

# Examining the Malaysian Consumer Attitude and Expectation Towards Consumption of Electricity - Phase 1

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## Abstract

**Purpose:** This study aimed to identify the socio-demographic characteristics of Malaysia's current domestic residential electricity consumers, their attitude and expectations.

**Design/methodology/approach:** The survey was conducted among consumers who are residents of Klang Valley. This study employed the frequency analysis, ranking method, and correlation analysis to describe the domestic residential consumers, to determine the favorable types of electrical appliances, and to measure the relationship between consumer awareness and consumer practice, respectively.

**Findings:** The empirical results show that Malaysian domestic residential consumers in urban areas are dominated by working adults aged 21–30 years, and the purpose of utilizing the electricity is for lighting, comfort, and cooking purposes. The preferable reason when making a purchasing decision is the ability of electrical appliances to save energy. In terms of the correlation between consumer awareness and their practice; the result shows the significant and positive moderate relationship between the indicators mentioned above.

**Research limitations/implications:** This study focuses on domestic residential consumers in Klang Valley, Malaysia (A pilot survey).

**Practical implications:** This study provides a good understanding of consumer dynamic response to craft reliable and accurate policies, and subsequently to improve the efficient use of energy services in line with the sustainable energy agenda.

**Keywords:** Domestic Residential Electricity Consumer, Survey, Energy Policy.

## Introduction

Over the last decade, there has been a growing interest in the field of energy economics due to a series of energy and environmental crises, oil price fluctuation, energy security, and sustainable development. One of the energy components that has a significant impact on the demand and supply side is electricity. Electricity, the secondary type of energy, is one of the vital inputs to support anthropogenic and economic activities in this world. Its function becomes rigorous, along with economic development and modernization. Due to its contributions, the world electricity consumption and economic activities represented by the Gross Domestic Product (GDP) show an increasing trend for 1980–2019 period (see figure 1). Comparable to that, Malaysia shows a similar trend for a similar period with the residential

electricity consumption accounting for about a third of total electricity consumption (See figure 2), and 100 percent of Malaysia’s population can access electricity in urban and rural areas (World Bank, 2020).

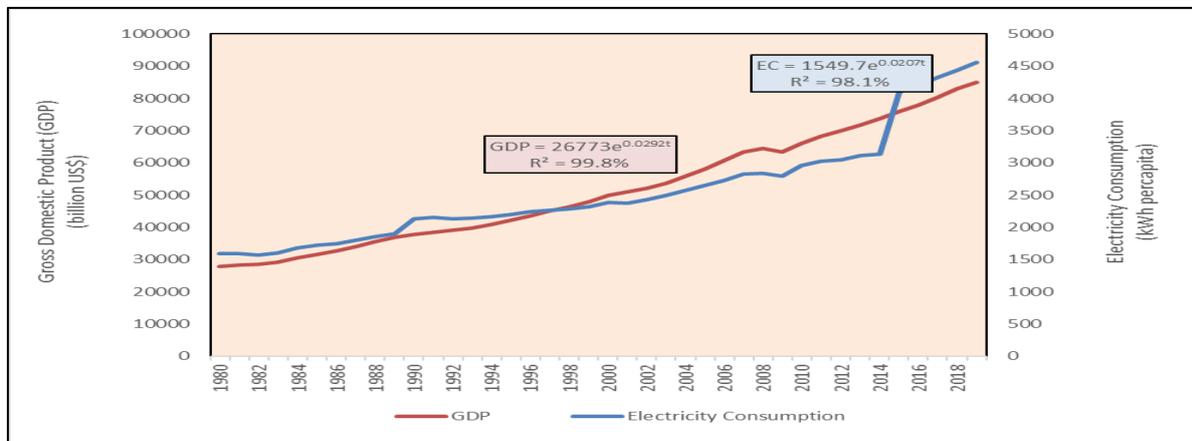


Figure 1: World Electricity Consumption and GDP  
Source: World Development Indicator (2020)

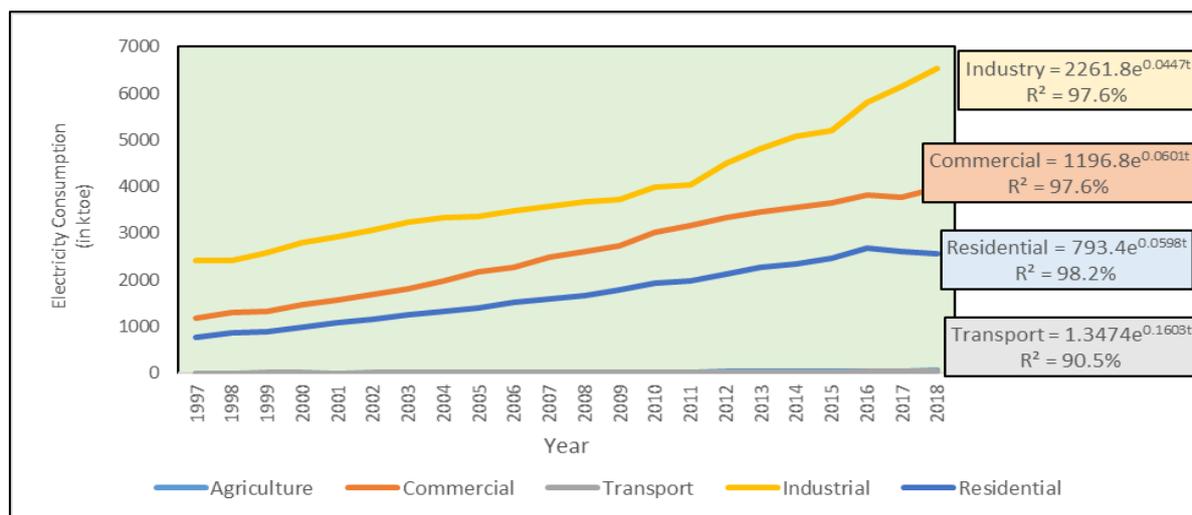


Figure 2: Electricity Consumption in Malaysia for 1997–2018 period (in ktoe)  
Source: Malaysia Energy Information Hub (MEIH), Energy Commission.

Consumers play an essential role in decision making and reflecting the increasing or decreasing use of products and services. Consumer behavior is primarily based on individual decisions, which is often driven by external factors such as economic incentives, existing demographics, environmental variables, social norms, and infrastructure (Paul et al., 2012). However, Adeoye & Spataru (2019) describe consumer behavior as a process of acquisition, consumption, and disposition.

Comparable to other industries, the role of customer behavior was found crucial in moving forward to the electricity industry, where decentralization of electricity generation creates a more dynamic electricity demand and supply system. A clear understanding of consumer dynamic response, mainly in Malaysia, could help policymakers in crafting reliable and accurate policies to improve the efficient use of energy services in line with the sustainable energy agenda. However, from the electricity provider perspective, understanding the way

electricity consumers behave can increase the sales of its products or services and gain the expected profit as the ultimate goal of its operation.

Although many empirical studies have been undertaken, there still remains a gap, specifically in the area of energy economics. One group of researchers is focusing on estimating the factor that influences electricity consumption by utilizing the secondary data and econometric analysis (Jumbe., 2004; Akinlo., 2009; Shahbaz et al., 2011; Bekhet & Othman, 2011; Bekun & Agboola, 2019). Conversely, another group of researchers is exploring the consumer behavior towards smart meter, internet banking, online business, etc. as a result of technology disruption (Ozaki, 2011; Gyamfi et al., 2013; Manjunath et al., 2014; Neaimah et al., 2015; De Dominicis et al., 2019). Consequently, the past researcher focuses less on consumer behavior on electricity and other energy-related matters. As a result, little is known about why consumers change their attitude, especially in the context of electricity demand.

The research aims to develop the best fit model for residential electricity consumption, and the process is divided into two phases. The first phase is focusing on identifying who is Malaysian residential electricity consumers. Specifically, to get an overview of Malaysian residential socio-demographic characteristics, the type of electrical appliances currently used by them, and their expectations. Then, in the second phase, this research focuses on developing the best suit model for determining the factor change in consumer behavior and habits toward electricity consumption.

A better knowledge of electricity in a consumer's characteristics, and a better methodology can be applied in the second phase of developing the residential electricity demand model for Malaysia. The best fit model enables us to produce more accurate electricity forecasts and better design to the energy policy. They are also of interest to the power companies, which can use the short-run knowledge for a smooth operation of the capacity-constrained electric utilities as it allows for better assessment of the electricity demand and, in turn, load management. The knowledge of long-run determinants of electricity demand is essential for investment decisions, such as power plant investments and construction of transmission lines, electricity market planning, and for setting pollution mitigation policies to tackle environmental pollution and climate change. To this end, this paper aims to understand the factors affecting residential electricity demand in Malaysia using current energy element in the new era.

The remainder of this paper is structured as follows. Section 2 presents the past literature on residential electricity demand. Section 3 presents the data that motivated the research and empirical methodology. Section 4 presents the empirical results. Lastly, Section 5 concludes the findings and its policy implications.

### **Past Studies**

Understanding the determinants of electricity consumption is a prerequisite for implementing effective energy policy, as well as for predicting future electricity consumption. Thus, many researchers in this era have shown their interest in investigating electricity consumption function. Unlike developed countries, the number of such studies in developing countries is relatively scant. Researchers have used various methods and approaches from micro to macro-level data in order to study the factors that have the most significant impact on electricity consumption.

Liu et al. (2016) investigated the relationship between residential electricity consumption and income in China. They employed a reduced piecewise linear model to examine the non-linear relationship. They performed the robust tests of different segment specifications and regression methods to ensure the validity of the research. The results provided strong evidence that the income elasticity was approximately one, which indicates the electricity as a normal good, and it remains stable across a period that affects household electricity consumption.

Chen (2017) examined the factors affecting residential electricity consumption by utilizing two approaches, namely a socio-economic perspective and a direct use perspective. The results showed that the GDP, employment rates, residential space, and the implementation of energy labeling schemes have a significant impact on residential electricity consumption.

Sukarno et al. (2017) utilized the cross-section analysis and on-site measurement methods. The results revealed that household lifestyles, cooking activities, number of households, the hours spent at home, power consumption (operation and standby mode), number of appliances, and operating hours contribute to the highest energy consumption in the residential sector. Ye et al. (2018) investigated the determinant of household electricity consumption in South Africa, revealing that household income and electricity prices are significant determinants of electricity consumption.

Study by Taale and Kyeremeh (2019) examines the drivers of household electricity expenditure in Ghana using ordinary least squares regression analysis. The result from this study indicates that income, stock of electrical appliances, number of rooms, and years of education completed by household head are significant towards household electricity expenditure. Other factors such as rural/urban location, employment status of household head, tenancy status, ownership of agricultural land, and ecological zone also exert significant influence on household electricity expenditure.

Onisanwa and Adaji (2020) examine electricity consumption and its determinants in Nigeria. The result reveals that the major propellers of electricity consumption in the long-run in Nigeria are per capita income, population per square kilometer, number of electricity customers as well as electricity shortages. Next, (Phu, 2020) investigate the factors affecting the demand for residential electricity, focusing on the elasticity of own price, income, and prices of alternative fuels. The result shows that both income and substitution elasticity are low but positive, indicating that electricity is a necessity and that there is limited substitutability between electricity and other sources of energy.

Kim (2020) investigates the determinants of household electricity consumption in Korea by using both the Ordinary Least Squares (OLS) regression and quantile regression. The results show that the effects of socio-demographic, dwelling, and electricity consumption characteristics on household electricity consumption may differ between two regressions and may differ across quantiles. The study found that age group of household head, number of household, housing area, the number of household appliances, and refrigerator usage time were significant in all quantiles.

Recently, Đurišić et al. (2020) investigated various socio-economic, dwelling-related, and appliance-related factors which influenced the electricity consumption in Montenegro. By employing the Structural Equation Modelling (SEM), results showed that the electricity bill, the dwelling size, family composition, and routines are the most important factors that influence electricity consumption.

Papageorgiou, Efstathiades, Poullou, and Ness (2020) investigate the main factors influencing electricity consumption in the domestic sector. This study examines factors that include the homeowners' behavior, demographic characteristics, attitudes and environmental concerns, energy savings, technical characteristics and equipment. The result shows that demographic characteristics and energy saving, technical characteristics and equipment are highly correlated with the electricity consumptions.

Next, Kostakis (2020) scrutinize the determinant of household electricity consumption in Greece using quantile regression analysis. The determinants that they use for this study is socio-economic, demographic and regional. From this study, the result reveal that household electricity consumption is positively related to disposable income, age, number of employed members in the household, and gender.

In the Malaysian case, Aris et al. (2018) investigated domestic consumer behavior towards electricity consumption. By using the convenience sampling method, the questionnaires were circulated to the Putrajaya residents. The results showed the significant effect between all of the appliances used with household electricity consumption. However, four out of the ten electricity saving behavior (i.e., switch off their thermos pots when not in use, cleaning the refrigerator condenser coil, filling up the refrigerator two-third full, and utilizing the timer setting feature of the air conditioner) have significantly influenced the household electricity consumption.

Based on the above literature, most of the studies were conducted in different regions, samples, and techniques. This study will fill the gaps in the literature by clarifying the status of Malaysian domestic residential consumers by investigating the type of electrical appliance currently used by them and their expectations.

### **Research Methodology**

The data employed in this study comes from a survey conducted among consumers who are residents of Klang Valley in Malaysia. The main reason for choosing residents of Klang Valley as a sample is because Klang Valley represents the highest population density and urbanization in Malaysia (Alam et al., 2019). During the survey, direct face-to-face interviews with respondents were conducted. Cooper et al. (2002) pointed out that a direct face-to-face interview is a more reliable approach in contingent valuation studies. The face-to-face interview offered one-on-one interaction with the consumers and provided an opportunity to explain some of the questions to respondents with low literacy levels. This method was vital to ensure the high reliability and accuracy of the data collected. The descriptive survey design was adopted, and a convenience sampling technique was used to obtain a sample of 63 respondents. A convenient sampling method is easy to implement and cost-effective and gets a higher response rate (Legard et al., 2003). Likert type scale was used (1 = strongly disagree to 5 = strongly agree) in the questionnaire. In this study a five-point Likert-type are used, instead of seven point likert scale because five point likert scale reduce the level of frustration among respondent and increase the rate and quality of the responses (Ladhari, 2008). In addition, the five-point itemized rating scale is easy to construct, administer and produce more reliable rating (Alexandrov, 2010).

The frequency analysis and ranking method were used to describe the domestic residential consumer and to determine the favorable types of electrical appliances, respectively. The correlation analysis was conducted to determine the relationship between the variables employed.

### **Result Analysis**

Objective 1: To identify the Malaysian residential electricity consumers by exploring Malaysian residential socio-demographic characteristic, and the type of electrical appliance used by them

As presented in Table 1 below, from a total of 63 respondents, 26 respondents were male (41.3%), and 37 were female (58.7%). In terms of marital status, the majority of the respondents were married, consisting of 45 respondents (71.4%). Most of the respondents were between 21–30 years old (21 respondents), 31–40 years old (16 respondents), 40–50 years old (10 respondents), 50–60 years old (7 respondents), and more than 60 years old (9 respondents). The majority of the respondents were Malay, consisting of 46 respondents (73.0%). In terms of occupation, most of the respondents were working in the private sector, that was 43 respondents (68.3%). Lastly, for the household income, the highest number of respondents were from the income range of 10,000 and below, with 37 respondents (58.7%).

Table 1: Sociodemographic characteristics of respondents ( $n = 63$ )

	Characteristics	Frequency	Percentage
<b>General Information</b>			
Gender	Male	26	41.3
	Female	37	58.7
Marital Status	Married	45	71.4
	Single	18	28.6
Age	21-30	21	33.3
	31-40	16	25.4
	40-50	10	15.9
	50-60	7	11.1
	>60	9	14.3
Race	Malay	46	73.0
	Chinese	10	15.9
	Indian	5	7.9
	Others	2	3.2
Occupation	Government	5	7.9
	Private	43	68.3
	Self-employed	3	4.8
	Student	2	3.2
	Unemployed/retiree	6	9.5
	Pensioner	4	6.3
Monthly Household Income	<4000	21	33.3
	4001-10000	16	25.4
	10001-15000	11	17.5
	15001-20000	4	6.3
	>20000	9	14.3

The findings of this paper coincide with some previous studies, as many researchers also indicate that the number of household appliances may play an essential role in affecting electricity consumption in the residential sector (Gajowniczek & Ząbkowski, 2017; Liao et al., 2017). To identify the number of appliances consumed by the household, the appliances were segregated according to their function. Below are the functions of the appliances:

- 1) Comfort: Consist of room air conditioners, dehumidifiers, air cleaners, and fans.
- 2) Lighting: Lighting systems provide adequate lighting, including fluorescent lamps and light-emitting diode (LED) lamps.
- 3) Cooking: The appliances for cooking include refrigerators, rice cookers, micro ovens, toasters, juicers, and water dispensers.
- 4) Recreation: Recreational appliances include personal computers (PC), TV, and audio equipment
- 5) Cleaning: Cleaning-use products include washing machines, range hoods, clothes dryers, dish dryers, electric iron, and water heaters. Source: Chen (2017)

Figure 3 below summarizes the results whereby the lighting system had the highest unit installed compared to others, followed by comfort and cooking appliances.

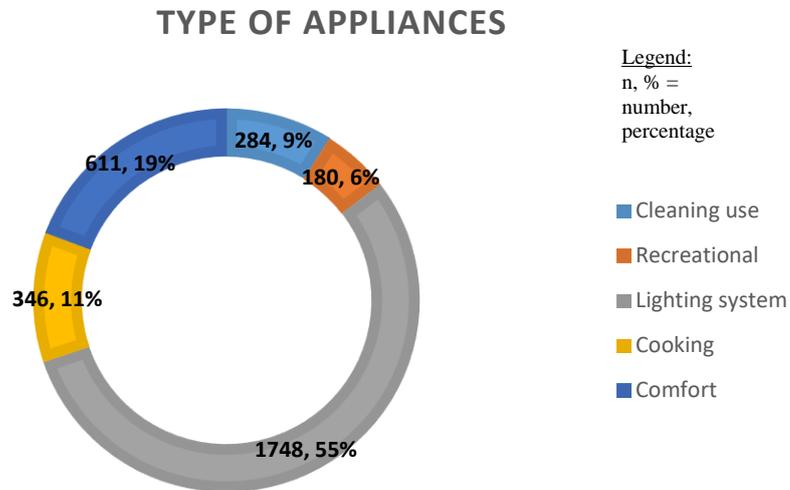


Figure 3: Type of appliances

Objective 2: To identify the most important influencing factor when purchasing electrical appliances.

To identify the consumer behavior in purchasing electrical appliances, the authors examined the crucial factors which were categorized into six groups: (1) Brand, (2) Price, (3) Feature/design, (4) Efficiency rating (star), (5) Warranty, (6) Electricity consumption per hour. The average rating of the essential factors when purchasing electrical appliances is presented in Table 2. When purchasing an electrical appliance, respondents considered electricity consumption per hour to be the most important (4.22). The next most important category for the respondent was the warranty (3.61) followed by feature/design (3.41). Price was positioned towards the bottom of the list at the 6<sup>th</sup> place (2.07).

Table 2: Assessment of own criteria when purchasing appliances

Appliances	Mean
Brand	2.59
Price	2.07
Feature/Design	3.42
Efficiency Rating (Stars)	2.92
Warranty	3.61
Electricity Consumption Per Hour	4.22

Objective 3: To identify the relationship between consumer awareness and practice.

According to Mathur et al. (2007), the correlation could be characterized as a measurable estimation of the relationship between two variables. Therefore, Pearson correlation analysis was run to determine the relationship between awareness and the energy efficiency practice in the residents' daily lives. There was a positive correlation between awareness and practice, which was statistically significant ( $r = 0.434$ ,  $n = 63$ ,  $p < 0.01$ ), as shown in Table 3. This

correlation means that an increase in awareness is an increase in practice. Therefore, both variables were necessary for the consumer to increase energy efficiency in residential areas.

Table 3: Correlation Results

Correlations			
		awareness	practice
awareness	Pearson Correlation	1	.434**
	Sig. (2-tailed)		.001
	N	63	63
practice	Pearson Correlation	.434**	1
	Sig. (2-tailed)	.001	
	N	63	63
**. Correlation is significant at the 0.01 level (2-tailed).			

### Conclusion and policy implication

The role of customer behavior was found crucial in moving forward to the electricity industry, where the decentralization of electricity generation creates a more dynamic electricity demand and supply system. The excellent understanding of consumer dynamic response, mainly in Malaysia, could help policymakers in crafting reliable and accurate policies to improve the efficient use of energy services in line with the sustainable energy agenda. This study aimed to identify the socio-demographic characteristics of Malaysia's current domestic residential electricity consumers, their attitude and expectations. To do so, the survey was conducted among consumers who were residents of Klang Valley, Malaysia, to represent the sample of domestic residential electricity consumption in the urban area. The empirical results show that the Malaysian domestic residential consumers in the urban area is dominated by working adults aged 21–30 years, and the purpose of utilizing the electricity is for lighting, comfort, and cooking purposes. The preferable reason when making a purchasing decision is the ability of electrical appliances to save energy. In terms of the correlation between consumer awareness and their practice, the result shows the significant and positive moderate relationship between the indicators above.

These results have implications for policy implementation and evaluation. On the road to achieving 8 percent savings from energy efficiency by 2025, as well as to reduce 25 percent of gross electricity consumption from the building sector (Malaysia Gas Association, 2017), the government of Malaysia has to play their role to increase consumer awareness. This is because awareness has a significant positive relationship with consumer behavior or practice. The awareness of energy-saving and energy efficiency can be generated, starting from primary and secondary school by taking account of the energy sustainability topic in a school syllabus. Meanwhile, to enhance awareness among working adults; campaigns, advertisements, and road tours around Malaysia can be implemented.

In 2016, the Energy Commission introduced energy efficiency (EE) labels and issued them to the electrical appliances manufacturers (i.e., manufacturers of television, refrigerator, domestic fan, air conditioner, and washing machine) that complied with the standards and requirements of energy performance tests (TNB, 2020). Instead of issuing EE labels to five types of products only, the Energy Commission needs to offer to other manufacturers who produced lamps, rice cookers, microwave ovens, water dispensers, air-cleaners and dehumidifiers, since these kinds of products are mostly used by domestic residential dwellers.

As mentioned in the earlier section, by utilizing this finding, further study can be expanded by proposing the best suit model for determining the factors affecting consumer behavior and habits towards electricity consumption.

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**References:**

- Adeoye, O., & Spataru, C. (2019). Modelling and forecasting hourly electricity demand in West African countries. *Applied Energy*, 242, 311-333.
- Alexandrov, Aliosha. (2010). Characteristics of single-item measures in Likert scale format. *The Electronic Journal of Business Research Methods*, 8(1), 1-12.
- Alam, S. S., Lin, C.-Y., Ahmad, M., Omar, N. A., & Ali, M. H. (2019). Factors Affecting Energy-Efficient Household Products Buying Intention: Empirical Study. *Environmental and Climate Technologies*, 23(1), 84-97.
- Aris, H., Dollah, R., & Jamaluddin, K-N. (2018). An Analysis on the Effect of Consumers Behaviour Towards Household Electricity Consumption. *IEEE Conference on Big Data and Analytics (ICBDA)*.
- Akinlo, A. E. (2009). Electricity consumption and economic growth in Nigeria: evidence from cointegration and co-feature analysis. *Journal of Policy Modeling*, 31(5), 681-693.
- Bekhet, H.A., & Othman, N.S. (2011). Assessing the Elasticities of Electricity Consumption for Rural and Urban Areas in Malaysia: A Non-linear Approach *International Journal of Economics and Finance*, 3(1), 208-217.
- Bekun, F. V., & Agboola, M. O. (2019). Electricity consumption and economic growth nexus: evidence from Maki cointegration. *Engineering Economics*, 30(1), 14-23.
- Chen, Y.-T. (2017). The factors affecting electricity consumption and the consumption characteristics in the residential sector—A case example of Taiwan. *Sustainability*, 9(8), 1484.
- Cooper, V., Buick, D., Horne, R., Lambert, N., Gellaitry, G., Leake, H., & Fisher, M. (2002). Perceptions of HAART among gay men who declined a treatment offer: preliminary results from an interview-based study. *AIDS care*, 14(3), 319-328.
- Đurišić, V., Rogić, S., Smolović, J. C., & Radonjić, M. (2020). Determinants of household electrical energy consumption: Evidences and suggestions with application to Montenegro. *Energy Reports*, 6, 209-217.
- De Dominicis, S., Sokoloski, R., Jaeger, C. M., & Schultz, P. W. (2019). Making the smart meter social promotes long-term energy conservation. *Palgrave Communications*, 5(1), 1-8.
- Gyamfi, S., Krumdieck, S., & Urmee, T. (2013). Residential peak electricity demand response—Highlights of some behavioural issues. *Renewable and Sustainable Energy Reviews*, 25, 71-77.
- Gajowniczek, K., & Ząbkowski, T. (2017). Electricity forecasting on the individual household level enhanced based on activity patterns. *PLoS One*, 12(4), e0174098.
- Legard, R., Keegan, J., & Ward, K. (2003). In-depth interviews. *Qualitative research practice: A guide for social science students and researchers*, 6(1), 138-169.
- Liao, H., Liu, Y., Gao, Y., Hao, Y., Ma, X.-W., & Wang, K. (2017). Forecasting residential electricity demand in provincial China. *Environmental Science and Pollution Research*, 24(7), 6414-6425.
- Liu, Y., Gao, Y., Hao, Y., & Liao, H. (2016). The relationship between residential electricity consumption and income: A piecewise linear model with panel data. *Energies*, 9(10), 831.

- Ladhari, Riadh. (2008). Alternative measures of service quality: a review. *Managing Service Quality: An International Journal*, 18(1), 65-86.
- Jumbe, C. B. (2004). Cointegration and causality between electricity consumption and GDP: empirical evidence from Malawi. *Energy economics*, 26(1), 61-68.
- Kim, M.-J. (2020). Understanding the determinants on household electricity consumption in Korea: OLS regression and quantile regression. *The Electricity Journal*, 33(7), 106802.
- Kostakis, I. (2020). Socio-demographic determinants of household electricity consumption: Evidence from Greece using quantile regression analysis. *Current Research in Environmental Sustainability*.
- Mathur, S., Badertscher, M., Scott, M., & Zenobi, R. (2007). Critical evaluation of mass spectrometric measurement of dissociation constants: accuracy and cross-validation against surface plasmon resonance and circular dichroism for the calmodulin–melittin system. *Physical Chemistry Chemical Physics*, 9(47), 6187-6198.
- Manjunath, M., Singh, P., Mandal, A., & Parihar, G. S. (2014). Consumer Behaviour towards Electricity-a field study. *Energy Procedia*, 54(1), 541-548.
- Malaysia Gas Association (2019). Briefing By MESTECC on its Strategic Initiatives. Retrieved on 7th October, 2020). [https://malaysiangas.com/2019/04/15/briefing-by-mestecc-on-its-strategic-initiatives/#:~:text=Achieving%2020%25%20Renewable%20Energy%20\(RE,Malaysia%20Electricity%20Supply%20Industry%20\(MESI](https://malaysiangas.com/2019/04/15/briefing-by-mestecc-on-its-strategic-initiatives/#:~:text=Achieving%2020%25%20Renewable%20Energy%20(RE,Malaysia%20Electricity%20Supply%20Industry%20(MESI)
- Neaimeh, M., Wardle, R., Jenkins, A. M., Yi, J., Hill, G., Lyons, P. F., ... & Taylor, P. C. (2015). A probabilistic approach to combining smart meter and electric vehicle charging data to investigate distribution network impacts. *Applied Energy*, 157, 688-698.
- Ozaki, R. (2011). Adopting sustainable innovation: what makes consumers sign up to green electricity? *Business strategy and the environment*, 20(1), 1-17.
- Onisanwa, I. D., & Adaji, M. O. (2020). Electricity consumption and its determinants in Nigeria. *Journal of Economics & Management*, 41, 87-104.
- Papageorgiou, G., Efstathiades, A., Poullou, M., & Ness, A. N. (2020). Managing household electricity consumption: a correlational, regression analysis. *International Journal of Sustainable Energy*, 39(5), 486-496.
- Phu, L. V. (2020). Electricity price and residential electricity demand in Vietnam. *Environmental Economics and Policy Studies*, 1-27.
- Taale, F., & Kyeremeh, C. (2019). Drivers of households' electricity expenditure in Ghana. *Energy and Buildings*, 205, 109546.
- Paul, A., Subbiah, R., Marathe, A., & Marathe, M. (2012). A Review of Electricity Consumption Behavior. Consortium for Building Energy Innovation report.
- Shahbaz, M., Tang, C. F., & Shabbir, M. S. (2011). Electricity consumption and economic growth nexus in Portugal using cointegration and causality approaches. *Energy policy*, 39(6), 3529-3536.
- Sukarno, I., Matsumoto, H., & Susanti, L. (2017). Household lifestyle effect on residential electrical energy consumption in Indonesia: On-site measurement methods. *Urban Climate*, 20, 20-32.
- Tenaga Nasional Berhad (TNB) (2020). Home Energy Savings Tips. Retrieved on 7<sup>th</sup> October, 2020. <https://www.mytnb.com.my/energy-efficiency/home-energy-savings-tips/energy-efficient-label>
- Ye, Y., Koch, S. F., & Zhang, J. (2018). Determinants of household electricity consumption in South Africa. *Energy economics*, 75, 120-133.