan yang mempengaruhi penggunaan tenaga. Kemudian, data akan dikumpulkan dan hubungan antara faktor yang mempengaruhi penggunaan tenaga dan trend tenaga disiasat dengan menggunakan analisis statistik. Daripada data juga trend tenaga dapat ditunjukkan untuk penggunaan tenaga di Kilang 2, FTK UTeM. Proses Pertama, jurnal dalam talian akan digunakan untuk menentukan faktor yang paling mempengaruhi penggunaan tenaga. Dari jurnal dalam talian, beberapa faktor boleh disenaraikan. Selepas itu, trend tenaga boleh dihasilkan selepas data dianalisis. Kemudian, hubungan antara trend tenaga dan faktor yang mempengaruhi penggunaan tenaga boleh disiasat. Dalam kaedah penyelidikan, beberapa kaedah akan digunakan seperti bahan bacaan dari jurnal dalam talian, pengumpulan data, dan pengiraan teori menggunakan kaedah statistik. Dari kaedah ini, data boleh dianalisis dan faktor yang paling mempengaruhi trend tenaga boleh dikaitkan dengan Kilang 2. Oleh itu, kajian ini dijalankan untuk memberi pengurusan FTK tentang pengurusan tenaga di Kilang 2.

ABSTRACT

FTK nowadays emphasize the energy efficiency is important to reduce the cost of electricity and manage the use of electricity efficiently. In this research, the factors of energy consumption are analyzed at Factory 2, FTK UTeM. Some factors are studied for the most influenced affecting the energy consumption. Then, the data are gathered to be investigated the relationship between energy trends and the factor affecting the energy consumption and calculate using statistical analysis. Then the energy trends are developed base from the data gathered. Firstly, online journal are used to determine the most influenced factor affecting the energy consumption. From the online journal, some factor can be listed down. After that, the energy trend can be developed after the data is analyzed. Then, the relationship between energy trends and factor affecting energy consumption can be investigated. In research method, some method are use such as reading material from the online journal, data gathering, and theoretical calculation using statistical method. From this method, the data are being analyzed and the most influenced factor affecting the energy trend can be related to the Factory 2. Therefore, this research is conducted to give the FTK management about the energy management at Factory 2.

DEDICATION

To my beloved mother and father, my family, my lecturer and my fellow friends,
thank you for the support and help given to me on completing this thesis

ACKNOWLEDGEMENT

Firstly, most thanks to God for giving me the opportunity to complete this report “Final Year Project 1” with a success after i went through a lot of obstacles with patience. I would also like to thanks my parents for encouraging me throughout all the heavy situation i am facing and keep supporting on my financial. I would not be in this university and not be able do my degree project without their permission and blessing. Not to forget, I would like to thanks my supervisor, Puan Nor Hafizah Binti Hussin for guiding me in completing this project and report. She has taught me a lot of useful things and knowledges not only in theoretical but also practical. Furthermore, thanks to all lecturers and technicians that has guided me to get a good knowledges and experiences either in the class or in the lab sessions. Besides that, I would also like to thanks all my fellow friends including my friends under the same supervisor for sharing and comparing opinions and report. Finally, I would like to thanks anyone that has contributed either they are in connection with me or not, for giving me the support and help in to makes this project success.

TABLE OF CONTENT

Abstrak	I
Abstract	II
Dedication	III
Acknowledgement	IV
Table of Content	V-VII
List of Tables	VIII
List of Figures	IX-X
List Abbreviations, Symbols and Nomenclatures	XI
CHAPTER 1: INTRODUCTION	1
1.0 Introduction	1
1.1 Background	2
1.2 Problem Statement	2-3
1.3 Objective	3
1.4 Scope	3-5
1.5 Research Significance	5
CHAPTER 2: LITERATURE REVIEW	6
2.0 Introduction	6
2.1 Factor Affecting the Energy Consumption	6
2.1.1 Energy Consumption Awareness	6-7
2.1.2 Power Factor	8
2.1.3 Number of Occupants	9
2.1.4 Temperature	9-10

2.1.5	Type of Lighting Used	10-16
2.2	The Statistical Review	16
2.2.1	Energy Consumption Trends at European Country	16-21
2.2.2	Future Scenario of Residential Energy Consumption and CO2 Emissions in Malaysia	21-22
CHAPTER 3: METHODOLOGY		23
3.0	Introduction	23
3.1	Method of Research	23
3.1.1	Reading Material	23
3.1.2	Data Gathering	24
3.1.3	Theoretical Calculation	24
3.2	Flow Chart	25-26
3.3	Gathering Data Method	27
3.3.1	Energy Audit	27
3.3.2	Daily Data Record	28
3.4	Analysis Part	28
3.4.1	Correlation Coefficient	28-30
3.4.2	Investigating the Relationship of Population Correlation Coefficient ρ	31-32
CHAPTER 4: RESULT AND DISCUSSION		33
4.0	Introduction	33
4.1	Data Collected	33
4.1.1	Data from Questionnaire	33
4.1.1.1	Having Classes at Factory 2	34
4.1.1.2	Laboratories Held in Factory 2	35
4.1.1.3	Factor That Contribute in Energy Consumption	36
4.1.1.4	Turn off Equipment used	37
4.1.1.5	Turn off Lighting before Leaving	38
4.1.2	Data Collected from Factory 2	39

4.1.2.1	Actual Power Consumption Vs Lighting Quantity	39-40
4.1.2.2	Actual Power Consumption Vs Equipment Used	40-41
4.1.2.3	Actual Power Consumption Vs Occupant	41-42
4.1.2.4	Actual Power Consumption Vs Temperature	42-43
4.2	Comparison between Questionnaire and Collected Data	43
4.3	Hypothesis Testing Between Actual Power Consumption To Other Factor That Affecting The Energy Consumption at Factory 2	44
4.3.1	Hypothesis Testing Between Actual Power Consumption and Lighting at Factory 2	44-45
4.3.2	Hypothesis Testing Between Actual Power Consumption and Equipment at Factory 2	46-47
4.3.3	Hypothesis Testing Between Actual Power Consumption and Occupant at Factory 2	48-49
4.3.4	Hypothesis Testing Between Actual Power Consumption and Temperature at Factory 2	50-51
4.4	Developed the Energy Trend	52
CHAPTER 5: CONCLUSION AND FUTURE WORK		53
5.0	Introduction	53
5.1	Summary of Research	53
5.2	Achievement of Objective	54
5.3	Future Work	55
REFERENCES		56-58
APPENDICES		
A	Total Lamp at Factory 2	59
B	Data Gathered For 60 days	60-61
C	Questionnaire	62-63

LIST OF TABLES

3.4	Obtaining the Data for Correlation Coefficient	29
-----	--	----

LIST OF FIGURES

1.0	The View of Factory 2, Faculty of Engineering Technology, UTeM	1
2.1(a)	Behavioural Coefficient	7
2.1(b)	The Dependency For 26mm Diameter Fluorescent Lamp	14
2.2(a)	Final Residential Energy Consumption Annual Growth Rates in the EU-28, 2000-2014	17
2.2(b)	Last energy consumption in the EU-28,2000-2014 residential area	18
2.2(c)	Last energy consumption in the EU-28(detailed), 2000-2014 residential area	19
2.2(d)	Last residential area energy consumption per capita in the EU-28,2000-2014	20
2.2(e)	Last residential area energy consumption per capita in the EU-28 Member State, Comparison 2005, 2010, 2014.	21
2.2(f)	Forecasted scenario of total residential energy consumption and CO2 emission from the 2008 and 2020	22
3.3	The Energy Audit Form	27
3.4(a)	Graphs Showing a Correlation Coefficient of -1,0 and +1.	29
3.4(b)	The Pearson Correlation Coefficient	30
4.1(a)	Respondent Classes Held at Factory 2	34
4.1(b)	Respondent Laboratories Schedule	35
4.1(c)	Energy Consumption Factor	36
4.1(d)	Equipment turn off after being used	37
4.1(e)	Respondent Helping Turning Off Laboratories Lighting	38
4.1(f)	The Actual Power Consumption vs Lighting Quantity at Factory 2 FTK UTeM	39
4.1(g)	The Actual Power Consumption vs Laboratory use at Factory 2 FTK UTeM	40
4.1(h)	The Actual Power Consumption vs Occupant at Factory 2 FTK UTeM	41

4.1(i)	The Actual Power Consumption vs Temperature at Factory 2 FTK UTeM	42
4.4	The Energy Trends For 60Days	52

LIST OF ABBREVIATIONS, SYMBOLS AND NOMENCLATURE

FTK	-	Faculty of Engineering Technology
UTeM	-	Universiti Teknikal Malaysia Melaka
LCD	-	Liquid Crystal Display
kW	-	Kilo Power (Watt)
kV	-	Kilo Volt
TNB	-	Tenaga Nasional Berhad
PFC	-	Power Factor Correction
lm/w	-	lumen per watt
CFL	-	Compact Fluorescent Lamp
FL	-	Fluorescent Lamp
IL	-	Incandescent Lamp
LED	-	Light Emitting Diode
HL	-	Halogen Lamp
ErP	-	Vitality Related Item
Mtoe	-	Million Tonnes of Oil Equivalent
Koe	-	Kilogram oil equivalent
CO ₂	-	Carbon Dioxide
LPG	-	Liquid Petroleum Gas
RM	-	Malaysian Ringgit
SD	-	Standard Deviations

CHAPTER 1

INTRODUCTION

1.0 Introduction

This section explains the project background, objectives, scope, and problem statement and project significant. In this research, the factor of energy consumption will be analyzed at Factory 2, FTK UTeM. Some factor will be discuss that affecting the energy consumption. Then, the data will be gathered and calculate using statistical analysis. From the data also the energy trends can be shown for energy consumption at Factory 2, FTK UTeM.



Figure 1.0: The View of Factory 2, Faculty of Engineering Technology, UTeM

1.1 Background

FTK nowadays emphasize the energy efficiency is important to reduce the cost of electricity and manage the use of electricity efficiently. But, FTK facilities now have 3 factories open for the student to use in laboratories session and class session. Each factory have to maintain it energy use for lighting system, air conditioner , LCD , and machine at the peak period when there are classes being held there. Therefore, this bring a high energy consume and high electricity bill.

Therefore, these researches are conducted to know which factor affects the energy consumption and its energy trends using statistical method. Statistical method are used to shown the energy consume per day for the period of 60 days from Monday to Friday. Through this method, it's much easier to determine the factor affecting the energy use. More than that, throughout this analysis, the energy trends in Factory 2, FTK also can be shown. Lastly, these researches also investigate whether there are relationship between energy trends and factor affecting energy used in FTK.

1.2 Problem statement

Nowadays, FTK has expanded its area in large scale due to increasing student intake and a new course has been introduced. This includes new equipment and machine that has put inside the laboratories for FTK student to use. This new equipment and machine will now also include in FTK billing for its energy usage.

This new installation of equipment and machine will not be turn off in the peak period because there are class and laboratories being held there, added with the other laboratories that also held in the same place. This energy consumption

increase will result in higher bill electricity and this energy consumption come with some factor affecting it.

Other than that, the average outside temperature at FTK is in the range of 29°C-31°C. This temperature will cause humidity to form inside the Factory 2, FTK facilities that causes machine to use more energy to start on when in use. In Factory 2, FTK UTeM, the machine that put inside in laboratories will not be in constant use unless there are classes held in there. Therefore the machine will be turn off until there are laboratories session held there. When the machines are turn on, the machine will have to consume a lot of energy to start. After the machine turn on, it will losses some energy due to the heat released. This heat released resulting on higher energy used.

1.3 Objective

The objectives of this research are :

- 1) To study the most influenced factor affecting the energy consumption in Factory 2, FTK
- 2) To investigate the relationship between energy trends and factor affecting the consumption of energy in Factory 2, FTK
- 3) To developed the energy trends in FTK

1.4 Scope

This research are conducted to know the factor affecting energy consumptions and the energy trends in Factory 2, Faculty of engineering Technology(FTK) UTeM using statistical method. For this research to be conducted, statistical method is being used as the main analysis and Minitab software as the graphic output. This research are divided into 3 phase; first phase is to determine the

factor affecting the energy consumption in Factory 2 FTK, some few factor will be listed and the most influenced factor will be used for the analysis part. Second phase is using the kilowatt hour meter reading to analyze the data to develop the energy trends, and the third phase is to analyze further using statistical analysis and Minitab software to investigate the relationship between energy trends and the factor affecting the consumption of energy in Factory 2, FTK.

For phase one, collecting data from the kilowatt hour meter at the meter and billing section at Factory 2, FTK. Besides that, the data related to the factor affecting the energy consumption will also be collected, such as temperature, lighting used, and equipment used. The kilowatt hour meter data collection will be taken on Monday to Friday for a period of 60 days. After that, the temperature data will be taken every 1 times also from the period of time 60 days Monday to Friday. These data collections are taken to study the most influenced factor in Factory 2, FTK. More than that, this data collection are taken to compare either each readings of electricity is high or low.

For phase two, the data will be analyzed using statistical trend analysis. The trend line will explain the energy trends in Factory 2, FTK whether it is positive or negative. These trend lines will be used to develop the energy trend and will be used to compare with the factor affecting the energy consumption.

For the third phase, the data will be further analyze using statistical analysis and Minitab software to investigate the relationship between energy trends and the factor affecting the consumption of energy. This research can be explained through this analysis because of its energy consumption percentage that can be shown using Minitab software whether the energy consumption are constant or increase during the period of 60 days.

Lastly, throughout this research, we can know the factor affecting energy consumption and energy trends in Factory 2, FTK with graphically result. As FTK expanding its area, the energy use will also increase due to increasing of occupant, student, the weather and new machine or equipment. More than that, the lighting

systems that are always turned on will also consume some energy that also affecting the energy consumption.

1.5 Research Significant

In research significant, analysis of energy consumption and energy trends in FTK UTeM are the main purpose for this research. This research will analyze the energy consumption in Factory 2, FTK by reading the kilowatt hour meter as the primary sources for gathering data. The data will then be analyzed using statistics method and regression line. Then, after finishing the calculation, the data will be further analyze using Minitab software to observe the factor that consuming energy. Online journal will also be used in this research as the secondary sources for this analysis. This research give advantage to FTK UTeM management as this research can give a better view on energy consumption based on the result gathered. Further, the methodology introduced in this paper can give a better view for this research.

CHAPTER 2

LITERATURE REVIEW

2.0 Introduction

In this chapter, it provides the discussion about the factor affecting energy consumption and energy trends. This also includes the statistical result taken from the selected journal. Besides that, some other factor that affecting the energy consumption can be discuss and further conclusion can be made base on this chapter.

2.1 Factor affecting energy consumption

2.1.1 Energy consumption awareness

The most general source of energy consumption are energy consume awareness. To understand the effect of awareness on electricity consumption, different behaviors are defined. Based on online journal, cooling behaviour was defined which where the occupant's behaviour, habits of usage and awareness towards using air conditioning and fan. In this part several items

related to the cooling behavior were defined and the amount of usage of each class once they were present and laboratories and their behavior towards cooling system once they leave the room (Nehza et al., 2014). More than that, ventilation behaviour where in this part, the amount of natural ventilation used by the occupants was evaluated. The possibility of the windows and doors being open to let the fresh air in was also investigated in this part which Malaysia having a hot humid climate makes it inevitable for most people to use air conditioning during the hot hours of the day (Nehza et al., 2014). However it can become a habit using air conditioning the whole day even if the occupants present or not. After that was the lighting behavior part, which the behavior of most respondents towards the usage of lighting equipments and their awareness towards that once they leave their classes or laboratories. Other than that was the appliance behavior which is the awareness of the person towards the usage of some electrical appliances such as hand phone charging, laboratories equipment, laptop, computer, etc and making sure it is off before leaving the room used (Nehza et al., 2014). Which in FTK UTeM cases, all the cases of energy awareness stated above exists. At the laboratories and the hallway, air conditioner and lighting was turned on from working hour even if there are occupants present or not. More than that, the computer power supply at laboratories sometimes forgotten been turned off by the person that used it.

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	4.629	1.022		4.528	.000
	Lighting behavior	-.471	.175	-.294	-2.692	.008
	Cooling behavior	-.570	.188	-.315	-3.032	.003
	Appliance behavior	-.252	.131	-.190	-1.925	.050
	Ventilation behavior	-.250	.104	-.232	-2.401	.180
	Environmental friendly behavior	.154	.125	.119	1.230	.222

Figure 2.1(a): Behavioral Coefficient (Nehzat et al., 2014)

2.1.2 Power Factor

Power Factor was a parameter used on electrical power to measure on how efficiently energy was consumed. At Malaysia, the power factor range was from 0.85 to 0.9. For customer that used 33kV below, the value of the power factor should be maintained at 0.85. For customer that used 132kV above, the value of the power factor should be maintained at 0.9. This was enforced by Tenaga Nasional Berhad (TNB). From the TNB handbook Electricity Supply Application Handbook (2007), upon reaching below the power factor stated, certain surcharge will be given to the customer based on the tariff used by the customer. The most ideal power factor was unity or 1. Unfortunately on real situation, highly inductive loads to 0.7 or less induction reduced the Power Factor caused by equipments such as electric motors, induction motor, power transformers, fluorescent lighting ballasts, welding sets, and induction furnace. Low power factor will caused a high energy consume that come with higher bill due to surcharge and energy loss. Based from online journal, a study on electric energy usage at the residential area, capacitive power factor correction (PFC) was applied to electric circuits as a means of minimizing the inductive component of the current and by that minimizing the losses in the supply. Charging of Reactive power can be made significantly smaller by using the Power Factor Correction Capacitors which was a widely recognized method of minimizing an electrical load and minimizing wasted energy, improving the efficiency of a plant and reducing the electricity bill. It was not always necessary to reach a power factor of 1 (Asmarashid et al., 2007).

2.1.3 Number of Occupants

For energy to be used, it must have a purpose. Based on online journal, stated that the number of occupants was a factor that influence energy consume at their present time. The present time stated was from 9am to 6pm or in other meaning peak-period (Chris et al., 2006). At FTK UTeM, this is the time that student, worker, lecturer etc present at. During this period of time, much electrical equipment is being use either for working and classes such as computer, electrical motor, projector etc to ensure the learning and teaching process is going smoothly. As FTK students are increasing, the electricity use are become more higher each year. But during the mid semester break, semester break and public holiday, the energy consumption are lesser because the occupants become lesser.

2.1.4 Temperature

Malaysia is part of the south-east Asian where the climate is normally hot-humid all year. In order to cope with this climatic condition, normal Malaysia house that in rural areas usually seen with lightweight material such as wood and thatch in order to fully use the natural ventilation. But in urban area, concrete and brick house are widely constructed that mainly don't use the natural ventilation (Kubota et al., 2009). According to national census (Department of Statistics, 2000), about 85% of the existing urban house are brick or cement or plank houses. These brick modern house