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ScienceDirect

Procedia - Social and Behavioral Sciences 222 (2016) 211 – 218

Procedia
Social and Behavioral Sciences

ASLI QoL2015, Annual Serial Landmark International Conferences on Quality of Life
ASEAN-Turkey ASLI QoL2015
AicQoL2015Jakarta, Indonesia. AMER International Conference on Quality of Life
The Akmani Hotel, Jakarta, Indonesia, 25-27 April 2015
"Quality of Life in the Built & Natural Environment 3"

Benchmarking for Energy Efficiency on School Buildings Design: A review

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Abstract

Increased energy demand end to the world grew by 39% between 1990 to 2008 and further increased by 40% between 2007 to 2030. Energy consumption in buildings has been identified to contribute up to 40% of the total world. Through the selection of methods and the right strategy will reduce the problem of increase energy in buildings. Based on the theory of energy efficiency developed it can be achieved through three main factors; a) building design; b) services design; and c) occupant behavior. This paper aims to discuss methods to benchmark energy efficiency in school buildings use energy-efficiency.

Peer-review under responsibility of AMER (Association of Malaysian Environment-Behaviour Researchers) and cE-Bs (Centre for Environment- Behaviour Studies, Faculty of Architecture, Planning & Surveying, Universiti Teknologi MARA, Malaysia.

Keywords: Benchmarking; energy efficiency; school building; user perception

1. Introduction

Rising energy demand in buildings can be reduced by improving the efficiency of energy use. However, based upon previous studies showing the business is not an easy task. Through the selection of method and the right strategy will reduce the problem of increasing energy in buildings. There are various methods used and proposed in

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Peer-review under responsibility of AMER (Association of Malaysian Environment-Behaviour Researchers) and cE-Bs (Centre for Environment- Behaviour Studies, Faculty of Architecture, Planning & Surveying, Universiti Teknologi MARA, Malaysia.
doi:10.1016/j.sbspro.2016.05.149

benchmarking energy efficiency in buildings (William Chung, 2011). However, very few existing methods proposed for building schools, especially in equatorial climates. Climatic conditions are believed to be difficult to give comfort to users outside or indoors with an average temperature of 27°C to 32°C and the average intensity of 500W/m^2 and heat that reaches 1000W/m^2 (AMA Rahman & MZ Kandar, 2005).

The requirements of energy-efficiency design in schools should concern duly and also not only just concerned with the reduction of energy consumption but the needs to optimize students' comfort was also a priority. This is because most of the time spent by students and teachers are in the school building. Comfort ness and student performance should be a priority in school next to the use of energy efficiency (Catalina T. and Iordache V., 2012). The importance of education is gaining a place in the planning within a country, plus with the needs of information technology infrastructure gradually boost the demand for energy in school buildings. In the developed country, this importance has begun to receive more attention (Kim Tae-Woo et al., 2012).

Reduction of energy consumption in school buildings that have higher numbers is reliable indirectly can reduce operating and development expenditure. Indirectly it can influence the reduction of energy demand. These requirements are influenced by referring budget statement that is issued by the US Department of Energy, where as many as 25% of energy expenditure in schools can be reduced through the building design and the use of energy-efficient technologies (US DOE-Energy Smart Schools).

Based on the results of previous studies, the average of school energy consumption use in Malaysia is 19kWj / m2 / per annum (K. Ibrahim et al., 2005). While the second result shows, the findings in the average of building energy index is 10kWj / m2 / year (MNM Salleh, 2008). The different result that is based upon the method used in benchmarking the energy efficiency in the buildings shows that the variety of method can be used in benchmarking energy efficiency in buildings. The objective of this paper is to the measurement of the user perception of energy efficiency in school buildings towards to benchmarking energy efficiency.

2. Literature review

Earth Summit, which results to Agenda 21, was formed from the United Nation Conference on Environment, and Development Organization (UNCED) held in Rio de Janeiro on 3 to 14 June 1992. Among the agenda that was discussed during the conference was the issues of greenhouse gasses and the thinning of an ozone layer (United Nations, 2012). The sequence of the summit conference, an assessment tool to benchmark the green building was first developed in instances of BREEAM (UK, 1990) and LEED (USA, 1996). The intended of this benchmark is sole to reduce negative environmental effects contributed to the building through greenhouse-gas emissions.

The resulting of benchmark criteria are intended to help designers, customers and society to consider the effect of greenhouse gas through each design produced, and the solution is through the energy efficiency and low-carbon technologies. However, the resulting benchmark is strongly influenced by the environmental factors, location, and climate.

Green Building is a general term that describes sustainability for a building or development. The term is also more often understood as Green Development or Sustainable Building (Peterson J., 2010) even though the building or development only involves part to the process of the formation of a Sustainable Development (M.N.M. Salleh, 2012). The term used is directly proportional to the understanding and benchmark criteria, and the method used. Most benchmarks have been laid criteria Energy Efficiency as a key factor in the assessment criteria. However, the benchmark for green building does not use the same method to measure the energy efficiency of a building. Usually, green building uses the scope of the assessment for the overall level of the building. The criteria focused to increase the efficiency of energy resources, water and construction materials and reduce the impact of buildings on human health and environment throughout the life cycle of the building, through the placement, design, construction, operation, maintenance, enhancement and modification, and destruction (Sanchez Y., 2008, PediaPress, 2009).

2.1. Energy demand

Green building issues are closely linked to the increasing of world energy demand. This issue can be proved by expectations of International Energy Agency (IEA), which indicated an increase in energy in 2030 will reach as much as 40% higher than demand in 2007 (González ABR et al., 2011). The increasing of this energy is due to the