Factors affecting domestic electricity usage

With reference to colombo, gampaha, and Rathnapura districts, Sri Lanka

ABSTRACT

Currently, Sri Lanka is facing a major economic crisis. In the face of this economic crisis, it is clear that the government has failed to provide the necessary facilities for individuals to carry out their daily activities properly. It has become a challenge for the institutions as well as the industrial sector to carry out their work in an atomic manner through the daily electricity disruptions. Due to the inefficiency of electricity consumption in Sri Lanka, the amount of electricity wasted annually is very high. Therefore, the objective of this study was to find factors affecting electricity consumption in domestic applications in order to reduce the wastage of electricity. For achieving the objective, three cities of Colombo, Gampaha, and Rathnapura were selected using the cluster sampling method. Accordingly, the total sample was 75. A questionnaire and interview methods were used to collect data. Principal Component Analysis and Multiple Linear Regression Analysis were used for the data analysis. The findings revealed that the number of family members, the size of the house, the income, the use of Florence bulbs, living in a rented house, and the use of electrical appliances contribute to the increase in household electricity consumption. Considering those factors that are affecting domestic electricity consumption, the government, focusing on sustaining electricity consumption and providing necessary facilities to consumers, should take necessary steps.

Key words: Electricity usage, Household, Sri Lanka, Sustainable

1. Introduction

In order to satisfy its energy requirements, Sri Lanka has a significant dependence on both commercial and non-commercial sources of energy. Non-commercial energy sources such as firewood, saw dust, coir and vegetable matter, are largely used in the rural and plantation sectors. On the other hand, commercial energy sources, which include petroleum, hydroelectricity, coal, and liquefied petroleum gas (LPG), are mainly used by urban households and industries. This dual dependence illustrates the distinct energy consumption patterns that prevail by area and sub-economic sectors of the country.

At this stage of national development, the Sri Lankan economy has to work towards increasing energy efficiency as a means of enhancing the overall sustainable growth of the nation. However, since 2021 the growth in the demand for electricity has been vastly out of proportion with the capacity to supply

(International Trade Administration, 2024). This reliance on energy sources that are primarily electrical has become an important issue today in the present urbanized sector.

Energy crisis is a global threat and solving the issue of urban household energy consumption requires defining what drives this particular consumption pattern. Determining these issues could aid intervention by policymakers and thus enhance the capacity to balance the supply and demand of energy more optimally. This study, therefore, attempts to address the question of the main causes and determinants of electricity usage.

Energy is a potential to operate a system. Electricity is the most widely used form of energy in the world. When the SS Helios docked in Colombo for a local electricity exhibition in 1882, Sri Lanka saw electricity for the first time. Before electric lights were a widely used commercial product, the first electric bulb in Ceylon was lit in the Billiard Room of the Bristol Hotel in Colombo in 1890 using a diesel generator. Electricity was introduced to Sri Lanka in 1895. "Bowsted Brothers Institute" provided electricity supply to selected locations in Colombo Fort area. "The United planters Company" built electric tramlines using the electricity supply. Lakshapana Power Plant was opened on 30th of October 1950. The Electricity Act was passed by the Act No. 19 of 1950, the Department of Ceylon as a major centre of Sri Lanka's electricity development. Electricity supply reached the rural areas, beginning from 1959.With the gradual increase in the demand for electricity in Sri Lanka; it was proposed to build power plants under the Rapid Mahaweli Scheme to meet the demand. As a result, on April 12, 1985, the President of Sri Lanka and Prime Minister of England, Margaret Thatcher, collaborated to launch the Victoria Project in 1905. The Colombo Gas Company also built a power plant in Kandy, which the Kandy Municipal Council eventually took control of in 1922. As a 1906 modification to Electricity Ordinance No. 5, Electricity Ordinance No. 36 was passed. A small hydroelectric power station at Black Pool was put into service by the government in 1912, marking the beginning of the Nuwara Eliya Electricity Scheme. In 1918, the Engineering Association of Ceylon received a report on the economic feasibility of hydroelectricity in Ceylon from D.J. Wimalasurendra. In 1920, local governments in Gampaha, Veyangoda, Ja-Ela, Peliyagoda, Kochchikade, Avissawella, and Minuwangoda started distributing electricity locally with diesel generators.

The Department of Government Electrical Undertakings was found in 1927 to take over, manage the Colombo power supply company, and eventually expand the provision to the rest of the country. Three-megawatt Stanley Power Station was put into service in 1929 and by the end of the year; it was supplying power to 16 communities. The Electricity Board Establishment Ordinance No. 38 of 1935 was passed by the State Council of Ceylon in 1935, only for it to be disbanded once more in 1937 with the re-establishment of the DGEU. The 4th of February 1948 saw the independence of Sri Lanka. On October 30, 1950, the Old Laxapana Power Station was completed, having been under construction since 1924.To decentralize the electrical works, regional offices were established in the same year in Norton Bridge, Nuwara Eliya, Diyathalawa, Panadura, Negombo, Avissawella, and Peradeniya. The Kankesanthurai Cement Factory was the source of electricity purchased from Jaffna distribution the following year.

By virtue of Parliament Act No. 17 of 1969, the present Ceylon Electricity Board (CEB) was found on November 1st, 1969. The country's development and coordination of electricity generation, supply, and distribution are still under the purview of the CEB (Seenadipathi, 1996). List of power plants in Sri Lanka are Victoria hydro power station, Laxapana hydro power station, Samanalawewa hydro power station, Wimalasurendra hydro power station, Udawalawa hydro power station, Lakvijaya power station, Inginiyagala hydro power station, and Kelanitissa thermal power station etc (Ceylon Electricity Board, 2023).

In 2020, the total amount of electricity generated, decreased by 1.3% to 15,714 GWh. March, April, and May of 2020 have shown a considerable drop in generation as a result of lower electricity consumption and lockdown regulations put in place to control the COVID-19 spread. Following the lifting of the state-wide lockdown and the gradual restoration of the economy to normalcy in June 2020, a recovery in electricity generation was noted. However, as the year came to an end, the second wave of the pandemic caused the generation as a whole to trend downward. In 2020, hydropower generation rose as a result of healthy reservoir levels brought about by sufficient rainfall in the catchment areas. Since there were no prolonged closure of the Kerawalapitiya coal power plant units in 2020, as there had been in previous years, the generation of coal power also increased. Moreover, the production of electricity from coal is less expensive than that from fuel oil-based power plants, which employ goods like diesel and furnace oil. The notable reduction in the more costly fuel oil-based power generation was supported by the combined effect of increased hydro and coal power

generation. In contrast, there was a rise in the production of electricity in 2020 from non-conventional renewable energy (NCRE) sources, such as mini-hydro generation. In total, the CEB provided 70.9 percent of the power generated, with the remaining portion coming from Independent Power Producers (IPPs). According to preliminary estimates, the industrial sector's decreased demand for electricity in 2020 was greater than the domestic sector's growth, resulting in a 2.2 percent decline in sales to 14,287 GWh. (Central Bank of Sri Lanka report, 2020; International Trade Administration, 2024; Sri Lanka Energy Balance 2021)

Electricity and LP gas are mostly used as sources of energy consumed in Sri Lanka. The urban sector of Sri Lanka has high electricity consumption compared to the rural sector and estates. This is influenced by the hectic nature of urban households. Electricity is used extensively in urban households for lighting, air conditioning, televisions, radios, washing machines, fans, and cooking. For a country to develop, the efficiency of energy sources must be increased. Attention should be given to electricity consumption in Sri Lanka especially, to the factors affecting electricity consumption.

Every year, Sri Lankan households waste a great amount of energy due to unproductive use of electricity. This wastage can be reduced considerably by eliminating inadvisable f actors which are known to the majority of electricity users residing in urban areas. If such factors contributing to both energy and its wastage are not arrested, the current energy crisis scenario can get uglier for sure. Thus, the objective of this study was to determine some of the factors that contribute towards domestic electricity consumption in Sri Lanka in an effort to reduce the energy crisis.

2. Literature Review

The factors, which act as measures of Socio-economics are people's behavioural factors, demographic and family composition status. They may influence the decisions of households' electricity consumption.

Research by Durisic et al (2019) has been conducted to investigate various socio-economic habitat-related and equipment-related factors affecting electricity consumption in Montenegro. This research has been conducted with the help of 964 households. Accordingly, it has been identified that factors such as income, residence size, equipment, age, family composition and habits influence the household electricity consumption in Montenegro. Also, the size of the residence has been identified as the most influencing factor on electricity consumption, followed by family composition and habits.

Research conducted on the use of domestic electricity and the factors affecting it by relating all 25 districts of Sri Lanka has identified that factors such as family monthly income and family size affect it (Ariyarathne et al 2021).

Kotsila and Polychronidou (2021) studied the determinants of household electricity consumption covering all regions of Greece. The study found that a number of occupants in the home, the size of the house, the type of heating, the heating and cooling times and the weather conditions affect the electricity consumption.

Research that was conducted on electricity consumption in Yalcintas and Kaya Hawaiian (2017) Islands, identified that there is a different pattern of electricity consumption in the islands of Hawaii. It has been identified that there is a difference in electricity consumption depending on the living area and people's lifestyle.

Research on the impact of factors such as demographic socio-economic and residential characteristics on household electricity consumption in Taiwan has found that all of these factors have a positive effect on it. Also, the study has found that the increase in the income level increases the household electricity consumption due to the presence of more members in the household and the presence of senior citizens in the household (Huang, 2015).

A study conducted in Canada by Ndiaye and Gabriel (2011) has studied the factors that determine household electricity consumption. The study found that electricity consumption increases when the number of family members increases and indicates that there is a positive relationship between the number of family members and electricity consumption.

Belaida and Joumni (2020) conducted a study on energy conservation using observed and stated attitudinal factors. The study has identified that the existing knowledge about electricity consumption and the existing attitudes towards securing electricity have a positive effect on it.

Heberlein and Warriner (1983) conducted a study on the factors influencing the electricity consumption of residential electricity consumers in northeastern Wisconsin, USA. There, people's attitudes towards electricity consumption have been studied. Thus, it has been identified that the existing attitudes towards saving electricity and the effect of recurring electrify consumption affect the safe consumption of electricity.

Al-Bajjali and Shamayleh (2015) conducted a research on electricity consumption in Jordan during 1986-2015. There, 6 independent variables have been used to understand the main determinants of electricity consumption. Accordingly, the variables of gross domestic product- electricity price, population, urbanization, structure of the economy and total water consumption have been considered. According to the results, it is clear that the variables of GDP, urbanization, economy structure and total water consumption have a significant positive effect on electricity consumption. It has also been found that electricity prices have a negative effect on electricity consumption. This study also found that population has a significant positive effect on short-term electricity consumption.

Simultaneously, previous literature can be examined on how the use of electrical appliances and home characteristics affect household electricity consumption.

Kim (2017) conducted a research on household energy consumption by the Korean Energy Economics Institute in 2015. The study has investigated factors affecting household electricity consumption between two groups. The number of electrical appliances has been identified as the factor affecting household electricity consumption for two groups.

Similarly, a research conducted in Delhi has studied the factors that determine domestic electricity consumption. Through that research, it has been identified that the electricity consumption of the house is determined by the amount of electrical equipment in the house (Tewathia, 2014).

A study on the determinants of electricity consumption was conducted using 620 urban households in Seremban, Malaysia. The research has identified that electricity consumption is high in urban areas. Also, it has been found that the higher the income of the people, the more they get used to a luxurious lifestyle and the higher the electricity consumption. It has also been found that the number of rooms in the house and the number of electrical appliances have a positive effect on electricity consumption (Ali and et al, 2021).

A study conducted on the determinants of electricity consumption based on Malaysian households found that the nature of the electrical equipment used has a positive effect on it. Accordingly, fluorescent lamps in air conditioners and flat screen televisions have been identified as the devices that have the most significant impact on electricity consumption. Also, the socio-demographic factors of individuals have also been found to have a positive effect on electricity consumption (Sena and et al, 2021).

A study on the factors that influence household electricity consumption in Sri Lanka's rural domestic sector has found that factors like the number of rooms, the number of electrical appliances, household income, consumers' awareness of energy conservation, and their degree of education all have an impact (Dissanayaka, 2019).

Adikari conducted a research on the factors influencing domestic electricity consumption demand. There, the number of rooms in the house and the size of the house have been identified as factors that have a greater effect on it.

In their 2015 study, Jones and colleagues delved into the factors influencing household electricity consumption. It has been found that the age of the residence, the number of rooms, the number of bedrooms and the size of the floor affect the electricity consumption. Also, it has been found that the use of machines like desktop computer, television, electric stove, refrigerator, dishwasher, tumble dryer and washing machine increases the electricity consumption. Accordingly, it has been identified that there is a positive relationship between the use of electrical equipment and electricity consumption.

According to the above literature investigations, it is clear that there are various factors that affect domestic electricity consumption. Accordingly, there has been no study on domestic electricity consumption determinants in Sri Lanka's Gampaha, Colombo and Rathnapura districts. Therefore, this study aims to fill that gap in the literature.

3. Research Methodology

The theoretical framework, methodologies, and procedures employed in this study to accomplish the major objective and provide answers to the research questions are designed and justified in this section.

03.1 Research approach, method and data collection

Following the current literature with theories and finding of empirical researches, this research employed a quantitative research approach as the conceptual framework. Pure quantitative research can be seen with the collection of numerical data whereas pure qualitative research presented as collection of qualitative data with non-numerical, including words and pictures (Kwadwo Antwi and Hamza 2015). Qualitative approach consists of several characteristics including proper, objective and rigorous, deductive approach, and systematic strategies for generating and refining knowledge to problem solving (Mohajan and Mohajan 2018). Present study used a quantitative research approach since this research is also organized with proper data collection techniques, proposed variables with measurable and mathematical techniques for the data analysis.

Primary data is collected by an individual with the intention of studying a particular problem directly from the main sources or respondents. Primary data is well known as raw data and those are not proceeding yet for any of the analysis. Researcher can be personally benefited mostly to maintain the standards of quality, availability of data, statistical power and sampling for a particular research question using this form of data collection. Household surveys, business (firm) surveys, or agricultural (farm) surveys are most appropriate for the collecting data as primary survey or interviews. There is an increase in demand for outsourcing online questionnaire activities. Automated WhatsApp surveys are a cost-effective replacement for conventional data gathering techniques that also allow for ongoing interaction, particularly with mobile populations (Fei et al. 2022).

Present study cantered on urban population in Colombo, Gampaha and Rathnapura provinces of Sri Lanka and the entire households located in these three Districts were the population. The selection of Colombo, Gampaha, and Rathnapura districts is justified by their respective levels of urbanization, population density, and socioeconomic diversity. These districts represent a mix of urban and suburban characteristics, providing a cross-sectional view of household electricity usage patterns across different household profiles in Sri Lanka. This selection allows for an analysis that reflects both the concentrated energy demands in urban areas and the varying consumption patterns in suburban regions, which are pertinent to the study's objectives.

03.2 Method of sampling

There are basically two types of sampling techniques as probability and non-probability (Combes 2019). By observing advantages, disadvantages and appropriateness of each sampling techniques, the ideal techniques for the present study were cluster sampling techniques under probability sampling techniques. Cluster area sampling was used for the purpose of this study. Area sampling is a particular kind of cluster sampling in which samples are categorized and clustered according to geographic location areas. This sampling strategy was chosen since the Household Income Expenditure Survey 2019 under Department of Census and Statistics provided a clear classification regarding household distribution in each district separately. The two-stage cluster sampling method was employed in this investigation. Based on the district distribution of the study area, the entire area was divided into five (clusters) in the first stage. Out of the five clusters, three (Colombo, Gampaha, and Rathnapura) were chosen at random. These three clusters were then divided into two sub clusters, urban and rural, in the second stage.

The total number of samples for this study were established using the methods used by Dillman (2011). Equation 1 was used to determine a representative sample:

$$S = \frac{NP(1-P)}{\left(\frac{\propto}{z}\right)^2 (N-1) + P(1-P)}$$

Equation 1

Where S is the required sample size, N is the size of the population, P is the population proportion expected to answer in a particular way (generally it is 0.5), $\propto$ is the degree of accuracy expressed as

a proportion (0.05) and Z is the Z statistic value based on the confidence level (generally it is 1.96 with 95% confidence interval). The value 0.5 is used in the sampling formula as a conservative estimate of the population proportion, following standard sampling procedures when specific proportions are unknown. This approach assumes maximum variability, optimizing sample representativeness and ensuring that the derived sample size adequately reflects a wide range of possible responses, which is essential for capturing variability in household electricity usage. For the present study, the required sample size was 75 household units.

$$S = \frac{NP(1-P)}{\left(\frac{\propto}{z}\right)^2 (N-1) + P(1-P)} = \frac{(2109000 * 0.5)(1-0.5)}{\left(\frac{0.05}{1.96}\right)^2 (2109000-1) + 0.5(1-0.5)}$$

$$S = \frac{527250}{7002.4 + 0.25} = 75.29$$

Equation 2

Selected sample size was allocated based on the household units in each districts. Selected household in Colombo was 29 ((614/1556)*75), Gampaha was 31(631/1556)*75) and Rathnapura was 15 ((311/1556)*75).

Three statistical methods were used in the study. Namely, Pearson Correlation for the testing of association between dependent and independent association, Principal Component Analysis (PCA) for constructing index of behavioural factor component and Multiple Linear Regression analysis for assessing the strength of the relationship among datasets of independent variables.

4. Results and discussion

04.1 Summary of descriptive statistics

This section provides information about the descriptive statistics. Table 1 showed the summary of responses of the sample (district) and the sample profile of respondent's results relating to gender, education level, working sector, type of ownership, and type of house. Data corresponding to the present survey was collected through primary survey of the household in selected districts. According to table 1, 82 filled questionnaires were returned from Colombo (42.7%) and Gampaha (36.6%) and Rathnapura (20.7%) respectively. The descriptive analysis revealed that 70.7% respondents were male whereas 29.3% were female. When considering education level of the respondents, most of them completed at least diploma, certificate courses (41.5%). Few of the respondents belonged to no schooling category (9.8%), graduate, and higher education category (15.9%).

Besides ownership characteristics, respondents were also questioned to mention whether the type of house ownership belongs to own, rent or other type. While 62.6% of the majority of the respondents represented the own ownership, the remaining few 22% and 15.4% were recorded in rent and other category respectively. Respondents were also asked to mention whether the household is single, double or flat. While 65.9% of the household indicated the single type, the rest of the 20.7% and 13.4% were double and flat type respectively.

Table 1 Profile of the Sample for categorical variable responses

Variable	**Frequency**	**Percentage**
District		
Colombo	35	42
Gampaha	30	36.6
Rathnapura	17	20.7
Gender		
Male	58	70.7
Female	24	29.3
Education level		
Primary education	8	9.8
Secondary education	27	32.9

Diploma or certificate	34	41.5
Graduate and Above	13	15.9
Working sector		
Government	19	23.2
Private	40	48.8
Agriculture, self-employment and other	23	28
House ownership		
Own	51	62.6
Rent	18	22
Other	13	15.4
House type		
Single	54	65.9
Double	17	20.7
Flat,other	11	13.4

Distribution of the descriptive statistics information corresponding to the continuous type variables are presented in table 2. Age of the respondents, family information and household, respondents' income and electricity consumption related to the output were other aspects, which were investigated as basic requirements of the questionnaire. 17 years of age has been recorded as the minimum age of the respondents and 62 were the highest years of age of the respondents of the survey. Based on the categorization provided in the questionnaire pertaining to family size, generally average size of the members of the sampled population were 4 members. Normally, average size of the school children in the family was 1 and it varied from 0 to 3 children within the household. Generally, if the average size of the house is within 1140 square foot, houses located in the sample were accepted.

Table 2 Profile of the Sample for continuous variable responses

Variable	Mean	StDev	Minimum	Maximum	Skewness	Kurtosis
Age (Respondent)	36.4	12.2	17.0	62.0	.58	-.7
Family Size	4.6	1.4	2.0	9.0	.79	.4
School Children	1.1	.94	.00	3.0	.19	-1.1
Monthly income	85930.4	85219.1	11000.0	720000.0	5.4	38.1
Electricity unit	88.2	39.8	29.0	251.0	1.7	5.2
Electricity cost	2333.7	2142.1	385.0	12765.0	2.9	12.1
House size(Sqft)	1140.4	649.0	150.0	3500.0	.5	.69
Bedrooms	3.2	.98	2.0	5.0	.4	-.81

04.2 Correlation and Multicollinearity issues

In the next section, a correlation analysis was conducted in order to explore the nature of the correlation that exists among variables used in this study. Usually, a negative value indicates a negative relationship between variables and a positive value indicates a positive relationship between variables. Table 3 exhibited the correlated values for variables in this study and the results could be used to check the multicollinearity issue of the selected sample data. Detecting multi collinearity could be elaborated using several techniques including the correlation coefficients and the variance inflation factor (Shrestha, 2020)

Table 3 Correlation among variable used in this study

Variable	Units	Cost	sqft	Bed	Age	Size	Chil	Incom	Awar	Eff	cal	Nobulb	LED
Units	1												
Cost	.945*												
sqft	.412*	.375*											
Bed	.119	.170	.424*										
Age	.171	.109	.349*	-.027									
Size	.512*	.531*	.271*	.068	.314*								
Chil	-.112	-.110	-.173	-.183**	.135	.183***							
Inco	.291*	.312*	.211**	.114	.034	.208**	-.139						
Awar	.344*	.339*	-.003	-.078	.121	.231*	.084	-.075**					
Effort	.505*	.484*	.184**	.148	-.053	.194**	-.099	.148	.199**				
Cal	.339*	.289*	.053	.078	.071	.232*	.070	-.123	.414*	.129			
No_bulb	.307*	.305*	.174	.099	.214**	.384*	-.200**	.177	.197**	.026	.252*		
LED_bulb	.452*	.432*	.282*	-.056	.100	.279	.026	.075	.330*	.215**	.236*	-.065	1

The correlation matrix exhibited that there was a positive relationship between the units of electricity consumption and the cost of electricity consumption (r = 0.945) and it was significant at 5 % level. Further units of electricity consumption correlated positively with the size of the house (r = 0412), family size (r = 0.512), monthly income of household (r = 0.291), awareness of power saving (r = 0.344), effort of recuing electrify consumption (r = 0.505), general knowledge of calculating consumption units and cost (r = 0.339), usage of Florence bulb (r = 307) and usage of LED bulb (0.452). However, there was no any association between electricity consumption with the number of bedrooms in the house, age of the respondents and school children in the family. Thus, for the analysis of multiple regressions, those variables have been removed initially. Since the

awareness of power saving, effort of recuing electrify consumption, general knowledge of calculating consumption units and cost is correlated with the multicollinearity issue, to discuss the attitudes of the respondents regarding electricity consumption as a factor PCA was used.

04.3 Principal Component Analysis Results

Table 4 component matrix of behavioural factor and Appliance usage factor

Variable	Loading of first component
Behavioural factor	PC1
Awareness of power saving	0.813
Effort of recuing electrify consumption	0.506
general knowledge of calculating consumption units and cost	0.776
Appliances usage time	
TV	0.692
Refrigerator	0.082
Rice cooker	0.706
Iron	0.839
Electric Kettle	0.432
Washing machine	-0.531
Fan	0.144
Water pump	0.596
Blender/mixer	0.376

The first step of PCA was performed separately for the variables under each type of dimensions that are presented in three variables in behavioural factor and nine variables of appliance usage factor. Kotsila and Polychronidou (2021); Kim (2017) have used these factors for their research. This was simply as the PCA shed lighted on the comparative contribution of individual indicators within each dimension. From the weights obtained from the first step of PCA, individual index for each type was calculated. Following the procedure and criteria described above, one component solution has been selected as the component in each dimension for the constricting of indexes.

When 51% of the variations in the chosen variables were shown, the eigenvalue of the principal components for the first dimensions was 1.58 and greater than 1. One component solution was produced using the three standard variables (Table 4).

The cumulative eigenvalue of the first four principal components for the second dimensions was 11.847 and the eigenvalue was greater than 1 when 64% of the variations in the selected variables were presented. The standardized nine variables generated four components solution. However, the first component of the analysis estimates the appliance usage index through the given weights for the first principal component of each variable, since the first component is higher than eigenvalue 1. Thus, a new variable Appliance usage index was constructed as the linear combination of the selected initial four variables.

04.4 Regression Analysis Results

Table 5 Summary of the final model

Source	DF	SS	MS	F-value	P-value
Regression	14	94260.35	6732.88	13.154	0.000**
Error	67	34295.26	511.87	-	-
Total	81	128555.6	-	-	-

Model	R	R-Sq	R-sq(adj)	Durbin-Waston
1	0.856	73.3%	67.7%	1.92

R square (0.856) showed how much the variation of electricity consumption of household as the dependent variable, and it has been explained by selected predictor variables (Demographic and family composition, Home characteristics, Socio-economic factor, Appliances usage and Behavioural

factor of occupant) in the population. Adjusted R square accounted for the number of predictors should be considered which resulted in dropping of degrees of freedom following the results of adding extra variables. According to the analysis results in table (5), R^2 and adjusted R^2 had a value of 73.3 and 67.7 percent, respectively which was indicated that the model fits the data well.

Equation 2 showed that when the family size increase by one member, electricity consumption unit increased by 4 units. Households, where the head had a high level of education, were estimated to decrease consumption of electricity units. Being a graduate head, the consumption has been reduced by 7 units and being diplomatic head, has reduced around 8 units while other factors remained unchanged. When the size of the house increased by 100 square feet, it caused to increase the electricity consumption by 8 units. Results showed that for each own ownership and rent ownership of house increased the usage of electricity consumption by 16 and 7 units respectively comparing to other type of ownership. Comparing to the flat and other type of house, single and double house electricity consumption decreased by 3 and 5 units respectively. Each additional usage of LED bulb decreased the electrify consumption by 0.2, whereas each additional usage of Florence bulb increased the electricity usage by 0.21 units. Households, where the head had a high-level awareness of power saving, effort of recuing electrify consumption, general knowledge of calculating consumption units and cost under the behavioural component, were estimated to decrease consumption by around 6 units. Most importantly, the amount of usage of appliance and the time of daily usage showed a strong positive influence to the electricity consumption, which means that those factors tend to increase electricity consumption. The usage of appliances might increase electricity consumption by 9 units.

Model equation is

Electricity consumption= -28.13 +3.93(Family size) + 0.09 (Income) +0.53 (Secondary education) -7.3 (Diploma/Certificate education) – 7.79 (Graduate education) +0.008 (House size SQFT) + 15.97 (Own house) +5.744 (Rent house)-2.588 (Single house) -5.04(Double house) -0.21(LED bulb) + 0.206(Normal bulb) -5.47(Behavioral factor) +9.292(Appliance usage)

Equation 3

P-value of the F-statistic presented that the overall significance level of the model used in the study. According to the table 5, F-statistic of 1315 pertaining to 0.000 probability value indicated that the model is significant at 1%. There is enough evidence to claim that the selected independent variables used for the study have jointly influenced on electricity consumption unit.

5. Conclusion

This study investigated the factors influencing consumers' electricity consumption. The study identified that the electricity consumption in the households increases due to the number of family members, the size of the house, income, the use of Florence bulbs, living in a rented house, and the use of electrical appliances. In addition, when the education level of the head of the household increases: the head of the household being a graduate, the head of the household being a government employee, as well as the use of LED bulbs and behavioural factors results in reducing the electricity consumption.

At present, Sri Lanka is facing a severe crisis regarding the supply of electricity. To address this issue effectively, it is crucial to not only identify the factors affecting consumer electricity consumption but also implement targeted solutions. Based on the findings of this study, several strategies can be adopted to mitigate high electricity consumption in households. Encouraging the use of energy-saving appliances, such as LED bulbs and low-power devices, could help reduce overall consumption. Additionally, educating consumers on energy-saving practices and fostering awareness of mindful electricity use can lead to more conscious consumption behaviours. Providing financial incentives or rebates for households that adopt energy-efficient practices may further motivate reductions in electricity use. Introducing regulations that mandate energy-efficient building designs and appliances for new constructions could also contribute to sustainable consumption patterns over time. Accordingly, it is vital for responsible parties, including government agencies and energy providers, to implement and support these solutions. Addressing these factors holistically will not only help alleviate the current crisis but also ensure a more stable and sustainable electricity supply for future generations.

Disclaimer (Artificial intelligence)

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Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

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Author(s) hereby declare that generative AI technologies such as Large Language Models, etc. have been used during the writing or editing of manuscripts. This explanation will include the name, version, model, and source of the generative AI technology and as well as all input prompts provided to the generative AI technology

Details of the AI usage are given below:

1.

2.

3.

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