Electricity sustainable energy management model for community development holistically in Phranakhon Rajabhat University

Isaree Srikun ^{1,*}

¹Faculty of Industrial Technology, Phranakhon Rajabhat University, 10210 Bangkok, Thailand

Abstract. The research of electricity sustainable energy management model for holistic community development aims to (1) study the electric energy management and human behavior towards energy efficiency in Phranakhon Rajabhat University, (2) study the cooperation of relevant agencies and the role of community participants between Faculty of Industrial Technology, Phranakhon Rajabhat University and other organizations and (3) study benefits, problems, obstacles and suggestions in implementing the proposed energy management model in the pilot area. From the experimental results, it was found that the effective energy management requires several factors to achieve. Also, the collaborative model among relevant agencies, faculty, staff, students as community owners is essential to promote energy awareness among students and faculty staff.

1 Introduction

As The study of energy management has currently become a matter of great importance because of the significant increase of interest in energy sustainability, which has grown up continuously in Thailand. Considering constant problems arising from global warming and effects of carbon emissions from fuels, there is an increasing interest in energy conservation. Phranakhon Rajabhat University is one of the educational institutions that have historical significance to Bangkok. This university was Thailand's first teachers' training school located in the metropolis of Bangkok supporting the ever-growing constructions for sky train projects, residential and commercial buildings. The campus itself consists of many different buildings, with variety of use such as faculty offices, laboratories, classrooms, therefore it has faced rising cost of electricity and energy consumption every year. The continued growth in the campus demand for electrical energy and the university's need for an effective energy management model that will help offsetting the rising costs and increasing energy demand by focusing on reductions in energy consumption from faculty staff, students, executives and other people involved.

As a result, this research, taken place in Faculty of Industrial Technology, Phranakhon Rajabhat University, has proposed to study the energy management and human behavior towards energy efficiency on campus. The research also investigated into benefits,

* Corresponding author: isaree@pnru.ac.th

problems, and suggestions in implementing the proposed energy management model in the Faculty of Technology building. In the paper are reported the energy management analysis from assessing human attitudes along with the university policies, and procedures that influence energy use in order to develop a suitable and sustainable energy management model for perpetuating energy savings and for incorporating energy efficiency into a wide range of university practices and procedures.

2. Research Method

In this study, questionnaire surveys on energy conservation behavior of 700 representatives of faculty staff and students were conducted to analyze energy consumption in Phranakhon Rajabhat University. An overview about the university energy management was investigated as fundamental information to analyze energy consumption on campus. Table 1 illustrated the current energy management matrix (EMM) according to several interviews with personnel in charge of the university's energy management.

Table 1. Current energy management matrix of Phranakhon Rajabhat University

	Policy	Organizing	Training	Performance Measurement	Communicating	Investment
(4)	Energy policy action plan and regular review, have active commitment from top	Fully integrated into management structure with clear accountability for energy consumption	Appropriate and comprehensive staff training tailored to identified needs	Comprehensive performance measurement with effective reporting	Extensive communication of energy issues within and outside organization	Resources routine committed to energy efficiency
(3)	Format policy but not active commitment from top	Clear line management and responsibility for improvement	Energy training targeted at major users following training need analysis	Weekly performance measurement for each building	Regular staff briefings, performance reporting and energy promotion	Some appraisal criteria used for cost reduction projects
(2)	Unadopted policy	Some delegation of responsibility but line management and authority unclear	Ad-hoc internal training for selected people as required	Monthly monitoring by fuel types	Some use of company communication mechanisms to promote energy efficiency	Low or medium cost measures considered if short payback period
(1)	<u>Unwritten set of guidelines</u>	<u>Informal mainly focused on energy supply</u>	Technical staff occasionally attend specialist courses	<u>Invoice checking only</u>	Ad-hoc informal contacts used for promoting energy efficiency	<u>Only low or no-cost measures taken</u>
(0)	No explicit policy	No delegation of responsibility for managing energy	<u>No energy related staff training involved</u>	No measurement of energy costs of consumption	<u>No communication or promotion for energy issues</u>	No investment for improving energy efficiency

Total of 700 surveys from the Faculty of Industrial Technology representatives were carried out and analysis of energy consumption behaviors and attitudes in university campuses were based on four aspects, which were (1) energy management measure, (2)

appliance repair and maintenance, (3) use of alternative/green energy and (4) energy conservation campaign and promotions. After that, several options of energy management model, practices and investment costs were primarily suggested and opened for public opinion, including university executives, faculty staff and students to develop social participation leading to a sustainable energy management model that can be extended to other peerred institutions.

3 Research Findings

According to the questionnaires and public discussions, it was found that in terms of energy management measure aspect, the university representatives mostly need a systematic performance measurement of electrical energy for each building to raise more awareness on energy conservation. Whereas, for the appliance repair and maintenance aspect, public suggested that all electrical appliances and equipment should be inspected regularly for use. For the use of alternative or green energy aspect, it was found that people in the university prefer to have trees around the building to reduce heat following by the use of alternative energy such as solar cells to save energy. Finally, for energy conservation campaign and promotion aspect, public need an extensive promotion of energy efficiency following by the publication of energy saving information as a way to reduce power consumption.

Apart from public surveys and discussions, the research also analyzed investment costs and payback period for improving energy efficiency of air-conditioning and lighting systems under different energy management approaches using the Faculty of Industrial Technology building as a pilot area as shown in Table 2.

Table 2 Investment costs for improving energy efficiency of air-conditioning and lighting systems

Energy Management Approach	Cost of savings		Investment Cost (baht)	Payback period (year)
	kWh/year	baht/year		
Lighting System				
Housekeeping (turn off lights during lunchtime)	4,873.04	29,238.24	-	-
Process Improvement (use of automatic light control)	5,256.18	31,537.08	52,200	1.66
Process or Equipment Change (Use of LED lights)	22,038.68	132,232.1	234,250	1.77
Air-conditioning System				
Housekeeping (turn off air-conditioners during lunchtime)	29,574	177,444	-	-
Process Improvement (Regular maintenance for air-conditioners)	16,561.4	99,368.64	69,600	0.7
Process or Equipment Change (use of automatic control)	59,148	354,888	217,500	0.61

4. Conclusions

This research mentioned the findings of electricity sustainable energy management model for community development in Phranakhon Rajabhat University. From the surveys and discussion results, there must be several factors promoting the electric power management on campus. Also, understanding and awareness of university staff and students including positive attitudes and behaviors toward effective energy conservation are necessary for effective and sustainable energy management.

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