

The Impact of Dwelling Factors on Electrical Appliances Usage through Residential Building Occupants

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Abstract

Residential structures such as terraced, condominium and clauster buildings plays an important role in providing shelter for occupants daily needs in the whole world. But these buildings plays a negatively role in terms of energy consumption. This is as a result of its contribution heavily to global warming. Although campaigns is on around the globe on energy awareness and mitigation on Green House Gas (GHG) emissions nearly half a centaury ago, but there was more than 100% growth in CO₂ emissions annually in the world. This paper is aimed at providing solutions in curtailing energy wastage in the residential buildings sector. Data information was obtained in the state of Johor, Malaysia using a 5-point likert scale questionnaire. Descriptive statistics was used in analysing the data collected using path analysis. The findings from the study indicates that, occupants understanding on socio-economic factors on building energy consumption is significant. In line with the output of this research, it is expected that developing countries like Nigeria will emulate this practice and improve in the field of energy behavior practice by residential building occupants.

Keywords: Socio-Economic Factors, Building Energy Consumption, Occupants, Electrical Appliances

Introduction

Electricity energy consumption in the residential buildings is increasingly becoming higher and multi dimensional, this makes it very difficult to conclude on the number of factors attributed to building energy consumption. Many researchers view it from different directions. This study concentrate on dwelling factors in relation to electrical energy consumption. One of the identified areas of energy consumption in residential building is electrical appliances used (McLoughlin, 2012). Electricity consumption in residential buildings accounted for 6% direct CO₂ emission, (Agency, 2013) and 11% indirect global CO₂ emission (IEA, 2013). Energy consumption in this study refers to the following factors which are i. Refrigeration system ii. Kitchen devices iii. Aircondition system iv. Electrical appliances and v. Other home

appliances. The study is geared towards establishing a linkage between dwelling factors and building energy consumption.

Forty percent (40%) of all energy is used in buildings, and twenty five percent (25%) of this energy is being used for occupant comfort of indoor climate control (Ahmad *et al.*, 2014). According to Milani *et al.* (2015), in tackling the consumption of electrical energy in residential dwellings, three important points need to be considered. These points are: i. Substituting the existing housing stock with low-energy buildings designed primarily to minimize heating and cooling loads ii. Developing and achieving widespread repetition for low-energy consuming domestic equipment (e.g. appliances and lighting) iii. Supporting “energy-conscious” behaviour among end users.

In addition to the above statement, (Kavousian *et al.*, 2013) identified four (4) major categories of factors that influence building energy consumption. These are: i. Weather and location. ii. Physical characteristic of the building. iii. Appliance and electronics stock and iv. Occupancy and occupant behavior towards energy usage. Brounen *et al.* (2012) in his research reported that, residential energy consumption is dependent on two things the characteristics of the dwelling and background of the occupants. Residential sector stands to play an important role in reducing energy consumption when it was fully understood (Kesicki, 2012).

There are enough literatures on building energy consumption by residential occupants in the last decades as reported from previous studies. Stern (2000) is of the opinion that, research conducted on buildings in respect to energy saving prove to be uncertain and ineffective because of the behaviours of the occupants. Vinther *et al.* (2009) added that, in order to ensure good performance of energy efficiency of buildings, designers should take occupants interactions with the building control systems into account. Jinlong and Hokao (2009) are of the belief that, changing occupant behavior towards energy usage can possibly make a great change towards building energy consumption.

Hoes, P., Hensen, J. L. M., Loomans, M. G. L. C., de Vries, B., & Bourgeois, D. (2009) reported that, "Energy use in buildings is associated with the operation and space utilization as well as characteristics and the behaviour of the occupants". Escrivá-Escrivá, G., Álvarez-Bel, C., & Peñalvo-López, E. (2011) added that, comfort provision of buildings has an impact on carbon emissions and energy consumption, this implies that occupants are the major contributors of the world energy consumption today. This is because, people in developed countries spends 80-90% of their time indoors (Frontczak & Wargocki, 2011).

Statement of the Problem

Buildings are well known for their role in providing shelter, offices and many more, but we should not forget about its negative contribution in global warming. Buildings globally are responsible for one-third global GHG emissions. Based on the reviewed literature, there is no doubt that building energy consumption in residential buildings is multi-dimensional. Encouragement in the use of energy efficient equipment alone is not enough in solving residential energy consumption. However, by understanding residential building occupants' ways and status in relation to their residential electrical appliances usage will definitely help in reducing the energy consumption in residential buildings. This is what this study is aiming at.

Purpose of the Study

The purpose of the study is to forecast the residential building occupants level of awareness and understanding in residential building energy consumption (Kitchen devices, Lighting appliances, Refrigeration system, Air-condition system and Home appliances) based on dwelling factors (building type, building size and building orientation).

Research Question

Does dwelling factors influence consumption of electrical energy in residential buildings?

Research Hypothesis

H0₁: Dwelling factors will not influence residential building occupants in building energy consumption practice.

Methodology

The study was conducted using descriptive survey. The study data was collected in the district of Skudai in the state of Johor Bahru Malaysia. The population of the study covers the residential buildings occupants of Skudai

province in the state of Johor, Malaysia. The population of the residential occupants in the district of Skudai is 22,390. The sample of the population was derived using the graph of Krejcie and Morgan, it indicates that for a population of twenty thousand (20,000) up to one million (1,000,000) requires a total number 384 (three hundred and eighty four) respondents (Krejcie & Morgan, 1970).

Six hundred questionnaires (600) were administered and 395 was returned using “drop and pick” method in collecting the study data. Descriptive statistical tool from SPSS software package version 22 and path analysis using SPSS AMOS statistical software package version 22 was

employed in analyse the quantitative data. A significance error level of 0.05 was allowed while testing the hypothesis.

Results

The data collected was analysed using Structural Equation Modelling (SEM) by considering AMOS (Analysis of Moment Structure) as the package for the analysis. Path Analysis weightage of the identified factors of building energy consumption (Kitchen devices, Lighting appliances, Refrigeration system, Air-condition system and Home appliances) was considered from the path analysis as the analysis tool considered as shown.

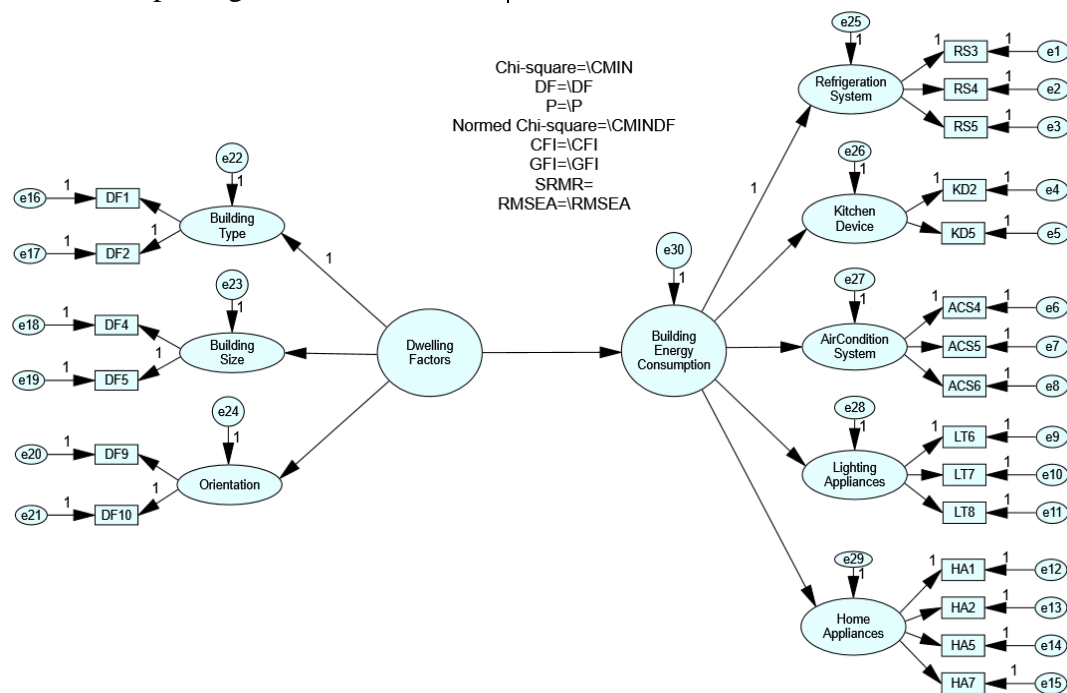


Figure 1: Showing the framework of the model exploring relationship of dwelling factor and building energy consumption.

The path analysis weightage of the dwelling factor and building energy consumption is shown.

		Estimate	S.E.	C.R.	P
Refrigeration System	<-Building Energy Consumption	1.000	.086	7.446	***
Kitchen Device	<-Building Energy Consumption	1.102	.165	6.686	***
Air-condition System	<-Building Energy Consumption	.126	.092	1.367	.172

Lighting Appliances	<-Building Energy Consumption	.186	.109	1.713	.087
Home Appliances	<-Building Energy Consumption	.959	.137	7.021	***

Results indicates that refrigeration system, kitchen devices and home appliances has a positive significance on building energy consumption as it indicates 0.00 level of significance. The analysis equally shows that air-condition system and lighting appliances have negative effect on the study. The normality of the structured model in Figure 1 shows the skewness and kurtosis of the factors observed, the standardized residual and the covariance of the model was equally checked.

Findings

The outcome of the 5 factors of Building Energy consumption shows that three (3) paths contributed positively to the study. Results shows that air-condition system and lighting appliances negatively influence the study. However the other 3 factors which are Kitchen devices, refrigeration system and other home appliances supports the study. Findings shows that in as much as the use of air-condition, lighting and laundry appliances was fully understands, there will be improvement in energy efficiency.

Based on the hypothesis question, The structured model portrayed that;

- ✓ Dwelling Factor have significant and direct relationship with factors of Refrigeration, Kitchen Devices and Home Appliances.
- ✓ On the other hand Dwelling Factor have no significant and no direct relationship with factors of Air-condition System and Lighting Appliances.
- ✓ However, literatures and research conducted by (Elisha et al., 2015;

Permana et al., 2015) shows that there is significant and direct effect of Dwelling features on Building Energy Consumption.

- ✓ This implies that Type, Size and Orientation of Building which defined Dwelling factor in this study are not well managed by the residential occupants
- ✓ This proved that one of the reason for high Residential Buildings Energy Consumption in Malaysia is this factor.

Conclusion

In conclusion, the study aimed at investigating the usage of electricity appliances by the residential occupants. The study portray a need for proper awareness in the field of energy usage and management of lightning and air-condition usage for proper sustainability. This study was conducted in Malaysia to check mate the causes and factors that influence the use of electricity in residential buildings. It could be of great advantage if the same study will be conducted in Nigeria so as to compare and see if there is anything in common so as to trim down the poor habit of electricity usage.

Recomendations

- Construction industries should consider the choice of the occupants before designing and constructing houses
- Government must focus and invest more in the field of renewable energy in order to trim the use of fossil fuels.

References

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