A SUCCESSFUL AND SUBSTANTIAL NON-STRUCTURAL ENERGY SAVING INITIATIVE IN THE PUBLIC TRANSPORT HUB BUILDING

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ABSTRACT

The Public Work of Department, Malaysia embarked on a non-structural energy saving initiative at a public building that is a transport hub of the city. The initiative commenced by executing an energy audit and followed by the implementation of various energy saving plans. A significant reduction energy usage was achieved with total cumulative kilowatt hour (kWh) saving to date are 2,480,015 and monthly kilowatt hour saving average are 190,770. This is equal to saving of 1,711,210 kilogram of CO2 and with an average of 131,632 kilogram of CO2 monthly. To date saving in Ringgit Malaysia is 764,537 or monthly average of RM58,811. This initiative also achieved an average of monthly saving percentage of 18.3 % from the baseline usage. Maximum demand also reduced from 1,763 units to 1,592 units or equal to 9.7 %. Building Energy Index kWh/m2/year is reduced from 144.26 to 113.74 or 21.15 %. A successful of the JB Sentral energy management implementation are due to three factors: (a) top management commitment; (b) clear understanding on technical aspects on energy usage and how to control them; and (c) continuous determination in developing an energy efficient culture.

KEY WORDS: Energy, Energy Management System, Energy Performance, Energy Measurement, Building Energy Index

1. INTRODUCTION

Since time immemorial, we have had climate change. In fact, the end of the ice age is due to the global climate change. Climate change has changed the landscape contributed to the evolution of the earth and living things. Various factors cause climate change as the world getting older. However, what is disturbing is when people become a major factor to climate change. Human activities in the modern life style have a direct impact on the earth disorder.

Increasing greenhouse gases argued to be the main cause of global warming. Gases that come from the waste of technology development have increased the temperature of the earth's atmosphere. As a result, the heat trapped in the earth and raised the temperature. A digital simulation of the global climate thatdeveloped in Japan has given the alarming data about the earth's future if drastic and significant actions are not taken now.

The world population needs to change the lifestyle towards green technology. Of smaller scope, we should contribute towards controlling global climate change. Use of fossil based energy must be maintained in addition to finding alternative energy and finding appropriate methods to maintain a balance between development and environmental preservation.

In addition to the global concern, escalation in energy costs has made energy savings for building owners as an essential cost reduction strategy. More energy efficient buildings thus not only hold monetary reward for owner but also to reduce the production of greenhouse gasses (E.H. Mathews & C.P. Botha, 2001). In order to implement or to develop the energy saving devices, it is necessary to understand the cause of energy loss. Energy losses in forms of electric power are mainly conductor losses, switching losses and magnetic losses (D.H. Wang & W.E. Cheng, 2005).

This paper reports an energy saving initiative at a public transport hub building in Johor Bahru, Malaysia, namely Johor Bahru Sentral (JB Sentral). The initiative was taken as a means of reducing operating costs associated with the maintenance of the building. The results indicate that both energy costs and maximum demand can be significantly reduced through the synchronisation of main activities.

2. JOHOR BAHRU SENTRAL BUILDING

Johor Bahru Sentral (JB Sentral) is the transport hub for Johor Bahru, similar to KL Sentral in Kuala Lumpur. The total area of JB Sentral is 79,000 square metres (850,348.9 sq ft), almost two times larger than KL Sentral that is 42,000 m2(450,000 sq ft) and constructed in five stories. The hub has a railway train station (opened on 21 October 2010) and a bus station, which occupies an area of 9,500 square metres (102,257.1 sq ft). The bus station is expected to handle approximately 15,000 bus passengers per hour, reducing traffic congestion at the 20-year-old Larkin Terminal Station. There are 2,000 parking spaces allocated at JB Sentral.

The trains operate in a north-south orientation. Arrival and departure hall are located at the 2nd floor. This includes immigration, custom, veterinary and other related government offices. At the 3rd floor, ticketing counter, retails shops and outlets including food and beverages for the traveler and passenger passing by and on the transit to Bangunan Sultan Iskandar. Both floor on 2nd and 3rd are air-conditioned floor.

The site's western boundary is constrained by the Caltex petrol station abutting the rail track fencing; Jalan Jim Quee to the east has a platform level up to 8 metres (26 ft) higher, which slopes to the rail tracks.

The terminal is designed to operate six rail lines and four island platforms (530 metres by 8 metres or 1,740 ft by 26 ft) on a straight alignment. The JB Sentral building is designed to fit this narrow site by placing the passenger hall and ticketing offices directly above the rail tracks, with escalators and lifts providing access to the rail platforms below. Parking facilities also includes on both wing of the building. A pedestrian bridge connects JB Sentral to Johor Bahru City Square at the Tun Abdul Razak Complex and Bangunan Sultan Iskandar.

3. ENERGY SAVING

Commonly, there are two approaches to promote energy conservation, namely structural energy conservation and non-structural energy conservation approaches. Structural energy conservation refers to the application of technology instruments, tools, or alternative energy resources, most of them require capital investment. Conversely, non-structural energy conservation is emphasizes on improving or changing of the user's energy use behaviour to achieve energy reductions. The fact that energy efficiency technologies may contributes to the reduction in energy consumption is undeniable. However, it can become not efficient in certain circumstances for it ignores the human dimension. One of the paradoxical aspects of the structural energy conservation is it creates rebound effects: People tend to use the appliances more often when the appliances are labelled as energy efficient.

As according to Peattie, K., & Peattie, S. (2009), the improvement made by efficiency appliances is always offset by the growth in frequency of utilizing the appliances. Subsequently, it will draw higher energy consumption. As technology approach requires no behaviour changes of the users, consequently, user could still waste energy in the same way (Choong W. W., 2008). In fact, installing expensive energy efficiency appliances or installation of insulation is not the ultimate solution to overcoming the energy sustainability issues. This was agreed by Kempton, W. and Schipper, L. (1994), "as we develop physical technologies to improve energy efficiencies, we only migrates the effects of energy use by human, not curing the energy problem we are experiencing".

Hence the best way in energy conservation is concentrated on behaviour aspects by improving or changing the user's energy conservation behaviour. This paper reports a non-structural initiatives that was done in the JB Sentral Building that is a transport hub building.

4. ENERGY SAVING INITIATIVES

The energy saving initiative was conducting in two phases; that are:

- **Energy Usage Auditing and**
- **Optimisation of Energy Usage.**

4.1 Energy Usage Auditing

The objective of energy usage auditing is to gather current electrical energy consumption, building energy index, total energy saving potential, cost, simple payback period for implementing the recommended energy saving measures and also to meet current regulation under Energy Commission.

Preliminary energy audit was started on 8/12/2010 that includes desktop data collection, field data collection, and cross checking of load demand on the entire building.

Key items, equipment and electrical systems studies include:

1. Energy bills – to know the previous electric bills.
2. Energy Balance – check whether there is activity conducted.
3. Building Energy Index – to identify the figure available.
4. Check the performance and capacity of mechanical equipments such as:
   a. chiller
   b. chilled water
   c. condenser water pump
   d. cooling tower
   e. air handling unit
   f. fan coil unit
   g. air cooled split unit
   h. mechanical ventilation
   i. lift
   j. escalator
5. Lighting – identify its system
6. Building Management System – check its functionality

Potential saving includes monetary and energy saving is RM687,659.00 per year and that reflects 18.36 % of saving from the current electricity bill.

4.2 Required Information and Data

By conducting electrical energy audit on the entire electrical installation, the following information and data can be identified:

a) Policy and targets;
b) Accounts and related documents;
c) Compliance towards the regulations;
d) Electrical Consumption information on:
   i. Electricity load profile of the installation (daily / weekly / monthly);
   ii. Estimated annual electricity consumption in kWh and the percentage (%) of load distribution according to electrical; system/equipment such as HVAC, production machinery, lighting etc; identified;
   iii. List of energy saving measures;
   iv. No cost / low cost with good housekeeping, minor repairs;
   v. With high cost / major investment required that includes major repair / replacement of major system / equipment, introduction of new energy efficient technologies; and Estimated potential of energy savings in energy unit (kWh).
e) Energy saving measurements and calculations based on the potentials identified;
f) Estimated return from the cost of implement energy saving measures (Simple Payback Period /Internal Rate of Return);
g) Proposed action plan and estimated time required to implement each saving measure:
   a. To develop and implement measures to ensure efficient management of electrical energy at installation;
   b. To monitor effective implementation of the measures;
   c. To supervise the keeping of records on efficient management of electrical energy at installation and verify it's accuracy;
   d. Attend one meeting every month:

i. Audit and monitor on electric bills including data compilations, analyse, verify and data confirmation based on current monthly total consumption of electrical energy information provided by customer;
ii. Audit and monitor on electricity bills including data compilations, analyze, verify and data confirmation based on previous six consecutive months total consumption of electrical energy information provided by customer;
iii. Audit on efficient management of electrical energy improvement measures proposed, not implemented together with reasons for not implementing proposed measures related information provided by customer;
iv. Audit on monthly estimated saving in total consumption of electrical energy data as a results of efficient management of electrical energy improvement measures implemented information data provided by customer; and
v. To supervise the keeping of records on items (b), (c), (d) and (e) at the installation and verify its accuracy.

e. Ensure timely submission of information and reports under the regulations.

4.3 Energy Usage Optimisation

A key to energy management system success is top management commitment from the JB Sentral organization management on establishing, implementing and maintaining the energy policy.

An established JB Sentral Energy Policy and Objectives are as follows:

Goals: JB Sentral is committed to use energy in the most efficient, cost effectives, and environmentally responsible manner possible. Towards this end, JB Sentral shall:

- Improve energy efficiency continuously by implementing effective energy management programs that support all operations and customer satisfaction while providing a safe and comfortable work environment.
- Become one of the most energy- efficient buildings on a kilowatt-hour per square foot basis.

Objectives: By comparing the November 2010 performance to March 2011, the objective of energy management is to reduce an electrical energy consumptions use as follows:

- **3% to 5%** percent **per m2** by 2011
- **8 %** percent per m2 by **2012**
- **12% to 15%** percent per m by **2013.**
- Reduce overall peak energy demand by enrolling in appropriate demand response programs and conserving energy
- Educate employees about how to save energy at work and at home.

5. CONCLUSION

This paper describes a successful and substantial non-structural energy saving initiative in the public transport hub building in Johor Bahru, Malaysia. Compared to November 2010 to March 2011 baseline, a substantial amount of energy saving was achieved through non-structural method. The whole initiative processes can be divided into two phases that are auditing and optimisation. From the initiative, the energy team has achieved savings more than targeted and meets the energy saving objective with an average of 18.3 % saving from April 2011 to April 2012.

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