



Electricity Consumption in Commercial Buildings: A Case Study of the Sri Lankan Construction Industry

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ABSTRACT

Electricity is an important secondary energy source. Every household, industrial and commercial sector highly demands for electricity. This leads increased electricity consumption in the Sri Lankan commercial buildings and adds a high price for their overhead costs. Therefore, this research attempts to identify the methods of electricity consumption and to suggest possible techniques to reduce electricity consumption. Both primary and secondary data were used in this research and the primary data were collected through a questionnaire and interviews. Twenty seven (27) engineers in all departments of the company were selected as the sample. The secondary data were gathered from energy audits conducted by the Sustainable Energy Authority (SEA). The data were analyzed descriptively and further the conclusions were derived by using correlation and factor analysis. The results showed that the equipment used, the technological advancement and the comfort levels of commercial buildings were the factors that affect the electricity consumption. Also, lighting and air conditioning affected differently in electricity consumption of the commercial buildings due to thermal conductivity and reflection level of the materials used.

KEYWORDS: Commercial Buildings, Electricity Consumption, Energy Saving Techniques, Highly Electricity Consuming Equipment, Technological Methods

INTRODUCTION

Energy is the source which contributes to all human, economic and social improvements that are essential for sustainable development in every country. Electricity is the main energy source in the Sri Lankan commercial buildings. In Sri Lanka, a large portion of electricity is generated by using the hydro power and petroleum based thermal power. According to the Figure 1, Hydro power production sources have dramatically decreased from 2003 to 2012.

Hydro power production has dropped by 0.36% and thermal power has increased by 53.12% due to the new establishment of Kerawalapitiya power plant on furnace oil.

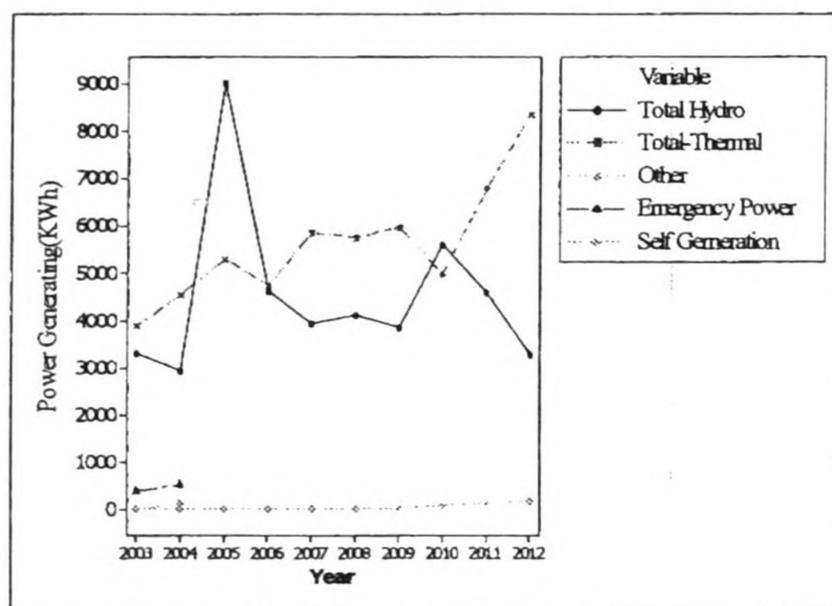


Figure 1: Power Generation in Sri Lanka

Figure 1 has considered the renewable energy in "other" category and it can replenish itself naturally such as sunlight, wind, rain, tides, waves and geothermal heat. Renewable energy sources can decrease the effects to the environment. The total contribution from the Non-Conventional Renewable Energy (NCRE) sector to the national grid still remains small and it is at the developing stage.

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Figure 2: Electricity Usage in GWh

RESEARCH PROBLEM

The research was conducted as a case study in the Sri Lankan construction industry. According to statistics, the company has to pay large amount of money for electricity, and also this is a compulsory overhead payment. This was a major problem for middle scale companies. The research was carried out in a selected company. The total payment details were gathered, for electricity consumption includes all the building of the company under general purpose category are depicted in the Figure 3.

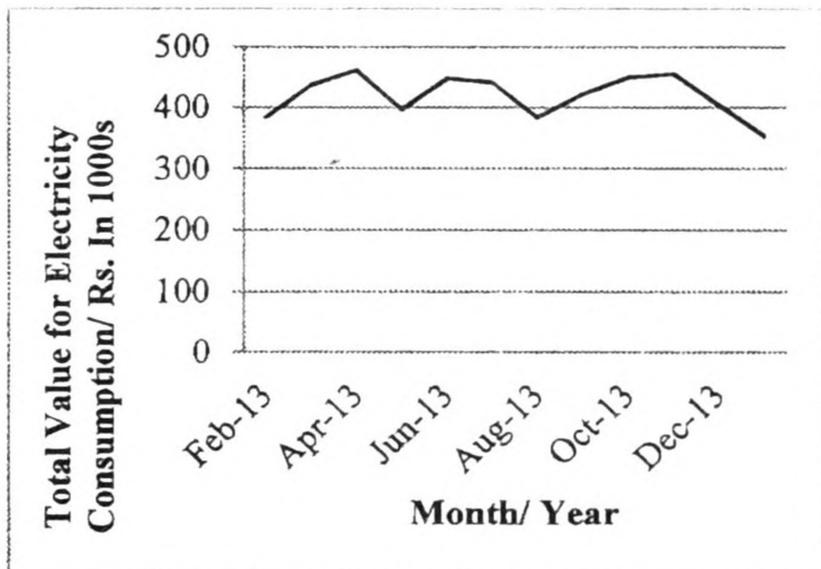


Figure 3: Total Value for Electricity Consumption/ (Rs.)

LITERATURE REVIEW

The commercial sector brings together categories of stationary energy use

associated with profit-seeking and nonprofit enterprises that provide services, including those for public administration. The commercial buildings consume electricity for different purposes. The sector focuses on energy consumed by heating and cooling systems, lights, water heaters, and other equipment in the buildings where businesses, institutions, and other organizations are located. As per the US researchers, the top three end uses in the commercial sector are space heating, lighting, and space cooling, which represent close to half of commercial site energy consumption (Commercial Sector, 2012). Also, Myers (2011) states that lighting uses more electric energy than any other system in a commercial building, about 38% of total energy output. Based on the energy audit data obtained by Sustainable Energy Authority (SEA), the ways of general electricity consumption in the commercial buildings are shown in the Figure 4. Therefore much evidence can be found for increasing demand for the electricity (Ruwanthi and Wickramasinghe 1999, Lombard et al. 2007).

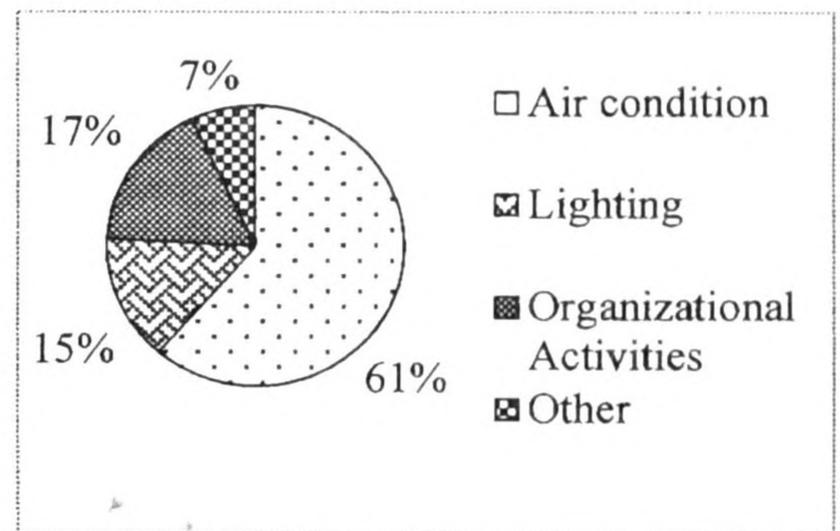


Figure 4: Ways of General Electricity Consumption in the Commercial Buildings

Non-building energy use is included in the commercial sector, where it contributes to such public services as traffic lights and water and sewer systems. As per the report of “International Energy Outlook (2013) the total world delivered commercial sector energy consumption grows at an average annual rate of 1.8 percent from 2010 to 2030, making it the fastest-growing demand sector.

As the Figure 4 reviews, more than half of the electricity consumption is allocated for air conditioning. Therefore, if more focus can be given on air conditioning and lighting in the Sri Lankan commercial buildings, the electricity consumption can be minimized saving the energy. Further, the literature reviews the following ways that create energy loss in the commercial buildings (Lombard et al. 2007, Myers 2011).

- Leaving lighting, cooling systems
- Keeping computers, printers and other computer equipment at stand mode
- Keeping doors or windows open when air-conditioners are active
- Neglecting of maintenance activities
- Using inappropriate technologies
- Light fittings are not properly focused on tables
- Tables are not arranged to get enough light of air-conditioning
- Building floors are not properly designed to a get same cooling level in everywhere

The empirical literature suggested the following variables to be considered in this research to minimize the energy losing ways. They are;

1. Design of the building
2. Appliances used in the work inside the building
3. Technology advancement of the equipment
4. Demand for the service comfort level
5. Energy policies followed

RESEARCH METHODOLOGY

Research Process

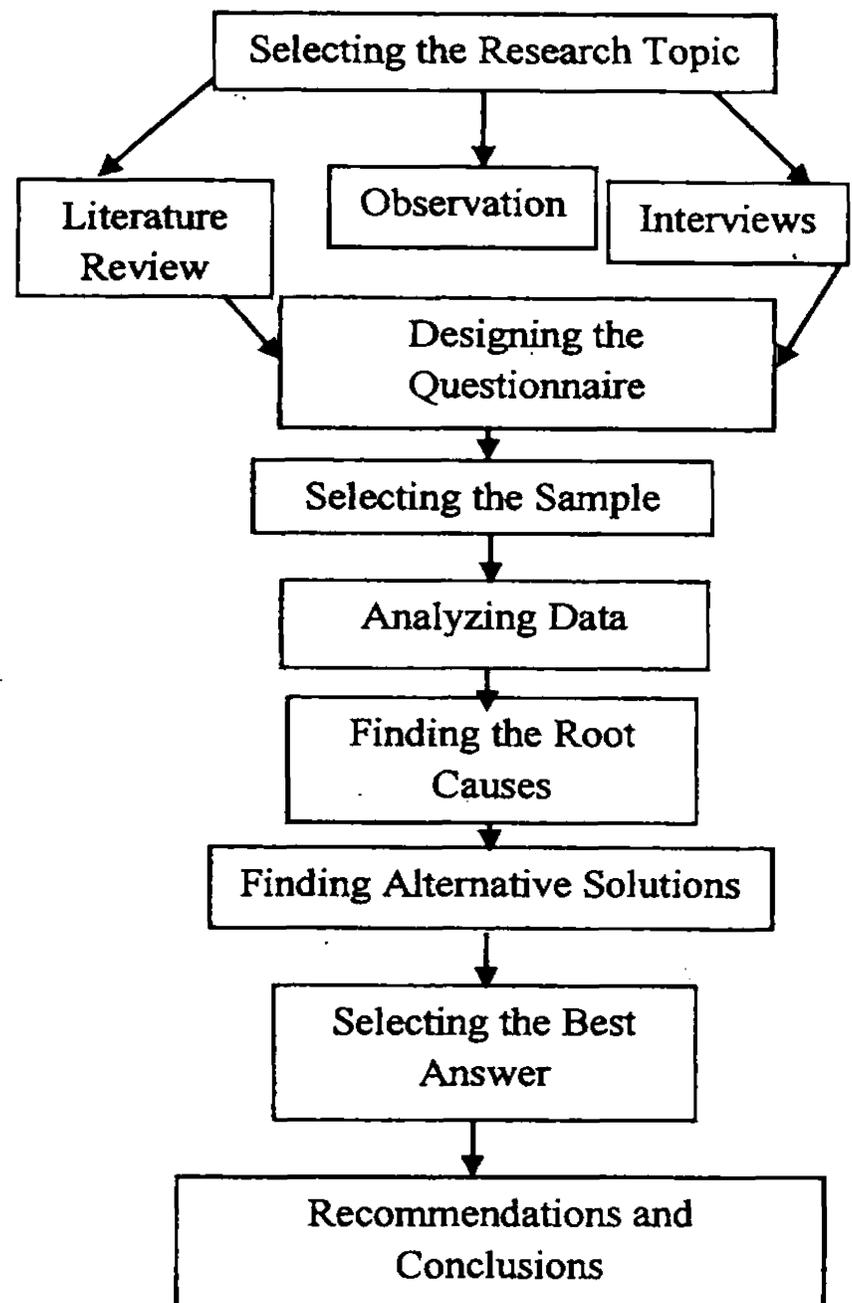


Figure 5: Research Process

Research Framework

In the research framework, the dependent variable was the electricity consumption in commercial buildings and it was described by using five independent variables: design of the building, appliances, technology advancement, energy policies used in the companies and demand for the service comfort level. Since these variables were qualitative, they were measured by using suitable indicators.

Data Collection

The sample size was 30 randomly selected commercial buildings in the Sri Lankan construction industry. The data were assured with the reliability by obtaining

primary data through electrical engineers and the technical staff of each company. Both questionnaire and relevant interviews were used to collect primary data for this study and secondary data were collected from the SEA.

DATA ANALYSIS

The data were descriptively analyzed by using mean, standard deviation, standard error of the mean. For further analysis, reliability and normality tests, principal component analysis, factor analysis etc. were used.

Results

This study showed that the electricity consumption in the Sri Lankan commercial buildings was affected by the equipment used, the technological advancement and the comfort levels of commercial buildings. Also, lighting and air conditioning affected differently in electricity consumption of the commercial buildings due to thermal conductivity and reflection level of the materials used.

DISCUSSION AND CONCLUSION

Organization can make profit by reducing its overhead expenditure. Electricity consumption has a proportional relationship with the overhead expenditure hence it should be minimized. Therefore, this study is very important in identifying possible methods of electricity consumption, when making the strategic and tactical decisions to minimize the electricity consumption.

This study showed that a large portion of electricity consumption in the commercial buildings was for air conditioning. Therefore, this research provides future insights to find out the possible ways of minimizing electricity consumption for air conditioning in the Sri Lankan commercial buildings providing a comfortable working environment.

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