Sustainable Energy Efficiency Implementation in Building

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Abstract

Energy efficiency and green technology are common terms been discussed in engineering world today with the aim to achieve a low-carbon society. In Malaysia, these two terms were boost up when the government starts to implement National Green Technology Policy pioneered by Ministry of Energy, Green Technology and Water starts by the year of 2009. Different area needs different approach of energy efficiency, without compromising the comfort level of the user. In focusing the implementation of energy efficiency in building, this research will discuss different measures starting from the simplest measures such as awareness program up to smart method which include hardware control and user interface. Smart energy efficiency measures will combine the use of control device, sensors, fast communication medium and a GUI which will enable user access, monitor and control. This research will also look on the wireless as a communication medium in order to enhance the process of control and monitoring.

Keywords:Energy Efficiency in Building, Wireless Control, Green Technology, Sustainable Energy Management

1. Introduction

Energy saving implementation in a building requires a lot of attention due to its complexity of purpose, system and equipment varieties. Building types also can be categorized by use, type of construction, size andthermal characteristic. Different building needs different solution. For example, proposed energy saving measures for shopping complex building will be different with measures for government complex building, so as for university building.

All researchers need to understand the process of implementing energy management and efficiency before proposing any measures in order to have the best solution for system.

As an example, proposing a solution for energy efficiency measures which requires a lot of wiring process seems not economically efficient if it is meant for old or existing building. The process of installing sensors and other equipment which require rewiring process will definitely increase the implementation cost, and thus will affect the return-on-investment calculation. A lower return on investment value may be achieved if the same proposal be implemented in newly constructed building. Therefore, prior knowledge in the process of energy management and efficiency is a must before proposing any energy saving solutions.

This paper will discuss the process of implementing sustainable energy management process starting with the principle of sustainable energy management up to the example of real project implementation, which is wireless energy control in a building.

2. Energy Efficiency in Malaysia

By definition, sustainable energy management refers to the process of managing energy consumption to ensure that energy has been efficiently consumed. Thus, sustainable energy management means we need a process to achieve it, not just merely a product or device installation.

In Malaysia, the Government has introduced a National Energy Policy in guiding the future energy sector development. There are three main objectives which cover the areas as follows:

i. The Supply; with the aim to ensure the provision of adequate, secure and cost effective energy supply.
ii. The Utilization; in promoting the efficient utilization of energy and discourage wasteful and non-productive pattern of energy consumption.
iii. The Environment; to minimize the negative impact of energy production, transportation, conversion, utilization and consumption on the environment.

The process in implementing energy management and efficiency project can be described as in the chart below:

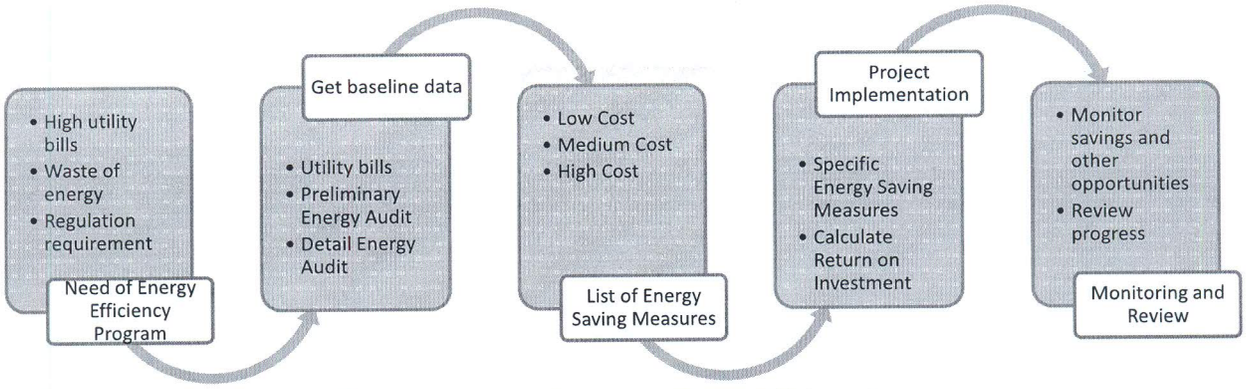

Figure 1: Process of Sustainable Energy Efficiency Program

Implementation of any energy saving project should also consider these factors to make sure no side effect or post-project problem.

i. Status of the building

The project should consider the status of the building whether it is an old of newly constructed building. For example, a device that needs a lot of wiring work will results in different cost if it is implemented in existing or old building. This is due to the rewiring process during the device installation. A lower project cost will achieve if the same device is planned and installed for newly constructed building, where the wiring process is only being carried out once.

ii. Function of the area / room

Different function of room will require different setting and configuration of energy saving implementation. There is no such thing as a universal energy saving product.

iii. Control and switching method

Not less important is how the device is being set up. As an example, an energy saving device that control motors using sensor and will cause often start and stop process will have a side effect. Frequent on and off switching will have the effect of inrush current and hence will raise the issue of device wear-and-tear and also breakdown.

3. A Step-by-Step Energy Efficiency ProcessImplementation

Based on Figure 1, a step-by-step energy efficiency process is implemented. By using university campus as the project area, the project team starts with studying the need of energy efficiency program. Based on observation, survey and discussion with the management, there is a need in implementing energy efficiency program due to high bills for utilities especially electricity and water.

The second process is to get the baseline data. These data can be obtained through electricity bills, studying the electrical single line diagrams and also occupancy data for each building in the university area. Based on the analysis, it is decided to focus the efficiency program to the classroom due to the high level of occupancy and usage. Focusing on the classroom, several energy saving measures for the classroom being listed as follow:

i. Put energy efficiency signage as awareness and reminder to the user.
ii. Install tinted film to the glass window to avoid direct heat from sun.
iii. Install spring door closer to make sure the aircond is fully utilized.
iv. Change the lamp to energy efficient lamp.
v. Install smart energy device to control the classroom.

Energy Saving Measures	Type	Analysis
Put energy efficiency signage as awareness and reminder to the user.	Low Cost	Implement Immediately
Install tinted film to the glass window to avoid direct heat from sun.	Medium cost	KIV as it is not critical
Install spring door closer to make sure the aircond is fully utilized.	Medium cost	Apply budget and can be implemented
Change the lamp to energy efficient lamp.	High cost	KIV due to cost
Install smart energy device to control the classroom.	Medium cost	Can be implemented through R&D
Change to more high efficiency aircond	High Cost	KIV due to cost

Table 1: List of Energy Saving Measures and Analysis

Implementation

A classroom in university building is used as a test area. The aim is to construct a device that can control the electrical energy supplied to the classroom by tapping the device to the main supply of the room. A GUI is also developed to make sure that user can easily monitor and control the devise. As to reduce the control and switching problem, the on-off process will be based on the timetable for the semester. Therefore, the issue of inrush current and wear-and-tear problem could be reduced.

connected to relays which been controlled by the microcontroller. Besides that, current information data from the center is display on PC by using GUI. All information of the schedule is saved in database before the system run and controls the main board. As to enhance the system, wireless transceivers used in order to enhance the communication process. By using wireless communication, hardware and wiring cost can be reduced and at the same time enhance the flexibility of the system. At any time, the system can be moved or transferred to other places if needed without affecting the cost.

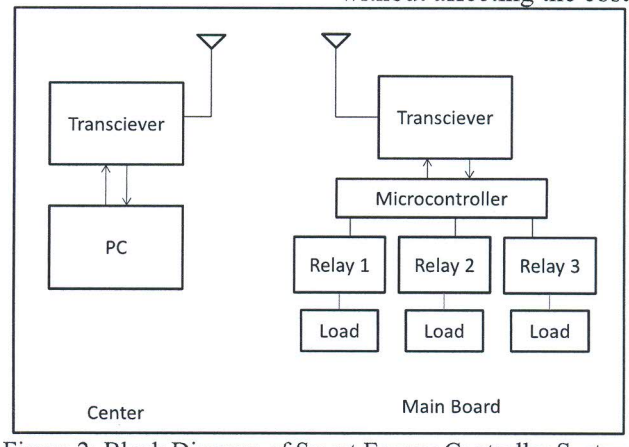

Figure 2: Block Diagram of Smart Energy Controller System

The main brain of the system is microcontroller PIC18F2550 has huge program memory size 32kilobytes or 16384 instructions can be programmed. Besides that, it also consists of 2kilobytes of SRAM and 256byte of EEPROM. Out of 28pins, 24 pins of the controller can become I/O ports. Thus, the features of PIC can fully utilized without adding any external hardware such RAM, ROM and PIA. When not receiving or transmitting data, both transceivers module is in Idle Mode. During Idle Mode, transceiver module is also checking for valid RF data.

A Graphic User Interface is also developed so that theperson-in-charge of the classroom can control or modify the setting without any delay or difficulties. The GUI contains the list of classroom and also option to insert or add the timetable for each area. Referring to Figure 4, it is use to insert the new schedule operation time or change any data. It shows the class number, start time and end time. For start time and end time, the data must insert according to the format given like day/month/ year follow by hour: minutes. The other button is design to assist whether add, delete, refresh, updates, search or close. All data will be saving to the database for monitoring and review purpose.

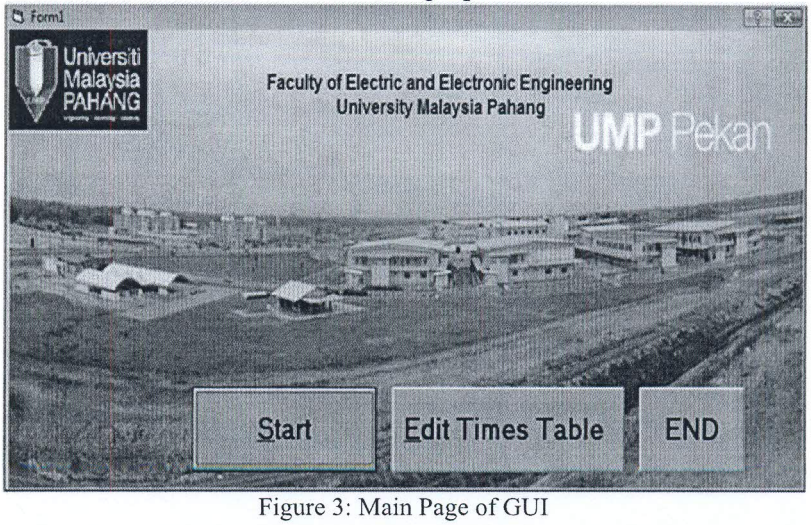

Figure 3: Main Page of GUI

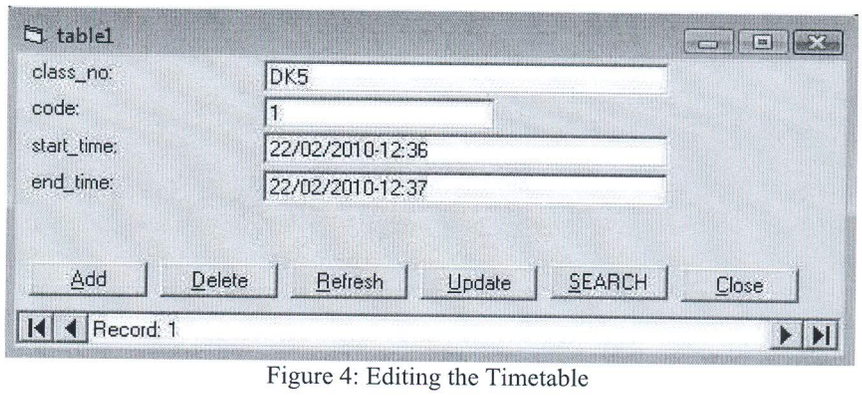

Figure 4: Editing the Timetable

Besides the editing option, the user is allowed to monitor the current room power supply ON or OFF. This screen show out which class or room is active and which one is shutdown as a monitoring purpose.

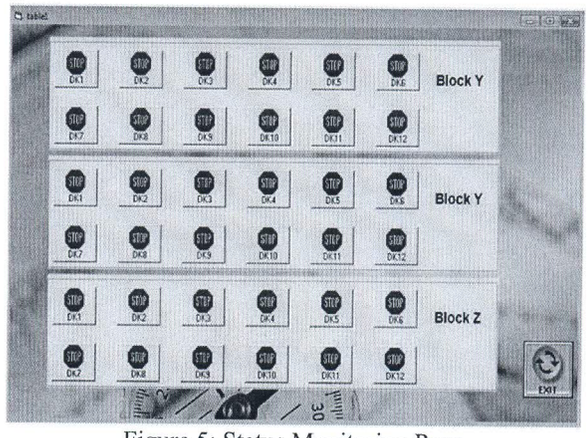

Figure 5: Status Monitoring Page

5. Conclusion

In conclusion, this paper discussed the process needed in implementing any energy efficiency project. Energy efficiency project is not merely change or install energy efficient device. The process should start with understanding the area, getting the baseline data and then through analysis, a specific project is decided. By following all these process, respected energy saving project can be categorized as sustainable energy efficiency program. With all the process, all energy efficiency program within the area, such as in university building, can be closely monitored and any review process can be organized in fast and accurate condition.

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