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Title: The Influence of User Awareness on User Behaviour in Electricity Consumption at Kumasi Technical University (KsTU), Ghana

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The influence of user awareness on user behaviour in electricity consumption at Kumasi Technical University (KsTU), Ghana

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Summary

The use of electricity is very essential and inevitable in the daily activities of all entities including universities. It, however, becomes an issue of global concern when more electricity is used than what is actually needed (excessive electricity consumption). Excessive electricity consumption is an issue of global concern as it contributes to the global environmental and socio-economic problems including climate change and energy insecurity. In the past few years, excessive electricity consumption has been reported in Kumasi Technical University (KsTU) which is reported to be caused mainly by the energy wasteful behaviour of staff and students of the university. This behaviour is attributed to the low level of energy awareness among staff and students of the university. The Norm-Activation Model (NAM) suggests that high level of awareness of energy use and its related consequences (Awareness of Consequence: AC) leads to the development of a feeling of responsibility for contributing to the problems caused by energy use (Ascription of Responsibility: AR). This feeling further leads to the development of moral obligation to reduce the use of electricity (Personal Norm: PN) which subsequently influence behaviour in the use of electricity.

The study aimed to explain how the level of user awareness (defined by AC, AR, and PN) influence user behaviour in electricity consumption at KsTU. Therefore with the following sub-research questions: 1. what is the level of user awareness of electricity consumption at KsTU? 2. what is the current practiced user behaviour in electricity consumption at KsTU? and 3. how does user awareness (AC, AR, PN) influence user behaviour in electricity consumption at KsTU? the extent to which the level of user awareness influence user behaviour in electricity consumption at KsTU was ascertained.

The study adopted survey as the main methodology and closed ended questionnaires were the main data collection instrument used to gather data from the 196 surveyed staff and students of KsTU. Data attained from the survey was analysed with the aid of SPSS.

The findings of the study revealed that the level of user awareness of electricity consumption among staff and students of KsTU is moderate and the more energy campaigns Users are exposed to the higher their level of user awareness (AC, AR, and PN). The practiced user behaviour in electricity consumption was measured as fairly energy saving. Staff were found to be slightly more energy conscious than students in the use of VAC and lighting systems, whereas, in the use of plug-in loads students were slightly more energy conscious than staff. The findings showed no correlation between Users awareness of the negative implications of excessive electricity consumption and their behaviour in the control of VAC, lighting and plug-in loads. Likewise, no correlation was found between their feeling of responsibility for contributing to the problems caused by excessive electricity consumption and their behaviour in the control of VAC, lighting and plug-in loads. However, the results showed a significant correlation between users feeling of moral obligation to reduce electricity consumption and their behaviour in the control of lighting and plug-in loads which is in line with the NAM.

The findings further suggest that the extent to which the level of user awareness influence user behaviour in electricity consumption at KsTU is moderate. Also, staff and student's personal norm to reduce electricity consumption was found to have the strongest influence on their behaviour in electricity consumption among the 3 components (AC, AR, PN) of user awareness. Based on the findings it is recommended to the management board of KsTU to invest in increasing the level of user awareness (AC, AR, PN) which will go a long way to improve user behaviour in electricity consumption and consequently help reduce the environmental and socio-economic problems associated with energy use. Recommendations for further and future studies are also made.

Keywords

Norm-Activation Model (NAM), User Awareness, User Behaviour in Electricity Consumption, Excessive electricity consumption

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Dedications

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Abbreviations

IHS	Institute for Housing and Urban Development
KsTU	Kumasi Technical University
NAM	Norm-Activation Model
AC	Awareness of Consequence
AR	Ascription of Responsibility
PN	Personal Norm
KWH	Kilowatt Hour
HVAC	Heating Ventilation and Air-condition
VAC	Ventilation and Air-condition
EC	Electricity Consumption
ECG	Electricity Company of Ghana
AMR	Automatic Remote Meter Reading
SPSS	Statistical Package for Social Science
SM	Senior Members
SS	Senior Staff
JS	Junior Staff
SRC	Student Representative Council
HND	Higher National Diploma
GH₵	Ghana Cedis

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Chapter 1: Introduction

1.1 Background

Electrical energy has over the decade played a vital role in the advancement and growth of the world's economy. It is extensively used globally in the day to day activities of all sectors including the building, transport, industrial, commercial and educational sectors. The use of electricity has become a norm in all aspect of human life such that it is argued that aside air and water, energy is the next most important basic necessity. Hence, global consumption of electricity is inevitable (Azodo, 2014, Rahman, Majid, et al., , 2004).

In recent times, universities have been noted as one of the sectors with huge electricity consumption. Statistics from the Korea energy management corporation ranked twenty-two universities in Korea as the top huge energy consuming domestic institutions out of 190 institutions (Kim, Jung, et al., , 2010). Huge electricity consumption in universities is attributed to the diverse range of building facilities and the behaviour of the multi-level users characterised in universities (Ma, Lu, et al., , 2015). This is not surprising as buildings have been rated to consume 20-50% of electricity produced globally with variations in regions (Elmualim, Shockley, et al., 2010). Universities have a sizeable number of building facilities comprising of lecture rooms, laboratories, offices, library, students accommodation etc that help in the core functions of universities (Sapri and Muhammad, 2010). The operational use of these buildings requires energy services utilised by users of university building facilities. Staff and students serve as the primary users of university building facilities and are considered as the main cause for the huge electricity consumption in university buildings aside from the physical characteristics of the buildings as the cause (Ting, Mohammed, et al., , 2011). This confirms the argument by Janda (2011), that energy consumed in buildings is not caused by the buildings itself but instead it users who consume energy by using the energy services provided in the buildings.

There is no doubt about the significance of energy[1] consumption in university buildings, however, the problem lies with the issue of excessive electricity consumption in universities reported in recent times (Kim, Jung, et al., , 2010, Choong, Mohammed, et al., 2009). Excessive electricity consumption means using more electricity than what is actually needed. The energy wasteful behaviour of users (eg. leaving electrical appliances on when not in use) is reported to be one of the main causes of excessive electricity consumption. For instance, in 2011 the Electricity Authority of Cyprus reported excess electricity consumption of 400MW resulting from energy wasteful behaviour pattern in Cypriots way of living (Georgiou, Ioannou, et al., , 2013).

The problem of excessive electricity consumption has become an issue of global concern as it contributes to the negative environmental and socio-economic effects from the use of energy experienced in the world today. Some of these effects include emission of carbon, energy insecurity, scarcity in electricity supply and high cost for energy services experienced in many organisations (Rahman, Majid, et al., , 2004, Ting, Mohammed, et al., , 2011). For instance, the management board of local universities in Malaysia moaned over the burden of high energy cost resulting from the problem of excessive energy consumption caused by energy wasteful behaviour of students (Choong, Mohammed, et al., 2009). Amos-Abanyie et al. (2016), attributes the energy wasteful behaviour of users to the lack of knowledge or awareness of users on the use of energy and its related implications. This is buttressed by Yen et al. (2010), who

[1] The use of electricity and energy in the content of this study is used interchangeably

reported that energy wastage in Malaysian universities is caused by lack of energy awareness amongst users. This translates the significance of the influence of user awareness on user behaviour in electricity consumption as reflective in the Norm-Activation Model (NAM) (Schwartz, 1977) and the Theory of Planned Behaviour (TPB) (Ajzen, 1991). The NAM and the TPB are behavioural models commonly used in environmental/energy studies and are sometimes combined in the theory/conceptual model of a study. The components of these two models are argued to overlap, hence, the use of either of them could yield similar results (Abrahamse and Steg, 2009). This study, therefore, focuses on the NAM considering the limited time available for conducting the research.

The NAM is a behavioural model widely used in several environmental and energy behavioural studies. The model stipulates three key components (Awareness of Consequence, Ascription of Responsibility and Personal Norm) that influence a person's environmental/energy behaviour. Awareness of Consequence (AC) is explained as a person's awareness about the adverse implications for the choice of action (eg. being aware of the consequence of excessive electricity consumption as in the case of this study). The Ascription of Responsibility (AR) is explained as the feeling of guilt for being responsible for the problems caused by the choice of action (eg. feeling guilty for being responsible for contributing to carbon emission) and knowing which actions to perform to help solve the problem. Personal Norms (PN) can also be explained as a person's moral obligation to act in a certain way (eg. feeling morally obliged to act to reduce electricity consumption and its consequence as in the context of this study) (Schwartz, 1977, De Groot and Steg, 2009). Based on these variables, the NAM relates that a person's performance of pro-environmental/energy behaviour is dependent on his personal norms which are influenced by an awareness of consequence and ascription of responsibility (Schwartz, 1977).

Researchers over the years have given two interpretations of the relationship between the variables of NAM. Some researchers interpret the relation of the variables as mediating effect (AC affects AR which also affects PN and subsequently behaviour in consuming energy), whiles others interpret it as a moderating effect (the effect of PN on energy behaviour is moderated by AC and AR). Both interpretations of NAM has been widely used in several studies and the elaboration on their distinction is less relevant in the context of this study. Hence, this study emphasizes on the mediating effect to explain the influence of the variables on behaviour in electricity consumption (De Groot and Steg, 2009).

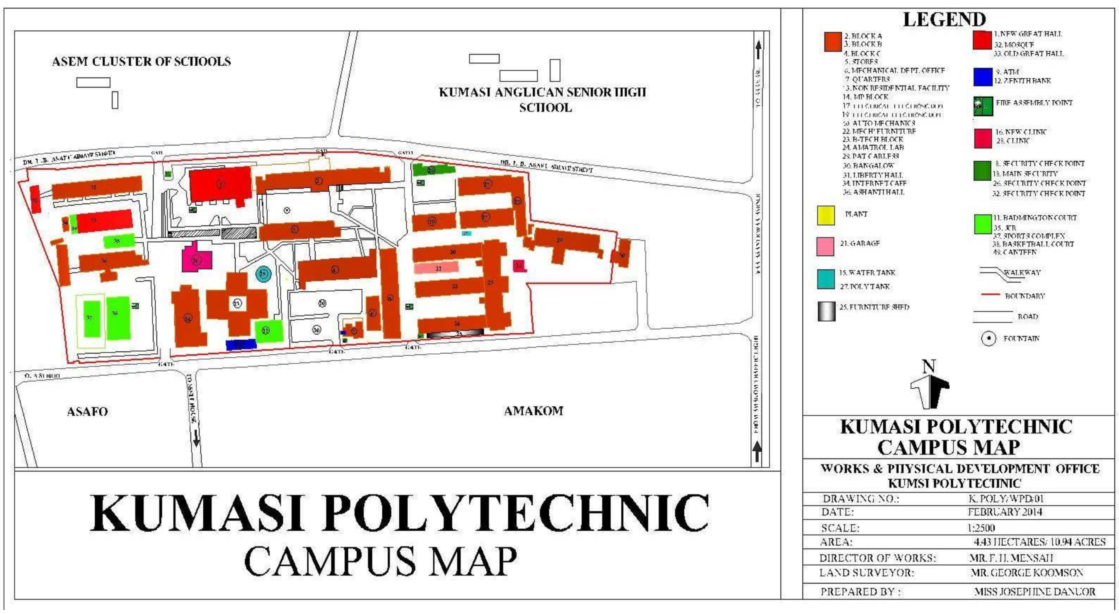
Based on the interpretation of the variables as having a mediating effect, NAM relates that user's awareness or knowledge of the negative environmental and socio-economic implications of their behaviour relating to the environment/energy use makes them feel responsible for causing the problems and tend to assign to themselves the responsibility to act towards solving the problems. This, in turn, strengthens their moral obligations to act in a pro-environmental or energy saving way, hence they are more likely to practice pro-environmental or energy-saving behaviour. The model theorizes that users who are not aware or do not know about the consequences of their behaviour relating to the environment or energy use do not feel responsible for the problems caused by their action and hence will not feel morally obliged to act to help solve the problems (Zhang, Wang, et al., 2013).

The above assertion of the NAM has been tested and confirmed in several studies relating to human behaviour towards the environment and energy use including studies by Steg and De Groot (2010), Werff and Steg (2015), Harland et al. (2007), De Groot and Steg (2009) and Zhang et al (2013). Human behaviour relating to the environment/energy use cuts across behaviour in the use of transport, water, recycling waste, and electricity. However, this study only focuses on human behaviour in relation to electricity consumption in a university setting where staff and students are the primary users of energy services.

1.2 Problem Statement

Kumasi Technical University (KsTU) is one of the public technical universities in Ghana, it was formerly known as Kumasi Polytechnic (founded in 1954) and attained its current status in the year 2016. The university has six faculties, four institutes, and a graduate school (Kumasi Technical University, 2018). The main campus of the university is characterised by twenty-one building blocks (as shown in the campus map in figure 1) consisting of laboratories, classrooms, libraries, offices, auto-workshops, student accommodation, sports facilities and recreational facilities (EMSD, 2013). KsTU currently has student and staff population of 9,859 and 649 respectively (Planning Office, 2018) who form the primary users of its building facilities and associated services including energy.

Figure 1 Campus Map of KsTU



The university relies on electricity for teaching, research, learning, students admissions and other administrative works, as well as for basic use in the student residence (Adjei-Twum, A., 2017). Electricity to the university is supplied from the national grid through an indoor 11KV/415V distribution transformer installed in the university by the Electricity Company of Ghana (ECG) (Adjei-Saforo, Adam, et al., 2016). Due to high demand, the university is categorised under the Special Load Tariff (SLT) customer (industrial consumption greater or equal to 100KVA). Electricity consumption of the university is monitored online through the Automatic Remote Meter Reading (AMR) system launched by ECG in 2014 (Awiah, 2014). The average daily electricity consumption of the university on weekdays is perked at 3663.81 KWH with an average maximum demand of 144 KVA (ECG, 2018).

Recently, Adjei-Twum (2017) reports an excessive electricity consumption in KsTU's annual electricity consumption levels. Electricity consumption of the university has doubled in the past few years. In the year 2015 the main campus of the university recorded an annual electricity consumption of 725,264.97 KWH, this increased to 1,448,306.51 KWH in 2016 and 2,173,571.48 KWH as at July 2017. These recent consumption levels translate more than 100% increase in electricity consumption, though student and staff population within this period increased by less than 10% annually. This infers an excessive use of electricity within the university's building facilities. This assertion is buttressed by Kwarteng (2017), who concluded based on an energy audit conducted in selected university buildings in Kumasi that, there is an annual excess of between 13-15% of energy consumed in university buildings. The excessive consumption is reported to be mainly caused by user behaviour and other factors including physical characteristics of the buildings, the use of appliance with minimum energy efficiency rating and the improper use of buildings and its systems (Adjei-Twum, A., 2017, Kwarteng, 2017).

Emphasizing on the behaviour of users as the cause for excessive electricity consumption, facilities users in KsTU have the energy wasteful behaviour pattern of leaving air-conditioners, computers, fans and other electrical appliances on when not in use, using air-conditioners with windows opened and leaving lights on in unoccupied spaces in the university. This behaviour is noticed to be practiced by both staff and students in places like offices, classrooms, halls of residence for students and other building space where energy service is provided in the university. It must be emphasized that the energy wasteful behaviour of users in KsTU is not noticed only during working hours but also after working hours, as electrical appliances are not turned off by some staff after the close of work (Adjei-Twum, A., 2017, Adjei-Saforo, Adam, et al., 2016). Masoso and Grobler (2010) report that electrical appliances that are left on by users after working hours contribute to more than 50% of energy consumed in buildings. This implies that energy wasteful behaviour pattern among staff and students of KsTU are evident as the main cause for the excessive electricity consumption.

Excessive electricity consumption arising from students 'ironing behaviour'[2] alone amounts to a monthly excess of 4.4KWH/student which translates to a cost of GH₵2.99 (0.55 Euro[3]) using the current electricity tariff of GH₵0.68 (0.13 Euro) per KWH (Adjei-Twum, Sapri, et al., 2017, Electricity Company of Ghana, 2017). A study by Adjei-Twum et.al (2017) suggest that 70% of students are fond of this behaviour. Hence, considering the number of students (574) accommodated in the halls of residence in the university's main campus, this excess (4.4KWH) in consumption suggests high financial implications. Thus, 401 students (70% of 574 students in university accommodation) implies 1,764.4KWH and GH₵5,275.56 (949.6 Euro) monthly excess consumption and cost respectively. These excesses contribute to the high electricity bills of the university. For instance, the April 2017 electricity bill for the university recorded GH₵3,759,158.23 (676,648.48 Euro) as the cost of electricity consumed (Adjei-Twum, A., 2017). Aside from the cost implications of excessive electricity consumption, it also leads to environmental effects like emission of carbon into the atmosphere and air pollution (Ting, Mohammed, et al., , 2011). There is, therefore, the need to understand the factors that influence users behaviour in the use of electricity in order to put in place measures to help reduce electricity consumption and its related implications.

On the other hand, Adjei-Saforo et al. (2016) report that, KsTU could save up to 24,540KWH of energy annually through no investment cost if users were aware or had knowledge on how waste in electricity consumption occurs during the use of computers, the cost and environmental implications, and how to prevent the waste by means of basic settings on the computer. This assertion translates low level of awareness of energy issues among staff and students of the university and implies that energy awareness plays a significant role in saving energy as it influences user behaviour in electricity consumption (Wai, Mohammed, et al.,

[2] 'Ironing behaviour' can be explained as the behaviour choice of ironing clothes as and when needed (energy wasteful) or ironing clothes in bulk (energy saving) (Adjei-Twum, Sapri, et al., 2017).

[3] GH₵1.00 equals 0.18 Euro based on the exchange as at 05-04-2018

2009). This is affirmed by the components of the Norm-Activation Model (NAM) which has been used in several energy behaviourial studies.

The NAM stipulates three main components (Awareness of Consequence AC; Ascription of Responsibility AR; Personal Norm PN) that influence human environmental/energy use behaviour (behaviour in the use of energy is broad, hence this study focused on behaviour in electricity consumption). Over the years researchers have interpreted the model as having either a moderating or mediating effect. Emphasising on the model as a mediating effect, the NAM relates that user awareness of the consequence of the use of energy strikes a sense of responsibility for contributing to the problem which makes them feel morally obliged to help resolve the issue, hence, performs a behaviour towards reducing the use of energy (Schwartz, 1977). De Groot and Steg (2009) and Zhang et al. (2013) in separate studies on energy saving behaviour used the NAM and concluded that the more energy users are aware or have knowledge of the use of electricity and its implications, the stronger their feeling of responsibility and personal norm to act to save energy hence performing energy-saving behaviour. Based on the foregoing, User Awareness in this study is defined by the components of NAM, being Awareness of Consequence (AC), Ascription of Responsibility (AR) and Personal Norm (PN).

1.3 Research Objective

The objective of this study is to explain how the level of user awareness influence user behaviour in electricity consumption at KsTU. Based on the NAM, User awareness in this study is defined by AC, AR, and PN.

1.4 Research Question

The main question that guided the study is: to what extent does the level of user awareness influence user behaviour in electricity consumption at KsTU?

Sub-research questions

- What is the level of user awareness of electricity consumption at KsTU?
- What is the current practiced user behaviour in electricity consumption at KsTU?
- How does user awareness (AC, AR, and PN) influence user behaviour in electricity consumption at KsTU?

1.5 Significance of the Study

The academic relevance of the study is that it adds to the existing body of knowledge on user awareness, behaviour in consuming electricity, the concept of electricity consumption and the NAM. However, this study specifically explains how user awareness (defined based on the variables of NAM) influence user behaviour in electricity consumption in the context of a university setting. This can be an important knowledge in literature since most of the existing studies on behaviour using the NAM focused on testing the variables of the model and their causal relations as well as focused on behaviour relating to other aspects of the environment and energy use (including reducing car use, closing the tap water, environmental protection, recycling etc) other than electricity consumption (De Groot and Steg, 2009, Werff and Steg, 2015, Steg and Groot, 2010, Onwezen, Antonides, et al., 2013, Harland, Staats, et al., 2007).

Practically, this study can help the management board of KsTU and other universities (generally) to realise the potential of reducing electricity consumption in universities through an increased level of user awareness which influences user behaviour in electricity consumption. Subsequently, investment in increasing the levels of user awareness in KsTU (and other universities) can help minimise electricity consumption, cost expenditure on electricity, demand for electricity, and the environmental effects of electricity consumption.

1.6 Scope and Limitation

The study has the following limitations in scope:

- Users in this study refer to staff (both teaching and non-teaching) and students of KsTU.
- User awareness in this study is defined by the variables of NAM (AC, AR, and PN).
- The relationship between the variables of NAM is interpreted as a mediating effect.
- The findings of the study are limited to the context of a university setting.

Chapter 2: Literature Review / Theory

2.1 Introduction

This chapter focuses on reviewing existing knowledge on the main variables found in the research question, which are *Level of User Awareness* (independent variable) and *User Behaviour in Electricity Consumption* (dependent variable). With these variables, the main theories/concepts that guided the study is electricity consumption, and behavioural theories focused on the Norm-Activation Model (NAM). These theories/concept are discussed and linked to the variables found in the research question. The chapter also discusses the conceptual framework that guided the study.

2.2 Electricity Consumption

Electricity consumption in universities is complex due it characteristics of multi-purpose building facilities, the variety of energy services provided in the building facilities and the magnitude of users of the facilities (Gul and Patidar, 2015). Multi-functional building facilities in universities comprise of facilities cutting across educational, residential and recreational facilities. These facilities consume high electricity as more energy services including power for heating, ventilation, and air-conditioning (HVAC), lighting, water supply, outlets for plugging electrical appliances etc are provided in the buildings. These energy services are needed for the daily operations of universities in achieving their primary goals of teaching, research, and learning. They are also needed for use in the student and staff residences, and in the provision of support services for the magnitude users of university facilities. The magnitude users of university facilities include teaching and non-teaching staff, students, researchers, visitors, and other people who work to provide support services in the universities (Oyedepo, Adekeye, et al., , 2015). The use of energy services in university building facilities are classified among the building sectors with the highest electricity consumption (Chung and Rhee, 2014).

The two main factors noted as the main cause for the high electricity consumption in universities is the physical characteristics of building facilities and the behaviour of the occupants in the buildings towards electricity consumption (Chung and Rhee, 2014). This suggests that the orientation, shape, size, and other design characteristics of building facilities affect the level of electricity consumption in buildings. Likewise, the behaviour of users towards the use of energy services in buildings affects the level of electricity consumed in buildings.

User behaviour is said to have a significant impact on electricity consumed in buildings such that, it contributes to differences in the electricity consumption of identical buildings with the same occupancy rates and periods of providing similar services (Gill, Tierney, et al., 2010). This assertion has been confirmed in several studies that concluded that user behaviour massively affects electricity consumption in buildings (Sun and Hong, 2017). It is argued that buildings that are designed to have the best energy performance will not perform well if the behaviour of users towards electricity consumption is wasteful (Gul and Patidar, 2015). For instance, a building that is designed to allow good airflow for natural ventilation will not functionally perform to achieve this aim if occupants always keep the windows closed. This is because keeping the windows closed will not allow natural airflow to cool the rooms consequently using the air-conditions to rather cool the rooms which affect the level of electricity consumed in the building (Sun and Hong, 2017). This indicates the significant role user behaviour towards the use of electricity play in contributing to the global environmental and socio-economic effects associated with energy consumption.

Ideally, energy consumption should not threaten the quality of life of living things in any way since it plays an essential role in their daily life and the development of nations as a whole (Goldemberg, 2000, Azodo, 2014). However, energy consumption contributes significantly to the trending global issue of climate change and its related impact on the environment. What makes the situation worse is the reported wastage in the consumption of energy experienced in the world today (Yen, Shakur, et al., 2010, Georgiou, Ioannou, et al., , 2013). This has led to an increase in demand for energy implying the exploitation of natural resource for energy production and its related issues of energy insecurity (Ting, Mohammed, et al., , 2011). These global problems are attributed to human behaviour in the use of the various resources including energy (Blok, Wesselink, et al., 2015). For the purpose of this study, the emphasis is only made on human behaviour in electricity consumption in the context of users of university building facilities (staff and students).

2.2.1 User Behaviour in Electricity Consumption

The behaviour of users in consuming electricity can be explained based on their interactions with the classifications of energy services provided in building facilities. Signifying, user interactions with lighting, HVAC, power outlets for plugging electrical appliances etc (Sun and Hong, 2017). User interactions with these energy services largely determine the share of electricity consumption of these systems in building facilities.

Among the energy services provided in building facilities, HVAC is considered to have the highest proportion of electricity consumed. Energy consumption through these energy services is considered to be greatly influenced by the behaviour of users, mostly in buildings where the service is not centrally controlled. For instance, energy is greatly wasted when users leave windows opened while cooling or heating a room. This happens even in buildings where cooling and heating is centrally controlled (Gul and Patidar, 2015, Oyedepo, Adekeye, et al., , 2015). Lighting and the use of high energy consuming appliance (like electric kettle, computers, printers etc) in building facilities also covers a considerable proportion of energy consumed and their usage is also influenced by the behaviour of users (Gul and Patidar, 2015). Zhao et al. (2014) corroborate that plug-in loads consume up to 40% of electricity in buildings and this consumption level is highly influenced by the behaviour of occupants. They further stipulate that about 40% of energy can be saved from the use of plug-in loads if occupant behaviour in controlling plug-in loads could be efficient.

Generally, building occupant's behaviour pattern in the control of energy services like HVAC, lighting (in buildings without automatic sensors), and plug-in loads can be classified as either being energy wasteful or saving. Energy saving behaviour pattern of users can be explained as the activities of users that help in reducing consumption and demand for energy. This behaviour pattern helps in reducing the environmental and socioeconomic effects associated with electricity consumption (Trotta, 2018, Ting, Mohammed, et al., , 2011). Zhao et al. (2014) gives an example of such behaviour as employees turning on the computer sets at the office only when they need to actively work on the computer and also turning the computer off and plugged out when they are engaged in other activities at the workplace such as engaged in meetings or working from the desk (paper-based) (see table 1 below for more instances).

On the other hand, the energy wasteful behaviour pattern of users are the actions of users that leads to excessive consumption of electricity. This behaviour contributes to the environmental and socioeconomic problems associated with electricity consumption (Trotta, 2018, Ting, Mohammed, et al., , 2011). Computer sets and other electrical appliances turned on and actively running in the workplace while not in use or in the absence of employees is considered energy wasteful. Likewise, lighting and HVAC systems left turned on by employees in unoccupied spaces in the workplace is considered as energy wasteful behaviour (see table 1 below for more instances) (Zhao, Lasternas, et al., , 2014).

Yen et al. (2010) attribute energy wasteful behaviour pattern of energy users to their lack of awareness on energy issues. This assertion is supported by Amos-Abanyie et al (2016) and implies that the pattern of user behaviour in electricity consumption is largely influenced by their level of energy awareness. Based on the foregoing, there is the need to delve into the various theories of human behaviour to ascertain which of them reflects the influence of user awareness on user behaviour in electricity consumption. The review of the literature on the various behavioural theories is elaborated in section 2.3 below.

Table 1 User behaviour Pattern in Electricity Consumption (EC)

User behaviour in EC	**Behaviour Pattern**	
	Energy Saving	**Energy Wasteful**
Control of HVAC	- Setting cooling temperature to the highest possible (above 24 ºC) - Setting heating temperature to the lowest possible (below 21 ºC) - Turning cooling and heating off in unoccupied space - Ensuring all openings are closed during cooling and heating a space - Frequent use of natural ventilation instead of heating or cooling system	- setting cooling temperature below 24 ºC - setting heating temperature above 21 ºC - leaving cooling and heating system on in unoccupied space - opened door or window when cooling or heating a space - frequent use of cooling or heating system instead of natural ventilation
Control of lighting	- turning off lights in unoccupied spaces - turning off lights when going out of the room - using daylight instead of lights during daytime	- leaving lights on in unoccupied spaces - leaving lights on when going out of the room - turning lights on during daytime instead of using daylight
Control of plug-in loads	- turning off and unplugging electrical appliances from sockets when not in use	- turned on and plugged-in electrical appliance when not in use

Source: Adapted from Sun and Hong (2017) and Ouyang and Hokao (2009)

Based on the foregoing, this study measured user (staff and student of KsTU) behaviour in electricity consumption with the indicators *control of VAC*[4]*, control of lighting, and control of plug-in loads.* Signifying their interactions with these energy services in the university (Sun and Hong, 2017).

- **Control of VAC:** this relates to users behaviour relating to the setting of temperature for the cooling systems. It also relates to the occupancy and start-up control of the cooling in buildings where the system is not centrally controlled. With respect to the ventilation component of the system, that is in relation to the use of natural ventilation and fan.

[4] This study focused only on the Ventilation and Air-condition component of the HVAC system since the university and the region at large has no heating system.

The indicator was measured based on the behaviour pattern of users in relation to VAC systems. That is, the number of times users consciously control VAC systems in an attempt to reduce electricity consumption and the number of times users unconsciously control VAC systems in an energy wasteful manner (Sun and Hong, 2017, Li, Menassa, et al., 2017).

- **Control of lighting**: this behaviour relates to users choice of action for turning lights on or off in a building space where automatic sensors are not in place. It also relates to the utilisation of daylight.

  The indicator was measured based on the behaviour pattern of users in relation to lighting. That is to mean the number of times users consciously turn off lights in an attempt to reduce electricity consumption and the number of times users unconsciously leave or turn lights on in an energy wasteful way (Sun and Hong, 2017, Li, Menassa, et al., 2017).

- **Control of plug-in loads:** this behaviour is in relation to users control of plug-in electrical appliances including computers, personal laptops, printers, and phone chargers etc. based on their active use.
  The indicator was measured based on the behaviour pattern of users in relation to the use of electrical appliances. That is the number of times users consciously turn off and unplug electrical appliances not in active use in an attempt to reduce the use of electricity and the number of times users unconsciously leave unused electrical appliances on and plugged in (Sun and Hong, 2017).

2.3 Behavioural Theories

There are several behavioural theories and models that have over the years been developing and improving. Behavioural theories and models explain the basis of how a person performs a specific action. A person goes through a complex psychological process to perform a behaviour, implying that psychological factors have an influence on behaviour.

Some of the psychological factors noted to influence behaviour are personal norms, beliefs, values, self-efficacy, environmental awareness, subjective norms etc. These factors mostly form the components of behavioural theories (Guo, Zhou, et al., 2018, Yang, Zhang, et al., 2016). The common behavioural theories and models mostly used in the environment and/energy studies relating to environmental/energy behaviour are briefly described below:

- **Theory of Reasoned Action (TRA):** this theory was formulated by Martin Fishbein and Icek Ajzen in 1975. The TRA relates that a person's behaviour is highly influenced by the intention to act (behaviour intention). Behaviour intention, on the other hand, is inspired by subjective norms (an external force that compels a person to act or not to act on a certain behaviour) and attitude.

  The theory has been used in several studies on energy consumption behaviour. Some of these studies adopted the theory in their study and identified subjective norms to mean environmental knowledge and awareness together with environmental attitude and peer pressure influencing behaviour intention to purchase green and energy efficient products (Ajzen and Fishbein, 1980, Zainudin, Siwar, et al., 2014, Guo, Zhou, et al., 2018).

- **Norm-Activation-Model (NAM):** this model was formulated by Shahlom Schwartz in 1977. The NAM relates that the Personal Norm (PN) of a person which takes it root from social norms (common attitudes, moral and values in the society) has an effect on a person's environmental/energy behaviour (environmental protection, energy, and water conservation behaviour etc.). However, this effect is greatly influenced by a person's Awareness of Consequence (AC: conscious about the consequence of the choice of action) and Ascription of Responsibility (AR: a sense of responsibility for ignoring the action). This means that personal norm does not certainly lead to environmental behaviour without the influence of awareness of consequence and ascription of responsibility (Schwartz, 1977, Guo, Zhou, et al., 2018).

- **Social Cognitive Theory:** this theory was formulated by Albert Bandura in 1986. The theory relates that a person's behaviour is influenced by the interaction between the individual (belief, aim, attitude, emotions etc which proves a person's cognitive ability), environment (physical situation and resources) and behaviour. The theory has been used in several studies establishing the relationships between energy user behaviour and social, economic, and cultural factors (Bandura, 1986, Guo, Zhou, et al., 2018).
- **Theory of Planned Behaviour (TPB):** this theory as formulated by Icek Ajzen in 1991 is an improvement of the theory of reasoned action. Ajzen added perceived behavioural control (ability to act in a certain behaviour) to subjective norms and attitude as factors affecting behaviour intention and subsequently actual behaviour. Perceived behavioural control may sometimes have a direct effect on actual behaviour.

  The TPB has also been used in several energy behaviour studies establishing the relationship between people's attitudes and energy savings approaches. It has also been used in a study to ascertain the relationships between subjective norms, perceived behavioural control, attitude, and energy behaviour (Ajzen, 1991, Scott, Jones, et al., 2014, Yazdanpanah, Komendantova, et al., 2015).
- **Value-Belief Norm Theory**: this theory was formulated by Paul Stern in 1999 combining the norm activation model to the concept of value and the new environmental paradigm. The theory relates that values (ecological, altruistic, and self-interested) influence beliefs (such as awareness of consequence, and ascription of responsibility) which also affects a person's norm (like environmental ethics) and subsequently actual behaviour. Per this theory, a person's energy-saving behaviour occurs when they consider factors like environmental protection as their obligation and having this kind of obligation mindset is influenced by variables like awareness of consequence and ascription of responsibility (Stern, Dietz, et al., 1999, Guo, Zhou, et al., 2018).
- **Model of Goal-Directed Behaviour**: the model was formulated by Perugini and Bagozzi in 2001 with roots from the theory of reasoned action and theory of planned behaviour. The model introduced desire as a mediating variable affecting behaviour intention, hence, implying that subjective norm, attitude, and perceived behavioural control do not have a direct effect on behaviour intention. The authors also introduced the concept of anticipatory effects (a positive and negative reflection of reality, eg. desire for success and fear for failure) as an additional variable influencing desire, behaviour intention and subsequently actual behaviour. This model has also been applied to studies on energy behaviour (Perugini and Bagozzi, 2001).

Amos-Abanyie et al. (2016) and Yen et al. (2010) reports that the lack of knowledge or awareness on the use of energy and its related implications contributes to energy wasteful behaviour which is noted as one of the main causes for excessive electricity consumption.

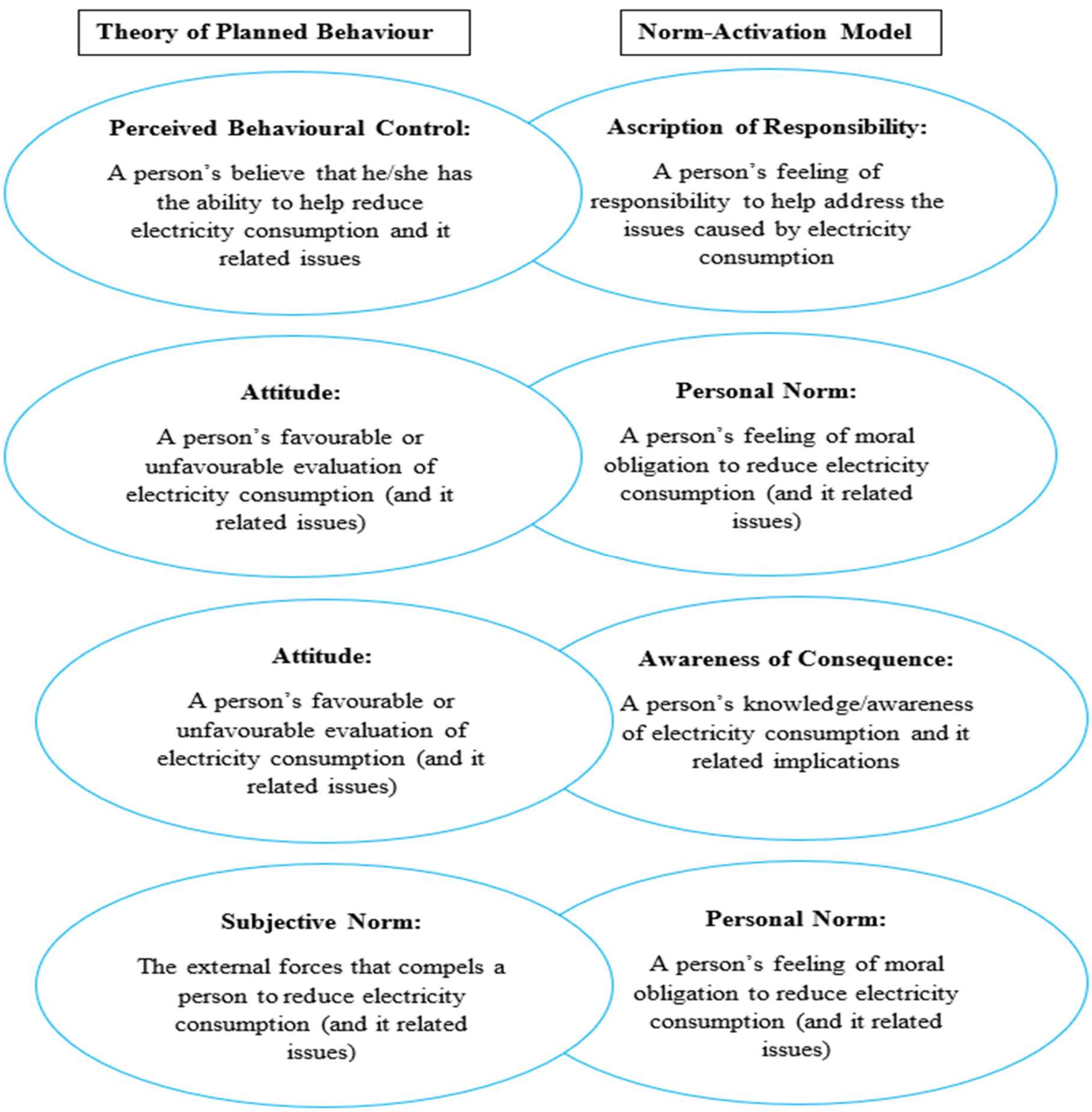
Relating this assertion to the components of all the above theories and models of human behaviour, it can be deduced that:

- The Theory of Reasoned Action cannot be used in this study to express the influential role that awareness or knowledge of energy and it related issues plays on behavior in the use of energy. This is because the components of the theory consider behaviour intention which is influenced by subjective (social) norms and a person's attitude as the main factors influencing behaviour (Ajzen and Fishbein, 1980, Guo, Zhou, et al., 2018). Although some researchers translate social norms to include environmental knowledge and awareness, such studies only relate or justify awareness and knowledge to the purchasing behaviour of people (Zainudin, Siwar, et al., 2014). Hence making the use of this theory less relevant in the context of this study.
- The Social Cognitive Theory is not appropriate for use in the context of this study to articulate the influence of awareness on behaviour in the use of energy. This is justified by the argument that, the components of the theory have no relation to a person's knowledge or awareness of energy and its related issues as influential factors on behaviour. The theory considers the interactions between environmental factors and a person's beliefs, intentions, and emotions as the main factors that influence behaviour (Guo, Zhou, et al., 2018).
- Although the Value-Belief-Norm Theory includes awareness of energy issues as part of the factors that influence behavior, the application of the concepts of value and new environmental paradigm in the theory make up too many components/variables when operationalized. Thereby, leading to many indicators that will be challenging to investigate within the limited timeframe for this research, hence, the justification for not adopting this theory.
- This study cannot adapt to the use of the Model of Goal Directed Behaviour because the components of the model have no relation to awareness of the use of energy and its implications as a factor that influences behaviour. The model stipulates subjective norms, attitude, perceived behavioural control, desire and intention as the factors that influence behaviour (Perugini and Bagozzi, 2001).
- The components of the Theory of Planned Behavior could be related to environmental knowledge or energy awareness and as such can be appropriate for use in the context of this study. The theory stipulates that behaviour is influenced by a person's intention to act in a certain way (behaviour intention). Behaviour intention is however influenced by a person's ability to act in a certain way (perceived behavioral control), external forces that compel a person to act in a certain way (subjective norms) and a person's favourable or unfavourable behaviour (attitude) (Ajzen, 1991).
- The Norm-Activation Model can also be appropriate for use in the context of this study. This is justified by the argument that, the components of the model clearly signifies the important role awareness or knowledge of energy and its related implications play in influencing behaviour in the use of energy. The model stipulates that a person's awareness of the consequence of the use of energy (Awareness of Consequence), the feeling of responsibility to help address the consequence (Ascription of Responsibility), and moral obligation to reduce energy use (Personal Norm) influences behaviour in the use of energy (Schwartz, 1977, Guo, Zhou, et al., 2018).

Based on the above reasonings both the Theory of Planned Behaviour (TPB) and the Norm-Activation Model (NAM) can be appropriate for use in this study. The components of the two models could be combined for use in this study as was done in the study of Abrahamse and Steg (2009). However, the combination of the two models makes up too many indicators when operationalised, which will be challenging to investigate within the limited timeframe for this research.

Moreover, the findings of Abrahamse and Steg (2009) revealed that *"higher levels of perceived behavioral control were related to stronger feelings of responsibility (r = .18,p < .05), and more positive attitudes towards energy conservation were related to stronger feelings of moral obligation to reduce energy use (r = .24, p < .05), and higher levels of awareness of consequences (r = .22, p < .05)"* (Abrahamse and Steg, 2009, pg. 716). This implies that the component 'perceived behavioural control' (of TPB) coincide with 'ascription of responsibilities' (of NAM). Likewise, the component 'attitude' (of TPB) coincide with 'personal norm' and 'awareness of consequence' (of NAM). It can also be inferred from the findings of Abrahamse and Steg (2009) that the TPB and the NAM overlap (see figure 2).

Figure 2 Overlapping nature of the components of the Theory of Planned Behaviour and the Norm-Activation Model



Source: Author's construct based on the TPB (Ajzen, 1991) and the NAM (Schwartz, 1977)

Based on the overlap of the components of the TPB and the NAM (as shown in figure 2), it can be argued that the use of either of the models in this study will yield similar results, hence, it is laudable to choose one. In choosing between the two models the number of components and the time available for this research was taken into consideration. Considering the fact that the TPB has 4 components influencing behaviour as against 3 components of the NAM influencing behaviour and the limited time available for this research, this study adopted to the use of the Norm-Activation Model.

Hence, the components of NAM (AC, AR, and PN) was adopted to define user awareness in this study. These components are worth elaborating in detail to help explain the influence of user awareness on user behaviour in electricity consumption, see 2.3.2 below.

2.3.1 Norm-Activation-Model (NAM)

The NAM was formulated by Shahlom Schwartz in 1977 to primarily explain the altruistic behaviour of people in the society. Altruistic behaviour is considered as the actions of people for the benefit of other people other than themselves, for example, making charitable donations and this can also be termed as pro-social behaviour (Steg and Groot, 2010).

According to Harland et al. (2007) "*norm activation is the process in which people construct self-expectations regarding prosocial behaviour*" (Harland, Staats, et al., 2007 pg.323). This definition of norm activation is based on Schwartz's explanation in the NAM that a person's altruistic behaviour is dependent on his/her Personal Norms (PN) which is explained as the moral obligation of a person that takes root from the common values, morals, and ethics of the society. Schwartz further specifies in the NAM that the personal norms of a person are influenced by Awareness of Consequence (AC) and Ascription of Responsibility (AR). AC is explained in the NAM as a person's consciousness about the implications of the choice of action eg. for not acting in a way that protects the society or environment. Whiles, the model explains AR as a person's sense of responsibility for the consequence of the choice of action, eg. acting pro-socially or pro-environmentally (Schwartz, 1977).

Based on the initial use of the model to explain altruistic behaviour, the model became commonly used in the social psychological field to explain behaviours relating to social altruistic activities like blood donations and other voluntary activities for societal benefits. However, over the years the use of the model has crossed the borders of social psychology and is now widely used in environmental studies.

The NAM has been used in several environmental studies and has been considered as one of the most effective models that explain the factors influencing the behaviour of a person in the use of environmental resources. This transition of the use of the NAM in environmental studies is justified based on the relation of pro-environmental behaviour with social altruistic activities (Steg and Groot, 2010, Harland, Staats, et al., 2007). This is to mean that when a person acts or behaves in a way that protects the environment and its resources the benefit that comes from that behaviour is collective and not individual benefits. Similarly, when a person acts or behaves in a manner that negatively impacts the environment and its resources the entire society suffers the consequence. Hence, the validity of the use of NAM in environmental related studies. Some of the environmental studies in which the NAM has been used includes studies on behaviour in the use of transport, water, energy and recycling of waste (Schwartz, 1977, De Groot and Steg, 2009, Guo, Zhou, et al., 2018, Werff and Steg, 2015, Harland, Staats, et al., 2007, Steg and Groot, 2010).

However, in the use of the NAM in social and environmental studies over the years has emerged two interpretation of the relationships between the variables of the model. Some researchers interpret the relation as mediating effects and others as moderating effects. That is to mean awareness of consequence affects ascription of responsibility which also affects personal norms and subsequently environmental/energy behaviour (mediating effect, see figure 3); the effect of personal norms on environmental/energy behaviour is moderated by awareness of consequence and ascription of responsibility (moderating effect, see figure 4) (De Groot and Steg, 2009, Onwezen, Antonides, et al., 2013). Both interpretations have been used separately in several environmental studies and have been proved to be right in their own context (Stern, Dietz, et al., 1999, Hopper and Nielsen, 1991). However, there has not been any proof of the use of the model interpreted as both mediating and moderating in the same study as claimed by some researchers (De Groot and Steg, 2009).

Figure 3 Theoretical framework of NAM as a mediating model

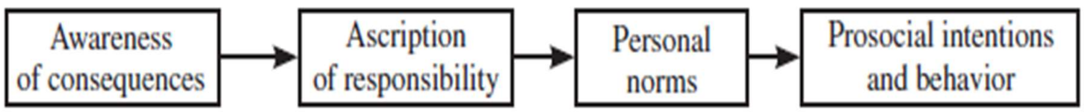
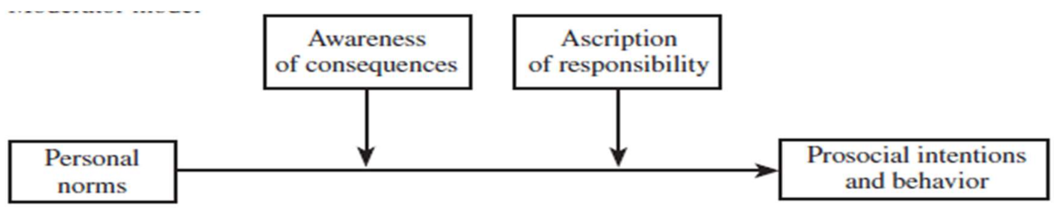


Figure 4 Theoretical framework of NAM as a moderating model



Source: Adapted from De Groot and Steg (2009)

De Groot and Steg conducted five studies in the prosocial and environmental context between the years 2005 and 2006 to test the interpretation of the NAM. In the first study, they focused on energy saving behaviour, which proved the NAM as a mediating model. The study showed that the more users were aware of the implications of energy use, the stronger they felt responsible for the problems relating to the use of energy and hence felt obliged to act or change their behaviour to save energy. In the second study, they focused on testing the effect of the NAM in a study to reduce the use of cars. Just like in the first study, this study also proved NAM as a mediating model as it revealed that respondents who felt more responsible and obliged to reduce the use of personal cars are those who are highly aware of the environmental effects of using cars. Hence, have stronger personal norms to perform the behaviour (reduce usage of cars). In summary, all the five studies supported NAM as a mediating model against moderating model.

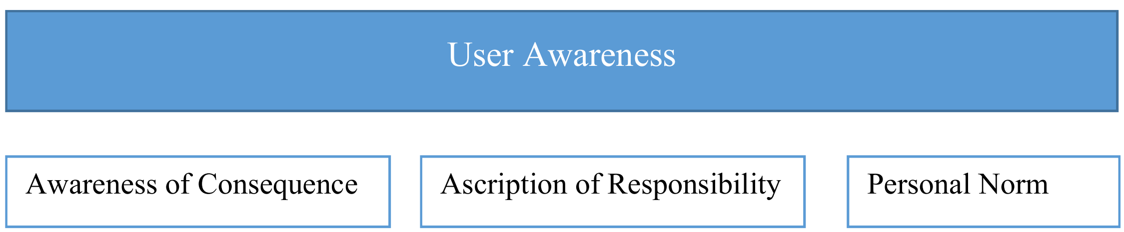
The five studies concluded that a person's awareness or knowledge of the consequence of his behaviour strikes a sense of guilt for being responsible for the problem which awakens a feeling of obligation to help resolve the problem. The feeling of obligation, in turn, stimulate a person to perform a pro-environmental behaviour (De Groot and Steg, 2009). This assertion is corroborated by Zhang et al. (2013) who used the NAM in a study to ascertain the antecedents of employees electricity saving behaviour in an organisational setting. They concluded after the study that workers with a high awareness of the consequence of their behaviour towards electricity consumption and an ascription of responsibility have stronger personal norms and are more likely to practice energy-saving behaviour. Similarly, Harland et al. (2007) in their study understood that a person's awareness of the negative implications of not closing the tap water, their feeling of guilt and responsibility for the problems caused by not closing the tap water, and their feeling of moral obligation to close the tap water projected a higher likelihood to close the tap water.

It must be emphasised that further elaboration of the distinctions between the mediating and moderating effects of the NAM is not significant for the achievement of the objective of this research. Hence this study adapted to the interpretation of the NAM as a mediating model to explain the influence of user awareness on user behaviour in electricity consumption.

2.3.2 Explaining User Awareness Based on the Variables of NAM

User awareness based on the variables of the NAM can be explained as the state of mindset where users (staff and students of KsTU) awareness of the consequence of their actions (eg excessive electricity consumption) makes them feel responsible for the problems caused by their action (eg air pollution) which in turn makes them feel morally obliged to act to resolve the problem. This definition is drawn from the variables Awareness of Consequence (AC), Ascription of Responsibility (AR), and Personal Norms (PN) of the NAM which serves as sub-variables to the independent variable (level of User Awareness) of the study (see figure 5) (Schwartz, 1977, De Groot and Steg, 2009). These sub-variables and their relations are elaborated below:

Figure 5 Components of User Awareness based on NAM



Source: Adapted from De Groot and Steg (2009)

2.3.2.1 Awareness of Consequence (AC)

Over the time researchers have defined AC in different closely related ways to suit the context of their study reflecting the original definition of AC by Schwartz in the NAM. Some of the common definitions of AC found in literature are *"a person's receptivity to situational cues of need"* (Harland, Staats, et al., 2007, pg. 324); "*a person's awareness of the consequence of their own behaviour for others or the environment*" (Abrahamse and Steg, 2009, pg. 712); "*whether someone is aware of the negative consequences for others or for other things one values when not acting prosocially"* (De Groot and Steg, 2009, pg. 426, Steg and Groot, 2010, pg. 725); *"the awareness that performing (or not performing) the particular behaviour has certain consequences"* (Onwezen, Antonides, et al., 2013, pg. 142); *"when people are aware of environmental problems caused by their behaviour"* (Werff and Steg, 2016, pg. 108); *"People's awareness of the environmental problems caused by energy use"* (Werff and Steg, 2015, pg. 8).

Based on the above definitions in literature, this study defines AC as users (staff and students of KsTU) awareness about the adverse environmental and socioeconomic implications of their use of electricity and how they can reduce their electricity consumption.

Some of the adverse environmental and socioeconomic implications noted to be related to electricity consumption includes air pollution, carbon emission (generally global warming), energy insecurity, conflicts between countries arising from dependence for energy supplies, exploiting of natural resources, and high cost for energy services (Ouyang and Hokao, 2009, Ting, Mohammed, et al., , 2011, Georgiou, Ioannou, et al., , 2013). According to Ouyang and

Hokao (2009), most people are not aware that their daily use of electricity has a close relation and contribution to the environmental and socioeconomic problems faced in the world today, so they do nothing to help solve the problems.

In accordance with the NAM, if Users are aware of the negative consequences of electricity consumption, they are likely to feel guilty for contributing to the problems and responsible for solving the problems, which implies a direct relation of AC with AR (see figure 6) (Schwartz, 1977). Base on this assertion by the model and other studies on NAM, Zhang et al. (2013) in their study on employee energy-saving behaviour tested the hypotheses "AC is positively related to AR" and confirmed in the outcome of their study that AC has a direct influence on AR. Similarly, Werff and Steg (2015) in their study on energy use behaviour using the NAM tested the effects of the variables of the NAM and established that people with high knowledge or awareness of the negative environmental consequence of consuming energy have a strong feeling of being responsible for the problems. Conversely, people are less expected to feel responsible for the problems when they are not aware that the problems are caused by their energy use (Steg and Groot, 2010).

Figure 6 Direct Effect of AC on AR

Source: Adapted from De Groot and Steg (2009)

In measuring AC, Harland et al (2007) in their study, measured how respondents strongly believed that their behaviour of not closing the tap water when brushing their teeth causes environmental problems. In measuring this they developed statements including *"no matter the circumstances not closing the tap water is detrimental to the environment"* and ranked their responses on a Likert scale. Similarly, Abrahamse and Steg (2009) in their study measured AC based on the degree to which their respondents believed that the use of energy contributes to environmental and socioeconomic problems. This was measured by rating their views on statements including *"energy conservation contributes to reducing the greenhouse gas effect"* on a five-point Likert scale. This approach to measuring AC was also used in similar studies by De Groot and Steg (2009), Steg and De Groot (2010), Zhang et al. (2013), Onwezen et al. (2013), Werff and Steg (2015), and Werff and Steg (2016).

However, it is believed that a person who is aware and able to relate his/her energy use with the environmental and socioeconomic problems, may have been exposed to some form of energy awareness campaigns. These campaigns are usually in the form of organised energy workshops, training, seminars, pasting of posters, distributing flyers, brochures etc. and informs people about vital energy use information, the consequences (negative environmental and socioeconomic effects) related to the use of energy and which actions will help to mitigate the problems (Werff and Steg, 2015, Wai, Mohammed, et al., 2009). It is only after a person's exposure to these energy campaigns/information that he/she can acknowledge that their use of energy causes problems to the environment and the society. Likewise, after a person's exposure to energy campaigns/information, he/she is able to acknowledge that their actions to reduce electricity consumption can help the solve problems (Werff and Steg, 2015, Li, Menassa, et al., 2017).

Based on the foregoing, AC in this study was measured by the indicators (1) *number of energy campaigns users have been exposed to,* (2) *users acknowledgement of the problems caused by electricity consumption,* and (3) *users acknowledgement that reducing electricity consumption will help solve the problems*. In measuring indicators (2) and (3), the items used in measuring

AC in the studies of Harland et al (2007), Abrahamse and Steg (2009), De Groot and Steg (2009), Steg and De Groot (2010), Onwezen et al. (2013), Werff and Steg (2015), and Van der Werff and Steg (2016) were adopted. These items were modified to reflect the indicators (2) and (3) of this study. Respondents views on the items were rated on a Likert scale as applied in the studies of Harland et al (2007), Abrahamse and Steg (2009), De Groot and Steg (2009), Steg and De Groot (2010), Zhang et al. (2013), Onwezen et al. (2013), Werff and Steg (2015), and Werff and Steg (2016).

2.3.2.2 Ascription of Responsibility (AR)

As described in the AC above, the development of AR is dependent on AC (see figure 6). People who are aware of the negative consequence of their use of energy develops AR. Similar to AC, AR has also been defined differently but closely related by researchers to suit the context of their own study with a basis from the NAM. Some of the definitions of AR found in the literature are: *"… feel personally responsible for the behavioural consequence"* (Abrahamse and Steg, 2009, pg. 712); *"feelings of responsibility for the negative consequences of not acting prosocially"* (De Groot and Steg, 2009, pg. 426); *"feeling of responsibility for performing the specific behaviour*" (Onwezen, Antonides, et al., 2013, pg. 142); *"feelings of responsibility for the problems"* (Steg and Groot, 2010, pg. 727); *"…feeling that they can help to reduce or solve the problems"* (Werff and Steg, 2015, pg. 8).

In this study, AR was defined as Users (staff and students of KsTU) feeling of guilt for contributing to the problems caused by electricity consumption and feeling responsible to help solve the problems.

Based on the NAM the feeling of guilt for contributing to the problems caused by electricity consumption is aroused by users awareness of the consequence of electricity consumption. Hence, if users are not aware of the adverse implications of electricity consumption they will not develop AR to feel responsible for the problems and for solving the problem. Strong AR developed by users is said to influence their moral obligation to help solve the problems caused by excessive electricity consumption. This translates a direct influence of AR on PN (see figure 7) and this effect is confirmed by Zhang et al. (2013) in their study of employees electricity saving behaviour. They tested the hypothesis *"AR is positively related to PN"* and their results revealed that employees with a developed feeling of responsibility for the negative effects of consuming electricity develop a personal norm to save electricity in their organisation. This is also corroborated by the results of the study by Werff and Steg (2015) which revealed that a person with a strong personal norm is a person whose feeling of responsibility for helping solve the problem is very strong. Contrary, users without a developed sense of responsibility for contributing to the problems caused by electricity consumption are not likely to develop PN (Steg and Groot, 2010, De Groot and Steg, 2009, Zhang, Wang, et al., 2013).

AR is also noted as a variable that mediates the effect of AC on PN as there is no direct influence of AC on PN (see figure 8). That is to mean that a person's awareness of the consequence of the choice of action is not likely to arouse his personal norm without a developed sense of guilt for contributing to the problem. This translates that the influence of AC on PN is mediated by AR (Shin, Im, et al., 2018).

Figure 7 Direct Effect of AR on PN

Source: Adapted from De Groot and Steg (2009)

In measuring AR, Werff and Steg (2015) in their study measured the extent to which respondents felt they are responsible to help solve the problems caused by the use of energy. This was achieved by evaluating respondents views on statements including *"I think I can contribute to reducing environmental problems by reducing energy use"* on a Likert scale. Likewise, Harland et al (2007) in their study measured AR by asking respondents to choose between a seven-point Likert scale how they agree or disagree with statements (including *"someone who does not close the tap water is personally responsible for the environmental consequences"*) reflecting their responsibility for the problems caused by not closing the tap water. Abrahamse and Steg (2009) also in their study measured AR by assessing the degree to which respondents felt responsible for the problems caused by the use of energy. They achieved this by rating respondents views on statements reflecting their feeling of responsibility for the problems like *"I feel jointly responsible for the greenhouse effect".* Respondents views were then rated on a Likert scale. These ways of measuring AR was also used in the studies of De Groot and Steg (2009), Steg and De Groot (2010), Zhang et al. (2013), and Werff and Steg (2016).

Based on the foregoing and the definition adopted for AR in this study, the study measured AR on the extent to which users felt guilty for the problems caused by electricity consumption and their subsequent feeling of responsibility to help solve the problems. Hence, the indicators for AR was framed as (1) *feeling of guilt for the problems caused by electricity consumption* and (2) *feeling of responsibility to help solve the problem.* These indicators were measured by adopting the items used in measuring AR in the studies of Harland et al (2007), Abrahamse and Steg (2009), De Groot and Steg (2009), Steg and De Groot (2010), Onwezen et al. (2013), Werff and Steg (2015), and Van der Werff and Steg (2016). These items were modified to suit the context of this study and respondents views on them were rated on a Likert scale as applied in the studies of Harland et al (2007), Abrahamse and Steg (2009), De Groot and Steg (2009), Steg and De Groot (2010), Zhang et al. (2013), Onwezen et al. (2013), Werff and Steg (2015), and Werff and Steg (2016).

2.3.2.3 Personal Norms (PN)

PN of a person determines how he/she behave in a particular way. Studies using the NAM defined PN in the context of their study as *"...feel morally obliged to..."* (Werff and Steg, 2015, pg. 8); *"feelings of moral obligation to engage in a prosocial behaviour"* (Steg and Groot, 2010, pg. 725); *"feelings of moral obligation"* (Onwezen, Antonides, et al., 2013, pg. 142, Abrahamse and Steg, 2009, pg. 712); *"behavioural self-expectations"* (Harland, Staats, et al., 2007, pg. 323); *"employee's moral obligation to save electricity in one's company"* (Zhang, Wang, et al., 2013, pg. 1121).

Based on the above definitions in literature PN is considered as the moral influence that induces a person to behave in a particular way. Hence, the adapted definition for PN in this study is Users (staff and students of KsTU) feeling of moral obligation to act to reduce electricity consumption and its related environmental and socioeconomic effect.

According to NAM the development of PN is dependent on AC and AR (see figure 8) (Schwartz, 1977). This means that for users to develop the moral obligation to behave in a manner that helps to reduce electricity consumption, they must have developed a feeling of responsibility for contributing to the problem and solving the problem, which was aroused by their exposure to vital energy information and acknowledged awareness of the problems caused by electricity consumption. This is corroborated by Zhang et al. (2013) who stipulated that *"when one feels the negative consequences for not acting pro-socially and their own responsibility for not acting pro-socially, one will develop high personal norm"* (Zhang, Wang, et al., 2013, pg. 1121).

Figure 8 Effect of AC and AR on PN

Source: Adapted from De Groot and Steg (2009)

A highly developed personal norm of a person makes him/her behave in a way that protects the environment and the society (pro-social/pro-environmental behaviour) (Zhang, Wang, et al., 2013). This implies that without developed PN users are not likely to behave in a manner to reduce electricity consumption and its negative implications on the environment and society. Several studies testing the influence of PN on pro-environmental or energy behaviour found a positive direct relationship between people's PN and their behaviour in the use of resources including transport, water, and energy. Zhang et al et. (2013) in their study tested the hypothesis *" PN is positively related to electricity saving behaviour in organisations"* and their results confirmed the hypothesis to be true. Similarly, Werff and Steg (2015) reported that energy users are more likely to reduce their consumption when they develop strong personal norm because they feel morally obliged to perform such behaviour.

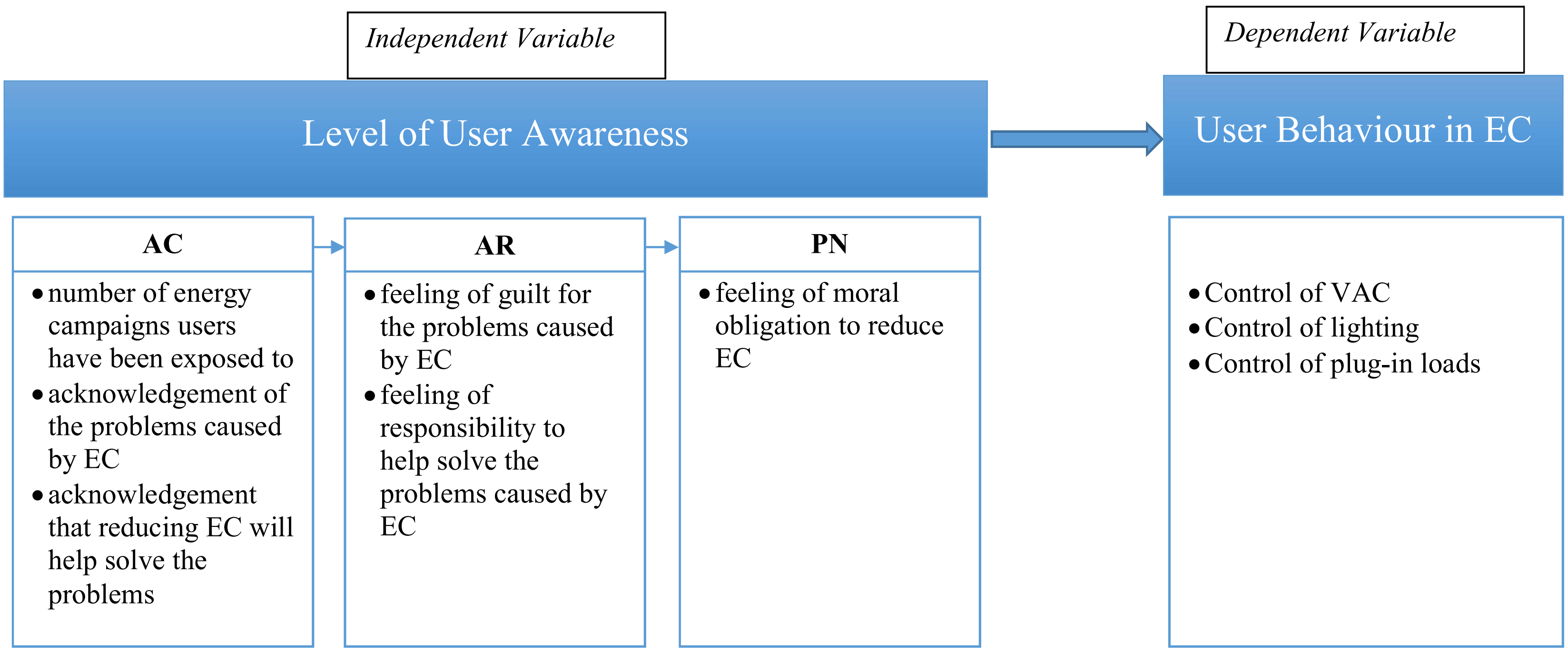
In measuring PN, Abrahamse and Steg (2009) assessed the extent to which respondents felt morally obliged to conserve energy. They achieved this by phrasing statements to reflect the feeling of moral obligation to save energy including the statement *"I feel morally obliged to reduce my energy use regardless of what other people do"* and *"I feel good about myself when I do not use a lot of energy"*. Likewise, De Groot and Steg (2009) in their study measured PN by evaluating how their respondents felt morally obliged to reduce the environmental problems caused by the use of energy. They asked respondents to score statements (including *"If I were to buy a new washing machine, I would feel morally obliged to buy an energy efficient one"*) within a five-point Likert scale. This approach to measuring PN has widely been used in other studies including studies by Harland et al (2007), Steg and De Groot (2010), Zhang et al. (2013), Werff and Steg (2015), and Werff and Steg (2016).

Based on the foregoing and the definition adopted for PN in this study, the study measured PN by the indicator *feeling of moral obligation to reduce electricity consumption.* The items used in measuring PN in the studies of Harland et al (2007), Abrahamse and Steg (2009), De Groot and Steg (2009), Steg and De Groot (2010), Onwezen et al. (2013), Werff and Steg (2015), and Van der Werff and Steg (2016) were adopted and modified to fit the context of this study. Respondents views on the items were rated on a Likert scale as applied by Harland et al (2007), Abrahamse and Steg (2009), De Groot and Steg (2009), Steg and De Groot (2010), Zhang et al. (2013), Onwezen et al. (2013), Werff and Steg (2015), and Werff and Steg (2016).

2.4 Conceptual Framework

The conceptual framework of the study aimed at displaying the main variables guiding the study in a graphical form. It shows the causal relationship between the variables and how they relate to each other. In figure 9 below, the independent variable '*Level of User Awareness'* and it sub-variables *'Awareness of Consequence (AC)', 'Ascription of Responsibility (AR)', 'Personal Norm (PN)',* as well as the dependent variable *'User Behaviour in Electricity Consumption'* are presented. Based on the literature reviewed on the concept of electricity consumption and the behavioural model of NAM, the conceptual framework shows the influence of the Level of User Awareness on User Behaviour in Electricity Consumption, where User awareness is defined by the sub-variables AC, AR, and PN. The framework also shows indicators for measuring the variables.

Figure 9 Conceptual Framework



Keynotes: AC: Awareness of Consequence; AR: Ascription of Responsibility; PN: Personal Norms; EC: Electricity Consumption; VAC: Ventilation and Air-condition

Chapter 3: Research Design and Methods

3.1 Introduction

Based on the literature reviewed on the concept/theories guiding the study, the variables of the study are defined and operationalised in this chapter. The chapter also presents the type of research design that was adopted for the study and highlights on the strategy, data collection methods, sample selection, and size as well as the techniques that were used in analysing the data collected. Further, the validity and reliability of the chosen research strategy and methodology are also presented in this chapter.

3.2 Research Questions

The main question that guided the study is: to what extent does the level of user awareness influence user behaviour in electricity consumption at KsTU?

Sub-research questions

- What is the level of user awareness of electricity consumption at KsTU?
- What is the current practiced user behaviour in electricity consumption at KsTU?
- How does user awareness (AC, AR, and PN) influence user behaviour in electricity consumption at KsTU?

3.3 Operationalisation

Definition of Theory /Concept, Variables, and Indicators

This section describes the adapted definitions for the behavioural model Norm-Activation Model and the concept of electricity consumption based on the reviewed literature. The adapted definitions for the variables of the study and their measurable indicators are also described below.

3.3.1 Norm-Activation Model (NAM)

NAM is one of the dominant behavioural models that explain the factors that influence human pro-environmental behaviour. The NAM stipulates Awareness of Consequence (AC), Ascription of Responsibility (AR) and Personal Norms (PN) as the three main variables that influence environmental/ energy behaviour (Schwartz, 1977, De Groot and Steg, 2009). The independent variable of the study 'User Awareness' was derived from this model with defined sub-variables as Awareness of Consequence (AC), Ascription of Responsibilities (AR), and Personal Norms (PN).

3.3.1.1 User Awareness (independent variable)

User awareness in this study is defined as the state of mindset where users (staff and students of KsTU) awareness of the adverse consequence of excessive electricity consumption makes them feel responsible for the problems caused by their action which in turn makes them feel morally obliged to act to resolve the problems (Schwartz, 1977, De Groot and Steg, 2009). This definition is translated into the sub-variables AC, AR, and PN defined below.

3.3.1.2 Awareness of Consequence (sub-variable 1)

This is defined as users (staff and students of KsTU) awareness about the adverse environmental and socioeconomic implications of their use of electricity and how they can reduce their electricity consumption. This sub-variable was measured by the indicators (1) *number of energy campaigns users have been exposed to,* (2) *users acknowledgement of the problems caused by electricity consumption,* and (3) *users acknowledgement that reducing electricity consumption will help solve the problems*. In measuring indicators (2) and (3), the items used in measuring AC in the studies of Harland et al (2007), Abrahamse and Steg (2009), De Groot and Steg (2009), Steg and De Groot (2010), Onwezen et al. (2013), Werff and Steg (2015), and Van der Werff and Steg (2016) were adopted and modified to reflect the indicators. Respondents views on the modified items were rated on a five-point Likert scale.

3.3.1.3 Ascription of Responsibility (sub-variable 2)

This sub-variable is defined as users (staff and students of KsTU) feeling of guilt for contributing to the problems caused by electricity consumption and feeling responsible to help solve the problems. This was measured by the indicators (1) *feeling of guilt for the problems caused by electricity consumption* and (2) *feeling of responsibility to help solve the problem.* These indicators were measured by adopting the items used in measuring AR in the studies of Harland et al (2007), Abrahamse and Steg (2009), De Groot and Steg (2009), Steg and De Groot (2010), Onwezen et al. (2013), Werff and Steg (2015), and Van der Werff and Steg (2016). The items were modified to suit the context of this study and respondents views on them were rated on a five-point Likert scale.

3.3.1.4 Personal Norm (sub-variable 3)

This sub-variable is defined as users (staff and students of KsTU) feeling of moral obligation to act to reduce the excessive electricity consumption and its related environmental and socioeconomic effect. This was measured by the indicator *feeling of moral obligation to reduce electricity consumption.* The items used in measuring PN in the studies of Harland et al (2007), Abrahamse and Steg (2009), De Groot and Steg (2009), Steg and De Groot (2010), Onwezen et al. (2013), Werff and Steg (2015), and Van der Werff and Steg (2016) were adopted and modified to fit the context of this study. Respondents views on the items were rated on a five-point Likert scale.

3.3.2 Electricity Consumption

This concept relates to the use of energy services for ventilation, and air-conditioning (VAC), lighting, outlets for plugging electrical appliances etc provided in buildings. The dependent variable of the study 'User Behaviour in Electricity Consumption' was derived from this concept as the use of energy services in buildings are largely influenced by the behaviour of users (Gul and Patidar, 2015, Chung and Rhee, 2014).

3.3.2.1User Behaviour in Electricity Consumption (dependent variable)

This variable is defined in this study as users (staff and students of KsTU) interactions with the classifications of energy services provided in building facilities. Signifying, user interactions with the control of lighting, VAC (ventilation and air-condition), and plug-in loads relating to their use of electricity in the university (Sun and Hong, 2017). The variable was measured by the indicators below:

- **Control of VAC**: the number of times users consciously control VAC systems in an attempt to reduce electricity consumption and the number of times users unconsciously control VAC systems in an energy wasteful manner (Sun and Hong, 2017, Li, Menassa, et al., 2017).
- **Control of lighting**: the number of times users consciously turn off lights in an attempt to reduce electricity consumption and the number of times users unconsciously leave or turn lights on in an energy wasteful way (Sun and Hong, 2017, Li, Menassa, et al., 2017).
- **Control of plug-in loads:** the number of times users consciously turn off and unplug electrical appliances not in active use in an attempt to reduce the use of electricity and the number of times users unconsciously leave unused electrical appliances on and plugged in (Sun and Hong, 2017).

3.3.3 Summary of Operationalisation

Table 2 Summary of Operationalisation

Theory or concept	Variables	Sub-variables	Indicators
Norm-Activation Model (NAM)	Level of User Awareness	Awareness of consequence (AC)	• number of energy campaigns users have been exposed to • users acknowledgement of the problems caused by EC (measured on a five-point Likert scale) • users acknowledgement that reducing EC will help solve the problems (measured on a five-point Likert scale)
		Ascription of responsibility (AR)	• users feeling of guilt for the problems caused by EC (measured on a five-point Likert scale) • users feeling of responsibility to help solve the problems caused by EC (measured on a five-point Likert scale)
		Personal Norm (PN)	• users feeling of moral obligation to reduce EC (measured on a five-point Likert scale)
Electricity consumption	User Behaviour in Electricity Consumption		• Control of VAC measured by the number of times users consciously or unconsciously operate the system in a way that saves or waste electricity • Control of lighting measured by the number of times users consciously or unconsciously turn off or leave lights on • Control of plug-in loads measured by the number of times users consciously or unconsciously control plugged in appliances in a way that saves or waste electricity

3.4 Research Strategy

The choice of a research strategy is influenced by several factors including the nature of the research problem, the number of units involved in the study, and the existing knowledge on the subject of study (Thiel, 2014). The main research question of this study is to what extent does the level of user awareness influence user behaviour in electricity consumption at KsTU? Considering this question, the nature of its variables and the number of units involved in the study, the survey was the most suitable research strategy to be used in this study.

The use of survey is suitable for studies that involve a large number of units as in the case of this research (Users: 9,859 students and 649 staff of KsTU). This strategy made it easy to efficiently gather primary data from the large population of students and staff of KsTU. Also survey is appropriate for gathering data such as data on people's behaviour, perception, and norms in a quantifiable form as reflective in the variables and sub-variables of this study (AC, AR, PN and user behaviour in electricity consumption) (Thiel, 2014, Creswell, 2012).

3.5 Data Collection Methods

Choosing an appropriate data collection method is also influenced by factors including the type of data required (whether primary qualitative/quantitative data or secondary qualitative/quantitative) and the time available to collect the data (Thiel, 2014). Considering the research question, the unit of study and the variables of this study, primary quantitative data was required to be able to meet the objective of the study. This was achieved through the use of close-ended questionnaires as the method of collecting data from a large number of respondents. The questionnaire was administered via an online survey to students and face-to-face with the staff of the university.

The items of the questionnaire were developed based on the review of literature on the methods of measuring the variables of NAM (AC, AR, and PN) (Werff and Steg, 2015, Werff and Steg, 2016, De Groot and Steg, 2009, Steg and Groot, 2010, Abrahamse and Steg, 2009, Harland, Staats, et al., 2007, Onwezen, Antonides, et al., 2013) and behaviour in consuming electricity (Sun and Hong, 2017, Li, Menassa, et al., 2017). Items on the questionnaire measuring AC, AR and PN were adopted from Harland et al (2007), Abrahamse and Steg (2009), De Groot and Steg (2009), Steg and De Groot (2010), Onwezen et al. (2013), Werff and Steg (2015), and Van der Werff and Steg (2016) and modified to fit the context of this study.

The questionnaire entailed an introductory paragraph, introducing the researcher and the objective of the research. This was followed by three parts, where part 1 sought to measure the level of user awareness with fifteen items. The first three items of part 1 were on a nominal scale and the remaining were on a five-point Likert scale. Part 2 of the questionnaire contained nine items on a five-point Likert scale measuring user behaviour in electricity consumption. The final part which is the part 3 had four items on nominal, ordinal and interval scale ascertaining the background information of the respondents (see Annex 1 for a copy of the questionnaire).

3.6 Area of Study

The area of study in this research was the main campus of Kumasi Technical University (KsTU) in Ghana. The campus is characterised by twenty-one building blocks (as shown in the campus map in figure 1) consisting of classrooms, offices, libraries, laboratories, auto-workshops, student accommodation, sports facilities and recreational facilities (EMSD, 2013).

3.7 Unit of Study

The unit of study in this research is the staff and students of KsTU who form the primary users of the university's building facilities and it associated energy services. These staff and students are termed as 'Users' in this study, meaning users of energy services in KsTU. The current population of Users in KsTU stands at 9,859 for students and 649 for staff making a total of 10,508 (Planning Office, 2018).

The staff of the university is categorised as Teaching (T) and Non-Teaching (NT) staff. The T staff comprises the various lecturers and researchers who provide academic services in the university. The NT staff are the staff that provides academic support services in the university including administrators, accountants, security personnel, cleaners etc. These NT staffs are further grouped under the categories Senior Members (SM), Senior Staff (SS) and Junior Staff (JS). Where SM are those NT staff with a master educational level, SS are those with first-degree educational level and JS are those with an educational level below first degree (see table 3 below for the various categories of Users in KsTU).

3.8 Sample Size and Selection

According to Thiel (2014), it is almost impossible to gather data from the entire unit of a study except in cases where the unit of study is limited in size. There is, therefore, the need to draw a sample size to represent the entire unit of a study. The sample size for this study calculated on a computer-based sample size calculator from 'SurveyMonkey' with a confidence level of 95% and 5% margin of error is estimated as 371 Users (SurveyMonkey, 2018). Due to the limited time available for the data collection and analysis, the sample size for the study was reduced to 250 Users which may affect the representativeness of the total population.

In apportioning the sample size it was laudable to consider the proportion of each category of Users that form the total population. However, considering the fact that only about 6% of the entire student population resides on the university's main campus (EMSD, 2013), it implied that generally students spend very few hours only attending lectures as compared to staff (who spend a minimum of 8 working hours daily on the campus). This can be translated in the magnitude of their use of energy services provided in the university's main campus. It was then also logical to categorise the students into those who reside on the campus and non-residence of the campus, however, the data collection period fell within the vacation period and made this division impossible.

Based on the above considerations the sample size was distributed equally among the initially considered categories of Users in KsTU (see table 3 below for the breakdown of users into categories and their apportioned sample size). This process of apportioning the sample can be considered as stratified sampling. In using stratified sampling, the unit of study is first grouped into various strata, after which any other type of probability sampling can be applied to select the sample from within the strata. This process ensures a better reflection of the entire unit of study (Neijenhuis, 2018).

Table 3 Categories of Users and apportioned sample size

Users	Categories	Population	Sample Size
Students		**9859**	**50**
Staff	Teaching (T)	272	50
	Senior Members (SM)	101	50
	Senior Staff (SS)	106	50
	Junior Staff (JS)	170	50
	Sub-total	***649***	**200**
Total		**10508**	**250**

Source: Planning Office (2018)

From table 3 it can be deduced that the sample was composed of a total of 50 students and 50 T staff, 50 SM, 50 SS and 50 JS (forming a total of 250 Users).

To select the number of Users from within the various categories of staff, the systematic probability sampling was used. The process of selection is explained below:

1. The list of all staff within various categories was obtained from the planning office of the university. The list of the staff was numbered 1 to 272 (for T), 1 to 101 (for SM), 1 to 106 (for SS), and 1 to 170 (for JS).
2. In applying systematic sampling, the sample interval for the various staff categories was calculated by dividing the population by the sample size:
   Teaching: 272/50= 5; Senior Members 101/50= 2; (SS) 106/50= 2; (JS) 170/50= 3
3. After obtaining the sample interval for all the categories, a number was randomly selected (manually) between 1 and 5, 2, 2 and 3 from the list of staff (T, SM, SS, JS respectively). This was to determine which user(s) to be the first to be included in the sample.
4. After the first number (sample) was obtained, every 5th, 2nd, 2nd, and 3rd number within the staff categories (T, SM, SS, and JS respectively) counting from the randomly selected number was selected as sample for the study until the total sample size for all categories was obtained.

In selecting the sample from within the student population an online distribution link for the survey was shared on the general KsTU student WhatsApp page through the Student Representative Council (SRC) of the university. The students were encouraged to share the link with other students of the university who were not on the WhatsApp platform via other mediums (eg. email). This provided a fair chance for all students to participate in the study. The Online survey was set to close down after the first 50 response were recorded (see annex 1 for the link to the online survey).

3.9 Fieldwork and Data Collection

Fieldwork and data collection began from 25th June to 20th July 2018 which is about 4 weeks. Starting 25th June 2018 the structured closed-ended questionnaire was administered face-to-face to the sampled staff within the various categories of the university by the researcher and one volunteered assistant.

Some of the staff preferred to fill in the questionnaire instantly while others preferred to keep the questionnaire and fill in later at their convenient time. The researcher and her assistant, therefore, took note of all those staffs who preferred to keep the questionnaire and followed up on them at a later time and/ days to collect them back. It must be noted that some of the respondents within the Junior Staff (JS) category who had a low level of education preferred the researcher and the assistant to read and translate the items of the questionnaire to them to aid them in their participation in the study.

Within the first 2 weeks of data collection, the researcher encountered that about 46% of the randomly selected staff were either on study leave or mostly on annual leave hence met their absence. This was noted as a general practice where staff of the university are encouraged to take their annual leave during the long vacation period (May-August) of the university. The data collection period fell within this long vacation period hence there was the need for the researcher to readjust the sample selection to convenient sampling. The researcher then conveniently distributed the questionnaire to those other staff who were available during the period of data collection in order to meet the targeted number of respondents.

To increase the response rate and to ensure the target sample size from the staff is reached, a total of 220 questionnaires was distributed to staff. Out of this number, 146 was retrieved by the end of the data collection period. This rate of response from staff can be attributed to the unwillingness of some staff to participate in the study, some of them took the questionnaire but failed to answer them even after constant reminders by the researcher. The response rate could also be related to the fact that most of the teaching staff were not regular on campus during the vacation period even though they were not on annual leave, hence questionnaires issued to such staff could not be retrieved.

With respect to gathering data from the students, a link to the online survey (containing the items of the closed-ended questionnaire) was shared on the general KsTU student WhatsApp page through the Student Representative Council (SRC) of the university on 25th June 2018. Students were encouraged to share the link with other students of the university who were not on the WhatsApp platform via other mediums (eg. email).

Observing the responses from the online survey, the survey closed down with 50 recorded responses within the first week of the data collection period. However, it was noticed that most of these responses were invalid (there were no recorded answers to the items of the questionnaire). Implying that most of the respondents just accessed the link but did not bother to answer the survey questions and once the link has been accessed and the session remains inactive for 24 hours the system closes the session and records it as an answered survey. Based on this observation, the researcher deleted all the invalid recorded responses from the system and remained with 8 valid responses. The survey was then reactivated to record more responses in order to meet the target number of sample. Through the SRC of the university, the researcher sent a message to the students thanking those who have completed the survey and reminding those who have not completed the survey to do so.

By the end of the second week, the observed valid recorded responses from the online survey increased to 41. The slow pace of response from the students could be attributed to the fact that students were on vacation during the period and some students do not get access to the internet when they are in their homes or outside the university campus. To increase the response rate another reminder message was sent within the third week and the survey closed down again with 50 recorded response from students by the end of the third week. Out of this number, 11 were considered as invalid and subsequently rejected. This was due to incomplete responses to the items on the questionnaire.

To cover up for the 11 incomplete and rejected response, the researcher during the last week of the data collection period conveniently distributed questionnaires face-to-face to those students who were on internships at the various faculties of the university. To avoid double participation, the students were asked if they had already participated in the study through the online survey, those who responded negatively were given the questionnaires to fill in. This approach allowed for the attainment of the total targeted sample size (50) for students.

In total, 196 responses were recorded from the various categories of Users in KsTU. This number represents 78% response rate from the final target of 250 Users and 53% of the original target of 371 Users.

3.10 Validity and Reliability

3.10.1 Validity

According to Thiel (2014), there are two types of validity in research namely internal and external validity. The internal validity relates to how well the concept(s)/theories of the study has been translated into unambiguous measurable indicators to measure what they are intended to measure. The internal validity also relates to the existence of the assumed causal relationship between the variables of the study.

Based on the above understanding of internal validity, literature was reviewed on the behavioural model of NAM and how the variables of the model (AC, AR, PN) were measured in similar studies. The items used in measuring these variables and their causal relation as applied in the studies of Harland et al (2007), Abrahamse and Steg (2009), De Groot and Steg (2009), Steg and De Groot (2010), Onwezen et al. (2013), Werff and Steg (2015), and Van der Werff and Steg (2016) were adopted and modified to suit the context of this study. These items are recognised as valid items for measuring the variables of NAM, as they have been successfully used in different studies to test the model and the causal relationship between it variables. Also, the literature reviewed on the concept of electricity consumption guided the translation of the dependent variable into measurable indicators to measure the variable (Sun and Hong, 2017, Li, Menassa, et al., 2017, Zhao, Lasternas, et al., , 2014).

Further, the adopted and developed items of the questionnaire were tested in a pilot among 10 colleagues (including staff of KsTU) before the actual data collection period. This was to assess how best the items are clear and easy to understand as well as the estimated time for completing the questionnaire by the respondents. This was also to ensure that the indicators and items of the questionnaire were capable of measuring the purpose to which they were constructed. The feedback and results from the pilot were good and aided the reframing of some terminologies in the questionnaire eg. ‘energy insecurity’ was changed to ‘unreliable electricity supply’ to fit the context of the region and for easy understanding by respondents. The words ‘consciously’ and ‘unconsciously’ were also bolded to avoid any form of oversight in reading the items by respondents.

External validity, on the other hand, is in relation to whether the findings of a study can be generalised and hold for similar units of study. This can be made possible through the right selection of the sample and sample size for a study. A fair representation of the unit of study and high response rate makes it possible to generalise the findings of a study (Thiel, 2014).

In this study, the generalization of the findings is weakened due to the fact that the required sample size (371) was reduced to 250 Users basing on the limited time frame available for data collection and analysis. This could be posed as a misrepresentation of the total population hence the findings cannot be generalised. The inability to generalize the findings can also be related to fact that the planned sampling procedure (systematic random) could not be fully implemented due to the challenges explained in section 3.9 above.

3.10.2 Reliability

Reliability relates to how accurate and consistent the variables of a study are measured. The variables of a study should be measured by items that are clear and precisely focused on the measured variables. The measurable items should be such that their use in similar studies should provide similar findings (Thiel, 2014). The items that were adopted in this study for measuring the variables have been used in similar studies which yielded similar results in their own context (Sun and Hong, 2017, Werff and Steg, 2016, De Groot and Steg, 2009, Steg and Groot, 2010, Abrahamse and Steg, 2009, Harland, Staats, et al., 2007, Onwezen, Antonides, et al., 2013, Li, Menassa, et al., 2017). Internal consistency for the items in the questionnaire and their scales were also measured on a Cronbach’s alpha using SPSS.

3.11 Data Analysis Methods

Quantitative data gathered from the field were coded, labelled, and entered into the Statistical Package for Social Sciences (SPSS) software for analyses. A descriptive statistical analysis was carried out by running the frequencies for both the dependent and independent variables as well as data on the background information of respondents. This helped to ascertain the mean and standard deviation scores for the measured variables and gained initial insight of the variables. Noted errors from the outcome of the frequencies were corrected by modifying (remove/replace/recode) the data in the database.

A reliability test was then carried out to ascertain the consistency of the indicators in measuring the variables of the study. With a Cronbach alpha value of ≥ 0.6, the consistency of the indicators was considered strong enough for aggregation and computation into variables for easy handling of data. The aggregated and computed variables showed the average scores for the items within the measurement scale.

The value(s) 1, 2, 3, 4, and 5 on the 5-point Likert scale indicates the level of User awareness and the frequency Users consciously/unconsciously control VAC, lighting, and plug-in loads in an energy saving or wasteful way. Using the mid-point (2.5) value of this measurement scale as the bases for evaluation of responses, a mean score above 2.5 indicates the existence of user awareness (AC, AR, and PN) among Users of KsTU. While a mean score below 2.5 indicates low user awareness (AC, AR, and PN) among Users. With respect to User(s) behaviour in electricity consumption, a mean score above 2.5 indicates a moderate to a high frequency of conscious effort by Users to reduce electricity consumption. Whiles a mean score below 2.5 indicates a low frequency of conscious effort to reduce electricity consumption, implying Users unconscious control of VAC, lighting and plug-in loads in a manner that waste electricity.

Furthermore, a Pearson correlation analysis was conducted on the variables to ascertain the correlation and the significance of the relationship between the variables of the study. The strength of the correlation and the significance of the relationship between variables are expressed by the correlation coefficient (r) and the p-value respectively. A correlation coefficient (r) value can either be a positive or negative value indicating a positive, negligible or negative relationship between the variables. The strength of the relationship is determined by the distance of the (r) value from zero, the further the (r) value from zero the stronger the relationship between the variables. Also, a p-value of ≤ 0.05 indicates a significant relationship between variables, whiles a p-value > 0.05 indicates no significant relationship between the variables (Herpen, 2018). This type of analysis, however, does not show the causal relationship between the independent (user awareness: AC, AR, and PN) and dependent (User behaviour in electricity consumption) variables hence an inferential statistical analysis was performed (Thiel, 2014).

In conducting and choosing the appropriate inferential statistical analysis, the measurement level of both the dependent and independent variables was taken into consideration (Thiel, 2014). Considering the fact that the measurement level of User Awareness (independent variable) and Behaviour in Electricity Consumption (dependent variable) were on a Likert scale, the appropriate inferential analysis to perform was the multiple regression analysis. The multiple regression analysis is expressed by the regression coefficient (B) value. The B value indicates the regression equation that predicts the dependent variable from the independent variable. The larger the value the greater the effect of the independent variable on the dependent variable. A negative B value indicates no or inverse relationship between the variables (Herpen, 2018). This analysis helped to explain the influence that User Awareness (AC, AR, PN) has on User Behaviour in Electricity Consumption.

It must also be emphasized that during the piloting of the questionnaire (which involved staff of the university) a discussion on the research with a lecturer specialized on energy issues and the responsible person for utilities on the campus brought some relevant information which is useful for gaining insights into the outcome of the research. These relevant information are referred to where necessary in the discussion of the results in the next chapter.

Chapter 4: Research Findings

4.1 Introduction

This chapter seeks to present the findings of the data gathered from the field. The chapter begins with a brief description of the case and the characteristics of the respondents of the study. This is followed by the findings presented and discussed in line with the variables of the study.

4.2 Description of the Case

The study was based on a survey of 196 Users (staff and students) of KsTU in Ghana. The objective of the study was to explain how the level of user awareness influence user behaviour in electricity consumption at KsTU. User awareness in this study was defined based on the three components of NAM being Awareness of Consequence (AC), Ascription of Responsibility (AR), and Personal Norm (PN).

KsTU is one of the public technical universities in Ghana with a total population of 10508 staff and students (Planning Office, 2018). Its main campus is the hub for the university's major activities and is characterised by building blocks that are connected with energy services to aid in the day to day activities of the university. The staff and students form the primary users of the university's facilities including energy services hence formed the sample for the study.

4.3 Characteristics of Respondents

To get a fair view of the representation of the sampled population of the study the gender, age, educational level and the category of the sample within which respondents fall under were asked of all respondents. Figure 10 below shows the summary of the characteristics of the surveyed respondents obtained from the descriptive statistical analysis conducted.

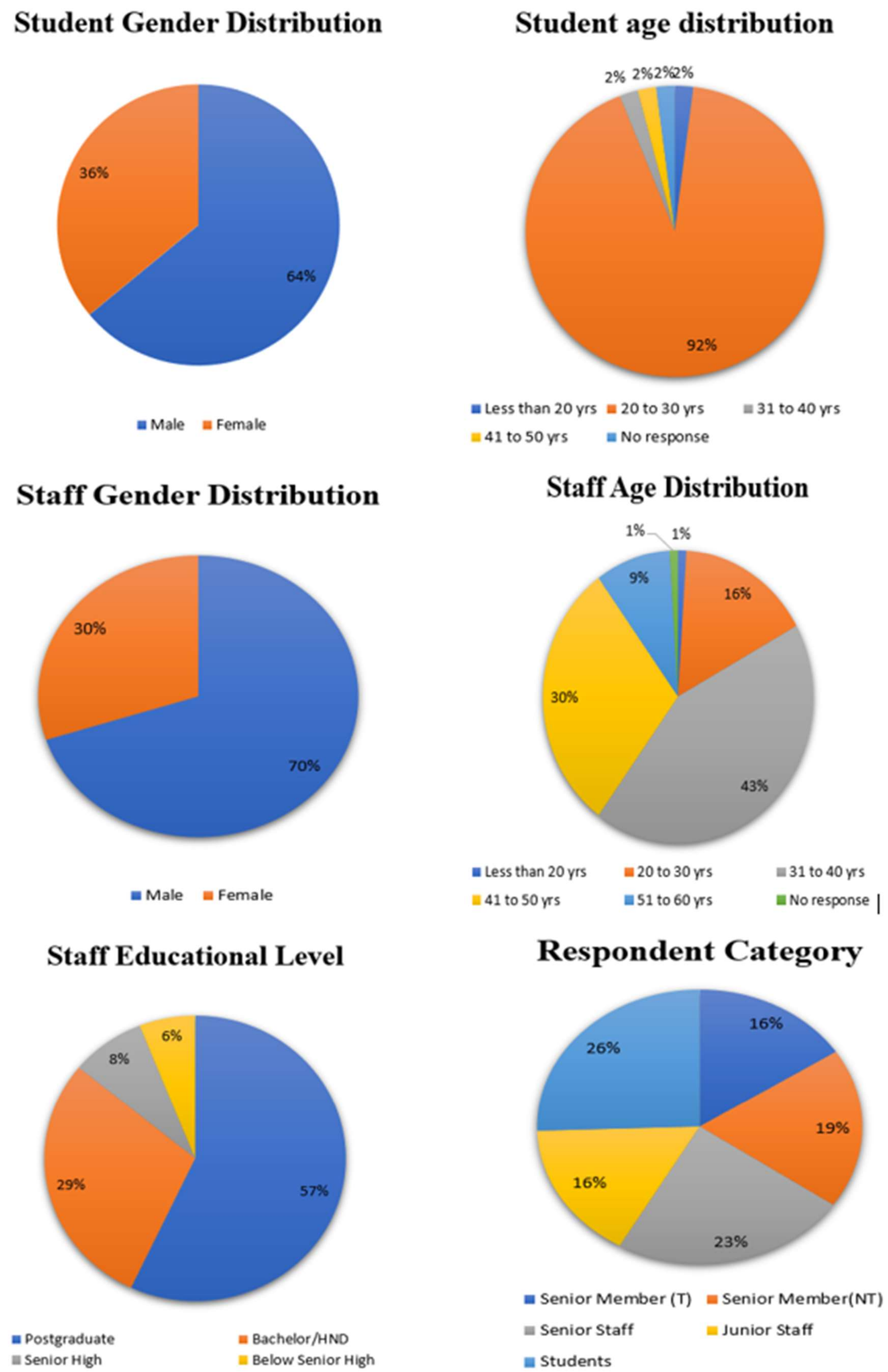
It can be observed from figure 10 that the majority of the surveyed respondents were male representing 70% and 64% for staff and students respectively. This can be related to the fact that the population of the university is male dominated (Kumasi Technical University, 2018).

It can also be deduced from figure 10 that the age distribution of students was largely distributed between the age group 20 to 30 years representing 92% of the sampled students. While the age distribution of staff was fairly distributed between the age groups 31 to 40 years and 41 to 50 years, with the former being 13% higher than the later. The least age group for staff was less than 20 years representing 1% of the sampled staff. Also, 3 respondents representing 1% and 2% of the surveyed staff and students (respectively) did not indicate their age group. This age distribution of the sampled respondents is in line with the age distribution of staff and students recorded by the Planning office of the university (Planning Office, 2018).

With respect to the educational level, it is obvious that all the surveyed students had Bachelor/HND as their level of education since that is the core level of education provided by the university (Kumasi Technical University, 2018). As shown in figure 10, the majority of the surveyed staff representing 57% indicated Postgraduate as their level of education and this could be explained by the fact that more than 50% of the university's staff population are Senior members (teaching and non-teaching) (Planning Office, 2018). This was followed by Bachelor/HND representing 29% and 6% representing the least level of education being below senior high education.

Generally, students represented 26% of the surveyed respondents followed by senior staff (23%), then 19% for senior member (non-teaching) and 16% each for both senior member (teaching) and junior staff.

Figure 10 Summary of the Characteristics of Respondents



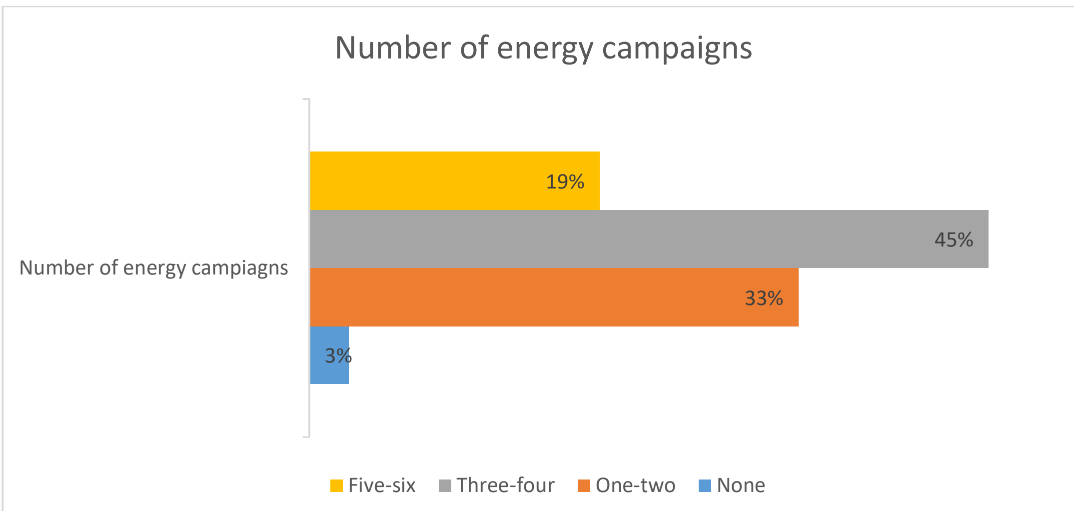
4.4 Level of User Awareness

User awareness as explained in the previous chapters is defined in this study by Awareness of Consequence (AC), Ascription of Responsibility (AR), and Personal Norm (PN). These 3 components are used to define user awareness based on the review of the literature on the NAM. The findings on the 3 components as obtained from the field data are elaborated and discussed in the subsections below.

4.4.1 Awareness of Consequence (AC)

AC was defined in the study as Users (staff and students of KsTU) awareness about the adverse environmental and socioeconomic implications of their use of electricity and how they can reduce their electricity consumption. This was measured based on the number of energy campaigns Users have been exposed to, Users acknowledgement of the problems caused by excessive electricity consumption, and Users acknowledgement that reducing electricity consumption will help reduce the problems. In measuring AC, 8 items were used with the first 3 seeking the number of energy campaigns Users have been exposed to. Figure 11 shows the summary of the frequency of the responses to the first 3 items expressed in percentages.

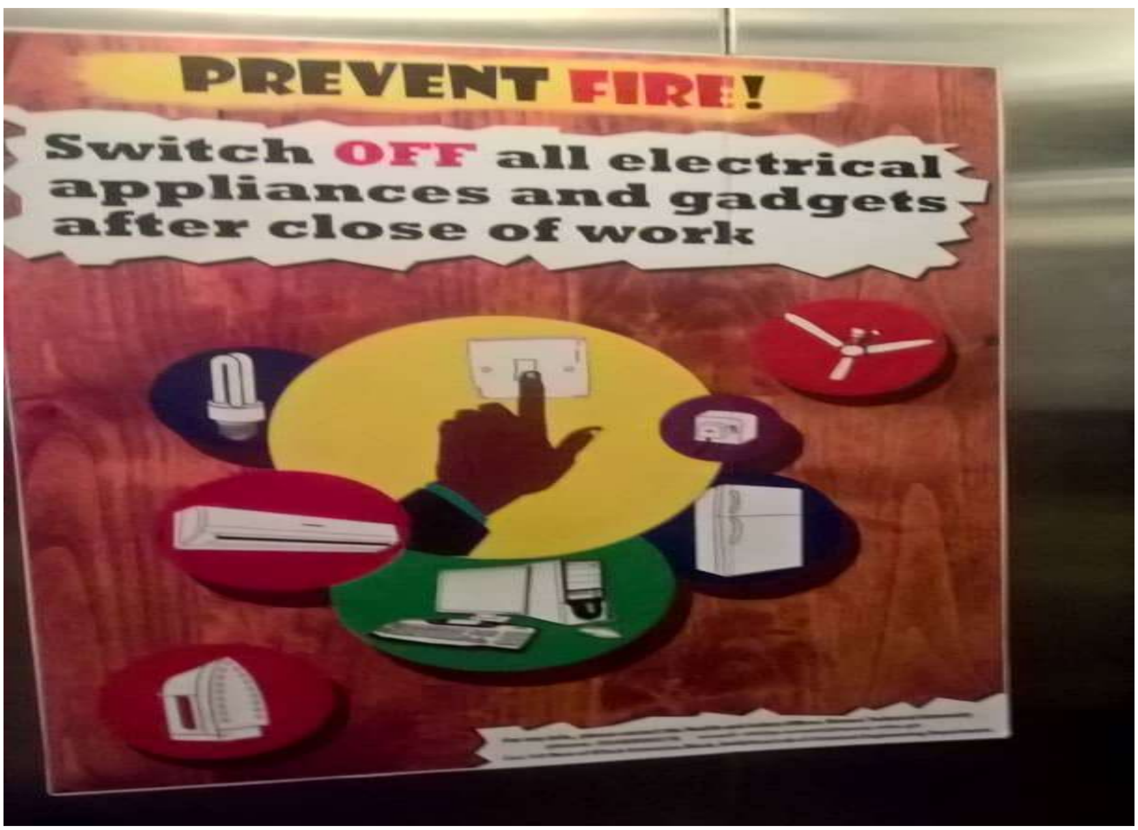
Figure 11 Summary of the number of energy campaigns users have been exposed to



From figure 11 it can be observed that 45% Users of KsTU have been exposed to 3 to 4 number of energy campaigns. This was followed by 33% Users exposed to 1 to 2 number of energy campaigns. Only 3% of the Users have not been exposed to any energy campaign. This result implies a moderate to high level of exposure to energy campaigns among Users of KsTU. This result could be related to the energy conservation awareness posters noted at different locations within the university campus during the data collection period. It was observed that these posters were targeted for fire safety but had energy conservation messages as well (see photograph 1 below for images of some of the noticed posters).

As stipulated from the literature reviewed, exposure to various forms of energy campaigns informs Users about important energy use information. This important information includes information about the adverse consequences related to excessive electricity consumption and the actions to help reduce the problem (Werff and Steg, 2015, Wai, Mohammed, et al., 2009). Based on Users exposure to this vital information, it is expected that Users should be able to acknowledge and relate their use of electricity to the environmental and socioeconomic problems caused by excessive electricity consumption. And also acknowledge that reducing electricity consumption can help reduce these problems (Werff and Steg, 2015, Li, Menassa, et al., 2017). The findings from the remaining five items measuring AC will either be confirmed or disputed by this assertion from the literature.

Photograph 1 Some of the fire safety posters showing energy conservation message at KsTU



Source: Author's photograph during the field visit

The remaining 5 items measuring AC were adopted from Harland et al (2007), Abrahamse and Steg (2009), De Groot and Steg (2009), Steg and De Groot (2010), Onwezen et al. (2013), Werff and Steg (2015), and Van der Werff and Steg (2016) and modified to fit the context of this study. Respondents were asked to indicate on a five-point Likert scale the extent of their agreement to the following statements (see table 4).

Table 4 Adopted and modified items measuring AC

		Strongly disagree	Disagree	Neutral	Agree	Strongly agree
4.	Excessive electricity consumption causes environmental problems such as carbon emission and climate change	1	2	3	4	5
5.	Excessive electricity consumption has no relation with the problem of climate change	1	2	3	4	5
6.	Excessive electricity consumption causes socioeconomic problems like unreliable electricity supply	1	2	3	4	5
7.	Reducing electricity consumption will not help solve the problem of unreliable electricity supply	1	2	3	4	5
8.	Reducing electricity consumption will help reduce carbon emission	1	2	3	4	5

For easy handling of the data, item(s) 5 and 7 (from table 4) which are reverse statements were reverse coded in the database for ‘Strongly agree’ to have the lowest value 1 up to ‘Strongly disagree’ which was given the highest value 5.

The summary of the responses and their measured mean scores are shown in figure 12 and table 5 respectively.

Figure 12 Summary of responses on the adopted and modified items measuring AC

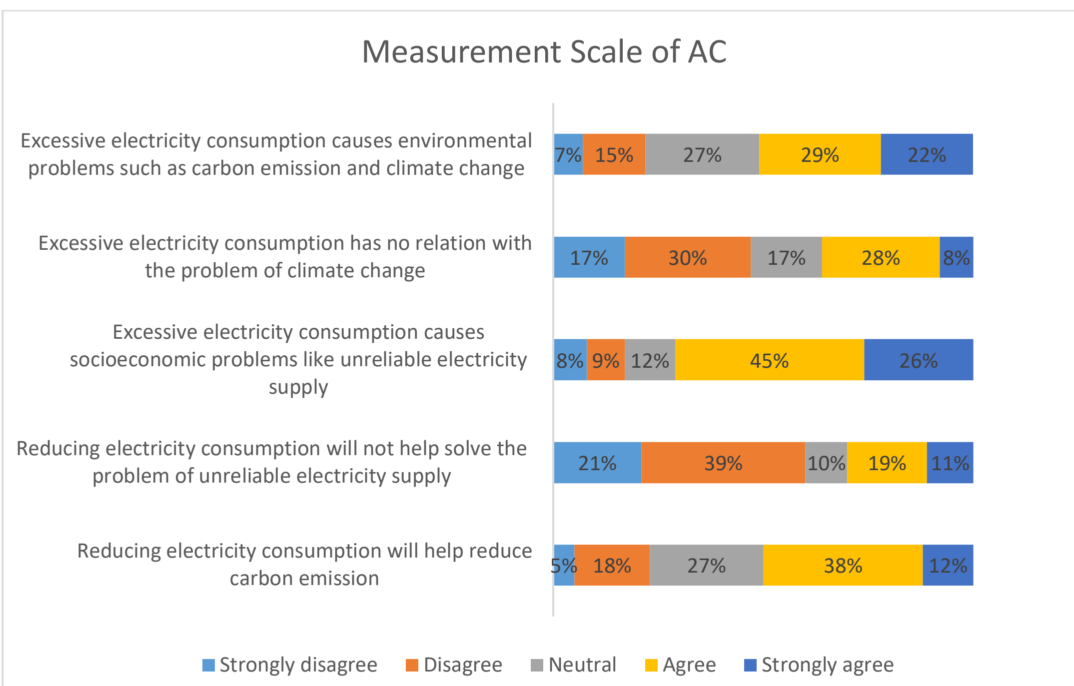


Table 5 Summary of the measured scores for the adopted and modified items measuring AC

Items		Mean	Std. Deviation	N
4.	Excessive electricity consumption causes environmental problems such as carbon emission and climate change	3.43	1.194	196
5.	Excessive electricity consumption has no relation with the problem of climate change	3.20	1.248	196
6.	Excessive electricity consumption causes socioeconomic problems like unreliable electricity supply	3.72	1.167	196
7.	Reducing electricity consumption will not help solve the problem of unreliable electricity supply	3.38	1.313	196
8.	Reducing electricity consumption will help reduce carbon emission	3.34	1.071	196
	Awareness of Consequence (AC)	**3.42**	**0.915**	**196**

Observing the mean scores from table 5 above it can be deduced that generally respondents fairly acknowledges and relates their use of electricity to the environmental and socioeconomic problems experienced in the world in recent times. The results also suggest that respondents fairly acknowledges that reducing electricity consumption will help reduce the problems caused by electricity consumption. This is reflective in the combined percentages for the respondents who chose 'Strongly agree' and 'Agree' for items 4,6, and 8 being 51%, 71%, and 50% respectively (as shown in figure 12). The percentages of those respondents who chose 'Strongly disagree' and 'Disagree' for the reverse statements (items 5 and 7) also depicts a fair level of awareness about the consequence of excessive electricity among Users of KsTU. This result is justified by the assertion in literature that for a person to be informed and aware of the negative effects of excessive electricity consumption and how to mitigate the problems, he/she may have been exposed to some form of energy campaign (Werff and Steg, 2015, Li, Menassa, et al., 2017, Wai, Mohammed, et al., 2009).

With a measured reliability score of 0.819 Cronbach's αlpha, the 5 items were aggregated and computed into the sub-variable Awareness of Consequence (AC). With a mean score of 3.42 (as shown in table 5) out of the highest value score (5), Users of KsTU are considered to have a fair/moderate level of AC.

According to the NAM, Users are likely to feel guilty for contributing to the problems caused by excessive electricity consumption if they are aware and well informed about the negative consequence of their use of electricity. And are also likely to feel responsible to help solve the problems caused by excessive electricity consumption (Schwartz, 1977). The findings from the Ascription of Responsibility (AR) component of User awareness as defined in this study will either be corroborated or criticised by this assertion of the NAM.

4.4.2 Ascription of Responsibility (AR)

AR in this study was defined as Users (staff and students of KsTU) feeling of guilt for contributing to the problems caused by excessive electricity consumption and feeling responsible to help solve the problems. In measuring AR 4 items adopted from Harland et al (2007), Abrahamse and Steg (2009), De Groot and Steg (2009), Steg and De Groot (2010), Onwezen et al. (2013), Werff and Steg (2015), and Van der Werff and Steg (2016) were modified to fit the context of this study. Respondents were asked to indicate on a five-point Likert scale the extent of their agreement to the following statements (see table 6).

Table 6 Adopted and modified items measuring AR

		Strongly disagree	Disagree	Neutral	Agree	Strongly agree
9.	I feel guilty for contributing to the problems caused by excessive electricity consumption (eg. climate change, unreliable electricity supply)	1	2	3	4	5
10.	My use of electricity does not contribute to the problem of climate change	1	2	3	4	5
11.	I feel jointly responsible to help solve the problems caused by electricity consumption (eg. unreliable electricity supply)	1	2	3	4	5
12.	It is not my responsibility to help solve the problem of climate change	1	2	3	4	5

For easy handling of data, items 10 and 12 which are reverse statements were reverse coded in the database for 'Strongly agree' to have the lowest value 1 up to 'Strongly disagree' which was given the highest value 5. Figure 13 and table 7 below shows the summary of the responses and their measured scores respectively.

Figure 13 Summary of responses on the adopted and modified items measuring AR

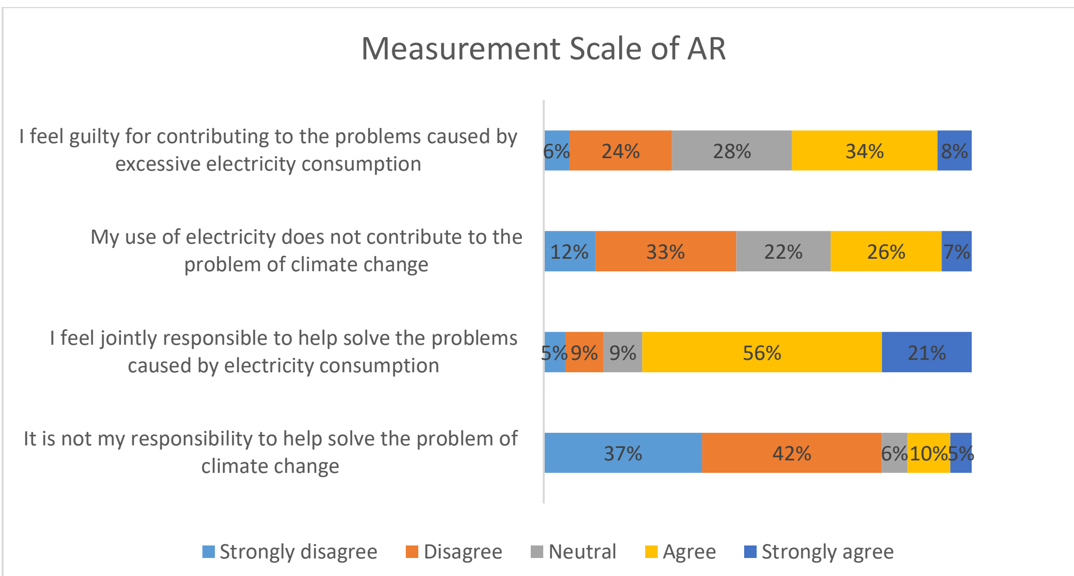


Table 7 Summary of the measured scores for the adopted and modified items measuring AR

Items		Mean	Std. Deviation	N
9.	I feel guilty for contributing to the problems caused by excessive electricity consumption (eg. climate change, unreliable electricity supply)	3.14	1.065	196
10.	My use of electricity does not contribute to the problem of climate change	3.17	1.158	196
11.	I feel jointly responsible to help solve the problems caused by electricity consumption (eg. unreliable electricity supply)	3.80	1.026	196
12.	It is not my responsibility to help solve the problem of climate change	3.95	1.134	196
	Ascription of Responsibility (AR)	**3.52**	**0.772**	**196**

From table 7 it can be observed that the mean scores for all 4 items were above the midpoint value 2.5. This infers a moderate level of developed AR among Users of KsTU and means that Users of KsTU fairly feel guilty for contributing to the problems caused by excessive electricity consumption and responsible to help solve the problems. This result is confirmed by the NAM, which suggests that when Users are aware of the negative implications of excessive electricity consumption, they will feel guilty and responsible to help solve the problems caused by excessive electricity consumption (Steg and Groot, 2010, Zhang, Wang, et al., 2013, Werff and Steg, 2015).

However, an examination of the summary responses presented in figure 13 shows that Users feeling of responsibility to help solve the problems caused by excessive electricity consumption is stronger than their feeling of guilt for contributing to the problems. This is represented by 79% (combined scores) for those who chose 'Disagree' and 'Strongly disagree' for item 12 and 77% (combined scores) for those who chose 'Agree' and 'Strongly agree' for item 11. Whereas respondents who chose 'Agree' and 'Strongly agree' for item 9 and 'Disagree' and 'Strongly disagree' for item 10 represent less than 50% (combined scores for each item). This outcome could be related to the fact that some Users believe that the physical characteristics of the buildings also influences their behaviour and contribute to the problem of excessive electricity consumption as documented in the literature (Adjei-Twum, A., 2017, Kwarteng, 2017, Chung and Rhee, 2014). This is also corroborated by the perception of the responsible person for utilities at KsTU and the expert on energy issues revealed during the discussion of the research. They perceived that the building characteristics including poor maintenance of the buildings also influenced how Users behave in their use of electricity at the university and also has a contribution to the excessive electricity consumption.

With the tested reliability score of 0.655 Cronbach's alpha, the 4 items were aggregated into the sub-variable Ascription of Responsibility (AR). With the mean score of 3.52 as shown in table 7 Users of KsTU are considered to have a moderate level of Ascription of Responsibility (AR).

Studies based on the NAM suggests that Users with developed AR tend to feel a strong moral obligation to reduce their use of electricity (Steg and Groot, 2010, Zhang, Wang, et al., 2013, Werff and Steg, 2015). This assertion from the literature will either justify or criticise the findings of the PN component of user awareness as defined in this study.

4.4.3 Personal Norm (PN)

PN was defined as Users (staff and students of KsTU) feeling of moral obligation to act to reduce the excessive electricity consumption and its related environmental and socioeconomic effects. In measuring PN 3 items adopted from Harland et al (2007), Abrahamse and Steg (2009), De Groot and Steg (2009), Steg and De Groot (2010), Onwezen et al. (2013), Werff and Steg (2015), and Van der Werff and Steg (2016) were modified to fit the context of this study. Respondents were asked to indicate on a five-point Likert scale the extent of their agreement to the following statements in table 8.

Table 8 Adopted and modified items measuring PN

		Strongly disagree	Disagree	Neutral	Agree	Strongly agree
13.	I feel a strong personal obligation to reduce my use of electricity	1	2	3	4	5
14.	I will feel guilty if I am not able to reduce my use of electricity	1	2	3	4	5
15.	I don't feel guilty when I excessively use electricity	1	2	3	4	5

It must be emphasised that item 15 which is a reverse statement was reverse coded in the database for ‘Strongly agree’ to have the lowest value 1 up to ‘Strongly disagree’ which was given the highest value 5. Figure 14 and table 9 below shows the summary of responses and the measured mean scores for the items above.

Figure 14 Summary of responses on the adopted and modified items measuring PN

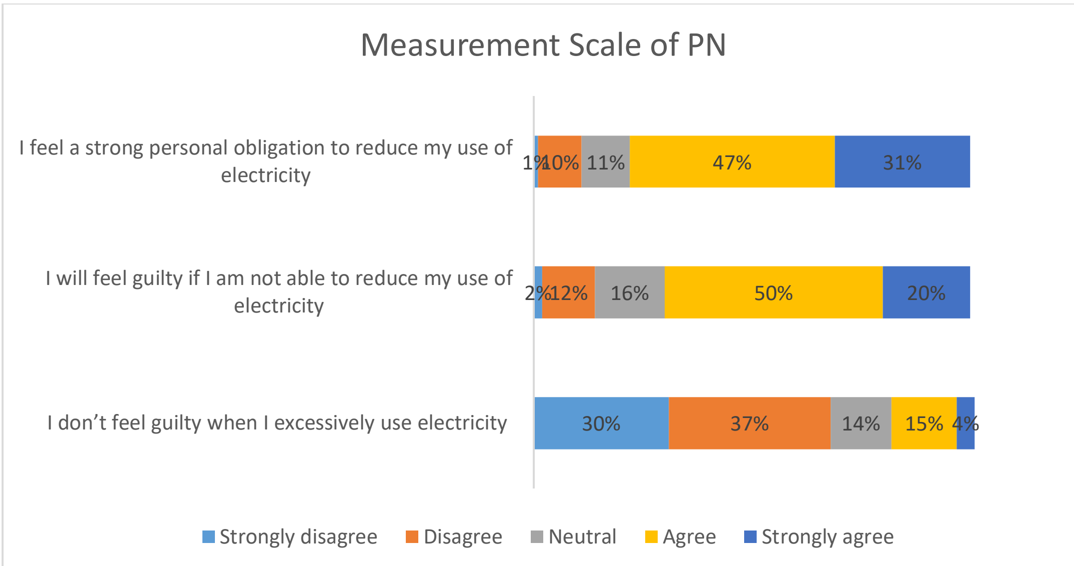


Table 9 Summary of the measured scores for the adopted and modified items measuring PN

Items		Mean	Std. Deviation	N
13.	I feel a strong personal obligation to reduce my use of electricity	3.98	0.941	194
14.	I will feel guilty if I am not able to reduce my use of electricity	3.73	0.998	196
15.	I don’t feel guilty when I excessively use electricity	3.75	1.161	196
	Personal Norm (PN)	**3.82**	**0.865**	**196**

From the mean scores of the 3 items, it can be observed that majority of the respondents have developed a fairly strong feeling of moral obligation to reduce their use of electricity. This is evident in the summary of the responses as shown in figure 14, where the combined percentages for respondents who chose ‘Agree’ and ‘Strongly agree’ for items 13 and 14 are 78% and 70% respectively and further confirmed by the responses for item 15. This result is corroborated and justified by the NAM which suggests that Users with strong personal norm to reduce their use of electricity are aware of the problems caused by excessive electricity consumption and feel responsible to help solve the problems (Steg and Groot, 2010, Zhang, Wang, et al., 2013, Werff and Steg, 2015).

Based on the measured reliability score of 0.773 Cronbach’s alpha the 3 items were aggregated and computed into the sub-variable Personal Norm (PN). From the aggregated mean score of PN (3.82) as shown in table 9, Users of KsTU are considered to have a moderate level of developed PN.

According to the NAM and the study by Zhang et al. (2013) people with a developed personal norm are more likely to behave in a way that protects the environment including their use of electricity. This assertion in literature will either confirm or dispute the findings of the variable 'User behaviour in electricity consumption' elaborated in section 4.5 below.

Before proceeding to the findings of the next variable, it is interesting to observe respondent's level of AC, AR, and PN based on the number of energy campaigns they have been exposed to (see table 10).

Table 10 The level of AC, AR, and PN based on the number of energy campaigns Users have been exposed to

Number of Energy Campaign	N	Level of AC	Level of AR	Level of PN
None (0)	5	2.44	2.95	3.40
1 to 2	64	3. 32	3.48	3.72
3 to 4	89	3.44	3.50	3.76
5 to 6	38	3.73	3.68	4.16
Total	**196**			

It can be observed from table 10 that respondents who have been exposed to 1 or more energy campaign generally have a fair level of AC, AR, and PN above the midpoint value of 2.5. While those respondents who have not been exposed to any form of energy campaign have a low level of AC (2.44) below the midpoint value of 2.5 but also a fair level of AR and PN above the midpoint value.

It can further be deduced from the table that as the number of energy campaign increases so does the level of AC, AR, and PN increases. Respondents who have the highest level of AC, AR, and PN are those respondents who have been exposed to 5 to 6 energy campaigns. This is followed by those who have been exposed to 3 to 4 campaigns, and then 1 to 2 campaigns with the least level of AC, AR, and PN being those who have not been exposed to any energy campaign. This implies that the more energy campaigns Users are exposed to the higher their level of AC, AR, and PN. This outcome could be linked to literature and the NAM which suggests that the more knowledge a person has on energy issues the higher the person's awareness of the adverse consequence of energy use. Which leads to a higher developed feeling of responsibility for the problems and feeling of moral obligation to reduce energy use (Werff and Steg, 2015, Li, Menassa, et al., 2017, Wai, Mohammed, et al., 2009, Schwartz, 1977).

4.5 The Current Practiced User Behaviour in Electricity Consumption at KsTU

User behaviour in electricity consumption in this study was defined as Users interactions with the classifications of energy services provided in building facilities. Signifying their interactions with the control of VAC (ventilation and air-condition), lighting, and plug-in loads at KsTU. Items measuring this variable were grouped under the three classifications of energy services (VAC, lighting, and plug-in loads). The findings on these three indicators as obtained from the field data are elaborated and discussed in the subsections below.

4.5.1 Control of VAC

This indicator was measured with 3 items and respondents were asked to indicate on a five-point Likert scale the frequency they consciously/unconsciously control VAC systems in an energy saving or wasteful way. See table 11 below for the 3 items

Table 11 Items measuring Control of VAC

		Never	Rarely	Sometimes	Often	Always
16.	How often do you use natural ventilation instead of fan or air-condition in the room	1	2	3	4	5
17.	How often do you **consciously** check to ensure that windows and other openings are closed before turning on the air-condition	1	2	3	4	5
18.	How often do you **unconsciously** leave the fan or air-conditioner on when going out of the room	1	2	3	4	5

Item number 18 was reverse coded in the database as respondents that choose 'Never' means they are energy saving conscious and respondents that choose 'Always' will mean they unconsciously waste energy. The summary of the responses and their measured scores are shown in figure 15 and table 12 below.

Figure 15 Summary of response on control of VAC

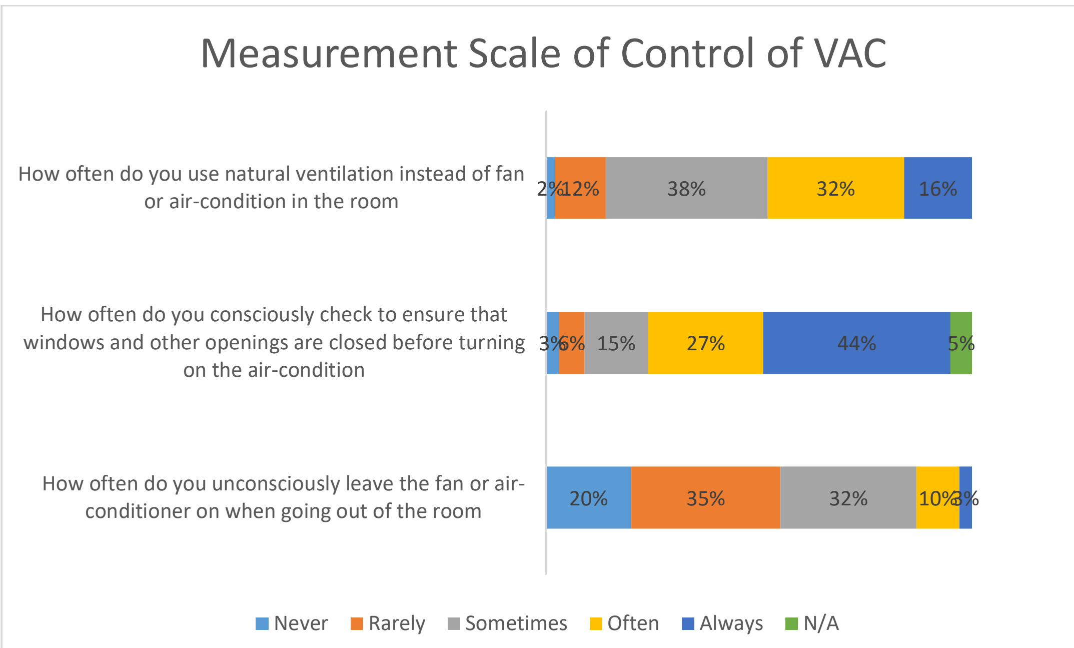


Table 12 Summary of the measured scores for Control of VAC

Items		Mean	Std. Deviation	N
16.	How often do you use natural ventilation instead of fan or air-condition in the room	3.50	0.963	196
17.	How often do you **consciously** check to ensure that windows and other openings are closed before turning on the air-condition	4.18	1.135	194
18.	How often do you **unconsciously** leave the fan or air-conditioner on when going out of the room	3.59	1.011	196

Observing the responses from figure 15 it can be deduced that about 14% (combined scores of never and rarely for item 16) of the respondents never or rarely used natural ventilation in the room, implying the frequent use of a fan or air-condition. This practiced behaviour could be influenced by the design and orientation of the room (Chung and Rhee, 2014). However, since the majority of the respondents representing 86% (combined scores for sometimes, often, and always for item 16) use natural ventilation instead of a fan or air-condition, the argument of Sun and Hong (2017) in literature could be valid in this situation. Sun and Hong (2017) argue that buildings that are designed to favour the use of natural ventilation will not function to achieve this purpose if building occupants decide to keep windows closed.

It can also be observed from the results that majority of the respondents representing 71% (combined scores of those who chose always and often for item 17) always/often checked to ensure all openings are closed before turning on the air-conditioner, with few respondents representing 24% (combined scores) who sometimes, rarely or never checked.

Further, 55% (combined scores of never and rarely for item 18) of the respondents rarely/never leave their fan or air-condition on when going out of the room. However, 45% (combined scores of sometimes, often and always for item 18) of the respondents sometimes, often/always unconsciously leave their fan and air-condition on when going out of the room. This result is confirmed by Adjei-Twum (2017) who stipulated that fans and air-conditions are sometimes found to be left on in unoccupied space in the university. However, observing the mean scores for all items on VAC it can be implied that Users of KsTU sometimes make conscious effort to control the VAC system in an energy saving manner and at other times unconsciously control them in an energy wasteful way, inferring a moderate energy saving behaviour. This behaviour could be improved to help reduce the challenge of high electricity bills faced by the university (Adjei-Twum, A., 2017) and the problem of unreliable electricity supply faced in the country at large (Ibrahim, Aryeetey, et al., 2016).

It must be emphasised that due to the low reliability score (Cronbach's alpha 0.359) for the 3 items measuring control of VAC, the mean scores were not aggregated into one indicator. One of the reasons that could explain the low reliability score is the fact that the VAC system as defined in this study has 3 different components (ventilation, air-condition and fan). Hence, there could have been separate items on each of these components assessing the frequency users consciously/unconsciously control the components instead of combining them. For instance, item 16 could have been phrased as '*how often do you consciously use natural ventilation in the room*'. To ensure consistency, this item could have been followed by items asking how often users consciously use fan and air-conditioner in separate items and then followed by items 17 and 18. Nonetheless, to aid in achieving the purpose of the study despite the supposed flaw in measuring VAC, it is appropriate not to aggregate the scores of the 3 items but rather use the scores as obtained from the analyses.

Moreover, it is worth distinguishing the practiced behaviour pattern of staff and students in their interactions with VAC systems in the university, as it is anticipated that there are variations between the behaviour of these Users (see table 13).

Table 13 Variations between the behaviour pattern of staff and students in their control of VAC

	Items	Staff (N= 146)	Student (N= 50)
16.	How often do you use natural ventilation instead of fan or air-condition in the room	3.57	3.30
17.	How often do you **consciously** check to ensure that windows and other openings are closed before turning on the air-condition	4.33; n= 144	3.74
18.	How often do you **unconsciously** leave the fan or air-conditioner on when going out of the room	3.70	3.28

From table 13 it can be deduced that the practiced behaviour pattern of both staff and students in their control of VAC systems are moderately energy saving as established in the earlier discussions. It can, however, be seen that the practice of energy saving behaviour pattern is slightly dominant among staff than students in their control of VAC systems. This could be related to the assertion in the literature that students do not perceive it as their responsibility to switch off electrical appliances (including components of the VAC system) in rooms were the facilities and energy services are shared with a large number of people (Whittle and Jones, 2010). However, the same cannot hold for staff who have their own offices or share the office space with few colleagues.

The variation could also be explained by the supposition of the responsible person for utilities in the university revealed during the discussion of the research. He perceived that some students wastefully use electricity because they feel the service is charged as part of their school fees and must use it at all costs even when they are not in need of it. Hence, the staff are slightly more energy conscious in their control of VAC systems than students in the university.

4.5.2 Control of Lighting

This indicator was measured with 3 items and respondents were asked to indicate on a five-point Likert scale the frequency they consciously/unconsciously control lighting in an energy saving or wasteful way (see table 14 for the items).

Table 14 Items measuring Control of lighting

		Never	Rarely	Sometimes	Often	Always
19.	How often do you **consciously** turn off lights when going out of the room	1	2	3	4	5
20.	How often do you **consciously** turn off lights in noticed unoccupied space(s) in the university	1	2	3	4	5
21.	How often do you **unconsciously** leave lights on when going out of the room	1	2	3	4	5

In conducting the descriptive statistical analysis, item 21 was reverse coded in the database. Figure 16 and table 15 below shows the summary of the responses and their measured scores.

Figure 16 Summary of responses on control of lighting

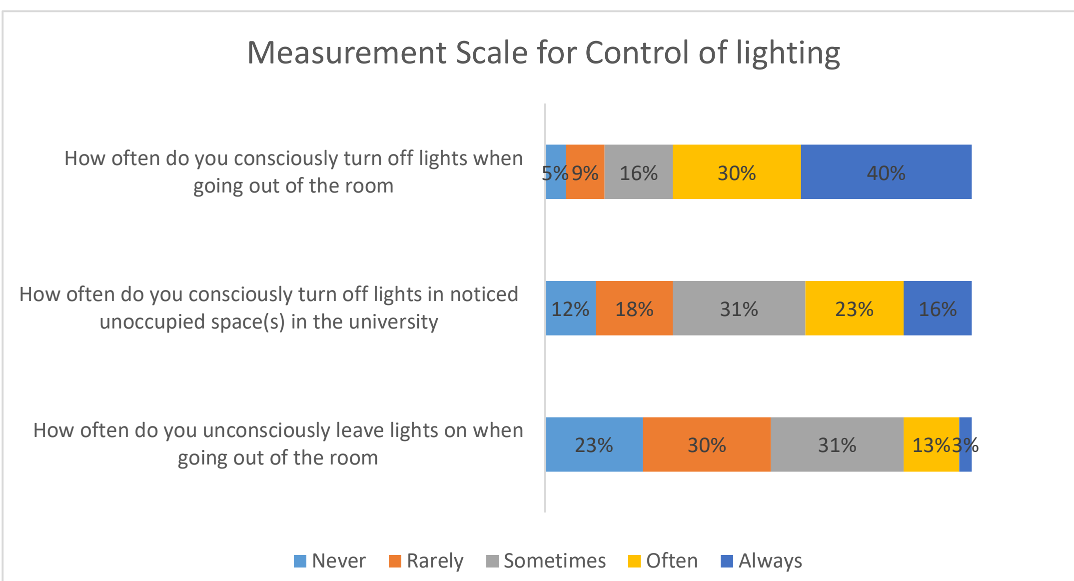


Table 15 Summary of the measured scores for Control of lighting

	Items	Mean	Std. Deviation	N
19.	How often do you **consciously** turn off lights when going out of the room	3.92	1.174	194
20.	How often do you **consciously** turn off lights in noticed unoccupied space(s) in the university	3.14	1.229	191
21.	How often do you **unconsciously** leave lights on when going out of the room	3.57	1.074	195
	Control of lighting	**3.54**	**0.887**	**196**

From the mean scores, it can be deduced that Users make fairly conscious effort to turn off lights when not in occupation of rooms. This is reflective in figure 16 when the percentages for 'often' and 'always' are combined for item 19 (70%).

Also, the majority of Users representing 70% (combined scores of sometimes, often and always for item 20) indicates that they sometimes, often/always turn off lights in noticed unoccupied space in the university. This behaviour is reflective of energy saving behaviour pattern as Ouyang and Hokao (2009) gives an example of such a behaviour pattern as turning off lights in rooms that are not in occupation. This behaviour pattern is noted to help reduce the environmental and socio-economic problems associated with energy use including unreliable electricity supply and climate change (Trotta, 2018, Ting, Mohammed, et al., , 2011).

However, about 47% of the response (combined scores for those who chose 'sometimes', 'often' and always) for item 21 indicates that Users sometimes unconsciously leave the lights on when going out of the room. This outcome is confirmed by Adjei-Twum (2017) who stated that lights are sometimes noticed to be left on in unoccupied rooms in the university.

Based on the tested reliability score of 0.632 Cronbach's alpha, the items were aggregated and computed into the indicator control of lighting. The mean score (3.54) for this indicator as shown in table 15 implies that Users of KsTU sometimes make conscious effort to control lighting in a manner that reduces electricity consumption and at other times unconsciously control lighting in a way that waste energy, inferring a moderate energy saving behaviour. This practiced behaviour could be improved to help reduce the challenge of high electricity bills faced by the university (Adjei-Twum, A., 2017) and the problem of unreliable electricity supply faced in the country at large (Ibrahim, Aryeetey, et al., 2016).

Reflecting on the outcome of the reliability score for the 3 items measuring control of lighting, the score though reliable is a bit low. This could be explained by the fact that a critical look at item 21 seem to have posed a little challenge for respondents to answer reliably. This is because a person who unconsciously leaves lights on in a room when going out is barely aware of such act and cannot answer reliably on how frequent he/she perform such act. Hence, the response to item 21 is supposedly a bit problematic.

Moreover, the variations between staff and students practiced behaviour in the control of lighting are observed in table 16.

Table 16 Variations between the behaviour pattern of staff and students in their control of lighting

	Items	Staff (N= 146)	Students (N= 50)
19.	How often do you **consciously** turn off lights when going out of the room	3.97; n= 144	3.80
20.	How often do you **consciously** turn off lights in noticed unoccupied space(s) in the university	3.18; n= 141	3.04
21.	How often do you **unconsciously** leave lights on when going out of the room	3.64; n= 145	3.36

From table 16 it can be observed that the moderately practiced energy saving behaviour in the control of lighting is slightly dominant among staff than students. This could be explained by the assertion in the literature that, students who find themselves in spaces where the facilities and services are shared with hundreds of other students do not perceive it as their responsibility to turn off lights and other electrical appliance when leaving the room (Whittle and Jones, 2010). However, the same cannot be perceived for staff who have their own offices or share the office space with few colleagues. Hence, the staff are slightly more energy conscious in their control of lighting than students in the university.

4.5.3 Control of Plug-in Loads

This indicator was measured with 3 items and respondents were asked to indicate on a five-point Likert scale the frequency they consciously/unconsciously control plug-in loads in an energy saving or wasteful way (see table17 for the items).

Table 17 Items measuring Control of plug-in loads

		Never	Rarely	Sometimes	Often	Always
22.	How often do you **unconsciously** leave your computer/laptop and other electrical appliances on when not actively in use	1	2	3	4	5
23.	How often do you **consciously** turn off your computer and other electrical appliances when not in use	1	2	3	4	5
24.	How often do you **consciously** unplug your computer and other electrical appliance when not in use	1	2	3	4	5

In conducting the descriptive statistical analysis, item 22 was reverse coded for easy handling of data. Figure 17 and table 18 below shows the summary of the responses and their measured scores.

Figure 17 Summary of responses on control of plug-in loads

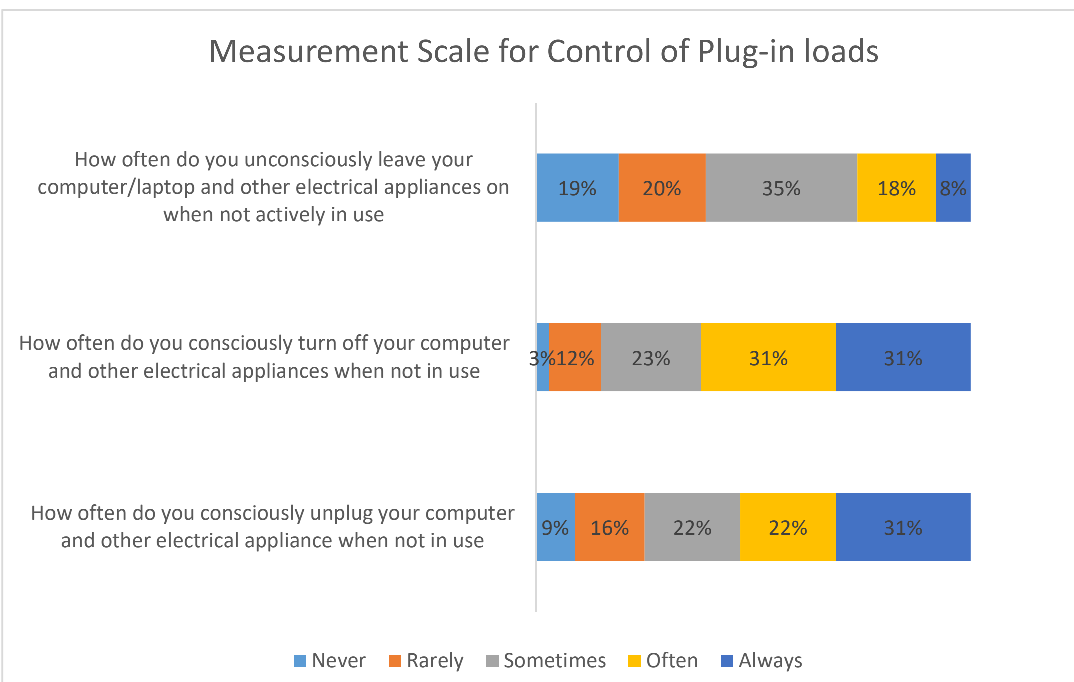


Table 18 Summary of the measured scores for Control of plug-in loads

Items		Mean	Std. Deviation	N
22.	How often do you **unconsciously** leave your computer/laptop and other electrical appliances on when not actively in use	3.25	1.178	196
23.	How often do you **consciously** turn off your computer and other electrical appliances when not in use	3.74	1.117	196
24.	How often do you **consciously** unplug your computer and other electrical appliance when not in use	3.49	1.318	195
	Control of plug-in loads	**3.50**	**0.936**	**196**

From the summary of responses, it can be observed that 62% (combined scores of 'often' and 'always' for item 23) of the respondents often and always make a conscious effort to turn off their electrical appliances when not in use. However, 61% and 47% (combined scores for 'sometimes', 'often' and 'always' for item 22 and 'sometimes', 'rarely', and 'never' for item 24 respectively) of the responses inferred that Users sometimes unconsciously leave their electrical appliances on and plugged-in when not actively in use. This result is justified by the observation by Adjei-Twum (2017) that electrical appliances not in active use are sometimes found to be left plugged-in at some offices and classrooms of the university. This behaviour pattern is considered energy wasteful and contributes to excessive electricity consumption which contributes to the problems of unreliable electricity supply and climate change (Trotta, 2018, Ting, Mohammed, et al., , 2011).

Based on the tested reliability score of 0.669 Cronbach's alpha the 3 items were aggregated and computed into the indicator control of plug-in loads. The result of the mean score (3.50) for this indicator depicted in table 18 implies that Users sometimes make fairly conscious effort to control plug-in loads in a manner that saves energy and at other times control plug-in loads in a manner that waste energy, inferring a moderate energy saving behaviour. This practiced behaviour could also be improved to help reduce the challenge of high electricity bills faced by the university (Adjei-Twum, A., 2017) and the problem of unreliable electricity supply faced in the country (Ibrahim, Aryeetey, et al., 2016).

Additionally, the variations between staff and students practiced behaviour in the control of plug-in loads are observed in table 19.

Table 19 Variations in the behaviour pattern of staff and students in their control of plug-in loads

Items		Staff (N= 146)	Students (N= 50)
22.	How often do you **unconsciously** leave your computer/laptop and other electrical appliances on when not actively in use	3.23	3.32
23.	How often do you **consciously** turn off your computer and other electrical appliances when not in use	3.77	3.66
24.	How often do you **consciously** unplug your computer and other electrical appliance when not in use	3.45	3.64

It can be deduced from table 19 that the moderately practiced energy saving behaviour in the control of plug-in loads is slightly dominant among students than staff (with the exception of item 23). This variation could be explained by the supposition of the responsible person for utilities in the university and the expert on energy issues revealed during the discussion of the research. They perceived that because students share classrooms and other spaces in the university with hundreds of other students, they often unplug their personal electrical appliances (eg. laptops and phone chargers) to take along when leaving the room. However, the same cannot be perceived for staff who have their own offices (or shared offices with few colleagues). It is therefore presumed that staff feels more secured (in their office) in the use of both their personal and communal electrical appliances and sometimes tend to unconsciously leave them on and plugged-in when leaving the office. Hence, students are slightly more energy conscious than staff in the control of plug-in loads in the university.

4.6 The Influence of User Awareness (AC, AR, PN) on User Behaviour in Electricity Consumption

To examine the influence of user awareness on user behaviour in electricity consumption the Pearson Correlation and multiple regression analyses were conducted. The Pearson correlation test helps to examine the nature and the strength of the relationship between the variables of the study. Whiles the multiple regression helps to ascertain the influence that user awareness (AC, AR, and PN) has on user behaviour in electricity consumption. According to literature there exist a relationship between AC, AR, and PN this section also presents a test for this relationship based on a Pearson correlation and a linear regression analysis.

See table 20 for the summary of the Pearson correlation and linear regression test results for AC, AR, and PN. Also, find the detail test results in annex 2

Table 20 Summary of Pearson correlation and linear regression test results for AC, AR, and PN

	r value	p-value	Coefficient B
AC X **AR**	0.434	< 0.001	0.366
AR X **PN**	0.332	< 0.001	0.372
AC X **PN**	0.401	< 0.001	0.379

From table 20 it can be observed that there exist a statistically significant and causal relationship between AC and AR, AR and PN, and AC and PN. This is based on the outcome that all the p-values are < 0.05 and also the regression coefficient values B shows a significant linear correlation between them.

The results show that for every one unit change in AC, AR and PN increases by 0.366 and 0.379 respectively. Also for every one unit change in AR, PN increases by 0.372. This implies that the higher a person's awareness of the adverse consequence of excessive electricity consumption, the stronger their feeling of responsibility for the problems and to help solve the problems caused by excessive electricity consumption. Likewise, a strong feeling of responsibility to help solve the problems translates into a strong feeling of moral obligation to reduce electricity consumption. The influence of a person's awareness of the consequence of electricity consumption on his/her feeling of moral obligation to reduce electricity consumption is mediated by his/her feeling of guilt for contributing to the problems and responsible to help solve the problems. This relationship is justified by the assertion of the NAM and confirmed in literature by Harland et al (2007), Abrahamse and Steg (2009), De Groot and Steg (2009), Onwezen et al. (2013), Van der Werff and Steg (2016), and Zhang et al. (2013).

Further, the NAM suggests that a highly developed PN of a person makes him/her behave in a way that protects the environment, hence in this case make Users reduce their use of electricity (Steg and Groot, 2010, Zhang, Wang, et al., 2013, Werff and Steg, 2015). This assertion will either confirm or criticise the outcome of the Pearson correlation test results for the dependent (user behaviour in electricity consumption: VAC, lighting, plug-in loads) and independent (user awareness: AC, AR, PN) variables (see table 21). Also, find the detail test results in annex 2.

Table 21 Summary of the Pearson correlation test results for the individual components of the dependent and independent variables

	Behaviour in the control of VAC 1	Behaviour in the control of VAC 2	Behaviour in the control of VAC 3	Behaviour in the control of lighting	Behaviour in the control of plug-in loads
AC	r= -0.110 p= 0.125	r= -0.021 p= 0.767	r= -0.20 p= 0.783	r= 0.043 p= 0.549	r= -0.021 p= 0.771
AR	r= -0.057 p= 0.428	r= -0.031 p= 0.669	r= 0.080 p=0.263	r= 0.135 p= 0.059	r=-0.014 p= 0.851
PN	r= 0.14 p= 0.847	r= -0.103 p= 0.154	r= 0.095 p=0.185	r= 0.168 p= 0.018	r= 0.154 p= 0.032

4.6.1 Influence of AC on behaviour in the control of VAC, Lighting, and plug-in loads

As can be observed from table 21, AC has no direct significant relationship with User behaviour in the use of any of the three classifications of energy services measured in this study. All the p-values showing the correlation between AC and the 3 classifications of energy services are > 0.05. A Pearson correlation test results give an indication of what the outcome of a regression analyses will be, hence, with no significant relationship established from the p-values there was no need to perform a regression analyses.

The result of the correlation implies that Users awareness of the negative consequence of excessive electricity consumption alone does not influence their behaviour in the use of electricity. This result was expected and can be justified with the fact that, none of the studies on NAM reviewed in literature established a direct relationship between AC and behaviour relating to the environment/energy use. Basing on the NAM, AC serves as a preceding condition to develop AR and PN to eventually influence behaviour in the use of electricity (De Groot and Steg, 2009, Werff and Steg, 2015, Steg and Groot, 2010, Onwezen, Antonides, et al., 2013, Harland, Staats, et al., 2007). This is confirmed in the established relationship between AC, AR, and PN as shown in table 20. Hence, AC as an isolated variable does not have an influence on behaviour in the use of electricity (VAC1,2,3, lighting, and plug-in loads).

4.6.2 Influence of AR on behaviour in the control of VAC, Lighting, and plug-in loads

The Pearson correlation test results showed no significant relationship between AR and behaviour in the control of VAC(1,2,3), lighting, and plug-in loads. The p-values for the tested correlations are > 0.05. With no established significant relationship the outcome of a regression analysis will show no significant influence, hence, the justification for no regression conducted at this point.

The outcome of the correlation as shown in table 21 implies that Users with a developed feeling of guilt for contributing to the problems caused by excessive electricity consumption and feeling of responsibility to help solve the problems does not automatically act to control energy services in a manner that seeks to reduce electricity consumption. Though it has been established in literature and also in this study (as shown in table 20) that AR is influenced by AC, and AR leads to the development of PN, there is no proven relationship and influence of AR on behaviour in the use of energy and other resources in literature (De Groot and Steg, 2009, Werff and Steg, 2015, Steg and Groot, 2010, Onwezen, Antonides, et al., 2013, Harland, Staats, et al., 2007). Therefore, there is no direct relationship and/ influence of AR in isolation on behaviour in the use of electricity.

4.6.3 Influence of PN on behaviour in the control of VAC, Lighting, and plug-in loads

The Pearson correlation test results showed a significant relationship between PN and behaviour in the control of lighting and plug-in loads as the p-values are < 0.05 (this is manifested in the regression analyses that is discussed in the next section).

The result implies that Users with a developed feeling of moral obligation to reduce their use of electricity act to control lighting and plug-in loads in a manner that seeks to reduce their electricity consumption at KsTU. This outcome is justified in the literature by the NAM and studies by Harland et al (2007), Abrahamse and Steg (2009), De Groot and Steg (2009), Onwezen et al. (2013), and Van der Werff and Steg (2016). These authors in their studies using NAM theorised that a person's pro-environmental (eg. energy saving) behaviour is highly dependent on his/her personal norm which is influenced by their awareness of the consequence of their action and the feeling of guilt for the consequence of their choice of action. Hence, there is a direct influence of PN on behaviour in the use of electricity, this influence is however preceded by the influence of AC and AR.

Moreover, the correlation test results as shown in table 21 further showed no significant relationship between PN and behaviour in the control of VAC(1,2,3) as the p-values are > 0.05 which gives an indication of no expected influence in a regression analyses. This outcome implies that Users with developed PN do not behave to control VAC systems in a way that saves energy. This outcome, although contrary to the proclamation of the NAM could be explained by the argument of Li et al. (2017), that building occupants with high motivation to conserve energy may not act to implement energy saving behaviour in their use of HVAC system if they experience low thermal comfort in the room. Another reason that could explain this outcome is the supposed internal inconsistency (Cronbach's alpha <0.6) in the measurement of the VAC system.

4.6.4 The Influence of User Awareness (AC, AR, PN) on the Combined User Behaviour in Electricity Consumption

After establishing and explaining the relationship between the individual components of user awareness (AC, AR, and PN) and the measured behaviour in electricity consumption under the 3 classification of energy services, there is the need to establish the relationship and influence of user awareness (AC, AR, and PN) on user behaviour in electricity consumption (behaviour in the control of VAC, lighting and plug-in loads combined). This was achieved by conducting a Pearson correlation and multiple regression analyses which also helped to ascertain which of the components of user awareness influenced user behaviour in electricity consumption the most. See tables 22 and 23 below for the summary of the statistical test results and also find the details in annex 2.

Table 22 Summary of the Pearson Correlation test results for the combined dependent and independent variables

	User Behaviour in Electricity Consumption	
AC	r= -0.016	p= 0.824
AR	r= 0.054	p= 0.451
PN	r= 0.151	p= 0.035

Table 23 Summary of the Multiple Regression test results for the combined dependent and independent variables

Predictors	User Behaviour in Electricity Consumption		
	Regression Coefficient B	**Sig.**	**Adj. R^2 X 100**
AC	-0.075	0.204	1.6%
AR	0.034	0.617	
PN	0.135	0.024	

From table 22 it can be deduced that among the three components of user awareness PN is the only component that has a proven statistical significant relationship with user behaviour in electricity consumption with a p-value of 0.035. This outcome is not too different from the outcome of the earlier correlation test between AC, AR, PN and the individual components of user behaviour in electricity consumption as shown in table 21.

Further, table 23 shows the outcome of a multiple regression where AC, AR, and PN were put together in 1 model as predictors for the dependent variable user behaviour in electricity consumption. The outcome depicts that user awareness (AC, AR, and PN) explained 1.6% of the variance in user behaviour in electricity consumption. Implying that the stronger the level of user awareness (AC, AR, PN) the more users make a conscious effort to practice energy saving behaviour in their use of energy services. This outcome is similar to the results of a multiple regression test conducted in the study of Werff and Steg (2015) which revealed that AC, OE (Outcome efficacy: used interchangeably with AR in some studies) and PN explained 4% and 5% of the variance in showering time and driving style respectively. The outcome is also confirmed by the NAM which specifies that the practice of pro-environmental behaviour (including energy saving) is dependent on the developed level of user awareness (AC, AR, and PN) (Schwartz, 1977).

Moreover, the outcome of the multiple regression test depicts that, the PN component of user awareness has the strongest influence on user behaviour in electricity consumption. This is followed by AR and then AC which is the component that has the least influence on user behaviour in electricity consumption.

Also, it can be observed from table 23 that PN is the only component with a significant relationship with user behaviour in electricity consumption which is in line with the outcome of the correlation results (shown in table 22). This compliments the result that PN has the strongest influence and implies that the PN component of user awareness explains significantly the variance in user behaviour in electricity consumption.

The above elaborated outcomes were expected and justified by the NAM which describes the influence of AC, AR, and PN on behaviour as developmental stages that begins with AC and ends with PN which has a direct influence on behaviour (Schwartz, 1977). This has also been confirmed in studies by Harland et al (2007), Abrahamse and Steg (2009), De Groot and Steg (2009), Onwezen et al. (2013), Werff and Steg (2015), and Van der Werff and Steg (2016). For instance, Werff and Steg (2015) in their study found PN to be the strongest predictor of behaviour in showering time and driving style among the 3 components of NAM.

Further, from the regression coefficient values B (as shown in table 23) it can be implied that for every one unit change in AC, user behaviour in electricity consumption declines by 0.075 depicting an inverse relationship between AC and behaviour in the use of electricity. This result is not too different from the nature of the relationship between AC and the 3 classifications of energy services discussed in section 4.6.1 above. This outcome could also be related to the fact that AC only serves as a first stage in the developmental stages of user awareness (AC-AR-

PN) and at this initial stage will not have any influence on behaviour based on the description of the NAM (Schwartz, 1977).

The regression coefficient value B for AR also indicates that for every one unit change in AR user behaviour in electricity consumption improves by 0.034. This influence of AR is not strong but depicts an improvement in the developmental stages of user awareness (AC-AR-PN) for an influence on behaviour as stipulated by the NAM and studies by Werff and Steg (2015).

Lastly, the B value for PN implies that for every one unit change in PN user behaviour improves by 0.135. This depicts a stronger influence on user behaviour in electricity consumption as compared to the influence of AR and marks PN as the end of the developmental stage of user awareness (AC-AR-PN) to influence behaviour as described by the NAM and in studies by Harland et al (2007), Abrahamse and Steg (2009), De Groot and Steg (2009), Onwezen et al. (2013), Werff and Steg (2015), and Van der Werff and Steg (2016).

Chapter 5: Conclusions and Recommendations

5.1 Introduction

This chapter seeks to present a general conclusion to the study after the presentation and discussions of the research findings in the previous chapter. The conclusion is presented in line with answering the sub-questions and the main research question of the study based on the findings from the field data analysed and linking with literature reviewed. The chapter ends with the presentation of practical recommendations, as well as recommendations for further and future studies.

5.2 Conclusions and Answering the Research Questions

5.2.1 Sub-research Question 1

What is the level of user awareness of electricity consumption at KsTU?

The findings from the field data analysed in the previous chapter depict that the level of user awareness of electricity consumption at KsTU is moderate.

As explained in the previous chapters, user awareness is defined by AC, AR, and PN based on the NAM. On the scale of 1-5, the level of AC was measured at 3.42 indicating that Users had fair knowledge on the use of electricity and are aware of the adverse environmental and socioeconomic consequence of excessive electricity consumption. This level of AC is justified by Werff and Steg (2015) and Mohammed et al. (2009) who suggests that exposure to energy campaigns informs people about the negative implications of energy use.

The developed level of AR was also measured at 3.52 indicating that Users moderately felt guilty for contributing to the environmental and socioeconomic problems caused by excessive electricity consumption and felt responsible to help solve the problems. This level of AR is confirmed by the NAM which suggests that when a person is aware of the consequence of excessive electricity consumption then they develop a sense of guilt for contributing to the problems caused by excessive electricity consumption and feel responsible to help solve the problems (Schwartz, 1977).

Lastly, the developed level of PN was measured at 3.82 indicating that Users moderately felt morally obliged to act to reduce excessive electricity consumption and it related environmental and socioeconomic problems. Again, this level of PN is confirmed by the NAM which specifies that a developed feeling of guilt for the problems caused by electricity consumption leads to the development of personal obligation to reduce electricity consumption (Schwartz, 1977).

The researcher was also interested in relating the number of energy campaigns Users have been exposed to and their developed level of AC, AR, and PN. The findings depicted that Users who have been exposed to more energy campaigns have higher levels of AC, AR, and PN than those who were exposed to less or no energy campaign. Implying that the more energy campaigns Users are exposed to the higher their level of AC, AR, and PN and this is justified by the NAM.

5.2.2 Sub-research Question 2

What is the current practiced user behaviour in electricity consumption at KsTU?

The current practiced user behaviour in electricity consumption at KsTU is moderately energy saving.

The findings from the field data analysed showed that on the scale of 1-5, the evaluated practiced behaviour of Users in electricity consumption was 3.76 (simple average for VAC1,2,3), 3.54, and 3.50 for the control of VAC, lighting and plug-in loads respectively. This indicates that Users sometimes consciously make effort to control VAC systems, lighting and plug-in loads in a manner that reduces electricity consumption. Implying that at other times they also unconsciously control VAC systems, lighting and plug-in loads in a way that waste electricity and leads to excessive electricity consumption. This result confirms the report by Adjei-Twum (2017) that lights are sometimes found to be left on in unoccupied space(s) in the university and Users sometimes leave their fans, air-conditions and other electrical appliances on when not in use.

The researcher was also interested in establishing the variations between staff and students practiced behaviour in electricity consumption at the university. The findings revealed that the staff are slightly more energy conscious than students in the control of VAC and lighting. However, in the control of plug-in loads students were found to be slightly more energy conscious than the staff of the university.

5.2.3 Sub-research Question 3

How does user awareness (AC, AR, and PN) influence user behaviour in electricity consumption at KsTU?

The influence of AC and AR individually on user behaviour in electricity consumption (control of VAC, lighting and plug-in loads) is weak with no established statistical significant relationship. Whereas, the influence of PN on user behaviour in electricity consumption (control of lighting and plug-in loads) is strong with an established statistical significant relationship.

The results of the analysed field data indicated that Users awareness of the negative consequence of excessive electricity consumption alone did not influence their behaviour in the control of VAC, lighting and plug-in loads. Likewise, Users feeling of guilt for contributing to the problems caused by excessive electricity consumption alone did not influence their behaviour in the control of VAC, lighting and plug-in loads. This result is corroborated by the NAM and studies by Harland et al (2007), Abrahamse and Steg (2009), De Groot and Steg (2009), Steg and De Groot (2010), Onwezen et al. (2013), Werff and Steg (2015), and Van der Werff and Steg (2016) which showed no established direct correlation between AC and behaviour in the use of energy, and AR and behaviour in the use of energy.

On the other hand, the results of the analysed field data showed that Users feeling of moral obligation to reduce electricity consumption has an influence on their behaviour in the control of lighting and plug-in loads. This result is also confirmed by the NAM and studies by Harland et al (2007), Abrahamse and Steg (2009), De Groot and Steg (2009), Steg and De Groot (2010), Onwezen et al. (2013), Werff and Steg (2015), and Van der Werff and Steg (2016) which proves an established direct relationship and influence of PN on behaviour in the use of energy. Further, the results showed no correlation between PN and behaviour in the control of VAC and this could be explained by the supposed flaw in measuring behaviour in the control of VAC system as explained in section 4.5.1.

5.2.4 Main Research Question

To what extent does the level of user awareness influence user behaviour in electricity consumption at KsTU?

The level of user awareness moderately influences user behaviour in electricity consumption at KsTU. As shown in the answers to the sub-questions above, the measured fair level of user awareness (AC: 3.42, AR: 3.52, PN: 3.82) translated into a moderately practiced energy saving behaviour of Users.

The researcher was also interested in ascertaining which of the components of user awareness (AC, AR, PN) influenced user behaviour in electricity consumption the most. Firstly, the Pearson correlation test conducted showed that only PN is significantly correlated with user behaviour in electricity consumption. This was also evident in the multiple regression test result which showed that among the 3 components of user awareness PN has the strongest influence on user behaviour in electricity consumption. However, the results also showed some magnitude of influence from AR with no significant influence from AC. This outcome could be explained and justified by the NAM which proves that behaviour is strongly influenced by a person's moral obligation to reduce energy use. This influence of PN is dependent on the feeling of guilt for contributing to the problems caused by energy use, which is also triggered by the awareness of the consequence of energy use (Schwartz, 1977).

From the above proclamation of the NAM, it is logical to suppose a developmental process which starts with AC to AR and ends with PN as the strongest developed component with an influence on behaviour. Although the outcome of the correlation showed no relationship between AC and behaviour and AR and behaviour, it is further logical to suppose and agree with the outcome of the multiple regression that at the stage of AC no change in behaviour is manifested. While at the stage of a developed AR there is at least if not a significant change, some level of improvement in behaviour in the use of electricity.

5.2.5 Conclusion

Based on the answers to the research questions elaborated above and the literature reviewed it can be generally concluded that User's (staff and students of KsTU) fair knowledge of the implications of excessive electricity consumption led to their developed fair feeling of guilt for contributing to the problems caused by excessive electricity consumption. This further led to their developed fair feeling of moral obligation to reduce electricity consumption which subsequently translated into their moderate practice of energy saving behaviour at the main campus of KsTU. Users fairly developed level of AC and AR alone does not stimulate them to practice energy saving behaviour until they developed a fair feeling of moral obligation to reduce their use of electricity. It is, therefore, logical to agree with the outcome that the extent of the influence of user awareness on user behaviour in electricity consumption at KsTU is moderate.

5.3 Limitations in the Findings

Readers should take note of the following limitations in the findings of this study:

- The supposed flaw in the measurement of the indicator 'control of VAC'. This indicator had a low score for the measured internal consistency. The suggested items explained in section 4.5.1 should be considered in measuring the indicator in future studies.
- The supposed problematic nature of item 21 measuring control of lighting elaborated in section 4.5.2.
- The final surveyed respondents of 196 poses as a misrepresentation of the sample population hence weakens the external validity of this research.
- The external validity of the research is also weakened by the use of convenient sampling at some point during the field data collection as explained in section 3.9. This also creates concern for the issue of representativeness of the sample population.

5.4 Practical Recommendations

After careful analyses of the data gathered and relevant information from the literature, it can be deduced that the level of user awareness (AC, AR, PN) determines how Users control energy services. The findings also suggest that the more energy campaigns Users are exposed to the higher their levels of AC, AR, and PN.

It is therefore recommended to the management board of KsTU to invest in increasing the level of user awareness (AC, AR, PN) among staff and students of the university. Although the majority of the staff and students have been exposed to at least 1 energy campaign, the established level of user awareness (AC, AR, PN) was fair which translated into Users, not at all times controlling energy services in an energy saving way. Hence, it is recommended that specific posters meant for displaying information on electricity use and its related implications be posted at various locations within the university in addition to the existing ones focused on ensuring fire safety.

Also, organised workshops, as well as other forms of energy campaigns, should be organised at least once in every academic year geared towards elaborating to Users about relevant energy use information including how waste in electricity consumption occurs and how this can be prevented. This will go a long way to increase Users knowledge on the negative consequence of electricity consumption and make them develop a stronger feeling of guilt for contributing to the problems and subsequently develop a stronger feeling of moral obligation to reduce electricity consumption (as depicted in the findings of the study see table 10). This will then become evident in their behaviour towards the use of energy services where they will always make a conscious effort to practice energy saving behaviour. The frequent practice of energy saving behaviour will help reduce the electricity cost of the university and will go a long way to help reduce the global environmental and socio-economic problems caused by electricity consumption including climate change and energy insecurity.

It is further recommended to the management board of KsTU to prioritise and practice preventive maintenance on the buildings and its related facilities. This, when implemented, will help address the hinderance that building defects may pose to Users in their quest of practicing energy saving behaviour when they have developed a strong personal norm to do so.

These recommendations are generally also useful to other university boards (aside KsTU) as well as other public and private institutions although the research was conducted in a university set up.

5.5 Recommendations for Future and Further Research

The adopted research strategy (survey) for the study made it possible to assess broadly the level of user awareness (AC, AR, and PN), the practiced user behaviour in electricity consumption, and how user awareness influenced user behaviour in electricity consumption at KsTU. This strategy is considered the most appropriate strategy for this kind of study as it has also been used in similar studies by Harland et al (2007), De Groot and Steg (2009), Steg and De Groot (2010), Onwezen et al. (2013), Werff and Steg (2015), and Van der Werff and Steg (2016). This notwithstanding, it would be interesting to see the outcome of future research in similar studies if interviews/ open ended questions are used as part of the data collection techniques. This method of triangulation will help compliment the responses obtained from the questionnaire and allow for in-depth knowledge which can help explain further on why the findings are geared in a particular direction.

The use of a mixed method also provides respondents the avenue to give further elaboration to their answers. This could for instance (based on reflecting on the findings of this study), help explain why respondents find excessive electricity consumption as a bad practice yet their measured level of AC, AR, PN, and practiced behaviour was moderate and not high. Why is their psychological feeling and thinking as well as their actions not highly reflective of their admittance that excessive electricity consumption contributes to climate change and unreliable electricity supply? In the face of these questions, further research is recommended.

Additionally, as disclosed in the discussion of the research with the lecturer specialised in energy issues and the responsible person for utilities at KsTU, building characteristics in relation to poor maintenance of buildings (and it related facilities) is perceived to also influence Users behaviour in the use of electricity and contribute to excessive electricity consumption. This was corroborated by personal observations of the buildings (and it related facilities) in the university during the field visit which revealed poor maintenance practice (see annex 3 for some photographs exhibiting poor maintenance practice). Hence, further research is recommended to ascertain if building characteristics in terms of poor maintenance also have an influence on User behaviour in electricity consumption.

Based on the above reasoning the combination of building characteristics (in relation to poor building maintenance) and the components of the NAM in a theoretical framework of the further/future studies are recommended. This will create an avenue to address 2 of the noted causes (low level of energy awareness and physical characteristics of buildings) for energy wasteful behaviour and consequently address the issue of excessive electricity consumption in one study. Additionally, such a study could help to ascertain which of the 2 factors has the most significant influence on user behaviour in electricity consumption.

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Annex 1: Questionnaire

Institute for Housing and Urban Development Studies (IHS)
Erasmus University Rotterdam, The Netherlands
Questionnaires

Introduction: I am Jannat Abbas, pursuing a Master of Science degree in Urban Management and Development at IHS, Erasmus University Rotterdam. As a requirement for the award of the Master degree, I am conducting a research on the topic: *The Influence of User Awareness on User Behaviour in Electricity Consumption*. The aim of the research is to explain how the level of user awareness influence user behaviour in electricity consumption. I therefore humbly ask for your co-operation to fill up this questionnaire to help me achieve the aim of my research. Your responses will be treated confidential and solely be used for academic purpose.

Part 1: This part seeks to assess the level of user awareness
Please tick below which of the following modes of energy awareness campaigns you have been exposed to

1. Electronic/media
   - ☐ Television/Radio
   - ☐ Social media
   - ☐ Both
   - ☐ None

2. Printouts/hardcopy
   - ☐ Posters/Brochures/Flyers
   - ☐ Newspaper/Articles
   - ☐ Both
   - ☐ None

3. Training(s)
   - ☐ Workshop/seminar/conference
   - ☐ Short course
   - ☐ Both
   - ☐ None

Please circle the number that express the degree of your agreement to the statements below

		Strongly disagree	Disagree	Neutral	Agree	Strongly agree
4.	Excessive electricity consumption causes environmental problems such as carbon emission and climate change	1	2	3	4	5
5.	Excessive electricity consumption has no relation with the problem of climate change	1	2	3	4	5
6.	Excessive electricity consumption causes socioeconomic problems like unreliable electricity supply	1	2	3	4	5

7.	Reducing electricity consumption will not help solve the problem of unreliable electricity supply	1	2	3	4	5
8.	Reducing electricity consumption will help reduce carbon emission	1	2	3	4	5
9.	I feel guilty for contributing to the problems caused by excessive electricity consumption (eg. climate change, unreliable electricity supply)	1	2	3	4	5
10.	My use of electricity does not contribute to the problem of climate change	1	2	3	4	5
11.	I feel jointly responsible to help solve the problems caused by electricity consumption (eg. unreliable electricity supply)	1	2	3	4	5
12.	It is not my responsibility to help solve the problem of climate change	1	2	3	4	5
13.	I feel a strong personal obligation to reduce my use of electricity	1	2	3	4	5
14.	I will feel guilty if I am not able to reduce my use of electricity	1	2	3	4	5
15.	I don't feel guilty when I excessively use electricity	1	2	3	4	5

Part 2: Behaviour in electricity consumption

Please circle the number that expresses your response to the questions below

		Never	Rarely	Sometimes	Often	Always	
16.	How often do you use natural ventilation instead of fan or air-condition in the office/classroom/lab	1	2	3	4	5	
17.	How often do you **consciously** check to ensure that windows and other openings are closed before turning on the air-condition	1	2	3	4	5	N/A
18.	How often do you **unconsciously** leave the fan or air-conditioner on when going out of the office/classroom/lab	1	2	3	4	5	
19.	How often do you **consciously** turn off lights when going out of the office/classroom/lab	1	2	3	4	5	
20.	How often do you **consciously** turn off lights in noticed unoccupied space(s) in the university	1	2	3	4	5	
21.	How often do you **unconsciously** leave lights on when going out of the office/classroom/lab	1	2	3	4	5	

22.	How often do you **unconsciously** leave your computer/laptop and other electrical appliances on when not actively in use	1	2	3	4	5	
23.	How often do you **consciously** turn off your computer and other electrical appliance when not in use	1	2	3	4	5	
24.	How often do you **consciously** unplug your computer and other electrical appliance when not in use	1	2	3	4	5	

Part 3: Background Information

25. Gender

☐ Male ☐ Female

26. Age

☐ Less than 20 yrs ☐ 20-30 yrs ☐ 31-40 yrs ☐ 41-50 yrs ☐ 51-60yrs

27. Educational Level

☐ Post graduate ☐ Bachelor/HND ☐ Senior High ☐ Below Senior High

28. Respondent Category

☐ Senior Member (Teaching) ☐ Senior Member (Non-Teaching)

☐ Senior Staff ☐ Junior Staff

NB: questionnaire for students was filled through an online survey on this link: https://erasmusuniversity.eu.qualtrics.com/jfe/form/SV_9zRbBwiZDL9td65

Annex 2: Results of Statistical Tests

Pearson Correlations between AC, AR, PN, and Control of VAC1,2,3, Lighting and Plug-in loads

		AC	AR	PN	VACq1	VACq2	VACq3	Lighting	Plug-in loads
AC	Pearson Correlation	1	.434**	.401**	-.110	-.021	-.020	.043	-.021
	Sig. (2-tailed)		.0000000002	.0000000058	.125	.767	.783	.549	.771
	N	196	196	196	196	194	196	196	196
AR	Pearson Correlation	.434**	1	.332**	-.057	-.031	.080	.135	-.014
	Sig. (2-tailed)	.0000000002		.0000019703	.428	.669	.263	.059	.851
	N	196	196	196	196	194	196	196	196
PN	Pearson Correlation	.401**	.332**	1	.014	-.103	.095	.168*	.154*
	Sig. (2-tailed)	.0000000058	.0000019703		.847	.154	.185	.018	.032
	N	196	196	196	196	194	196	196	196
VACq1	Pearson Correlation	-.110	-.057	.014	1	.163*	.190**	.128	.237**
	Sig. (2-tailed)	.125	.428	.847		.024	.008	.074	.001
	N	196	196	196	196	194	196	196	196
VACq2	Pearson Correlation	-.021	-.031	-.103	.163*	1	.144*	.173*	.089
	Sig. (2-tailed)	.767	.669	.154	.024		.045	.016	.216
	N	194	194	194	194	194	194	194	194
VACq3	Pearson Correlation	-.020	.080	.095	.190**	.144*	1	.431**	.356**
	Sig. (2-tailed)	.783	.263	.185	.008	.045		.000	.000
	N	196	196	196	196	194	196	196	196
Lighting	Pearson Correlation	.043	.135	.168*	.128	.173*	.431**	1	.459**
	Sig. (2-tailed)	.549	.059	.018	.074	.016	.000		.000
	N	196	196	196	196	194	196	196	196
Plug-in loads	Pearson Correlation	-.021	-.014	.154*	.237**	.089	.356**	.459**	1
	Sig. (2-tailed)	.771	.851	.032	.001	.216	.000	.000	
	N	196	196	196	196	194	196	196	196

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

Regression analysis for AC X AR

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.434[a]	.188	.184	.697

a. Predictors: (Constant), Awareness of consequence

ANOVA[a]

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	21.858	1	21.858	45.005	.000[b]
	Residual	94.221	194	.486		
	Total	116.079	195			

a. Dependent Variable: Ascription of Responsibility

b. Predictors: (Constant), Awareness of consequence

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	2.266	.193		11.755	.000
	Awareness of consequence	.366	.055	.434	6.709	.0000000002

a. Dependent Variable: Ascription of Responsibility

Regression analysis for AR X PN

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.332[a]	.110	.106	.818

a. Predictors: (Constant), Ascription of Responsibility

ANOVA[a]

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	16.089	1	16.089	24.061	.000[b]
	Residual	129.721	194	.669		
	Total	145.810	195			

a. Dependent Variable: Personal Norm

b. Predictors: (Constant), Ascription of Responsibility

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	2.508	.273		9.184	.000
	Ascription of Responsibility	.372	.076	.332	4.905	.0000019703

a. Dependent Variable: Personal Norm

Regression analysis for AC X PN

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.401[a]	.161	.156	.794

a. Predictors: (Constant), Awareness of consequence

ANOVA[a]

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	23.442	1	23.442	37.165	.000[b]
	Residual	122.368	194	.631		
	Total	145.810	195			

a. Dependent Variable: Personal Norm

b. Predictors: (Constant), Awareness of cons

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	2.523	.220		11.487	.000
	Awareness of consequence	.379	.062	.401	6.096	.0000000058

a. Dependent Variable: Personal Norm

Pearson Correlations between AC, AR, PN and the combined behaviour in EC

		AC	AR	PN	User Behaviour in EC
AC	Pearson Correlation	1	.434**	.401**	-.016
	Sig. (2-tailed)		.0000000002	.0000000058	.824
	N	196	196	196	196
AR	Pearson Correlation	.434**	1	.332**	.054
	Sig. (2-tailed)	.0000000002		.0000019703	.451
	N	196	196	196	196
PN	Pearson Correlation	.401**	.332**	1	.151*
	Sig. (2-tailed)	.0000000058	.000		.035
	N	196	196	196	196
User Behaviour in EC	Pearson Correlation	-.016	.054	.151*	1
	Sig. (2-tailed)	.824	.451	.035	
	N	196	196	196	196

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Multiple regression analyses for AC, AR, PN on combined user behaviour in electricity consumption

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.176[a]	.031	.016	.644

a. Predictors: (Constant), PN, AR, AC

ANOVA[a]

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	2.545	3	.848	2.045	.109[b]
	Residual	79.659	192	.415		
	Total	82.204	195			

a. Dependent Variable: User Behaviour in EC

b. Predictors: (Constant), PN, AR, AC

Coefficients[a]

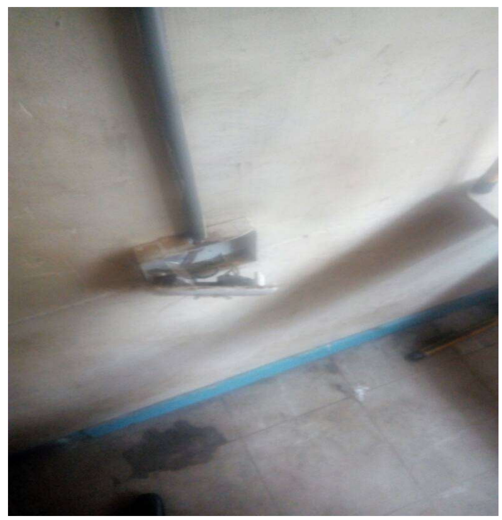
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	3.220	.262		12.274	.000
	AC	-.075	.059	-.105	-1.275	.204
	AR	.034	.068	.040	.500	.617
	PN	.135	.059	.180	2.274	.024

a. Dependent Variable: User Behaviour in EC

Annex 3: Photographs depicting poor maintenance practice at KsTU

Annex 3 Photograph 2: Window Defects

Annex 3 Photograph 3: Electrical Defects



Annex 3 Photograph 4: Cracks in columns and beams

Annex 3 Photograph 5: Plumbing Defects

Annex 4: IHS copyright form

In order to allow the IHS Research Committee to select and publish the best UMD theses, participants need to sign and hand in this copy right form to the course bureau together with their final thesis.

Criteria for publishing:

A summary of 300 to 500 words should be included in the thesis.

The number of pages for the thesis is about 60.

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