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The Economics of Energy Efficiency and Energy Conservative Attitudes in the Ghanaian Public Sector

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Abstract
The rising threats of climate change and energy security has recently resulted in an increased interest in energy consumption reduction using behavioral change interventions. However, structures, power and culture within organisations could propel or inhibit energy efficiency and conservation management practices. While opportunities for energy efficiency exist in public procurement and the refurbishment of a public building until energy management becomes a top priority of public sector organizations, energy efficiency and conservation opportunities will not be exploited. In the Ghanaian public sector, several interventions including the installation of Automatic Load Capacitor Limiters and Pre-paid Meters in some public facilities have been initiated by the Energy Commission of Ghana. However, these interventions cannot be sustained if no conscious efforts or policies are put in place to encourage energy conservation and attitudinal change in the public sector. Against this background, this study focused on the economics of energy efficiency and conservation in the Ghanaian public with a specific focus on the drivers and barriers influencing efficient energy use in the public sector. The positivism paradigm was employed through the use of a quantitative approach. In all, 108 public sector personnel responsible for energy management responded to the study through questionnaires. The study observed a positive attitude towards conservative energy among public institutions. However, the intention to be energy-efficient was perceived to be difficult by the personnel. There were fewer motivators for energy efficiency in the public sector. Developing a program that uses multifaceted approaches from both a structural and non-structural perceptive to achieve energy savings in the Ghanaian public sector is necessary.

Keywords: Energy Efficiency, Conservation, Public Sector, Attitude, Ghanaian

Overview

Access to reliable electricity is generally recognized as a key element of sustained economic growth (Allcott & Greenstone, 2015). However, the International Energy Agency (IEA, 2014) noted that while Sub-Saharan Africa accounts for 13 per cent of the world's population, only four per cent of its populace has access to reliable electricity. The rising threats of climate change and energy security has recently resulted in an increased interest in energy consumption reduction using behavioral change interventions

(Shove, Mika & Matt, 2012; McGrath, 2019). Therefore, the efficient use of energy resources presents an opportunity to combat climate change and energy wastage. According to Apeaning (2012), adequate and reliable supply of energy that is attained by the economics of energy efficiency is important for sustainable development.

Conceptually, Akinbami and Lawal (2009) defined the economics of energy efficiency as a concept of conservation that involves using the minimum amount of energy for service. The philosophy behind the economics of energy efficiency is the use of energy resources in a manner that will save energy and ensure minimal wastage. While energy efficiency is the amount of energy consumed in a given input of energy supplied, energy conservation is a reduction of the total amount of energy consumed by deliberately using less energy (Gillingham, Newell & Palmer, 2009; McClaren, 2015). Therefore, energy conservation can be attained by increasing the efficient use of energy through a reduction in energy consumption. However, while energy efficiency does not necessarily lead to less energy consumption, both are effective energy management practices. Using behavioral economics, IEA (2016) argued that energy conservation is a behavior that results in the use of less energy through efficient energy practices. However, there is low uptake of available cost-effective energy management measures among consumers in the adoption of the economics of energy efficiency and conservation (Farrell & Remes, 2009; Catteno, 2019). Accordingly, the IEA (2016) recommends that every energy policy should include energy efficiency and conservation management practices as part of its objectives.

A range of economic, behavioral and organizational perspectives provide conceptual explanations of the paradox of energy efficiency and conservation (Cagno et al., 2013; Gerarden, Newell & Stavins, 2017). The major market failures that inhibit the adoption of cost-effective energy management practices include the failure of energy prices to reflect environmental externalities and imperfect information (Sorrel, 2015). Non-market failures related to energy management practices that involve rational behavior. Most often if the cost of being energy efficient is considered high by consumers, an efficient measure may turn out to be economically inefficient. Economic models used to inform energy policy systematically ignore the importance of human dimensions and behavior in energy decisions. Consequently, economic models are unable to explain why individuals and organizations fail to adopt energy efficiency and conservation measures (Pegels, Figuera & Never, 2015).

The organisation perspective on the energy efficiency gap is based on the argument that the structures, power and culture within organisations propel or inhibit energy efficiency and conservation measures. According to the European Commission's Energy Efficiency Plan (ECEP, 2011), several opportunities for energy efficiency exist in the public sector including public procurement, the refurbishment of public buildings and energy efficiency measures involving cities and communities. However, until energy management becomes part of public sector organizational values and norms, energy efficiency and conservation opportunities may not be recognised and exploited (Sorrel, 2015).

In the Ghanaian economy, issues of energy security due to energy inefficiencies constantly threaten the economy (Apeaning, 2012). The non-residential sector which includes public institution and buildings has progressively increased its average energy consumption by 9% annually from 2000 to 2010 (Energy Sector Strategy and Development Plan, 2010). The Electricity Company of Ghana (ECG, 2015) also noted that Government Ministries, Departments and Agencies (MDAs) who provide essential services consume 15 per cent of the electricity production in Ghana. As part of improving energy supply in the public sector, the Government of Ghana (GoG) through the utility institutions installed Automatic Load Capacitor Limiters in some public facilities. The objective of the installation was to manage the

consumption of users to automatically disconnect power to the premises when consumption exceeds the allowable quota. According to the EC (2013), 10 to 15 per cent of energy is being wasted by public sector institutions in Ghana. However, energy efficiency interventions cannot be sustained, if no conscious efforts or policies are put in place to encourage energy conservation and attitudinal change in the public sector.

The inefficiency in energy use in the Ghanaian public sector has partly resulted in the recent energy crises in the country leading to a continuous request for load shedding exercises by the utility supplier to suppress demand. These among other factors, according to the Ministry of Energy (2015), have led to the closing down of some manufacturing companies. Also, public sector institutions that provide basic social amenities to support economic growth seem to be at the verge of collapsing due to lack of adequate electricity supply. Therefore, the need to develop a public sector energy management plan that regulates and promotes energy efficiency in Ghana is critical. Against this background, this study seeks to explore the factors and interventions that could promote efficient energy use behavior in the Ghanaian public sector.

Problem Statement

According to the Government of Ghana (GoG, 2017), over the past decade, the annual electricity demand growth centered around 10 per cent, with generation expansion unable to match up. Consequently, the ECG was compelled to announce a load shedding guide where a typical customer is guaranteed power 12 out of any given 36 hours. As a result, the economic growth rate in Ghana, according to GoG (2017) has reduced from 14 per cent in 2011 to 3.6 per cent by 2016. Energy efficiency and conservation management are therefore essential options in addressing the electricity demand and supply mismatch in Ghana.

According to Farrell and Remes (2009), 65 per cent of potential lessons concerning energy efficiency are located in developing countries, such as Ghana. Yet, the focus has rather been extensively placed on the production of energy. Integrating behavioral insights into energy efficiency programmes to promote the principles of the economies of energy efficiency is limited in Ghana (Pegels, Figueroa & Never, 2015). In the public sector, major interventions used for the improvement of energy efficiency had always been technological and economic. Thus, the human factor still seems to play a minor role in promoting energy efficiency in the public sector (Hardt et al., 2019). However, Seniwoliba and Yakubu (2015) argued that the best way of promoting energy conservation is to change the conservation behavior of energy users.

The current state of the Ghanaian power sector is a combination of increasing reliance on more expensive generation mix with historically low tariffs and high default rates. While the electricity tariff has been reviewed upwards on 14th December 2015, the issue of default remains unresolved. The default rate is particularly high among government subvention institutions. For instance, 51.4% of consumers' indebtedness to the ECG is owed by government institutions even though they constitute only 15% of total demand (ECG, 2015). Therefore, there is an urgent need for the government to champion energy efficiency and conservation to narrow the energy efficiency gap.

Additionally, while several studies (Apeaning & Thollander, 2013; Ackah, 2017; Braimah, & Amponsah, 2012; Ofosu-Ahenkorah, 2008) have been conducted on the economics of energy conservation and efficiency in Ghana, these studies focused mainly on residential and industrial consumers. There is relatively less attention on energy efficiency and conservation in the services and industrial sectors, particularly, the public sector. This could be linked to the fact that efforts of the GoG

to improve energy efficiency have largely been focused on residential and commercial sectors of the economy. The few studies (Apeaning, 2012; Seniwoliba & Yakubu, 2015; Twum, Low & Muin, 2016) that focused on the public sector have also ignored the behavioral component of energy efficiency and conservation. Consequently, information on the drivers and barriers to energy efficiency and conservation in the Ghanaian public sector is limited. Therefore, this study presents the opportunity to factor human behavior and efficient- technological policies that will work to handle the recurring energy challenges in the public sector in Ghana.

Research Design

The success of every research is dependent on the research design employed. Every component of the research methodology is informed by the design and that it links the research paradigm to the selected research methods (Creswell, 2014). Thus, the research design forms the foundation for any empirical studies and describes how each component of the methodology work together in obtaining relevant data to answer the research questions. A research design ensures that the relevant data is obtained and analyzed accurately following the research questions and hypotheses at hand. Essentially, the objective of research determines the research paradigm (quantitative or qualitative or both). In this study, a quantitative approach was adopted since the positivism paradigm is associated with the quantitative approach. According to Tannor (2014), quantitative approach operates on the principles of inferential statistics/science (generalizing from a sample to the entire population understudy). As such, the approach involves statistical representativeness of the sample, data quality and accuracy of estimates (confidence limits, margin of error). The approach aims at producing descriptive and inferential statistics that produce means, frequencies and other estimates of the population. The foundation of quantitative research according to Babbie (2010) is dependent on the survey type, the format of the questionnaire, quality of data analysis and report writing.

The quantitative data for this study was obtained through the administration of questionnaires to the mid-level officials of selected public sector organizations, and the collection of statistical data on annual energy consumption, equipment purchase, etc. The use of quantitative data was to help determine the statistical effect of efficient energy use behavior on energy conservation in the public sector. This choice was explained by the fact that quantitative research seeks to determine the relationship between the independent variables made up of attitude, subjective norm and perceived behavioral control and the dependent or outcome variable (behavioral intention) within the public sector with regards to energy conservation. Figure 3 further shows the details of the topology of the study pproach.

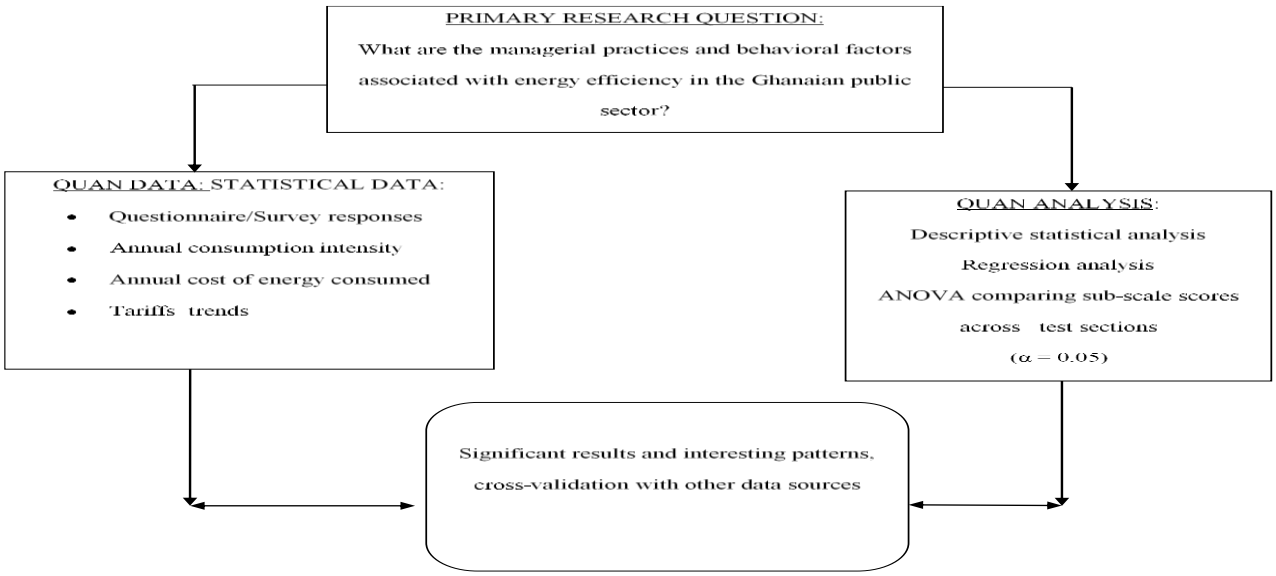

Figure 3. Research Approach
Source: Developed by the candidate (2018)

The quantitative approach was chosen because it is deductive and ensures the generalizability and reliability of research findings. This research study is predominantly quantitative because quantitative methods make up the largest percentage of topics and research methods published in energy efficiency and conservation behavior. Most previous studies (János, 2011; Zainudin, et al., 2014) have used quantitative methods to understand the economics of energy efficiency and conservation through the application of the behavior change theory. In other words, the choice of the quantitative research method in this study is empirically grounded in other previous energy research studies. However, Babbie (2010) argued that although the quantitative approach is adequate in testing hypotheses, the approach could miss out details such as behavior, attitudes, and motivation. In this study, however, the application of the quantitative approach was relevant to statistically predict consumer attitude and its influence on the energy conservation behavior of the public sector.

Quantitative research approaches are either descriptive or experimental (Babbie, 2010). For this study, a descriptive survey design was employed since the study seeks to establish the associations between attitude, subjective norm, perceived behavioral control and the behavioral intention of the public sector to be energy efficient. Descriptive design involves questions often prepared in the form of a written questionnaire and reports the way things are observed or recorded by drawing responses from a wide range of people (Frankel & Wallen, 2000). Therefore, the descriptive nature of the research questions demands the use of the descriptive survey design.

According to Seifert and Hoffnung (2012), unless the respondents are people who can articulate their thoughts well and sometimes even put such thoughts in writing, the descriptive design cannot be relied upon. This shortcoming was beyond this study since the respondents were people who could read and write, and accurately respond to the questionnaire. DoInicar (2013) also noted that with survey designs, it is sometimes difficult to ensure the clarity of the items to be answered, unless efforts are taken to word the items. This shortcoming was addressed by pre-testing the questionnaire. Despite the few problems inherent in the use of the descriptive survey design, it was found to be the most appropriate for this study because the design has the potential to provide adequate information regarding energy conservation

attitude from quite a large sample of individuals within a short period (Saunders, Lewis & Thornhill, 2016). There is also a rapid turnaround in data collection using the descriptive survey design (Tannor, 2014).

Research Questions and Hypotheses

This quantitative study was designed to address the economics of energy efficiency and conservation attitudes in the Ghanaian public sector and to identify the drivers and barriers for effective energy management practices. The following research questions (RQ) were analysed in this study:

RQ1. What are the energy management practices in the public institutions of Ghana?

RQ2. Do energy management practices vary across institutional types?

RQ3. What are the barriers or drivers of cost-effective energy management practices within and across the public sector of Ghana?

RQ4. To what extent is an investment in cost-effective energy efficiency technologies inhibited/facilitated by various types of barriers/drivers?

RQ5. What is the relationship between overall energy management practices and electricity consumption intensity?

RQ6. What specific energy management practices drive such a relationship?

RQ7. What is the nature of the association between energy efficiency and conservation behaviour within and across the public sector of Ghana?

Population and Sampling Strategy

The population for this study was limited to the relevant stakeholders in energy management across the 36 ministries, 12 Municipal, Metropolitan, Municipal, 133 Departments and Agencies, five militaries, five police barracks, five public tertiary institutions and five health institutions in the Greater Accra metropolis (Public Sector Commission, 2018). Thus, the study population was limited to the 201 public sector institutions in the Greater Accra metropolis. The Greater Accra was selected for the study since the metropolis has the majority of public sector institutions. The study also focused on the public sector because there are relatively little empirical studies on the economics of energy efficiency and conservation in the Ghanaian public sector. Yet, the sector is one of the major consumers of electricity in Ghana (Energy Commission, 2017). The objective of this study was to gather responses from mid-level officials of the selected public institutions on drivers and barriers of energy efficiency. In other words, the study involved people who have a responsibility towards the management and maintenance of public sector energy resources. Specifically, these included heads and officers of the estate/property and, procurement and/maintenance management departments of the respective institutions. These departments are responsible for the management and maintenance of the institutions' facilities, including electricity.

According to Castillo (2009), the large sizes of populations make it difficult, although impossible for researchers to include every element in the population because it is too expensive and time-consuming. Against this background, selected mid-level officials of the public sector institutions in the Greater Accra metropolis were sampled. The multistage sampling technique where sampling is done sequentially across two or more hierarchical levels by systematically moving from a general to a specific sample (Taherdoost, 2016), was adopted in the sampling process. The first stage of the sampling process involved the stratification of the public institutions into five sectors (MDA, MMDA, Health, Security

and Education). The stratification creates a sample which mirrors these sectors. Such a sample is more representative of the population across these sub-groups than a simple random sample would be (Tannor, 2014). The stratification was essential to help determine whether the barriers or drivers of cost-effective energy management practices statistically differ across the public sector institutions. The sampling of management in charge of energy management from each institution was done after the stratification. The participants were purposively selected since the candidate wanted to discover, understand and gain insights into the public sector's behavioral intention to energy conservation, and must, therefore, select participants from whom the most can be learned. Thus, all the officials who play major roles in the management of energy consumption in each of the selected public institutions were purposively selected. Berg (2007) suggested that in purposive sampling, researchers use their expertise or knowledge to include subjects in the sampled population. This includes those from which one can learn a great deal about issues of central importance to the purpose of the research (Moser & Korstjens, 2018).

Fundamentally, the size of a sample should be optimal. While deciding on the size of the sample, researchers must determine the desired precision and an acceptable confidence level for the estimates (Saunders et.al, 2012). Accordingly, the sample size for the study was determined using the Slovin Formula developed by Yamane (1967)

$$n = \frac{N}{1+N(e)^2} \quad \text{.....(1)}$$

Where n= sample size, N= population size (Number of targeted stakeholders in the management of energy resources), e=significance level in the percentage of error that was allowed is five percent.

Of the 201 public institutions, the number to participants selected for the study was calculated as:

$$n = \frac{201}{1 + 201(0.05)^2}$$

$$n = 134$$

The calculated sample size was further distributed proportionally across the five public sector institutions using stratified proportional allocation formula by Neyman (1964).

$$nh = \left(\frac{Nh}{N}\right) n \quad (2)$$

Where nh = sample size for a particular public sector, Nh = population size for a particular public sector, N = Total number of participants for the study, n = total sample size for the study. Table 6 shows the distribution of the sample size across the five public sector institutions.

Table 6

Distribution of Sample Size across Sectors

Institution	Study Population	Sample Size
MMDA	12	8
MDA	169	113
Security	10	7
Education	5	3
Health	5	3
Total	201	134

Source: Developed by Candidate (2018)

Research Instrument

Both primary and secondary sources of data were used to explore the research questions and hypotheses. The primary sources were obtained directly from the study's unit of analysis including the relevant stakeholders in energy management across the various public institutions. Structured questionnaires were used in this regard to collect quantitative data (behavioral and conservation attitude data measured on a four-point Likert scale). Structured questionnaires were used as the main tool for data collection because, besides its potential to produce information from many respondents within a short time, questionnaires are quite inexpensive in terms of time (McLeod, 2014; Sauders, Lewis & Thornill, 2016). Specifically, the questionnaire was used as the main data collection instrument because, cost-effectively, a large amount of data was collected from a lot of the participants within the shortest possible time, as compared to other forms of data collection instruments such as interview guides. Questionnaires could also be more objectively analyzed (Sauders, Lewis & Thornill, 2016). Despite these advantages, Creswell (2014) argued that questionnaires do not allow for probing and clarification of answers given. These limitations were addressed by complementing the questionnaires with the statistical data on annual energy consumption which allows for further elaborations.

To ensure that the questionnaire contains relevant items that can answer the research questions and hypotheses, the instrument was structured into sections with each section focusing on one of the objectives of the study using the key variables in the conceptual framework as the basis. In other words, the questionnaire for the study consisted of five sections starting with background information followed by four sections measuring different constructs. According to Creswell (2014), background characteristics of research respondents is essential in accessing the credibility and relevance of a sample in providing valid and more reliable data for research. The background characteristics of the participating institutions including the name of the organization, type of organization, the position occupied by the participants and number of years of working in the public sector. A psychometric questionnaire concerning planned behavior was adopted from Gardner and Ashwoth (2007) where attitude, behavioral control, subjective norms and behavioral intention were measured on a four-point Likert scale. A four-point scale was used against the traditional five-point scale due to the tendency for participants to select responses in the centre of the scale if an odd number response scale was used as indicated by Best and Kahan (1995). While various rating scales have been developed to measure attitude, the most widely used is the Likert scale developed in 1932 (Juneja, 2019).

Behavioral intention was measured using five-items adopted and modified from Gardner and Ashwoth (2007). Perceived behavior control was also measured using concepts adopted and modified from Gardner and Ashwoth, (2007). Subjective norm was measured using six-item adopted and modified from Gardner and Ashwoth (2007). The attitude was measured using ideas adopted and modified from Gardner and Ashwoth (2007). These measures of attitudes, subjective norm, perceived behavioral control and behavioral intentions were presented to the participants as statements anchored by the Likert scales from strongly agree (4), agree (3), disagree (2), and strongly disagree (1).

Instrument Validation

A questionnaire is valid if it measures what it is intended to measure and accurately achieves the purpose for which it is designed (Patten, 2004). According to Patten (2004), no survey instrument is perfectly

valid. Researchers require some level of assurance that the survey instruments employed will result in an accurate conclusion using pilot-testing. In this study, the initially designed questionnaire was pre-tested with 15 senior officials in charge of energy resource management at the Ministry of Energy to determine how reliable it was for data collection in the main survey. The pre-testing was against Moser and Kalton (2008) assertion that however experienced the questionnaire designer may be, any attempt to shortcut the pre-testing stage will seriously jeopardize the validity and reliability of the questionnaire. Pre-testing of the survey instrument helped to improve the items, avoid repetitive items and identified the key issues to be investigated. Few revisions were made to the instruments after the pre-test. Thus, the pre-testing helped to determine the strength and weaknesses of the questionnaire regarding its reliability and validity before proceeding to the actual fieldwork. To ensure the validity of the instrument, the questionnaire was given to the supervisor for scrutiny, since validity is determined by expert judgment (Tannor, 2014).

Since the questionnaire employed the Likert scale, reliability of the items was performed using the Cronbach Alpha Coefficients which reports on the internal consistency of psychometric scales as recommended by Serbetar and Sedlar (2016). According to Nunnally (1994), if the Cronbach's alpha is less than 0.7, then the indication is that the instrument being used has low reliability and that not all the items met reasonable standards of internal consistency and reliability. Table 7 shows the Cronbach Alpha for each of the constructs measured.

Table 7

Reliability Test for Behavior Change Construct

Items	No. of Items	Cronbach Alpha
Environmental awareness	4	0.767
Attitude	8	0.840
Subjective Norm	7	0.835
Behavioral control	8	0.819
Behavioral Intention	3	0.750
Overall Scale	30	0.811

Source: Pre-test Data (2018)

In this study, Table 7 shows that a Cronbach Alpha coefficient of at least 0.7 was obtained for each of the dimensions. This means that the items had relatively high internal consistency as suggested by Nunnally (1970). Secondary data on the total cost and unit of energy consumed by the institutions as well as energy-consuming equipment purchased across the institutions in the last four years (2015-2018) were obtained from the institutions. The secondary data obtained from the institutions on the annual energy consumption expenditure and equipment was validated with that of consumption intensity data from the ECG. As part of relating the total cost of consumption and unit of energy consumed, data on tariffs trends were also collected from the ECG for the last four years (2015-2018).

Data Collection Procedures

This study used a combination of survey and administrative data. Primary data collection was conducted through a designed survey targeted at the stakeholders that have a responsibility towards the management of energy resources within and across the public sector in the Greater Accra metropolis. These stakeholders included the following:

1. Senior Management Staff of Ministry, Municipals, Department, Agencies (MMDAs)

2. Senior Management Staff of Military and Police barracks
3. Senior Management Staff of Public Tertiary Institutions
4. Senior Management Staff of the Procurement Department
5. Senior Management Staff of Estates and Premises Maintenance
6. Senior Management Staff of Administration and Personal
7. Senior Management Staff of Accounts and Budgets
8. Senior and Junior staff of the MDAs

The procedure for data collection from the various stakeholders was flexible to accommodate participants' desired options to receive and answer the structured questionnaires to minimize the major problem of low response rate with the self-administered questionnaire (Tannor, 2014). The questionnaire was self-administered because the participants had a busy schedule and could not be subject to about 45-60 minutes interview, while the self-administration method was relatively inexpensive. Additionally, the participants are educated and could read and write to adequately respond to the study while obtaining very large samples was feasible, making the results statistically significant (Creswell, 2014). The method also eliminated observer subjectivity thereby increasing the validity of the results. However, a major problem with a self-administered questionnaire is a low response rate (Tannor, 2014). Constant follow-ups were made through the Human Resource Managers of the corresponding institutions, who helped to retrieve the complemented questionnaires. In other words, the Human Resource Managers of the respective institutions administered the questionnaire to the respective personnel and retrieved the complemented questionnaire on behalf of the Candidate. Out of the 134 questionnaires administered, 108 (80.6%) were returned. In other words, 108 government institutions (MMDA, MDA, Health, Security and Education) participated in the study. According to Jack (2008), *response rates* approximating 60% for most research should be the goal of researchers.

According to Creswell (2014), gaining access to research sites requires obtaining permission from the essential stakeholders who can facilitate the collection of research data. Officially, the candidate obtained an introductory letter from the University to the participating public sector institutions. The consent of the respondents was obtained by giving a written explanation of the aims of the study as well as how the findings of the study will benefit them as recommended by Bell, Bryman and Harley (2018). In collecting the data and reporting the research findings, no information was provided that will lead to the identification of the institutions and the respondents. Only relevant details that helped in answering the research questions were included as suggested by Tannor (2014). The respondents were also assured of their confidentiality and anonymity by asking them not to mention their names during the data collection to be anonymous. All the respondents also had the right to withdraw from the study at any time without being forced by the candidate to complete the questionnaire.

Data Analyses

The quantitative data gathered was coded and captured using the Statistical Package for the Social Sciences (SPSS, version 20). Quantitative analysis in this study involved the generation of descriptive and inferential statistics. The descriptive statistics involves the generation of means and standard deviations. The inferential statistics employed included the Analysis of Variance (ANOVA), Pearson Correlation and the Regression analysis. The Bivariate Person product-moment correlation analysis was conducted to identify the relationship between attitude, subjective norm, perceived behavioral control and individual intention to perform energy conservation behavior. Regression analysis was conducted to

analyze the contribution of attitude, subjective norm and perceived behavioral control towards the public sector's intention to be efficient in its energy use.

The ANOVA was used to determine differences in the behavioral intention of energy conservation across the type of public sector institution. The independent-sample t-test was used to determine the difference in the behavioral intention to energy conservation across institutions paying for their electricity bills and those being paid for by the government. In this case, the intention to be energy efficient was used as the dependent variable, with attitude, subjective norm and perceived behavior control as the independent variables. With the regression analysis, this study was able to model and predict the intention of the public sector to be energy efficient. The explanatory variables for the regression analysis include attitude, subjective norm and perceived behavior control. The intention to be energy efficient is the response variable.

From the regression, the model coefficients were obtained along with their p-values for testing the hypothesis of zero slope coefficients (test of statistical significance) where all inferential statistical analyses were performed at a 95.0 percent confidence interval. Thus, statistical significance was tested at a five percent significance level ($\alpha = 0.05$). Specifically, in testing the hypotheses, if the significant value of the test-statistics (p-value) obtained is less than 0.05, then the hypothesis was accepted. In other words, the researcher failed to reject the hypothesis if the corresponding p-value obtained was less than the tested alpha value (0.05). In statistical terms: if

- p-value > 0.05 => Reject H_1 at 0.05
- p-value ≤ 0.05 => Do Not Reject H_1 at 0.05

Table 8 Analytical Technique across Research Questions

Research Question (RQ)	Statistical Data Analysis
RQ1	Descriptive (mean, standard deviations, percentages).
RQ2	ANOVA
RQ3	Descriptive (weighted mean, standard deviation), regression
RQ4	ANOVA, t-test
RQ5	Correlation
RQ6	Regression
RQ7	Correlation

Source: Developed by candidate (2018)

Main Finding and Results

The results of the data analysed are presented in this chapter in relation to the research questions. Using the research objectives as the framework, this chapter analysed and presents the results based on the responses from the questionnaire administered to the various government institutions within the Greater Accra region of Ghana. The 108 responses received from these government institutions are presented with the aid of tables and charts to capture the important details and outcomes concerning the Research Questions (RQs)

This chapter comprises three main sections, the demographic statistics of the respondents, details of analyses of the results based on the administered structured questionnaire and the summary of results. In all, 134 government institutions, made up of Municipals, Ministries Departments Agencies (MMDA), Health, Security and Education organisations were visited. However, 108 out of the 134 institutions

visited participated in the study. The overall objective of this study was to ascertain the economics of energy efficiency and conservation attitudes within government institutions in Ghana and to determine the barriers or drivers of cost-effective energy management practices. The relationship between the overall energy management practices and the electricity consumption intensity of these institutions were also analysed.

Demographic Statistics

The background analyses of the 108 government institutions were captured in Section A of the administered questionnaires. Background analysis of the institutions was evaluated to determine their credibility in providing accurate data that is essential for enhancing the reliability and validity of the findings. Table 9 shows the distribution of the 108 public sector institutions that participated in the study.

Table 9 Type of Government Institutions

Institution	Frequency	Percent (%)
MMDA	32	29.6
MDA	60	55.5
Health	10	9.3
Security	3	2.8
Education	3	2.8
Total	108	100

Source: Field Work (2018)

Table 9 shows that more than half (55.5%) of the institutions that participated in the study are from the Ministries, Departments and Agencies (MDA). This was expected since over 80 percent of public sector institutions in the Greater Accra metropolis are from the MDAs (Public Sector Commission, 2018).
The positions of the respondents that provided information for the public institutions visited were analysed and the results depicted in Table 10.

Table 10 Positions of Key Informants

Position	Frequency	Percent (%)
Estate/Property Officers	70	64.8
Procurement Officers	15	13.9
Maintenance Officer	23	21.3
Total	108	100

Source: Field Work (2018)

Table 10 shows that more than 60 percent (64.8%) of the respondents responsible for energy management from the 108 public institutions were Estate/ Property Officers. A little over 20 percent of the respondents were also Maintenance Officers (21.3%). Less than 20 percent (13.9%) of the respondents were Procurement Officers. These representatives are responsible for the management and maintenance of the institutions' facilities, including electricity. Generally, the respondents occupied

essential positions that are relevant in providing valid and reliable data on the economics of energy efficiency and energy conservation attitudes in the Ghanaian public sector.

Background analysis is essential in accessing the credibility of research respondents in providing valid and more reliable data for research (Creswell, 2014). Therefore, in providing a background analysis of the respondents that participated in the study, Table 11 shows a summary of the demographic statistics of the respondents.

Table 11 Summary of Demographic Statistics

Variable	Frequency	Percent (%)
Gender		
Male	94	87.0
Female	14	13.0
Total	108	100
Age (Years)		
18-29	14	12.9
30-39	43	39.8
40-49	29	26.9
50-59	22	20.4
Total	108	100
Period of Working (Years)		
1-5	65	60.2
6-10	22	20.4
Above 10	21	19.4
Total	108	100
Educational Background		
Primary or Below	18	16.6
Secondary	7	6.5
Post-Secondary/University	61	56.5
Post Graduate	22	20.4
Total	108	100

Source: Field Work (2018)

Table 11 shows that more than 80 percent (87.0%) of the respondents were males. Thus, the proportion of males that participated in the study was 74.0 percent more than females. There are clear indications that females have not been attracted to the profession of Estate/Property Managers as well as Maintenance Officers in the public sector.

The ages of the respondents were also captured to ascertain the spread of ages of persons within the public sectors responsible for the management of their energy consumption and related activities. Aggregating the results in Table 11 shows that a little over half (52.7%) of the respondents were aged 18-39 years, while less than half (47.3%) were in the age range of 40-59 years. Comparing the ages to the National Youth Policy of Ghana (2010) that defines youth as a person within the age bracket of 15 and 35, it is clear that the respondents were made up of both young and old Estate, Maintenance and Procurement Officers.

Table 12 shows the descriptive statistical analysis on the period for which the respondents have worked with their institutions.

Table 12 Period of Working with Institution

Variables	Statistics (Years)
Mean	6.7857
Standard Deviation	5.782
Minimum	1.000
Maximum	24.000

Table 12 shows that on the average, the respondents have worked with their institutions for seven years. The minimum and maximum periods of work are respectively one year and 24 years. Based on the minimum and maximum years, the number of years of working was recoded as shown in Table 12 above. About 60.2 percent of the respondents have worked with their institutions for 1-5 years, while 39.8 percent has worked for above five years. Generally, the respondents have had more working experience with their institutions as Estate, Maintenance and Procurement Officers. The long working experience of the respondents, according to Tannor (2014), makes them credible in providing accurate data regarding the economics of energy efficiency and energy conservation in the public sector.

The educational backgrounds of the respondents were also analysed. Aggregating the results in Table 11 above shows that majority (76.9%) of the respondents were university holders. Thus, the respondents had relatively high educational backgrounds. This, according to Owens and Driffill (2008), is expected to make them knowledgeable in the procurement of energy-efficient equipment.

Details of Analysis and Results

This section assessed the use of electrical energy among institutions. Key issues discussed in this section included the consumption intensity of electricity by the institutions, the frequency of payment of electricity bills and whether the institution is the payer of electrical energy or it is paid directly by the government.

Table 13 Electrical Energy use among the Institutions

Variable	Frequency	Percent (%)
Payer of electricity bills		
Institution	89	82.4
Government	19	17.6
Total	108	100
Frequency of paying electricity bills		
Weekly	4	3.7
Monthly	81	75.0
Quarterly	23	21.3
Total	108	100

Source: Field Work (2018)

The study also analysed if the institutions are responsible for the payment of their electricity bills or the bills are being paid by the government. Table 13 shows that the majority (82.4%) of the institutions pay their electricity bills. In other words, for the respondents from these institutions that participated in this

study, less than 20 percent have their electricity bills being paid for by the government directly to the suppliers. Further inferential statistical analysis was performed in Table 29 to determine if the consumption intensity of the institutions varies across institutions paying for their electricity bills and those institutions that the government pays. Table 13 also shows that more than 70 percent (75.0%) of the institutions pay their electricity bills monthly. None of the institutions pays their electricity bills half-yearly. The monthly payment was expected since most institutions prepare their accounts monthly and electricity bills are also issued monthly by the suppliers, which is regulated under the Energy Commission Act L.I. 1816 session (5).

Electricity consumption intensity. This section reviews the total cost and unit of energy consumed by the institutions in the last four years (2015-2018). The outliers in the data set were discarded using the trimmed mean. The Trimmed Mean is an averaging method which eliminates a partial percentage of the greatest and smallest values before evaluating the standard mean of the given data (Arulmozhi, 2009).

The application of the trimmed mean was as follow: Trimmed Mean (μ) = $\frac{\sum Xi}{n}$

Where,

$\sum X_i$ - Sum of the Trimmed Set, n - Total Numbers in Trimmed set, μ - Trimmed Mean

The timed mean was used because it is less sensitive to outliers than the normal mean. The data set was trimmed at 5% as recommended by Arulmozhi (2009). Table 14 represents the average grid cost of electricity End User Tariff (EUT) indicating the trend of the average cost of electricity in Unites States of America Dollars (USD) and Ghana Cedis (GHS) for the past 10 years.

Table 14 Average Grid Cost of Electrical End User Tariff (2009-2018)

Years	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
GHS/kWh	0.148	0.211	0.245	0.232	0.307	0.464	0.541	0.817	0.798	0.705
Exchange Rate (GHS/USD)	1.430	1.450	1.550	1.880	1.970	3.200	3.680	3.890	4.360	4.590
US$/kWh	0.104	0.145	0.158	0.124	0.156	0.145	0.147	0.210	0.183	0.154

Source: Energy Commission (2009-2018)

Figure 4 presents a trend analysis on the general cost and unit of consumption of energy across the institutions from 2015 to 2018.

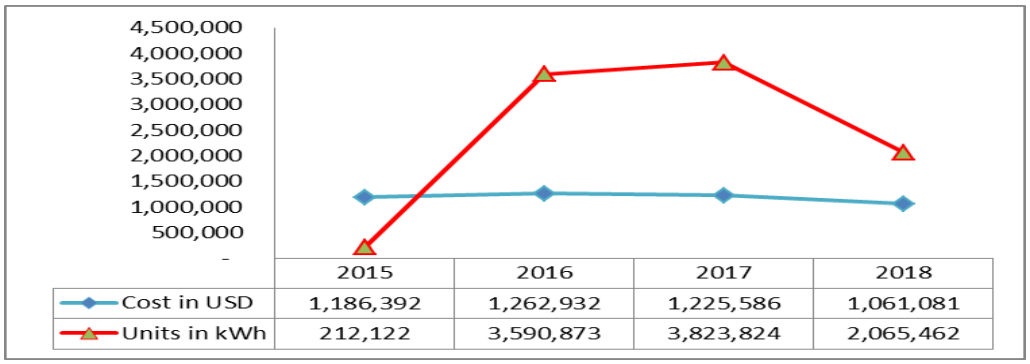

Figure 4. Cost and unit of electricity consumption trends per annum

Source: ECG (2015-2018)

Figure 4 shows that there is an increase in the cost and unit of consumption from 2015 to 2016 with a continuous decline from 2016 to 2018. The electricity consumption cost of the institutions increased by 6.5% from 2015 to 2016. However, between 2016 and 2018, the consumption cost and units respectively decreased by 13.0 percent and 42.48 percent among the institutions. The low consumption in electricity among the institutions is explained by the high-powers outages that occurred between 2015 and 2016.

Figure 5 shows the trends in tariffs.

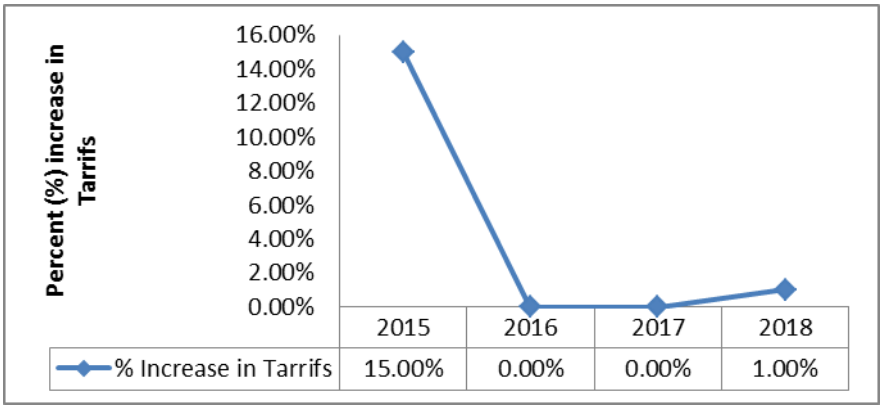

Figure 5. Percentage increase in tariffs
Source: ECG (2015-2018)

Figure 5 above shows a reduction in tariffs from 2015 to 2016. However, there was an increase in consumption as shown in Figure 4 above for the same period. Similarly, between, 2016 to 2017, Figure 5 shows no increase in tariffs, however, there was a slight increase in consumption as shown in Figure 4 above. Finally, there was however an increase in tariffs from 2017 to 2018, yet consumption decreased as shown in Figure 4 above. There is a corresponding reduction in consumption anytime there is an increase in tariffs and that the institutions are price elastic. In other words, the price of electricity seemed to have a significant role to play in the downwards cost trends.

Although price impacts on behavior, Sanquist et al. (1993) argued that there is more to behavior than price signals. Therefore, while several other factors may have accounted for the reduction in consumption of electricity among the institutions apart from price, it is clear that these institutions are reducing their cost of consumption. Further analysis will be applied to determine the underlying declining nature of the consumption in recent times.

According to the Energy Commission (2006), energy consumption varied across public sector institutions. Therefore, further analysis was done to determine the annual energy consumption cost across the institutions in Figure 6.

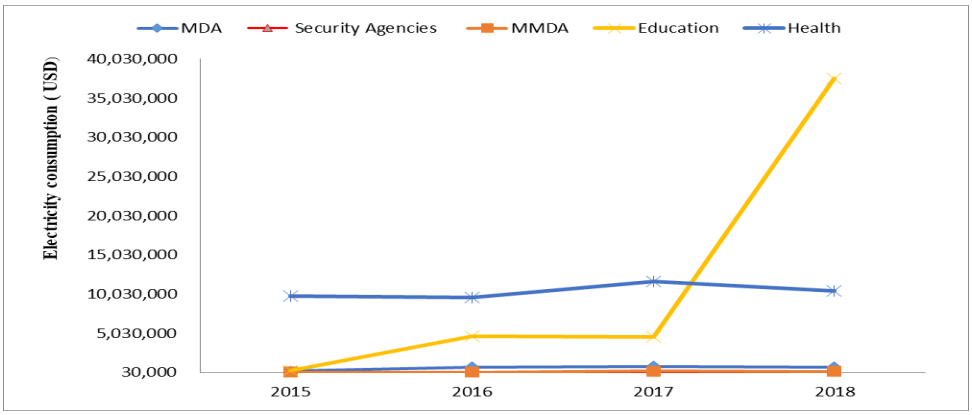

Figure 6. Energy consumption cost across institutions

Source: Field Work (2018)

In Figure 6, it is seen that except for 2018, health institutions recorded the highest consumption of electricity followed by educational institutions. Consumptions for the MMDA and the MDA were almost the same across the years. The average consumption of electricity over the four years 2015 to 2018 across the institutions is shown in Table 15.

Table 15 Average Electrical Consumption cost across Institutions

Institution	Average Cost (USD)	Units (kWh)
MMDA	229,172	973,981.
MDA	199,514	845,297.
Health	6,435,512	29, 302,346
Security	53,887	232,240
Education	1,952,679	8,306,560

Source: Field Work (2018)

An assessment of the results in Table 15 shows that the security institutions had the lowest average consumption of electricity over the past four years (USD 53,887, kWh 232,240), while the health sector had the highest consumption (USD6,435,512, kWh=29,302,346). The MMDA consumed (USD 29,658, kWh 128,684) more than the MDA.

Table 16 also shows the average amount of energy consumed over the past four years across institutions paying their bills and those that the government pays for directly.

Table 16 Consumption Cost across Payer

Variable	Average (USD)	Units (kWh)
Institution	514,030	2,477,336
Government	1,568,279	6,257,622

Source: Field Work (2018)

Table 16 shows that institutions that pay their electricity bills either from their internally generated fund or budget allocations from the government have a consumption intensity of USD 514,030 (kWh 2,477,336) annually. On the other hand, those that government pays for directly had a consumption intensity of USD 1,568,279 (kWh 6,257,622) annually. In other words, those that government pays for

annually spending USD 1,054,284 (kWh 3,780,286) more on electricity bills as compared to those that pay their electricity bills. As part of testing whether the differences observed regarding electricity consumption across the institutions is significant, several analyses were performed based on the research questions.

Energy management practices (RQ1). This section explored the energy management practices undertaken by the institutions. Table 17 shows the results.

Table 17 Energy Management Practices in percentages (%)

Variable	Never	Sometimes	Always
Appliance purchase and use behaviour:			
Electrical appliances are always switched off if not in use	3.20	45.20	51.60
Electrical appliances are always cleaned and maintained	0.00	74.20	25.80
This Institution always procures energy-efficient equipment	0.00	67.70	32.20
Leadership:			
Communication of information on energy conservation	10.10	48.40	35.50
Good leadership traits by management on energy savings	20.00	50.00	30.00
Employees' commitment:			
There is a feeling of teamwork to conserve and use energy	13.30	60.0	26.70
Employees feel they are part of the decision making processes	10.70	50.00	33.30

Source: Field Work (2018)

Appliance purchase and use behavior. Table 16 shows that just a little over half (51.6%) of the respondents indicated that electrical appliances are always switched off if not in use. Having about 45.20 percent of the respondents sometimes switching off the electrical appliance when not in use means that electrical energy management practices regarding the efficient use of electrical appliances have not become a habitual attitude of public sector institutions as required by the behavior change theory. Table 16 also shows that 74.20 percent of the respondents indicated that electrical appliances are not always cleaned and maintained per specifications to achieve efficiency. About 67.7 percent of the respondents also indicated that they sometimes procure energy-efficient equipment.

Leadership and employees' commitment to energy saving. Table 16 shows that half (50.0%) of the respondents indicated that they sometimes involve employees in their energy efficiency decision-making process. This explains why less than half (33.3%) of the respondents indicated that their employees always feel they are part of the decision-making process in energy conservation. Further significance analysis of RQ1 has been performed in RQ2, RQ3, RQ5, and RQ6 to respectively determine if energy management practices differ across institutions, the relationship between the overall energy management practices and electricity consumption intensity, and the energy management practices driving the relationship of electricity consumption intensity.

Energy management practices across institutional types (RQ2). This section analysed whether energy management practices vary across institutional types. Thus, in research question (2), this section analysed whether there are any significant differences in the energy management practices across the type of institution using the one-Way Analysis of Variance (ANOVA). Table 18 shows the ANOVA results.

Table 18 ANOVA for Energy Management practices across Institutions

Source	Sum of Squares	df	MS	F	p
Between	1.183	4	0.296	5.382	0.278
Within	5.688	103	0.055		
Total	6.871	107			

Source: Field Work (2018)

Table 18 summarises the differences in results of an ANOVA between groups, which shows insignificant differences were found (p = 0.278) between the energy management practices and the type of institutions. The results imply that energy management practices did not significantly differ across the type of institutions. Since the p-value (0.278) obtained in Table 18 is greater than the tested alpha (0.05), the candidate concluded that the energy management practices will not vary significantly across institutional types. However, the management practices of the security institutions seem to be effective than other institutions. For example, the security institutions had the highest mean response for switching off electrical appliances when not in use (Mean =2.50) and the procurement of energy-efficient equipment (Mean = 2.600).

Barriers or drivers of cost-effective energy management practices (RQ3). This section analysed the factors facilitating or inhibiting cost-effective energy management practices among public institutions. Table 19 shows the views of the respondents on other important factors that influence their energy conservation. Thus, the section analysed the most important factors that influence the energy efficiency of public sector institutions. The study quantitatively ranked the factors by using the weighted mean.

$$\text{Weighted Mean } (\mu) = \frac{\sum w}{N} \quad (1)$$

where w is the weights given to each factor by the respondents, ranging from 1 to 7, A is the highest weight (i.e. 7 in the study) and N is the total number of respondents (108) that participated in the study. Using the weights, the weighted mean and the rankings are shown in Table 19. The ranking is as follows: Rank 1 = Least important factor and Rank 7 = Most important factor. Table 19 shows the weights for each of the factors. Therefore, a higher weighted mean suggests the most important factor.

Table 19 Ranking of factors influencing the Energy Conservation of Public Institutions

Weights / Factors	1	2	3	4	5	6	7	Total
High electricity price	11	0	7	15	0	4	71	108
Behaviour (self-discipline)	5	28	14	9	9	38	5	108
Awareness on energy savings activities	0	5	26	21	46	5	5	108
Using more efficient equipment structure	5	10	5	34	15	34	5	108
Availability of information on energy savings	11	9	42	23	9	14	0	108
Sanctions and rewards to conserve energy	51	41	10	3	3	0	0	108
Involvement of employees in energy policies	32	38	22	11	5	0	0	108

Source: Field Work (2018)

Using the weights in Table 19, the calculated weighted mean, as well as the corresponding ranks for each factor, are shown in Table 20. On a scale of 1-7, a rank of 7 was assigned to the highest weighted mean, while a rank of 1 assigned to the lowest weighted mean.

Table 20 Weighted Means and Ranks

Factors	Weight mean	Ranking
High electricity price	5.680	7
Behaviour (self-discipline)	4.139	4
Awareness of energy savings activities	4.324	5
Using more efficient equipment structure	4.534	6
Availability of information on energy savings	3.481	3
Sanctions and rewards to conserve energy	1.759	1
Involvement of employees to roll out energy policies	2.250	2

Table 20 shows that the most important factor that influenced the respondents in being conservative and efficient in their energy use is high electricity bills (weighted mean = 5.680) followed by using more efficient equipment structure (weighted mean = 4.534). Though ranked as the third most important factor (weighted mean = 4.324), awareness of energy-saving activities (education) also seemed to influence the behaviour of the respondents to be energy efficient. Sanctions and rewards to conserve energy (weighted mean = 1.759) and management involvement of employees to roll out energy conservation policies (weighted mean = 2.250) were respectively ranked as the least factors in being conservative and efficient in energy use.

The determinants of energy efficiency and conservative behavior in the public sector were also analysed in this section from a behavioural change perspective. Determinants of energy efficiency and conservative behavior were analysed using 30 items. Thus, to scientifically determine the determinants of energy efficiency and conservative behavior in the public sector, 30 items were used on a four-point Likert scale across six major determinants (See Questionnaire in Appendix B).

Environmental protection. Table 21 shows the mean and standard deviation (SD) for each of the constructs on environmental protection awareness.

Table 21 Environmental Protection Awareness

Statement	Mean	SD
The amount of energy we use do not affect the environment significantly	2.61	1.17
The country's economic growth and increase in the human standard of living must take precedence over environmental concerns	2.42	1.27
Ghana has an excess supply of electricity and natural resources, hence there is no need to worry about energy conservation	1.88	1.14
Most Ghanaians do not put in much efforts to conserve energy, so it will be fruitless even if this institution does so	2.54	1.16
Overall Mean	2.27	0.33

Source: Field Work (2018)

In Table 21, the overall mean obtained for the four items (Mean = 2.27) used to measure environmental protection awareness of the respondents in these institutions implies that the respondents disagreed to almost all the items. All the respondents disagreed that the amounts of energy their institutions use do not affect the environment significantly. In other words, the respondents were aware that the amount of energy their institutions use has an impact on the environment. The respondents held a positive attitude

towards environmental protection awareness through the consumption of energy. Further analysis was done in Table 29 to determine whether the environmental protection awareness of the participants for the survey in these institutions on energy conservation has any correlation with their intention to be efficient in their energy use.

Attitude to Energy Conservation. Niura (2013) and Lynch and Martin (2013) noted that attitude has a direct impact and the most essential determinant on the behavioral intention that helps to predict the behavior of energy users. Table 22 shows the views of the attitude of the respondents towards energy conservation.

Table 22 Energy Conservation Attitude

Statement	Mean	SD
The Institutions have at least three things they do consistently to reduce energy consumption	3.18	0.77
The institution serves money when it reduces its energy consumption	3.68	0.67
Reducing my energy use in this institution will improve the institution's energy conservation	3.75	0.44
It would make me feel good to contribute to the reduction of this institution's energy consumption	3.50	0.92
Reducing this institution's energy consumption would be inconvenient to the employees	2.50	1.00
Managers of this institution care about saving energy	3.36	0.83
The institution is willing to pay more for energy conservation	3.25	0.84
To be energy efficient, staff are willing to spend time learning and implementing good energy	3.25	0.70
Overall Mean	3.31	0.39

Source: Field Work (2018)

Table 22 shows that the respondents agreed with the eight items delineating the attitude of the respondents in the institutions to energy conservation. The overall mean (3.31 of 4.00) implies that the respondents seemed to have some positive attitude towards the conservation of energy. The average fall was between (2.50 and 3.75). The respondents showed strong agreement to the following energy conservation items: Reducing my energy use in this institution will improve the institution's energy conservation (3.75), the institution serves money when it reduces its energy consumption (3.68), it would make me feel good to contribute to the reduction of this institution's energy consumption (3.50). The respondents, however, disagreed that reducing this institution's energy consumption would be inconvenient to the employees (2.50). Further analysis was done in Table 35 to determine whether the positive attitude of the respondents in these institutions on energy conservation has any correlation with their intention to be efficient in their energy usage.

Subjective Norms. According to Kano (2013), the subjective norm has a significant effect on the behavior of energy conservation. Against this background, Table 23 shows the subjective norms of the respondents regarding energy conservation.

Table 23 Subjective Norms

Statement	Mean	SD
Employees in this institution think we should reduce energy consumption	3.32	0.77
The Government think we should reduce our energy consumption	3.50	0.58
Other public institutions have taken steps to reduce energy consumption	3.54	0.64
Energy experts think we should reduce our energy consumption	3.46	0.88
Management of these institutions are committed to less energy consumption	3.32	0.95
Public institutions think that the government values energy conservation	3.43	0.74
Public institutions need to conserve energy for generations	3.39	0.96
Overall Mean	3.42	0.08

Source: Field Work (2018)

Table 23 shows that the respondents agreed with the seven items delineating subjective norms. The overall mean is (3.42 of 4.00). This shows that the respondents seemed to have some positive attitude towards the conservation of energy and forms a favorable evaluation of the need to conserve energy efficiently. The average fall was between (3.32 and 3.54). The respondents showed strong agreement to almost all the eight items on subjective norms. However, there was a strong agreement to the following items: Other public institutions have taken steps to reduce energy consumption (3.54), the Government think we should reduce our energy consumption (3.50). Though the respondents agreed that there is a commitment from the management of their institutions to reduce energy consumption (3.32), the commitment is not very strong. The results show that there is a perceived social pressure for public institutions to be efficient in energy use. Further analysis was done in Table 35 to determine whether the formation of positive subjective norms has any correlation with the intentions of the respondents in these institutions to be efficient in their energy use.

Perceived Behavioural Control. According to Lynch and Martin (2013), the public sector's perceived behavioral control has the characteristics to either strengthen or weaken the sectors intention to be conservative in its energy use. Against this background, the perceived behavioral control of the participants for the survey has been analysed as presented in Table 24.

Table 24 Perceived Behavioral Control

Statement	Mean	SD
This institution has taken steps to reduce its energy consumption	3.36	0.86
This institution has complete control to reduce its energy consumption	2.04	0.89
The decision to use less energy in this institution is beyond my control	3.00	0.91
The decision to install energy-saving devices in this institution is beyond me	2.68	0.99
Staff are sanctions if they fail to be efficient in their energy use	1.92	0.95
This institution has appropriate incentives for being efficient in energy use	2.04	1.17
This institution sees energy conservation as realizable and pressing	3.20	0.82
There are existing channels of reporting energy misuse in this institution	2.96	0.94
Overall Mean	2.65	0.53

Source: Field Work (2018)

Table 24 shows that the respondents disagreed with most of the items delineating perceived behavioral control. The overall mean is 2.65 of 4.00. This implies that the intention to be energy efficient is perceived to be difficult by the respondents. The respondents agreed with the following statements: In the past years, the management of this institution has taken steps to reduce its energy consumption (3.36), the management of this institution sees energy conservation as realizable and pressing (3.20), the decision to use less energy in this organisation is beyond my control (3.00).

On the one hand, the respondents disagreed to the following items: Staff are sanctions if they fail to be efficient in their energy use (1.92), there are appropriate incentives for being efficient in energy use in this institution (2.04), there are existing channels of reporting /rectifying energy misuse and electricity faults in this institution (2.96), this institution has complete control to reduce its energy consumption (2.04). Thus, the respondents perceived their ability to be efficient in energy use as difficult, while there were no rewards for being energy efficient. Further correlation analysis was done in Table 35 to determine whether the formation of positive perceived behavioral control has any correlation with the intentions of the respondents to be efficient in their energy use.

Behavioral Intention. According to the literature, the intention of the public sector staff to be energy efficient precedes the actual behavior of being efficient. Table 25 shows the intention of the sector staff to be energy efficient.

Table 25 Behavioral Intention

Statement	Mean	SD
This institution will try to reduce its energy consumption 3.36	0.64	
This institution is unlikely to make attempts to reduce its energy use	2.68	1.25
There is a 100% chance this institution will try to reduce its energy use	3.28	0.79
Overall Mean	3.11	0.37

Source: Field Work (2018)

Table 25 shows that the respondents agreed with almost all the three items delineating behavioral intention. The overall mean is 3.11 of 4.00. Thus, the respondents for these institutions have the behavioral intention to be energy efficient. The respondents agreed with the following statements: The management of this institution will try to reduce its energy consumption (3.36), there is a 100 percent chance that the management of this institution will try to reduce its energy consumption (3.20). However, the respondents disagreed that it is unlikely that the management of this institution will make attempts to reduce its energy consumption (2.68). Table 26 shows a summary of the determinants of energy efficiency.

Table 26 Summary of determinants of Energy Efficiency statistics

Determinants	Mean	Standard Deviation
Environmental Protection Awareness	2.27	0.33
Attitude to Energy Conservation	3.31	0.39
Subjective Norms	3.42	0.08
Perceived Behavioral Control	2.78	0.53
Behavioral Intention	3.11	0.37

Source: Field Work (2018)

Regression Analysis. This section performed the inferential statistical analyses relevant to the determination of the factors that influence the energy conservation of public sector institutions. The model is estimated using the ordinary least square hierarchical regression with the forward stepwise procedure. In other words, a stepwise selection process was used in developing the model. Thus, each independent variable was inserted into the model one by one and checked. Only those variables that reached a level of significance greater than 95 percent were left in the model.

The independent variables were attitude, subjective norm and perceived behavioral control, which according to the behavior change theory significantly impacts on the intention to be efficient in energy usage. Though many previous studies have not included environmental awareness in their models, this study has included same based on Zainudin, Siwar, Choy and Chamhuri (2014) argument that high environmental knowledge shows higher intention to buy energy-efficient products. The dependent variable for the regression analysis is the intention of the respondents from the public sector institutions to be efficient in their energy use.

Multi-collinearity. Before the multiple regression analysis was performed, a multi-collinearity test was done to determine the correlation between the independent variables (environmental awareness, attitude to energy conservation, subjective norm and behavioral control). This is because highly correlated independent variables are explaining the same part of the variation in the dependent variable (behavioral intention) and so their explanatory power and the significance of their coefficients is divided up between them. Thus, as part of testing the predictive power of the models, a multi-collinearity test was done to prevent a situation where some or all of the explanatory variables are highly related making it difficult to tell which of them is influencing the dependent variable (behavioral intention).

The severity of multicollinearity is manifested in a situation where all p-values of the regression coefficients are insignificant but with the overall model having significant F statistic. Multicollinearity increases the standard errors of the coefficients. The increased standard error, in turn, means that coefficients for some independent variables may be found not to be significantly different from 0. In other words, by overinflating the standard errors, multicollinearity makes some variables statistically insignificant when they should be significant. Without multicollinearity (and thus, with lower standard errors), those coefficients might be significant. A means used in this study to measure multicollinearity is the Variance Inflation Factor (VIF), which assesses how much the variance of an estimated regression coefficient increases if the predictors are correlated. If no factors are correlated, the VIFs will all be 1. A VIF between 5 and 10 indicates high correlation that may be problematic. And if the VIF goes above 10, you can assume that the regression coefficients are poorly estimated due to multicollinearity (Martz, 2013). Table 27 shows the results of the collinearity diagnostic test for the independent variables used in this study.

Table 27 Collinearity Diagnostic Test

Independent Variables	Tolerance	VIF
Environmental Awareness	0.755	1.325
Attitude to Energy Conservation	0.661	1.514
Subjective Norms	0.595	1.680
Perceived Behavioral Control	0.702	1.425

An assessment of the independent variables for collinearity shows tolerance of above 0.20 or 0.10 and a Variance Inflation Factor (VIF) not between 5 and 10. This suggests that the estimated independent

variables are well established in the regression model and do not have the problem of multi-collinearity. This implies that the estimated regression coefficients may not vary substantially and may not have extremely large sampling errors.

Diagnostic Tests (R-square). Table 28 shows how the predictors improve the estimated model based on a model fit criterion (R-squared). The R-square statistic measures how much of the variation in the dependent variable (intention to conserve energy) has been explained by the independent variables. To ensure that the variations explained by the independent variables are not due to chance, the adjusted R-square is reported.

Table 28 R-square for the Models

Step	R	R Square	Adjusted R	Std Error of Estimate
1	0.080	0.006	0.026	1.80196
2	0.395	0.156	0.065	1.72359
3	0.530	0.280	0.101	1.65629
4	0.779	0.606	0.463	1.65629

Note **Step1**: Environmental awareness, **Step 2**: Environmental awareness and attitude, **Step 3**: Environmental awareness, attitude and subjective norm, **Step 4**: Environmental awareness, attitude and subjective norm and perceived behavioural control.

Source: Field Work (2018)

From Table 28, as more variables were added to the model at each stage, the Adjusted R^2 improved from 0.026 to 0.463. The statistics show that the inclusion of other variables at each stage is justified and thus the final estimation of the model is the best representation of the relationship under study. This implies that the intention of the respondents from the public sector to be energy efficient is determined by several factors. In Table 28 above, environmental awareness of the institutions explained 2.6 percent of the variation in the behavioral intention to use energy efficiently. However, when the attitude of these respondents to energy conservation was included in the model, 6.5 percent of the variation in the behavioral intention to use energy efficiently has been explained. In other words, attitude to energy conservation explained 3.9 percent of the variation in the intention of the participants to use energy efficiently. The inclusion of subjective norm increased the adjusted R^2 from 6.5 percent to 10.1 percent (An increase of 3.6 per cent) as indicated in Table 28 above. Thus, the subjective norm explained 3.6 percent of the variation in the intention of the respondents to use energy efficiently. Table 28 further shows that the inclusion of behavioral control into the model increased the adjusted R^2 from 10.1 percent to 46.3 percent (An increase of 36.2% percent). In other words, perceived behavioral control of the participants in energy conservation explained 36.2 per cent of the variation in their intention to be energy efficient.

The contribution of the independent variables on the intention of the respondents for the institutions to be efficient in their energy use has also been analysed using the regression coefficients. Table 29 shows the results.

Table 29 Coefficient

Model	Beta	Std Error	t	Sig(p)
Environmental awareness	0.263	0.135	-1.944	0.072

Attitude	0.697	0.114	2.429	0.032
Subjective Norm	0.289	0.190	1.517	0.153
Perceived Behavioral control	0.306	0.109	2.815	0.014

Source: Field Work (2018)

In Table 29, it was observed that except for environmental awareness and subjective norm, all the predictors met the conventional 0.05 standard for statistical significance. Thus, the attitude of the respondents towards energy conservation ($\beta = 0.697$, $p < 0.05$) and behavioral control ($\beta = 0.306$, $p < 0.05$) have significantly predicted the intention of the institutions to be energy efficient. However, perceived behavioral control had the most significant effect on the intention of the institution to be energy efficient ($t = 2.815$, $p = 0.014$).

Subjective norm and environmental awareness had positive, yet insignificant influence on the respondents' intention to be energy efficient. Table 29 also shows a positive but insignificant effect of environmental awareness on the intention to be energy efficient ($\beta = 0.263$, $p > 0.05$).

Energy consumption across institutional types and related cost for energy consumed (RQ4).This section analysed whether there is any difference in energy consumption and cost across the various types of public institutions (MMDA, MDA, Education, Health and Security). The section also analysed the energy consumption across public institutions paying for their electricity bills and those that the government pays for. In research question 4 the one-way analysis of variance (ANOVA) was used to determine any differences in the energy consumption between the types of government institution and their cost for energy consumption. The independent-sample t-test was also used to determine the difference in energy consumption across institutions paying for their electricity bills and those being paid for by the government.

Table 30 shows results on whether there is any significant difference in the energy consumption across institutions paying for their bills and those government pays for using the independent t-test.

Table 30 t-test for Energy Consumption cost Across Payer of Electricity Bills

Payer	N	M	SD	t	p
Institution	89	514,031	1,416,100	3.810	0.000
Government	19	1,568,279	2,114,377		

Source: Field Work (2018)

The results in Table 30 shows descriptive statistics on the average energy consumed across the institutions paying for their electricity bills and those that the government pays for (Institution =USD 514,031; Government =USD 1,568,279). On average, the institutions that the government pays for had higher bills (USD 1,054,248) more than those that pay themselves. Further inferential analysis using the t-test results as shown in Table 30 shows that the differences observed are statistically significant ($p = 0.000$) between institutions paying for their electricity bills and those that government pays for. Since the p-value (0.000) obtained in Table 30 is less than the tested alpha (0.05), the candidate concluded that the average energy consumed will be significantly lower in institutions paying for their electricity bills than those that government pays.

In research question 4, the study also analysed whether there are any significant differences in energy consumption across the type of institution using the Analysis of Variance (ANOVA). Table 31 shows

the ANOVA results.

Table 31 ANOVA for Energy Consumption across Institutions

Source	Sum of Squares	df	MS	F	p
Between	8.776	4	2.194	91.42	0.000
Within	2.503	103	0.024		
Total	11.279	107			

Table 31 summaries the differences in results of an ANOVA between groups, which shows that significant differences were found (p = 0.000) in the mean energy consumption and the type of institution. The results imply that the mean energy consumption significantly differed across the type of institutions. Following the significant ANOVA results, a further post-hoc test was performed using the Least Significant Difference (LSD) to determine which of the institutions contributed to the significant results. Security institutions had the most significant effect (p= 0.000). Since the p-value (0.000) obtained in Table 31 is less than the tested alpha (0.05) and the LSD results also indicated that security institutions had the most significant effect, the candidate concluded that the mean energy consumption in security institutions will be significantly lower than non-security institutions.

Relationship between overall energy management practices and electricity consumption intensity (RQ5). This section analysed the relationship between the overall energy management practices and electricity consumption of the institutions.

Table 32 Correlation Matrix

Management		Consumption	
Management	1		- 0.976
Consumption		1	

Note that the asterisks indicate significant levels: * implies significant at 5% (p<0.05)
Source: Field Work (2018)

The Pearson correlation analysis as presented in Table 32 shows a strong but negative (r = -0.976) and significant relationship (p = 0.000) between energy management practices and consumption. In other words, as efficient energy management practices are being used in the public sector, the sector's consumption of electrical energy is likely to be low.

Energy management practices driving the relationship with electricity consumption intensity (RQ6). In determining the specific energy management practices that drive the negative relationship between energy management practices and consumption, the logit regression analysis was performed.

Diagnostic Tests (R-square). Table 33 shows how the predictors improve the estimated model based on a model fit criterion (R-squared). The Log-Likelihood statistic measures how poorly the model predicts the decisions, the smaller the statistic the better the model.

Table 33 R-square for the models

Diagnostic	Statistics
-2 Log likelihood	58.251
Cox & Snell R Square	0.652
Nagelkerke R Square	0.712

Source: Field Work (2018)

The Pseudo R-Square analysis presents a Nagelkerke value of 0.712 which implies that 71.2 percent of the variation in the energy consumption of the institutions has been explained by the energy management practices. The regression model was significant (χ^2 = 58.251, p= 0. 000) and that at least one of the regression coefficients in the model was not equal to zero.

Table 34 presents the outputs of the logit regression estimation. The Wald Chi-Square statistic tests the unique contribution of each predictor. Table 34 also shows the energy management practices that met the conventional 0.05 standard for statistical significance. In other words, the energy management practices that drive the relationship with consumption are shown in Table 34.

Table 34 Logit Regression outputs

Step	Estimate	S.E	Wald	df	Sig.
Procure energy-efficient equipment	9.789	4.511	4.709	1	0.030
Information on energy conservation	12.180	5.224	5.436	1	0.020
Feel of teamwork to conserve energy	13.279	5.712	5.404	1	0.020
Participation in energy decisions	12.723	5.677	5.024	1	0.025

Source: Field Work (2018)

Table 34 shows that the procurement of energy-efficient equipment by the institutions will significantly reduce their energy consumption (χ^2 = 4.70, p < 0.05). Similarly, the communication of information on energy conservation to employees in the public sector will significantly reduce their energy consumption (χ^2 =5.224, p < 0.05). Table 34 also shows that the promotion of teamwork to energy conservation (χ^2 = 5.712, p < 0.05) as well as the inclusion of employees in energy efficiency decisions (χ^2 =5.677, p < 0.05) will significantly reduce the energy consumption of the institutions.

Nature of association between energy efficiency and conservation behavior across public institutions of Ghana (RQ7). According to Azen (2005), the behavioral intention of the public sector to be efficient in its energy usage is influenced by three constructs (Attitude, subjective norm and perceived behavioural control). A correlation matrix among the independent variables was constructed. This was to help determine the correlation between attitude to energy conservation, subjective norms, perceived behavioral control and behavioral intention.

Table 35 Correlation matrix

Attitude	Subjective Norm	Behavioral Control	Behavioural Intention	
Attitude	1	0.704 *	0.288	0.460*
Subjective norm		1	0.393	0.397
Perceived Behavioral control			1	0.491*
Behavioural intention				1

Note that the asterisks indicate significant levels: * implies significant at 5% (p<0.05)

Source: Field Work (2018)

Table 35 shows that the behavioral intention of public sector respondents in these institutions to be efficient in their energy usage correlates positively with the sector's attitude to energy conservation, subjective norms and perceived behavioral. This means that attitude alone is insufficient to predict the

public sector's participants' intention to be efficient in its energy use. However, this study found that the intention of the participants to be energy efficient is significantly ($p< 0.05$) influenced by their attitude and perceived behavioral control to energy conservation, than subjective norm ($p>0.05$).

The Pearson correlation analysis as presented in Table 35 above shows a strong positive ($r = 0.704$) and significant relationship ($p = 0.000$) between attitude to energy conservation and subjective norms. However, though a positive correlation ($r = 0.397$) was found between subjective norm and behavioral intention, the relationship is insignificant ($p = 0.061$).

The correlation results in Table 35 above also shows that the participants' attitude to energy conservation correlates positively ($r = 0.460$) and significantly ($p = 0.027$) with behavioral intention. While their attitude towards energy conservation correlates positively ($r = 0.288$) with behavioral control, the relationship is insignificant ($p = 0.183$). Table 35 above also shows a positive ($r = 0.491$) and significant relationship ($p = 0.020$) between the respondents' behavioral control to energy conservation and their behavioral intention to conserve energy. As part of RQ 7, the study also analysed whether the participants' attitude to energy conservation will correlate positively with their intention to conserve energy. Since a positive and significant correlation ($r = 0.460$, $p < 0.05$) was obtained as indicated in the correlation matrix in Table 35above, the candidate concluded that the public sector's attitude to energy conservation will correlate positively with the respondents' intention to conserve energy. In RQ7, the study further analysed whether the subjective norm of employees to energy conservation in the public sector will correlate positively with their intention to conserve energy. Since a positive correlation ($r = 0.397$) was obtained as indicated in the correlation matrix in Table 35 above, the candidate concluded that the subjective norm of employees to energy conservation in the public sector will correlate positively with their intention to conserve energy. However, as noted earlier, the correlation is insignificant. In RQ7, the study further analysed whether the public sector's perceived behavioral control to energy conservation will correlate positively with the sector's intention to conserve energy. Since a positive correlation ($r = 0.491$) was obtained as indicated in the correlation matrix in Table 35 above, the candidate concludes that public sector's perceived behavioral control to energy conservation will correlate positively with the sector's intention to conserve energy.

Conclusions and Practical Recommendations

There is a reduction in energy consumption by the public sector institutions with the security institutions having the lowest, while the health sector had the highest consumption. A positive attitude was observed among the institutional respondents towards conservative energy use. However, the intention to be energy efficient was perceived to be difficult by the respondents including the adoption of green energy procurement. The study also concluded that public sector institutions that pay for their electrical consumptions from their internally generated funds (IGF) are more likely to be energy efficient and conservative than those that the government pays for directly.

The procurement of energy-efficient equipment, communication of information on energy conservation to employees in the public sector, the promotion of teamwork to energy conservation and the inclusion of employees in energy efficiency decisions are the significant energy management practices relevant in driving the energy consumption of the institutions. However, there remains a significant energy efficiency barrier in the public sector. While several other factors are influencing the consumption of electricity among the institutions, developing a programme that uses multifaceted approaches from both

a structural and non-structural perceptive to achieve energy savings is necessary. There were virtually fewer motivators as compared to the barriers for energy efficiency and conservative behavior among the institutions. The major motivator was awareness creation on energy efficiency and social norms and that the public sector's energy use behavior could be influenced by broader engagement and what other public sectors around them are doing regarding efficient and conservative energy use.

The sector's management behavioral intention to engage in efficient energy use was significantly influenced by several behavioral control factors including limited autonomy to undertake energy efficiency behaviour and the non-inclusion of staff in taking energy-efficient decisions by government. Thus, when public institutions believe that they have a higher intensity of control over the effects of their deeds on energy including paying for their energy bills, they are more likely to conserve energy. Therefore, an efficient energy use model for the public sector requires the removal of the several barriers to facilitate efficient and conservative behavior that can create minimum energy consumption and impact on climate changes.

The introduction of behavioral energy change systems in the public sector in Ghana together with the procurement of energy-efficient equipment could create opportunities for energy efficiency improvements. Thus, the integration of behavioral and educational strategies into the sectors' energy programmes can help increase energy savings in the public sector. This approach emphasizes the departure from the over-reliance on the traditional method using legislations, targeted government subsidies and structured government campaigns to behavior change targeted approaches that motivate people to conserve energy.

Education on energy efficiency: Before proper investment decisions into buildings and office equipment procurement, satisfactory knowledge of energy efficiency requirement is needed. Promoting efficient energy use behavior in the public sector management teams requires the creation of awareness through education to support behavioral changes around energy usage. Currently, awareness of energy efficiency practices among the public institutions seemed to be low. In this regard, the Energy Commission in collaboration with Electricity Company of Ghana (ECG) should organize workshops, seminars and conferences for public sector institutions staff as well as monitor and evaluate their behavioral changes and adoptions. Additionally, the Cabinet office in Ghana can adopt relevant aspects of the United Kingdom's Cabinet Office strategies by the Behavioral Insight Team established in 2010 to make reality the intention of the government to influence citizens to incorporate energy conservation behavior in their everyday life.

Coordination of energy efficiency motivators: There is a related number of competing policy priorities of government on energy efficiency. Although the instinct to target attitudes and behaviors through education and awareness-raising remains strong, information is unlikely to be effective if it runs counter to other powerful influences such as the procurement of inefficient energy equipment. To ensure that energy-saving policies are not treated entirely separately from broader energy management practices in the public sector, a Coordination Forum should be implemented by the Head of Public Sector Services to ensure a common basis, cooperation and coordination across sectors, agencies, organisations and authorities.

Provision of rewards and incentives: The provision of utility incentives for the successful management of energy efficiency programmes and conservative behavior is limited in public institutions. However, aligning utility incentives with investment in energy efficiency and conservative behavior is essential in the delivery of cost-effective energy efficiency supports to capture energy savings. The ECG is

encouraged to reward energy-saving behavior of public institutions through the design of proper performance ranges and incentives. To incentivise the public sector to be energy efficient, ECG can offer preferential discounts to public institutions which have been highly efficient in their energy consumption periodically in the payment of the amount of energy consumed. While there should be a fixed discount for institutions who reach the threshold, the discount should be based on the value of the kWh saved and the cost of energy. Furthermore, non-cash incentives and recognitions for institutions that achieve their targeted energy consumption can be embraced to motivate other institutions to collaborate in the efforts in conserving energy knowing that they can also make a difference when they give it a try. When these motivators are carefully established, there would be the need to bridge the gap between what people intend to do and what they do by regularly monitoring their behavioral changes through proof-of-concept trials and surveys.

Periodic energy efficiency audit of public sector institutions: Data on public sector energy use was limited in most of these institutions. Energy audits should be periodically conducted by hiring Energy Consultants to determine the costs and benefits of various energy efficiency options that present themselves. The Government of Ghana commitment to budget, execute and monitor energy efficiency audits for the public institutions will help to enforce the disposal of office equipment which are energy inefficient and the building of office complexes that enforces the use of renewable energy systems. The ranking and benchmarking of public buildings using the DEA model will also facilitate decision-making strategies in energy conservation.

Procurement of energy-efficient equipment: The public sector is one of the major consumers of energy-using equipment such as office appliances including office computers, air conditioners, hospital equipment and photocopiers among others. Therefore, the purchasing power of the public sector can be leveraged upon in its procurement process to create demand for highly energy-efficient technologies. The successful evaluation of energy efficiency equipment in the procurement process requires technical expertise in contractual issues. Therefore, to ensure that the public sector confirms to the purchasing of energy-efficient equipment with lower life cycle costs of energy consumption, the Energy Commission is advised to organize regular training programmes for procurement officers in the public sector. Such training programmes are essential to equip procurement officers on the principles of energy efficiency in the procurement process. The Energy Commission's legislation on the importation of energy-efficient equipment should also be intensified to ensure that only energy-efficient equipment are imported into the country.

The successful inclusion of energy efficiency equipment in the procurement process requires a sufficient legal framework. Therefore, to introduce some level of energy efficiency practices into the procurement process of the public sector institutions, the Procurement Act should be extended to include efficient energy procurement practices including the:

1. The purchasing of energy-efficient product specifications based on minimum life-cycle cost
2. The purchasing of equipment that has efficient energy consumption in all modes, including standby mode
3. Purchasing, building or renting of energy-efficient office buildings including legislations to ensure that such buildings deploy renewable energy techniques in their architecture plans.

The views of procurement officers and management, as well as suppliers, should be taken into consideration in the revision of the Procurement Act. Thus, management should increase employees' and suppliers' involvement in designing and planning, and greater autonomy in decision-making when

making improvements into the formulation of the energy-efficient Procurement Act. The Act should also favor the harmonisation of energy laws, regulations and standards. There is the need to, therefore, monitor, evaluate and communicate regulatory developments so that they are reflected in the energy equipment procurement strategies of public institutions.

Procurement officers who exhibit non-compliance to the revised Act should be sanctioned for non-compliance once the Act is enacted. Coordinated by the Energy Commission, the review of the Procurement Act must describe the progress, gaps and proposed adjustments for energy-efficient procurement in Ghana. An Energy-efficient Procurement Evaluation Management System (EPEMAS) should be institutionalised by the Public Procurement Authority (PPA). The implementation of EPEMAS is to help provide a formal, recorded and regular review of energy-efficient procurement on public projects and purchases towards the achievement of the Strategic National Energy Plan for the country.

Top management commitment to energy efficiency: The promotion of energy efficiency in the public sector has no chance of success without top management and employees' commitment. This requires the promotion of institutional autonomy in energy-efficiency decision-making in the public sector. However, the management of public institutions should be held accountable for inefficiency in energy conservation. This requires the conduct of an independent energy auditing, verification and certification of the equipment the institutions procure. Performance contracts that include energy-saving targets using the necessary conditions for successful performance contracting including budgetary allocation should be used by the Ministry of Finance in the allocation of institutional budgets.

Installation of solar panel in public institutions: The recent intention of the Government of Ghana to install solar power in all government institutions should be harnessed to help reduce the cost of energy consumption in the long run. The Government through the Ministry of Energy should harness private sector investment and participation in the installation of these solar panels for renewable energy and cleaner environment.

This study being the first in the Ghanaian public sector arena, it will provide a useful platform for the formulation of appropriate energy efficiency and conservation strategies for the public sector institutions in Ghana and similar geographical settings within the West African region. To attain the desired outcomes and to influence the Ghanaian public sector workers behavioral changes to conserve energy, information and strategies should make use of the drivers that motivate the targeted group than investing in only high-end technologies and legislations. Behavioral intentions are not the sole predictor for narrowing the energy efficiency gap among the Ghanaian public workers, but attitude, behavioral control and beliefs also have a significant impact. Hence the need for a comprehensive package that incorporates and addresses all the important barriers to behavioral changes to energy efficiency within the Ghanaian context by exploring those that worked in similar countries.

Finally, globally, efforts are being made by engineers to explore ways and means to mitigate climate change and protect the environments through the use of energy-saving equipment and the development of strategies to conserve energy. Therefore, Ghana cannot look unconcerned but master every effort to participate in the energy-saving paradox.

Recommendations for Further Research

The study presents results that require further empirical investigations. Based on the key findings, the following recommendations are made for further research.

- Provision of Energy Incentives for Public Sector Institutions: Challenges and Prospects: Information on the opportunities and challenges for incentivizing the Ghanaian public sector to be energy efficient is currently limited. Therefore, further study should be conducted to explore the potential barriers and prospects in rewarding and the provision of energy savings incentives for the public sector.
- The Adoption of Green Energy Public Procurement: Challenges and Prospects: An integral component of public procurement for improving the operational efficiency of public authorities is Green Public Procurement (GPP). Therefore, a further study on the challenges and prospects associated with the adoption of Green Energy Public Procurement in the development of green energy technologies and products in the Ghanaian public sector.

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