FAZ Publishing
JCF

Journal of Complex Flow, Vol. 4 No. 1 (2022) p. 8-11

Journal of Complex Flow

Journal homepage : www.fazpublishing.com/jcf

e-ISSN : 2672-7374

Review on Preliminary Energy Audit for 27 Years Old Building at Kemaman Terengganu, Malaysia

Meor Amirul Muhailmin Norhisham[1], Mohd Azahari Razali[1*], Makeen Mohd Amin[2], Norhadiman Abdul Hadi[2]

[1] Faculty of Mechanical and Manufacturing Engineering,
Universiti Tun Hussein Onn Malaysia, Batu Pahat, 86400, MALAYSIA

[2] Building Lindungan Sdn Bhd,
No. 6446, Jalan Telipot, Kota Bharu, Kelantan, MALAYSIA

*Corresponding Author

Received 13 March 2022;
Accepted 28 April 2022;
Available online 15 May 2022

Abstract: Malaysia Energy Statistic Handbook 2020 shows the Malaysia energy scenario in 2019 recorded the coal is the highest energy sources used by 13,067 MW, followed by natural gas by 12,539 MW. The preliminary energy audit review is a reviewing the articles and journal related to the preliminary energy audit. The main purpose of this review is to discuss the refereeing sources regarding the related journal or article with the preliminary energy audit. The method in this review will be using the reading of articles and journal sources form the internet. The findings will be consisting of the discussing that has been made using different articles and journal sources which will be discuss in detail. The preliminary energy audit review will improve the understanding of the preliminary energy audit from a different perspective which will help in making the preliminary energy audit to success

Keywords: Energy, Preliminary Energy Audit

1. Introduction

This review will demonstrate knowledge and comprehension of academic literature on a specific topic as it relates to the preliminary energy audit in context. A literature review includes a critical analysis of the material that will be used as the main content of the review. All academic literature will refer to the journal or article that will be used to assist in the completion of this journal.

2. Green Building Index

The Green Building Index is a building environmental rating system created by PAM (Pertubuhan Arkitek Malaysia / Malaysian Institute of Architects) and ACEM (Association of Consulting Engineers Malaysia). The concept of green building is introduced in this technology as a means of transforming the building market and transforming the common way of thinking about designing, inhabiting, and operating buildings [1]. “A green building focuses on enhancing the efficiency of resource use energy, water, and materials while reducing building impact on human health and the environment during the building's lifecycle, through better sitting, design, construction, operation, maintenance, and removal,” according to the Green Building Index (GBI) fact sheet. By means the green building purpose to develop a high efficiency building without harming the environment and other living things near it. "Green building rating systems are in fact environmental assessment methods applied to buildings that have emerged as a widely adopted way to evaluate the performance of buildings across a broad range of environmental considerations," [2].

The GBI rating system allows architects, designers, and developers to create sustainable buildings that offer energy savings, water savings, a healthier indoor environment, better connectivity to public transportation, carbon footprint reduction, and are appropriate for the locality, climate, and culture.[3]. As stated in the GBI fact sheet, GBI is design for the Malaysia tropical climate which rain and humidity all year round and the development of the building and to be designed to:

- Define green buildings by establishing a common language and measurement standard.
- Promote an integrated, whole-building design that provides a better environment for all.
- Recognize and reward environmental leadership.

**Corresponding author: azahari@uthm.edu.my*

- Transform the built environment to reduce its negative environmental impact; and
- Ensure new buildings remain relevant in the future and existing buildings are refurbished and upgraded to improve the overall quality of our building stock.

However, as a new product in the built environment market, the GBI application is still being monitored to see how it works in rating and selecting the best "green building." The GBI's application has grown, reflecting its potential to be one of the accredited and recognized green rating systems such as the Building Research Establishment Environmental Assessment Method (BREEAM) used in the United Kingdom, the Green Building Challenge Assessment Framework (GBTool) developed in Canada and used by three countries - the Republic of Korea, Italy, and Brazil, as well as Leadership in Energy and Environmental Design.

In general, 46 percent of energy used in the housing sector is for room warmers and 9 percent for cooling [4]. While heating and cooling in commercial buildings reached 32 percent and 16 percent, respectively. To that end, it has created a few technologies that complement and support the concept of green buildings. The role of various sciences in building planning is required, not only from the perspective of architecture and the building itself, but also from the mechanical and electrical equipment used in a building.

3. Building Energy Index

Building Energy Index (BEI) is used for comparing energy consumption in buildings for one year or more, depending on the audit range, and is measured in kilowatt hours divided by the building's gross floor area in square meters [5]. BEI is used to analyze the energy usage of each area in a 27-year-old building. This analyze is important to measure the energy use is accordance with the baseline provided. The recommended building energy index, BEI, according to MS1525, is 135 kWh/ m2/yr [6]. This recommended building energy index is a maximum BEI for a building which will categorize the building either it's an efficient in energy saving or not.

Building Energy Index (BEI) is based on the ISO 50001 energy management. ISO 50001 provides a recognized framework for organizations to develop an effective energy management system. It adheres to the "Plan-Do-Check-Act" process for continuous improvement, as do other ISO management system standards. This ISO 50001 outline is the best way to achieve energy efficiency and energy conservations act, whatever the nature of your business. Using the ISO 50001 based for the calculation and guideline for the Building Energy Index (BEI) analysis. Thus, the analysis that has been made is truth and accordance with the right format.

Usually Building Energy Index (BEI) is in kWh/(m^2/yr) unit because its involving energy consumption, time taken and the area in the analysis that will be taken place. The equation that involving in this Building Energy Index:

$$\text{BEI} = \frac{\text{Energy consumption} \times \text{Time period}}{\text{Area in whole building}} \quad (1)$$

4. Regression Analysis

Market researchers can use regression analysis to examine relationships between one independent and one dependent variable [8]. The use of regression analysis is a must to analyze the baseline that will be used in energy audit or other audit project which using a baseline analysis as their main base data to compare the results. There are three benefits by using the regression analysis in the research journal:

- Indicate whether the independent variables have a significant relationship with the dependent variable.
- Describe the relative strength of the effects of different independent variables on a dependent variable.
- Make forecasts.

Regression analysis can be used to compare the effects of variables measured on different scales. Regression analysis can also be used to predict the future that will be obtained using the baseline data that has been obtained. Figure 1 shows the dependent (y) variable (weekly sales) against an independent (x) variables (Index of Promotional Activities). Regression analysis is a technique for fitting a "best" line through a set of observations. By "best," its mean that it is fitted in such a way that the sum of squared differences between the observations and the line itself is minimized. It is important to know that the best line fitted with regression analysis is not necessarily the true line.

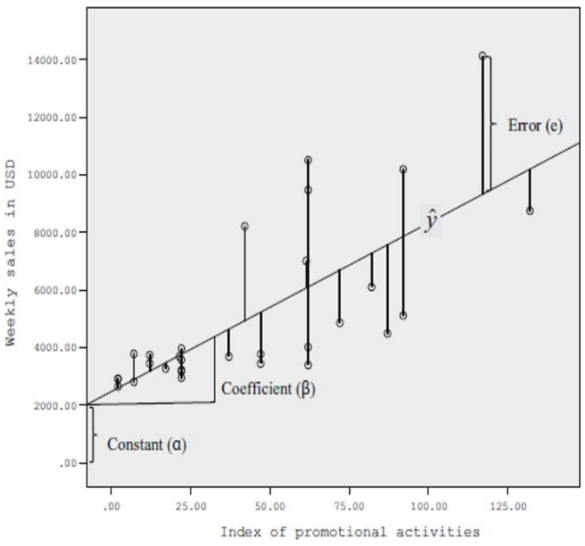

Fig. 1 – Regression analysis

Before going deeper into regression analysis, regression notation is important to know how its work and what its mean. Regression models are commonly identified as follows.

$$y = \alpha + \beta_1 x_1 + e \quad (2)$$

The y variable represents the dependent variable, which is the variable being explained. The dependent variable is plotted on the vertical axis in Figure 1. The represents the regression model's constant (also known as the intercept) and indicates what the dependent variable would be if all the independent variables were zero. The constant is indicated on the y-axis in Figure 1. If the promotional activity index is zero, sales of around $2,500 are expected. It may of course not always be realistic to assume that independent variables are zero (just think of prices, these are rarely zero) but the constant should always be included to make sure that the regression model has the best possible fit with the data. x_1 represents the independent variable. The (regression) coefficient of the independent variable x is denoted by β. This coefficient, also known as the slope, represents the gradient of the line and is depicted in Figure 1. +1 coefficient indicates an upwardly sloping regression line, whereas a -1 coefficient indicates a downwardly sloping line. The gradient in this example slopes upward. This makes sense because as promotional activities increase, so do sales. In the example, the estimate value is 1 to be 55.968, which means that increasing promotional activities by one unit will increase sales by $55.968 on average.

The final element of the notation, the e, denotes the equation's error (or residual). In research, the term "error" is frequently used. The error is the measurement of the distance between each observation and the best-fitting line. Consider Figure 1 once more to better understand what a regression error is. The difference between the regression line (which represents our regression prediction) and the actual observation is the error. $\hat{y}$ represents the predictions made by the "best" regression line. As a result, the first observation's error is,

$$e_1 = y_1 - \hat{y}_1 \quad (3)$$

In the above example, there is only one independent variable. This is referred to as bivariate regression. Multiple regression is used when multiple independent variables are included. Multiple regression is defined in the same way as bivariate regression. If there are three independent variables, say the index of promotional activities (x_1), the price of competitor 1 (x_2), and the price of competitor 2 (x_3), it would be written as,

$$y = \alpha + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + e \quad (4)$$

Each independent variable (i.e., β_1, β_2, and β_3) requires one regression coefficient. Technically, the βs represent how a change in an independent variable influences the dependent variable when all other independent variables are held constant. The regression using a single independent variable is known as univariate analysis, whereas the regression using multiple independent variables is known as multivariate regression analysis [9-11]. The relationships between a dependent variable and an independent variable are examined using univariate regression analysis, and an equation representing the linear relationships between the dependent and independent variables is developed [12]. However, regression models with one dependent variable and multiple independent variables are referred to as multivariate regression analysis [13]. There are two types of linear regression in regression analysis that has been used in this research journal Single and multiple linear regression, both linear regression is used in developing mathematical model which will be the energy baseline with dependent and independent variables [14].

5. Energy Management in WCPU System

Energy management is critical for the world's growing population. As the population grows, so does the demand for energy, making adequate energy consumption control a higher priority [15]. The construction industry is one of the most energy-intensive, accounting for a significant portion of a country's total energy consumption [16]. Building energy consumption continues to rise, accounting for approximately 40% of primary energy consumption in 2015 and is expected to rise to approximately 45 percent in 2025 [17]. HVAC is the largest energy consumer in buildings, so increased use of the air-conditioning system will have a significant impact on total energy consumption

The HVAC system's primary function is to provide thermal comfort to the occupants of the indoor space. Given the need for environmental sustainability, it is critical to provide thermal comfort while using the least amount of energy. Population growth increased thermal comfort demands, and global climate change have all contributed to an increase in the use of HVAC systems and, as a result, an increase in energy consumption in the building sector. As a result, most countries focus on the building sector as having the greatest potential for energy savings. According to studies, even a minor increase in system operating efficiency can result in significant energy savings

Multi refrigerant circuit systems are becoming more common in building air-conditioning systems, providing some flexibility in capacity control by matching the cooling demand of the building with the system's operating capacity. However, it is common practice for centralized air-conditioning systems in commercial buildings and offices to set the compressor to run at maximum speed, which may result in overcooling of the conditioned space. This could also result in indoor thermal discomfort and energy waste.

6. Conclusion

The review is based on an article and a journal article about a preliminary energy audit for a 27-year-old building in Kemaman, Terengganu. The discussion has been made throughout all the articles and journals that have been referred to that can aid in the success of the preliminary

Published by FAZ Publishing
http://www.fazpublishing.com/jcf

energy audit. The review also examines other author's perspectives on the preliminary energy audit topic. Equations and formulae should be typed in Mathtype and numbered consecutively with Arabic numerals in parentheses on the right-hand side of the page (if referred to explicitly in the text). They should also be separated from the surrounding text by one space.

Acknowledgement

The author gratefully acknowledge the financial support provided by Universiti Tun Hussein Onn Malaysia (UTHM), Building Lindungan Sdn Bhd (BLSB) and Ministry of Higher Education (MOHE) through the Research Enhanced – Structured Internship Programme (RE-SIP) Grant (Vot M046) and Research Management Centre (RMC) UTHM for managing our research grant.

References

[1] J. S. Hassana, R. M. Zinb, M. Z. Abd Majid, S. Balubaid, M. R. Hainin.(2014). Building Energy Consumption in Malaysia: An Overview.Jurnal Teknologi, 2

[2] Dogan, Eyup and Fahri Seker. (2016). Renewable Energy. Vol. 94, (2016) page 429-439.

[3] K.C.Mak, S.K. Lo. (2008). Energy Audit for Commercial Buildings in Mandatory Implementation of Building Energy Codes. Energy Efficiency Office, Electrical and Mechanical Services Department, 2 (3)

[4] M. Singh, G. Singh, and H. Singh, "Energy Audit: A Case Study to Reduce Lighting Cost," vol. 5, pp. 119–122, 2012. (4)

[5] Matzarakis. F. Thomsen. (2008). Heating and Cooling Degree days as an indicator. University of Freiburg, Germany (5)

[6] M.Zamhari, M.Nasrun, M. Farizal. (2015). Building Energy Index: A Case Study of Three Government Office Buildings in Malaysia. Universiti Utara Malaysia, 21(6) 1799-1802 (6)

[7] M.Amlus. A.Ibrahim. A. Abdullah. N.AzizanUmmi. (2017). Evaluation on Innovation approaches on Performance from Malaysian perspective: A study on Malaysian Building energy saving. MATEC Web of Conferences 150, 06040 (2018) (7)

[8] Petersen, J. E, Shunturov, V., Janda, K., Platt, G., & Weinberger, K. (2007). Dormitory residents reduce electricity consumption when exposed to real-time visual feedback and incentives. International Journal of Sustainability in Higher Education, 8(1), 16-33. (8)

[9] S.Aris. N.Dahlan. M.Nasrun M.Nawi. T. Nizam. M. Tahir. (2015). Quantifying Energy Savings for Retrofit Centralized Hvac Systems at Selangor State Secretary Complex. 77:5 (2015) 93–100 (9)

[10] M.Zamhari, M.Nasrun, M. Farizal. (2015). Building Energy Index: A Case Study of Three Government Office Buildings in Malaysia. Universiti Utara Malaysia, 21(6) 1799-1802 (10)

[11] Suhaida M S, Chua K H, & Leong Y P (2011) Sustainable Development in the Building Sector

[12] Voss K, Musall E, & Lichtmeß M 2011 From Low-Energy to Net Zero-Energy Buildings: Status and Perspectives Green Building 6(1) 46–57.

[13] A.Fakharuddin, N. Abdalla, M.Rauf, M.Kamil. (2012). A smart energy management system for monitoring and controlling time of power consumption. Scientific Research and Essays Vol. 7(9), pp. 1000-1011

[14] M. Sarstedt & E. Mooi (2014). Regression Analysis. A Concise Guide to Market Research. DOI 10.1007/978-3-642-53965

[15] G. Kaya, & N. Guler. (2013). A Study Multiple Linear Regression Analysis. Procedia- Social and Behaviour Science 106, 234-240

[16] Z. Noranai, & N. Kammalluden. (2012). Study of Building Energy Index in Unvirsiti Tun Huessein Onn Malaysia. Academic Journal of Science. 1(2): 429-433

[17] H. Abdullah, O. Ibrahim, M. N. M Jaafar, M. Maziah, A. Baharain, S. Sulaiman. (2020). Energy Savings in a Multi-Circuit Water Cooled Packaged Unit Air-Conditioning System. Journal of Advanced Research in Fluid Mechanics and Thermal Sciencees.