The Development and Comparison of Energy Management Systems in Electronics Manufacturer

Sittikul Chayapoosorn and Jeerapat Ngaoprasertwong

***Abstract*—Energy Management System (EMS) was applied to many electronics industries in order to reduce energy consumption and energy cost. This paper is to present a comparison of various energy management systems, for finding the energy conservation issue that may not be addressed. First of all, paper includes: analysis of existing energy management system in organization, energy politics and finally comparison among others energy management systems. The results show the way to fulfill energy efficiency by concerning the production process and guideline the suitable energy management system to organization.**

***Index Terms*—Energy management system, energy efficiency, ISO 50001, BS EN 16001, ANSI/MSE 2000, electronic industry.**

I. Introduction

Increasing energy demand, global climate change, and constrained energy supplies are likely to impact industrial sector in Thailand as shown in Fig. 1 that electricity consumption has grown up every year especially in industry [6]. It is known that the electronic industry producing circuit boards for export had increased from high demand in foreign markets. The energy consumption has increased accordingly, especially electricity, because the machine must be operated 24 hours a day and the environmental process line must be controlled for preventing excessive moisture or static electricity in floor area. The electronic industry is one of most high energy consumption which is the main cost suffering the organization. In this paper, the term "Energy Management System" is defined and applied for increase and maintain energy saving in the electronic industry.

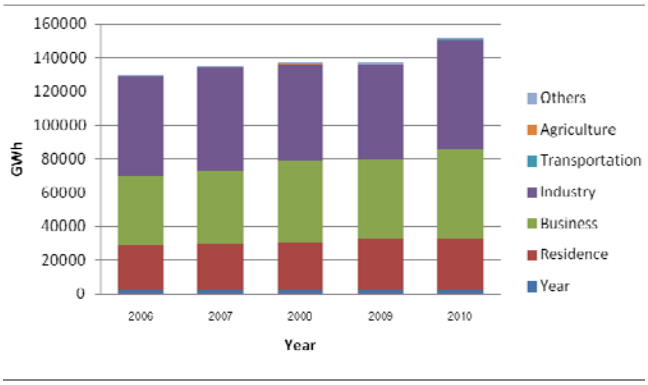

Fig. 1. Electricity consumption in Thailand, 2006-2010.

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Moreover, there have been significant attempts over the last many years to define appropriate national standards and practices such as International Management Standard for Energy ISO 50001, UK – BS EN 16001, United States – ANSI/MSE 2000, Total Energy Management, etc. The comparison had shown the advantages and drawbacks of each standard guideline if appropriate applied in the electronic industry.

II. Literature Review

Energy management system (EMS) is a term that mainly concerned with the one that relates to saving energy in businesses, public-sector/government organizations, and homes. Besides, Gordić et.al. [3] defined energy management system as a set of well planned procedures aimed at reducing a company's energy costs and increasing productivity. The aim of this study is to provide a guideline for entrepreneurs in metal-working industry in implement energy management system. He analyzed the existing energy (energy matrix), the principle of effective energy management organization and the energy management politics. The result after implemented shows a 12% reduction of electricity energy consumption. Shin-Ku Lee et.al. [1] defined energy management is a process of optimizing energy consumption, it is multidisciplinary in nature, combining skills of architecture, engineering, management functions. This study described the testing of the energy management system and facility monitoring and control systems (FMCS) in information industry in Taiwan. He surveyed the current power consumption of the facility systems, and found that HVAC is the most energy intensive system. An Energy Agent Sever is the software (EMS) residing on a PC sever using the network to analyze the measured incoming data from the FMCS. It consists of two modules: energy fault detection and diagnostic and energy audit. So the real time energy management is able to provide the optimal conditions from interaction parameters in facility operation system. Sirichan [4] presented methods of energy management in industries. For example, the plant layout must be considered for effective movement of production and also consideration of where to place energy-consuming by using the Provincial Electricity Authority's Time of Use Rate (TOU).

In term of energy management using models, Wen-shing Lee [2] studied Data Envelopment Analysis (DEA). This model is known as a mathematical procedure that uses a liner programming technique to assess the efficiencies of decision making unit. Factors related to the evaluation of building energy performance are divided into scale factors and management factors. Samples under evaluation incorporate

47 government office buildings in Taiwan, and floor area are used as scale factors for climate-adjusted building energy consumption after regression analysis. The results show that five evaluated buildings have been reported minimum energy consumption in different scales and they are rated as 100% for best management performance, six buildings received the rating of 80-99%, 23 buildings fall under 60% and poorest rated 31%. The total average of energy performance reads 65%. In the area of standards Eric G.T. Huang [5] defined ISO 50001:2011 energy management system standard is a requirements for an organization to establish, implement, maintain and improve an energy management system, which enables a systematic approach in order to achieve continual improvement of energy performance, including energy efficiency, energy use and consumption. The standard will be based on the continuous improvement and PDCA approaches. Nevertheless, he also defined the BS EN 16001:2009 energy management system standard is a road map to help organizations improve energy efficiency, reduce greenhouse gas (GHG) emission and drive down energy cost.

Besides, Michael L. Brown et.al. [7] defined ANSI/MSE 2000 is a system that describes the structure necessary to avoid organization disorder without being bureaucratic and sacrificing innovation. This energy management system can be achieved by implementing the twelve elements: Management Commitment, Resources, Energy Market, Energy Data, etc. They demonstrated to three different facilities from different economic sectors: industry, government and commercial. The result shown after implemented, MSE 2000 improved energy efficiency of all three locations. The key success includes a commitment by top management, energy management team responsible and a comprehensive plan of implementation.

III. The Process of Developing An Energy Management System

For Thailand, the Ministry of Energy defines eight steps in energy management system shown in Fig. 2.

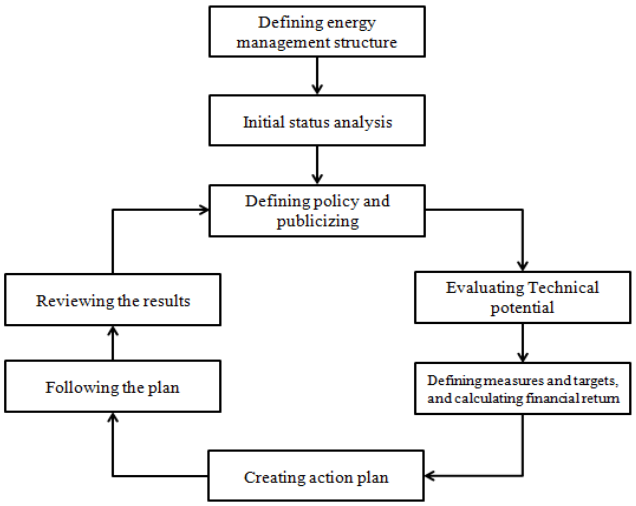

Fig. 2. The process of developing an energy management system.

A. Defining Energy Management Structure

To provide sustainable development the structure of the work responsible for coordinating the energy management system must be essentially defined. The energy team must manage energy projects and public activities for every department in organization. The team must have been appointed from senior management as shown in Fig. 3.

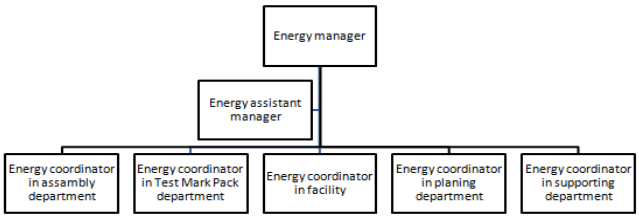

Fig. 3. Organization structure of energy management.

B. Initial Status Analysis

Energy Matrix is applied to evaluate current status of the present company's energy management effort.

TABLE I: An example of Energy Management Matrix In Electronics Factory.

Level	Energy management policy	Oganising	staff motivation	Tracking, monitoring and reporting system	Staff awareness, training and promotion	Investment
4						
3	x	x			x	
2			x	x		x
1						
0						

The state of energy management system in the company can be described as:

- The organization has a policy document. But do not propagate to the employees.
- The organization has appointed an official committee, but did not announce widely.
- The organization stimulate and motivate unofficially to the employees.
- The organization has reported the cost of energy use in limited format.
- Training and learning applied to employees.
- The organization has considered the energy investment cost with the fastest break even point.

C. Defining Policy and Publicizing

The committee publishes a formal energy policy so that the employees at all levels in the organization are aware of the serious energy consumption by providing information via organization's intranet.

D. Evaluating Technical Potential

The committee find out the potential to improve energy efficiency by using historical consumption and technical support such as chilled efficiency and new technology

E. Defining Measures and Targets, and Calculating Financial Return

TABLE II: Summary of Energy Saving Projects in 2010.

No.	Name of energy saving projects	Annual energy saving (Kwh per year)	Financial effect of saved energy ($)	Payback time (years)
1	Heat recovery project	167687	23000	2.02
2	Intelligent flow control	489984	41971	2.04
3	Changing new chiller	1216512	104272	3.29
4	Chiller watt Saving	464640	46400	-
5	Chiller plant automation	253440	60000	2.37
6	Optimize voltage tapping	75000	8000	-

F. Creating Action Plan

The committee set up a meeting once a month to monitor and implementing the decisions and then publish news to the employees.

G. Following the Plan

The committee follow up the plan by quarterly meeting with energy manager in order to report and evaluate the plan.

H. Reviewing the Results

The committee review and present the energy management action plan to manager every year. The result was shown approximately a 7.1% reduction of electricity power consumption as in Fig. 4.

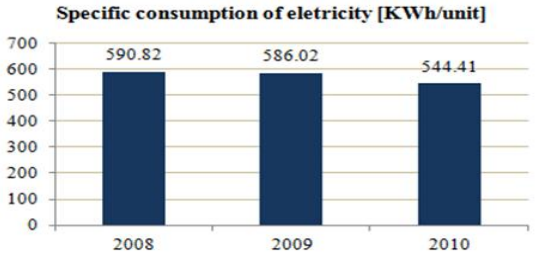

Fig. 4. Comparison of specific electricity consumption in 2008-2010.

IV. The Comparison of Energy Management Systems

We addressed to compare each energy management systems on 6 dimensions and created the short definition to explain each system as the table. 3 in order to find the good conclusion for applied to electronics manufacturer case study.

TABLE III: Comparison of Energy Management Systems.

Theme	Thailand EMS	ISO 50001	BS EN 16001	ANSI MSE 2000
Management responsibility	Seting energy management team	Considering energy performance in long term planning	Set up a management system	Providing adequate resources and setting goals
Energy policy	Publishing energy policy to all level	Energy policy	Energy policy including scope and boundary	Energy policy
Energy planning	Legal obligations and energy matrix	Energy review, energy base line, energy performance indicators and legal obligations	Legal obligations and develop energy targets	Develop energy goal
Implementation and operation	Energy conservation projects	PDCA method, procurement of energy services, product and equipment	PDCA method, consideration of only purcheasing energy consumption equipment	Formalizes communication
Checking	Internal audit and review results	Energy metering plan, internal auditing	Energy measurement plan and internally audit	Follow-through
Management review	Review action plan	Input and output management review	Input and output management review	Reviewing goals

V. Conclusion

Due to increasing energy demand especially electricity consumption, this paper explores the eight steps energy management system was applied to the electronic manufacturer in Thailand. As a result of implementing energy management in this factory, approximately a 7.1% reduction of electricity power consumption was obtained. The process of developing an energy management system shown in the paper can be applied to other electronic factories with minor modifications. Moreover, the paper also compares and guidelines others energy management systems worldwide in order to provide the gaps between the systems.

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