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A Case Study of Green Building in Malaysia: Cost Saving Analysis

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ABSTRACT

The building sector consumes about forty percent of world energy, making energy efficiency in existing buildings an important issue. This study has been undertaken to investigate energy consumption of a building that has been redesigned to incorporate energy efficient features. It was found that the introduction of energy efficient features has helped to achieve savings up to 46% of the total spent on energy particularly based on electricity bills.

Keywords: Cost saving, energy efficiency, green building, greenhouse gases, Malaysia

INTRODUCTION

In developed countries across Europe, America and Asia, green building has been widely adopted and integrated into the building and construction sector (Ding, 2008; Gray, 2015). Particularly, countries like Canada, Germany and United States have successfully implanted the concept of green building deep into their building foundation, to become the leaders in sustainability (Kats, 2003; Wang et al., 2005; Kibert, 2016). In Malaysia, the awareness level of sustainable construction is still nascent. With the launch of Green Building Index (GBI), Malaysia has taken a huge step forward to rate the performance of green buildings in the country (Chua and Oh, 2011). The evaluation of Green Building Index (GBI)

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is based on six important criteria: Energy Efficiency, Indoor Environmental Quality, Sustainable Site Planning and Management, Material and Resources, Water Efficiency and Innovation (Yusoff & Wen, 2014; GBI, 2016).

In order to reduce energy usage and greenhouse gas emission, existing buildings need to be redesigned to meet green building standards. To this end, a rating category known as Green Building Index for Non-Residential Existing Building (GBI-NREB) was established to ensure greater environmental consciousness. Thus, by selecting a building as a case study, its energy efficiency features can be studied and energy efficient design concepts introduced.

Green Building

Green building is defined as a structure that is environmentally responsible and resource efficient for the duration of its lifetime (EPA, 2014; Kibert, 2016). Green Building Index (GBI) is Malaysia's industry recognised green rating tool for buildings to promote sustainability in the built environment and raise awareness among construction practitioners on environmental issues (Papargyropoulou et al., 2012; Sin et al., 2011). The GBI rating tool provides an opportunity for developers and building owners to design and construct green, sustainable buildings that can provide energy savings, water savings, a healthier indoor environment, better connectivity to public transport and the adoption of recycling and greenery (GBI, 2016).

Study Area: Case Study of Building X. For confidentiality purposes, the study subject is labelled as Building X. It is a federal administrative office building that is 12 years old. Building X is integrated with an efficient building design concept and achieved Silver rating of GBI after obtaining a score of 68 out of 100 maximum points. The breakdown of the score according to criteria is given in Table 1.

Table 1
Summary of GBI scores obtained from Building X

Part	Item	Maximum points	Score
1	Energy Efficiency	38	32
2.	Indoor Environmental Quality	21	16
3.	Sustainable Site Planning and Management	10	4
4.	Materials and Resources	9	6
5.	Water Efficiency	12	1
6.	Innovation	10	9
	Total Score	100	68

The design features of the Building X can be divided into: passive and active design. Passive design can be further broken down into building orientation, daylighting, space and layout planning and natural ventilation. Active design, on the hand consists of air conditioning and mechanical ventilation, an innovative lighting system, energy efficient office appliances and comprehensive Energy Management System (EMS).

MATERIALS AND METHODS

The necessary data was gathered for a period of 6 months using site visit approach. During the site visit, the data for the study is obtained from the building manager. The provided data, including building history, the redesign cost, energy efficiency features and energy usage of the building from 2005 until 2012.

RESULTS AND DISCUSSION

The energy that is consumed is in the form of electricity from Tenaga National Berhad and chilled water from the district cooling plant. The chilled water consumption is shown in ton/day and electricity in kWh/day. It can be seen from Figure 1 that the average chilled water consumption is 2014 ton/h/ day and the average electricity consumption is 4532 kWh/day. This means that the energy used for electric is higher than chilled water. The percentage of the total energy consumption for equipment, lighting and cooling usage is shown in Figure 2.

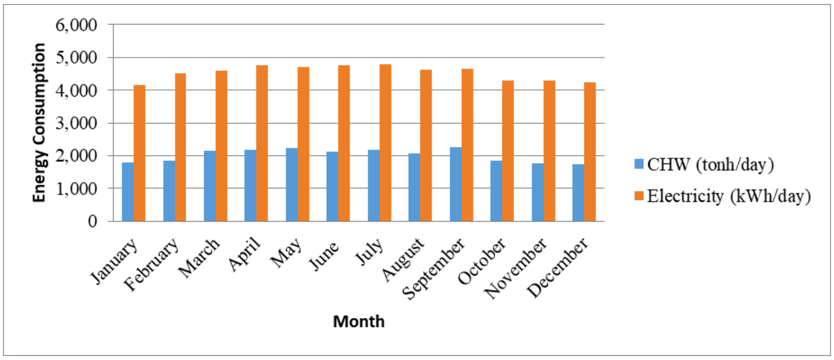

Figure 1. Monthly energy consumption of the Building X

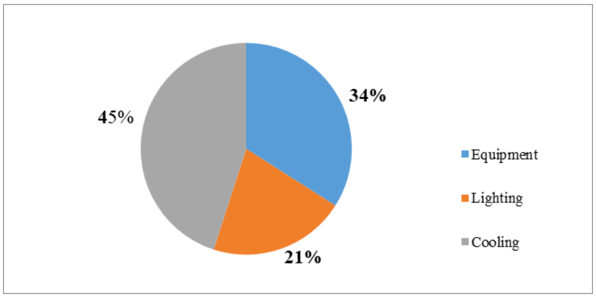

Figure 2. Percentage of energy consumption

It was also found from Figure 2 that the energy consumption allocated for cooling purpose is 45% of the total building energy usage. The energy demand for equipment is 34% and it includes energy demand for small power and fan energy; while lighting constitutes 21% of the total energy consumed. The cost saving on energy consumption with and without energy efficiency features is as shown in Table 2. Actual total savings from 2005 till 2012 successfully recouped the investment of RM5 million in 8 years. It can be seen clearly from Table 2 that the total amount of saving is of RM5,863,369.00.

Table 2
Cost saving analysis of the Building X with energy efficiency features

Year	Conventional Building (Cost in RM)	Building X with Energy Efficiency Features (Cost in RM)	Total Saving (RM)	Percentage of saving (%)
2005	1,098,000	492,700	605,300	44.5
2006	1,166,889	480,471	686,418	41.2
2007	1,166,889	558,832	608,057	47.9
2008	1,449,933	628,363	821,570	43.3
2009	1,449,933	738,197	711,736	50.9
2010	1,426,087	740,430	685,657	51.9
2011	1,547,417	697,253	850,164	45.1
2012	1,547,417	652,950	894,467	42.2
TOTAL	10,852,565	4,989,196	5,863,369	46.0

CONCLUSION

The performance of Building X depends on how effective its energy efficient features functioning. Given that almost half of the energy in Building X is used for cooling purposes, it was found that savings in energy expenditure can be achieved through redesigning. It is proven that within 8 years it was possible to recoup the additional investment of RM5 million spent on redesigning.

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