"I hereby declared that I have read through this report and found that it has complied with the partial fulfillment for awarding the degree of Bachelor of Electrical Engineering (Industrial Power)."

Signature : .....

Supervisor's Name : MOHD. ARIFF BIN MAT. HANAFIAH

Date : 30-4-2007

ENERGY EFFICIENCY IN OFFICE BUILDING – PRACTICAL CASE STUDY

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This Report Is Submitted In Partial Fulfillment Of Requirement For The Degree of Bachelor In Electrical Engineering (Industry Power)

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May 2007

"I hereby declared that this report is a result of my own work except for the excerpts that have been cited clearly in the references."

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Date : 30-4-2007

DEDICATION

I dedicate this project to my beloved family especially my parents, Haji Puteh bin Haji Ismail and Hajjah Hindon binti Haji Mohd Isa who over the year have been helped and guided me to discover the meaning of life. It is my hope that I can return their helped by being a successful engineer and a useful man.

Last but not least, this project also dedicated to a very special person, Nur Asma binti Mohd Razali that has been helped me a lot during hard and good time for all this years. It is not possible to have one without the others.

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Finally, I would like to thank Allah for giving me the motivation, strength and guidance to successfully complete this project.

ABSTRACT

This project is conducted to perform energy audit in office building in order to find energy saving measures that can be implemented using Energy-10 software. The objectives of this project is to obtain information about the building cooling system, lighting system, plug loads and finally to find no cost and low cost measures that can be implemented to reduce energy consumption of that building. Besides that from this project, the awareness among people to use electricity wisely furthermore to take care the environment could be in calculated. One building has been chosen for this project and a detailed energy audit has been conducted in the building with the permission from the building management. In order to protect the company's name, the building name and person in charge of the building has been considered confidential. Finally there are a few energy saving measures recommended for this building and the energy consumption is decrease after implementing those measures in the building.

ABSTRAK

Projek ini dilaksanakan dengan cara melakukan audit tenaga di bangunan pejabat yang terpilih bagi mengenalpasti langkah-langkah penjimatan tenaga yang boleh diaplikasikan di bangunan tersebut dengan menggunakan perisian Energy-10. Objektif projek ini adalah untuk mendapatkan maklumat mengenai sistem penghawa dingin, sistem lampu dan alat-alat elektrik yang terdapat di bangunan tersebut. Berdasarkan maklumat yang diperolehi, langkah-langkah penjimatan tenaga yang tidak memerlukan kos dan langkah-langkah penjimatan yang hanya memerlukan kos yang rendah akan diperolehi bagi mengurangkan kos penggunaaan elektrik di bangunan tersebut. Selain itu kesedaran masyarakat berkaitan pentingnya menggunakan tenaga elektrik dengan berhemah dapat diwujudkan dengan adanya projek ini. Sebuah bangunan pejabat telah dipilih untuk projek ini dan audit tenaga yang terperinci telah dilakukan dengan kebenaran pihak pengurusan bangunan tersebut. Bagi menjaga nama baik bangunan ini, nama bangunan dan nama pihak pengurusan yang terlibat akan dirahsiakan sepanjang projek ini. Di akhir projek beberapa langkah untuk menjimatkan penggunaan tenaga telah dikenal pasti dan ia telah dicadangkan kepada pihak pengurusan bangunan tersebut. Jumlah penggunaan tenaga elektrik dapat dikurangkan dengan mengaplikasi langkah-langkah penjimatan tenaga yang dicadangkan.

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INTRODUCTION

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Energy Efficiency in Office Building – Practical Case Study

1.1 Introduction

Energy (electricity) efficiency means using electricity wisely in order to accomplish the same tasks, whether at home or at the workplace. Using energy efficiently also means paying less for electricity used to get the same amount of amenities required. Electricity tariff for office building as we know is higher than domestic tariff. Because of that fact, building owner need to find ways to decrease their building energy consumption. It is not necessary to replace the existing equipment with energy efficient equipment even though the equipment is still in good condition because this will cost a lot of investment. In order to achieve less energy consumption, the most important thing is awareness among people to use the electricity wisely.

1.2 Project Objectives

Before a building owner takes action to retrofit his/her building for enhancing energy efficiency, he/she must be totally convinced that his/her building is low in performance with respect to a similar cohort of buildings operating under similar conditions. In order to convince the building owner, detailed energy audit has to be conducted in the building. Hence, the objectives of this project are:

i. to get overall idea on building energy management system in office building
ii. find information about energy efficient equipment available nowadays
iii. learnt how to conduct energy audit in order to collect data about the building
iv. to obtain information on related energy efficiency programs that implemented in this country
v. create awareness among people to use electricity wisely and furthermore to take care the environment

1.3 Project Scope

The project scopes for completing this project are:

i. To obtain information about the building cooling system, lighting system and plug loads which has large effect on the building energy consumption. By gathering this data, ones can evaluate whether the building operating efficiently or not.
ii. Conduct a walkthrough energy audit in the building to collect related data about the building operation system and energy use operation of that building.
iii. Find no cost and low cost measures that could be implemented to reduce energy consumption of that building by using Energy-10 software. All the energy saving measures will take into account the comfort level of the people in the building before being implement.

1.4 Problem Statement

Waste of energy not only costs money, but it also bad for the environment. The fossil fuels which used to generate electricity are depleting resource and escalate in price as they are exhausted. As a result recently the oil price in our country has increased to RM0.30 per liter.

Fossil fuels also need to be saved because gases produced from this fuel produce green houses gases such as Sulfur (Sox) and Nitro (NOx) [1]. Furthermore to make thing worse, this gases causing acid rain and of course bad for human and environment.

The electricity tariff structure also has increased as much as 30% effective from 1st June 2006 effect of the increasing oil price. By reducing electricity use means lower bills for users especially after the increasing of the tariff structure.

Tariff C1	Before 1 Jun 2006	After 1 Jun 2006
RM/kW	17.30	19.50
Cent/kWh	20.8	23.4

Table 1.0: Electricity Tariff before and after 1 Jun 2006

From the above problems, the pressure is to further diversify the resources and to look for alternative resources. For this case is to study the way to conserve and use energy efficiently.

CHAPTER II

PROJECT BACKGROUND

The project background for this Energy Efficiency In Office Building – Practical Case Study project consist of detailed energy audit and building simulation. The purpose of this project is to find energy saving measures that can be implemented in the building.

In this project, Detailed Energy Audit has been conducted at the selected building and all related data about that building was collected in order to get overall picture of the building energy consumption. From this data, potential energy saving measures that can be implemented in the building were discovered.

The detailed energy audit is a process of collecting and measuring data from the selected building. Process of collecting data divided into desktop data collection, field data collection and cross checking of load demand data [7]. For measuring data, a few portable meters were used such as thermometer, lux meter, and hygrometer (humidity meter).

Those raw data will be transferred into the Energy-10 software and simulated to find the area that can be retrofit in order to save energy. This software also can find amount of saving for a year if the recommended measures were implemented.

Finally a complete energy audit report with the recommended energy saving measures for the audited building will be produced.

CHAPTER III

LITERATURE REVIEW

3.0 Literature Review

Literature review is all about the research that needs to be done before started the project based on the books, journals, internet and also the lecture notes. It is about the detailed explanation for the keywords of the project and be the guidance for the student to do their project. For this energy efficiency in office building project, the literature review is divided into many sub topics such as national policy, program and implementation, energy management practice in buildings, design for energy efficient building in tropics, energy efficiency saving measures in lighting system and energy efficiency saving measures in air conditioning system. Besides that there were also explanation about energy audit and air conditioning and mechanical ventilation (ACMV) system in this chapter.

3.1 Energy Efficiency - National Policy, Program and Implementation

3.1.1 National Energy Policy

Three principal objectives of National Energy Policy (1979) are supply objective, utilization objective and environmental objective [2]. All three categories is a policy of sustainability developed by our government. The supply objective is to ensure provision of adequate, secure and cost-effective energy supplies by developing indigenous energy resources. The both non-renewable and renewable energy developed by using least-costs option and diversifying supply resources within and outside the economy.

Besides that, utilization objective is to promote the efficient utilization of energy and the elimination of wasteful and non-productive patterns of energy consumption. Finally for environmental objective, the purpose is to minimize the negative impacts of energy production, transportation, conservation, utilization and consumption on the environment.

There are four main key players in this country that conducting energy efficiency program actively. They are Ministry of Energy, Water and Communication (MEWC), Energy Commission (EC), Pusat Tenaga Malaysia (PTM) and Centre for Education and Training in Renewable Energy and Energy Efficiency (CETREE).

Our Prime Minister, YAB Dato' Seri Abdullah bin Haji Ahmad Badawi in his Budget Speech 2006 also talk about saving energy. The budget speech below shows that our government is seriously trying conserving energy in this country.

"The Government will take the lead in energy conservation. I strongly believe that there is much scope for us to save energy. All Government agencies will be required to target a 10% savings in energy consumption for 2006. We are being wasteful if we keep our offices air-conditioned at excessively low temperatures and leave the lights on when no one is at work."

3.1.2 National Energy Efficiency Programs and Measures

a. Promotion and Awareness
   i. Seminars and workshops since late 1980's
   ii. Energy Efficiency Awards (early 1990's)
   iii. Energy Efficiency Week (early 1990's)

b. Education and Training
   i. Introduction of Energy Efficiency and Renewable Energy in Curriculum by CETREE

c. Energy Efficiency in Industries and Buildings
   i. Establishment of Malaysian Associations Energy Service Company(s) (MAESCO)
   ii. Conduct of energy audits in industries and buildings
   iii. Extension of Malaysia Industrial Energy Efficiency Improvement Program (MIEEIP)
   iv. Introduction of Energy Performance Contracting
   v. Establishing of Building Energy Benchmark

d. Introduction of Standards and Regulations
   i. Introduction of Appliance Labeling (Voluntary)
   ii. Electrical Energy Management Regulation
   iii. Incorporation of MS:1525 : Energy Efficiency in Non-Residential Buildings as Regulatory

e. Advertising and Campaigns (A&P)
   i. High Efficiency Motors (HEMs)
   ii. Energy Efficient Refrigerators (EER)