Critical Success Factors as a Tool for Sustainable Efficient Electricity Management in Nigerian Public Universities

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Abstract
University subsector is one of the fastest-growing electricity consumers in Nigeria and is known to have significant impacts on Nigeria energy mix. Various electricity conservation measures have been adopted for improving efficient electricity use but in terms of sustainability, little success has been achieved due to inability to tackle some barriers. Exploring CSFs has been identified as one of the surest ways of removing barriers towards meeting sustainable efficient energy management and savings in HEIs. Focusing on the importance of practicing energy management effectively, this study developed a set of critical success factors for implementing electricity management in university subsector with emphasis on sustainability. Data for the study were collected from three public universities in Southwestern Nigeria, namely Obafemi Awolowo University, Ile-Ife, University of Ibadan and Federal University of Technology, Akure, to obtain stakeholders' perspective on the importance of proposed CSFs. The existing 23 CSFs were utilised and evaluated by 4728 experts and users randomly selected from academic office buildings, students' hostels, staff quarters and business units. The data for the study were collected through a structured questionnaire and were analysed using mean index, factor analysis and logistic binary regression. The results showed that all the attributes are significant for achieving sustainable efficient electricity management. The study concluded that achieving sustainable efficient electricity management practice in public universities requires seeking top management support, establishment of comprehensive energy management team and inclusion of stakeholders in energy management of facility.
Keywords: CSFs, Efficient, Electricity, Nigeria, Tool, Sustainable, University

1.0 Introduction

Throughout the world, electricity is the most widely used and desirable form of energy [Oyedepo, 2012a, 2012b, 2014; Unachukwu *et al*., 2015]. There is hardly any aspect of economy life of nations that does not have the imprint of electricity input. Nigerian University subsector is not exempted from the use of electricity. It is used for virtually all their daily activities and operations [Adelaja *et al*., 2009; Unachukwu, 2010; Aziz *et al*., 2012; Ahmad *et al*., 2012; Bakar *et al*., 2014; Oyedepo *et al.,* 2015]. It is the predominant energy resource for teaching and research aids. It is also the main source of energy for lighting, comfort cooling, refrigerated storage, cooking and provision of support services like operation of computers, photocopiers and other social activities. Despite its indispensability, the proper management of this valuable resource and input should be of concern.

In Nigeria, the body of research studies investigating into energy efficiency and conservation programmes have for some time now centred around major sectors of Nigeria economy namely, industrial, residential, commercial, office, agriculture, transportation, health, government secretariat, military and police barracks, and public services [Unachukwu, 2003; Energy Commission of Nigeria, 2003; Dayo *et al*., 2004; Oyedepo, 2012a, 2012b, 2014; Unachukwu *et al*., 2015]. Whereas, potential energy studies in the university subsector have remained a matter for speculation over the years mainly because electricity consumption in this sector represented only a small proportion (2-3%) of the whole national consumption [Unachukwu, 2010; Oyedepo *et al*., 2015]. The situation has however changed in the past few years.

Notwithstanding the pit falls that had rendered public electricity supply in Nigeria unreliable and inefficient [Oyedepo, 2014], the trend of electricity consumption in university subsector is becoming more and more important in Nigeria energy mix. In recent years, the university subsector has been ranked among the most electricity-intensive public institutions in Nigeria. This assertion was confirmed by sectoral electricity demand data published by National Control Centre, Osogbo [2014] and NDP [2014] report, which compared the performance of electricity use in various sectors of Nigeria economy – residential, industrial, manufacturing, and commercial, office, public service, hospitals and government secretariat. Although the residential, industrial and commercial sectors still account for the largest share of electricity use in the country. The sectoral electricity demands report reveals that between 2000 and 2005, the share of university sub-sector to the total electricity mix ranged from 5% to 6%. This proportion increased to 7.9% in 2007. Between 2008 and 2009 the share of university subsector to the electricity consumption in the country rose to 8.7%. By the end of 2013 the electricity consumption of the subsector has increased to 12.3% and was projected to increase to nearly 17% by

2020. The typical daily electricity demand of some major sectors of Nigeria economy is reported as 396.4057 MWh for residential, 223.9429 MW for industrial, 175.3629 MW for commercial, 144 MW for government secretariat and 104 MW for hospital sector [Nwachukwu *et al*., 2014]. The reported electricity demand for university subsector was 320 MW per day [Nunayon, 2016].

In a bid to address this increasingly critical concern, many universities have employed various strategies such as efficient technologies as well as policies related to tariff adjustment, load shedding strategies and installation of pre-paid meters [Peter, 2012]. A few studies on improving university electricity efficiency such as light retrofitting and energy audit have been conducted also (Olanipekun *et al*., 2004; Adelaja *et al*., 2009; Unachukwu, 2010; Oyedepo *et al.,* 2015, Sambo *et al*., 2015). These studies also provided general electricity saving tips such as replacement of incandescent bulbs with compact fluorescent lamps. These notwithstanding, the full potential of the expected savings is often not achieved with the energy-efficient technologies introduced. This action and all others earlier taken by successive university administrations have not improved the situation. In spite of these efforts, it has been observed that many of the energy management programmes have failed to be sustainable after introduction and without sustainability, energy management efforts will not be preserved. The progress of achieving sustainable savings is very slow and disappointing with various obstacles. Instead, high trend of electricity consumption is still consistently witnessed in most Nigerian Universities [Unachukwu, 2010; Oyedepo *et al*., 2015; Nunayon, 2016].

Although high electricity demand could be justifiable due to growth in students' population and development across various university campuses [Unachukwu, 20010; Oyedepo *et al*., 2015], most universities are not realizing the significant of sustainability due to inability to tackle the following barriers as noted by CREDC [2009], Unachukwu [2010], Oyedepo [2012a, 2012b, 2014], Lo [2013], Kate [2014]; Gram-Hassen, 2014], Unachukwu *et al*., [2015], Oyedepo *et al*. [2015] and Saleh *et al*., [2015a, 2015b] such as lack of effective stakeholders' based participation in energy management initiatives, lack of skilled personnel or energy managers to collate, process energy data information, interpret and apply information on energy consumption to improve efficiency of use, energy audits are almost never done in most of these universities, most public universities in Nigeria received funds from government, so, general apathy towards energy conservation and improvement is common, the concept of sustainable efficient electricity management practice was poorly developed, absence of appropriate mechanisms for achieving consistent and sustainable energy savings, lack of diligence, commitment and readiness of staff to compliment management efforts in conserving and using electricity efficiently, inadequate data and lack of access to energy use information in the subsector that will guide and strengthen regulatory measures to use electricity efficiently, lack of awareness and ignorance of the economic and social benefits of energy efficiency measures, lack of financial support to invest in energy efficiency measures, lack of maintenance and good housekeeping, lack of management support and inability of top management staff to take it upon themselves to constantly go round the school with a view to checking all the avenues whereby electricity is being inefficiently utilized and risk of inconvenience to personnel, conflicts between staff interests, students' welfare and electricity conservation. More importantly, lack of teamwork, non-existence of policy framework and Energy Management Unit (EMU) as well as lack of engaging energy experts responsible for long-term planning, managing daily operations, and promoting energy efficiency and to regulate electricity use in the subsector.

The situation therefore calls for laudable measures that will ensure its proper utilisation and optimise its use in this sector. From the foregoing, to effectively address the issue of rising electricity consumption in the subsector, we need to focus on barriers that inhibit sustainability in efficient electricity usage and savings.

Various strategies have been adopted to promote efficient energy management practice and use in HEI's internationally [EC, 2003; Action Energy, 2003; Gorp, 2004; Lancashire, 2004; Ismail, 2005; Imperial College, 2005; Denny *et al*., 2008; Riddel *et al*., 2009; Saengsuwan *et al*., 2010; Mohammed *et al*. 2011; Wai *et al*., 2011; Bakar *et al*., 2014]. However, recent studies pointed out that, to achieve sustainability in efficient energy management improvement programme, there is need to study, identify and explores Critical Success Factors (CSFs). Exploring CSFs has been one of the most promising ways to handle the challenges of energy demand and utilisation problems in HEIs. Sustainable energy management in the context of this study is viewed as the process of managing the electricity consumption in the university subsector to ensure that electricity is efficiently and effectively consumed and consistent savings is achieved for an extended period. The sustainability practices allow consumers to have the benefits of a social infrastructure with limited earth's resources and degrading environment in future.

2.0 Literature Review

Studies have been carried out to determine or explore CSFs for managing electricity in HEIs around the globe. CSFs refer to the limited number of areas in which satisfactory results will ensure successful competitive performance for the individual, department, organization (Rockart and Bullen, 1981). Although the researches into CSFs are common in construction project management [Huang and Lai, 2012; Wiengarten and Pagell, 2012; Wai *et al*., 2012; Babu and Sudhakar, 2015], however, in the last one decade, research on CSFs for implementing EM towards sustainability in HEIs is becoming popular in energy field as well. This is because exploring CSFs is an inevitable aspect of energy management initiatives. Saleh *et al*. [2014] provided one of the early studies that carried out a comprehensive review of literature to identify the CSFs for implementing Energy Management (EM) towards sustainability in Malaysia universities. The study revealed that the 23 CSFs can be classified into five clusters namely, (i) top management support, (ii) comprehensive energy management team, (iii) stakeholders' involvement, (iv) awareness, and (v) risks management. Observation from their study showed that by identifying these CSFs, it can be a reference to assist people involved in energy management initiative to know exactly the most crucial factors for achieving success and implementing EM towards sustainability in HEIs. Saleh *et al*. [2015a] explored the CSFs towards sustainable university by presenting the earlier identified 23 CSFs to stakeholders in Malaysian Universities. The findings disclosed the relative importance of all the 23 CSFs. The study concluded that if managements of universities can keep a good track of implementing EM based on five groups of CSFs identified, they are likely to move towards achieving success in consistently reducing electricity consumption. In another study, Saleh *et al*. [2015b] explored CSFs for Sustainable University in terms of energy. They also developed a framework that could help to hypothesize the significant relationship amongst the CSFs identified with KPIs in respect to performance and universities' strategy using PLS-SEM test. The study pointed out that by identifying these CSFs and relate to KPIs, it could help to ensure that the Malaysian universities achieve sustainability in terms of energy. Besides, they noted that exploring CSFs has a potential to provide an understanding and explore a new finding. In addition, the study empirically validates that exploring CSFs can assist the managements of universities in deciding the priority and direction to ensure that EM is practiced effectively. Mashburn [2009], Mosakhani and Jamporazmey [2010] and Choong *et al*. [2012] commented that the inclusion of stakeholders in energy management initiative and exploring into CSFs could be one of the optimum steps of a solution to providing a roadmap to institutionalise efficient energy management improvement programme in HEIs. According to Mosakhani and Jamporazmey [2010] exploring CSFs is something which must be implemented if any organization wants to be successful in a specific field. Various studies have been conducted also to evaluate the effectiveness of CSFs in improving energy saving in HEIs. These studies demonstrated that the approach could improve energy savings in HEIs [Mobey and Parker, 2002; Mashburn, 2009; Choong *et al*., 2012; Mohammadi *et al*., 2013].

The typical electricity use per square metre of some major sectors of Nigerian economy is reported as 192kWh/m^2 for residential, 157kWh/m^2 for industrial and 96 kWh/m^2 for commercial. On the other hand, the specific electricity consumption for university building was 238kW/m^2 [Olanipekun, 2012]. Moreover, electricity use per square metre in a university facility is greater than in any other kind of educational building and more than triple what a government secretariat utilizes per square metre and at least thirty times what a hospital facility uses per square metre in Nigeria. The sector is widely believed to be one of the fastest growing electricity end users and highest per capital consumption. It is also one of the sectors that has consistently accounted for high electricity demand in the last five years. The annual electricity usage trend is also one of the highest due to the increased number of students and the increased number of buildings within the campus. Based on past studies conducted for individual universities (Adelaja *et al*., 2009; Unachukwu, 2010; Oyedepo *et al.,* 2015), it was observed that electricity consumption in the university sector is significant as well. For example, estimations made by Adelaja *et al.* [2009], Unachukwu [2010] and Oyedepo *et al*. [2015] based on studies in University of Lagos, Lagos, University of Nigeria, Nsukka and Covenant University, Ota, respectively and similar data from Obafemi Awolowo University, Ile-Ife [Olanipekun, 2012; Nunayon, 2016] revealed that a typical Nigeria university consumed between 500, 000 kWh to 850, 000 kWh of electricity for effective operation per month. By comparison, residential, industrial and commercial sectors, respectively consumed 938, 500 kWh, 489, 300 kWh, 398,000 kWh [Ekpo *et al*., 2011; Nwachukwu *et al*., 2014]. Nowadays, electricity bills also constitute a sizeable proportion of the sector overhead costs and the subsector is also known for astronomical rise in electricity bills. For example, in University of Nigeria, Nsukka, electricity bill was ₦15 million in 1998; this jumped to over ₦60 million in 2007, an increase of over 160% [Unachukwu, 2010]. At Obafemi Awolowo University, Ile-Ife, between ₦4.5 million and ₦7.5 was spent on electricity bills monthly in 2001; this amount has now jumped to over ₦50 million in 2016, an increase of over 1000%. In Covenant University, Ota, Oyedepo *et al*. [2015] study revealed that as population of the school doubled, the electricity consumption increased by tenth folds and the annual electricity bills increased by more than 500%. Similar pattern was observed in University of Lagos [Adelaja *et al*., 2009]. This is unmistakable evidence that the subsector contributes to high electricity demand in

Nigeria. Disturbingly, Nigeria is facing acute shortage of power and the rapid growth in population has made the demand for electricity to be greater than the supply [Suidur *et al*., 2010; Oyedepo, 2012a, 2012b, 2014; Oluwale, 2015]. In the present circumstance Nigeria finds herself, the proper management of available electricity resources in all the sectors with high electricity demand should be of concern to everybody. For this reason, studies are also needed to promote sustainable efficient electricity management in this subsector of Nigeria economy.

Several reasons can be put forward to emphasise the need for efficient and rational use of electricity in the subsector. As an educator of people, improving the electricity efficiency practice at this level, not only does this reduce electricity bill, but also act as an example of change for others [UCA, 2009; Unachukwu, 2010; Hui, 2012; Oyedepo *et al*., 2015], (ii) it is in the universities that future leaders, captains of industries, entrepreneurs, professionals and scientists are developed. These people can be an ambassadors of change in future in every sphere of Nigeria economy [Hui, 2012], (iii) optimizing and defining measures to improve the electricity efficiency is very important and a matter of public interest [Dragicevic *et al*., 2013], (iv) decrease their environmental impact thus improving the green performance of the university [Energy Efficiency News, 2003; Unachukwu, 2010; Oyedepo *et al*., 2015], (v) conserving this electricity will lead to reduction in operating costs, lesser maintenance of electricity supply infrastructure and lighting fixture replacement as well as reduction in accumulated heat generated by them, thereby leading to parts of the drive towards mitigating change and making their buildings more environmentally sustainable [Unachukwu, 2010; Manjunatha *et al*., 2013; Oyedepo *et al*., 2015], (vi) by promoting such actions, it is believed that the subsector can set good examples for other organisations, influence the attitude of other people in the local community and motivate relevant sectors to grasp the opportunities in building energy efficiency **[**UCA, 2009; Hui, 2012], (vii) reducing the university electricity use can ensure that the subsector is better equipped to optimise energy efficiency and free up their resources to be used for other aspects of university operations and activities [UCA, 2009; Hui, 2012], (viii) the environmental degradation caused by a huge amount of electricity consumption in this subsector should also be of greater concern too [Unachukwu, 2010; Oyedepo *et al*., 2015], (ix) dwindling government subvention, financial constraints, steady increase in students' enrolment, electricity price increases, increasing energy costs, growing infrastructural development and environmental responsibility are motivating factors for university communities to re-evaluate their electricity demand and related conservation programmes [Unachukwu, 2010; Olanipekun, 2012; Oyedepo *et al*., 2015], (x) besides, Nigeria is facing acute shortage of power supply and the rapid growth in population have made the demand for electricity to be greater than the supply [Suidur et al., 2010]**,** (xi) as well, analysis of Nigeria's electricity supply problems and prospects showed that electricity demand far outstripped the supply, which is epileptic in nature [Oyedepo, 2014; Unachukwu *et al*., 2015]. Thus, if we use electricity efficiently, electricity at current levels of generation can be made to go round a higher proportion of Nigerians, more people will have access to electricity as savings in one part of the country can be made available in another part of the country and reduce the building of more power stations [Oyedepo, 2012a, 2012b, 2014; Unachukwu *et al*., 2015]. By extension, with good electricity management at the residential, industrial, commercial, public and private sectors, there will be no need to alternate electricity supply and the cost of power to the consumers could fall drastically in the face of prudent demand side management [Oyedepo, 2014]. Thus, the money for building power stations can be spent on other sectors of the economy. Moreover, increased electricity efficiency would provide this country with significant economic, environmental, and security benefits, (xii) more importantly, as stated by Lozano [2008], universities are like any other organisations, should have a holistic view of the roles and responsibilities and consider the long-term impacts of their decisions which are beyond the present time. Thus, universities should establish energy management as a stepping stone for a sustainable future [Pike *et al*., 2003], (xxii) finally, a few studies on university electricity efficiency noted that the potential for electricity savings is substantial in this subsector. They also stressed that electricity consumption is one of the key areas that the subsector must address to reduce their operating costs [Olanipekun, 2002; Olanipekun *et al*., 2004; Adelaja *et al*., 2009; Unachukwu, 2010, Olanipekun, 2012; Oyedepo *et al*., 2015; Nunayon, 2016]. These energy audit studies revealed that up to 20% of electricity can be saved by adopting simple housekeeping measures and proper management. Thus, engagement in electricity efficiency in the subsector will provide a source of compounding gain in reducing greenhouse gas emissions from utilities since every kWh of electricity consumed or saved is equivalent to the emission (or avoidance of the emission) of 0.44 $kgCO_2$ [Unachukwu, 2010].

For example**,** Mohammadi *et al*. [2013] argued that in addition to the existing strategies and practices, to promote sustainability in energy management practice and increase the chances of a project success, it is necessary to understand what the critical success factors are and then choose appropriate methods of dealing with them. Saleh *et al*. [2014] investigation into the causes and techniques for achieving sustainable efficient energy management in Malaysia Universities have seen an increase in the need to study and explore CSFs, particularly in HEIs where many people are involved. According to them the perceived barriers to achieving sustainable efficient energy management improvement programme and savings could be quickly overcome if we can study and explore CSFs. Saleh *et al*. [2015a, 2015b] observed that energy management programme is move effective when CSFs are studied and explored**.** Mashburn [2009] noted that studying and exploring the CSFs remain one of the most dynamic efficient energy management improvement programmes. He stressed further that studying and exploring CSFs is one of the key issues for achieving sustainability in efficient energy management improvement programme**.** Mohammadi *et al*. [2013] noted that studying and exploring CSFs is an inevitable aspect of energy management programme in HEIs due to its nature of being carried out by conglomeration of many people from diverse backgrounds and disciplines with everyone's output determining the level of success to be recorded. According to Saleh *et al*. [2014], CSFs is a new paradigm in energy management in HEIs with the aim of motivating stakeholders in a facility to be more involved in the conscious management of energy of their facilities. They also added that CSFs are key areas of activity that must be performed well if university is aiming to achieve the mission, objectives or goals of implementing EM towards sustainability. Again, Saleh *et al*. [2015a, 2015b] explained that effectiveness in energy management programme cannot be achieved without recourse first to study and explore CSFs. In fact, they pointed out that EM cannot be practiced well towards sustainability without exploring and/or taking the CSFs into consideration.

Basically, it is a dynamic group process in which all members of a group contribute, share or are influenced by the interchange of ideas and activities towards problem-solving or decision-making [Mohammadi *et al*., 2013]. Two primary reasons for exploring CSFs were given: CSFs as an energy management initiative places value on people, see them as material of transformation, as well as central in energy management of a facility. CSFs are an energy management initiative that evolved through the participation and opinion of all the stakeholders in a facility and acknowledge the importance and recognize the need for them to participate in day-to-day energy management of their facilities. CSFs as an energy management initiative see energy management and use from the eyes of the consumers [Carter, 2014]. Exploring CSFs is a bottom-up and all-inclusive approach to address sustainable efficient energy management improvement and savings in this sector [Saleh *et al*., 2014, 2015a, 2015b]. CSFs focus on the importance of use relative to design [Carter, 2014]. One important attribute of CSFs is that it will assist any organisation in understanding and identifying key prominent factors, which must be managed to deliver sustainable efficient electricity use. An important attribute of exploring CSFs as an EM initiative is the ability for quick identification of areas needing attention [Energy Star, 2002]. The key benefits of exploring CSFs have been summarized by McCabe [2001], Mashburn [2009], Chong *et al*. [2012] and Saleh *et al*. [2014, 2015a] as thus: (i) exploring CSFs could reveal the significant practices and the best to be done to achieve sustainable efficient electricity management, (ii) it could produce the factors necessary for institutionalising sustainable efficient energy management improvement programme. This could lead to more energy savings as occupants often would remain motivated and committed and wastefulness of energy will not thrive, (iii) it allows organizations to focus their efforts on building their capabilities to meet the CSFs, or even allow firms to decide if they have the capability to build the requirements necessary to meet CSFs, (iv) it can help in improving bottom-up approach to address energy problem, (v) it can help university to plan, review and benchmark, as well as allocate resources better, (vi) CSFs promote the development of human, organizational and management capacity to solve problems as they arise in order to sustain the improvements made over the time, (vii) exploring CSFs also helps to inculcate a long term symbiotic relationship between the management and the employee where employees see themselves as partner in progress, (viii) it could also help to reduce the use of inefficient electrical appliance, block leakages and waste as well as unwholesome practice which affect high energy demand as a result of motivated and inspired stakeholders.

Thus, from the foregoing it can be concluded that exploring CSFs can make university sector to achieve better results. Despite the importance of CSFs in helping HEIs to achieve better results, to date, CSFs for implementing electricity management towards sustainable university in Nigeria context has not been fully explored. Since electricity plays a very important role in day-to-day activities and operations of any university in Nigeria**,** therefore, exploring CSFs is one of the important areas of activity that must be performed well if they are aiming to achieve the mission, objectives and goals of implementing EM towards sustainability. A comprehensive list of CSFs is important for Nigerian Universities for it will reveal the significant practices to be focused on to achieve consistent and sustainable efficient electricity use. In addition, this will help university to plan, review and benchmark, as well as allocate resources better. It will also show the best to be done to achieve sustainable energy saving goal**.** If exploring CSFs is of crucial importance to success as explained above, what then are the CSFs that would go into making sustainable efficient electricity management possible in Nigerian Public Universities. Indeed, it is a question begging for an answer and a question of practical relevance. Therefore, the identification of CSFs to successful sustainable efficient electricity management in this sector is necessary. It is this contention that inspired the authors to undertake this study. Focusing on the importance of practicing energy management (EM) effectively and using stakeholders as contact point, this paper developed a set of CSFs for implementing electricity management in university sector towards sustainability. The viewpoints of occupants are of utmost important and their perceptions regarding the problem are significant to researchers looking for solutions for sustainable efficient electricity management in this sector [Taheri *et al*., 2009; Claude, 2012]. The proposed list of CSFs is a complement to their existing strategies and practices. This study is part of a larger project, 'Achieving Sustainable Energy Management in Nigeria Public Institutions' at the Department of Building, Obafemi Awolowo University, Ile-Ife.

3.0 Methodology

This study was embarked upon to propose a list of critical success factors for achieving sustainable efficient electricity management in Nigerian Public Universities. A non-experimental, quantitative, and survey research design was used. The study was carried out in three relatively old public universities in Southwestern Nigeria that had facilities for academic buildings, staff quarters and students' hostels as well as business units, namely Obafemi Awolowo University, Ile-Ife, University of Ibadan, Ibadan and Federal University of Technology, Akure, to obtain stakeholders' perspective on the importance of proposed critical success factors. A careful study of previous literature showed that 23 CSFs grouped under five main categories: top management support, comprehensive energy management team, stakeholders` involvement, raising awareness and risk management are vital and can enhance sustainable efficient electricity management in HEIs [Saleh *et al*., 2014, 2015a, 2015b]. The list was adopted and presented to the respondents in the study area. However, the preliminary list of 23 CSFs was presented for confirmation by energy experts and professionals in universities and industries during pilot study before developing the final questionnaire instrument. From the interview conducted, all interviewees agreed that the proposed 23 factors were critical and comprehensive and could assist university management to achieve sustainable efficient electricity savings. Meanwhile, some interviewees commented that the responsibilities to reduce the consumption of electricity should come from all, and not only technical persons in charge. To elicit information on the relative significance of the proposed list of critical success factors from electricity users, we prepared a structured and closed-ended questionnaire that consisted of two sections. Section A contained respondents' background information such as their position and the length of experience and Section B contained the list of factors to be ranked. At the end of the questionnaire were suggestions for improving EM implementation towards sustainable university if any**.** A total of 7000 copies of questionnaire were delivered to the respondents in the study area, only 4728 (67.5%) of completed copies of questionnaires were received as follows: 2799 (59.2%) from students, 258 (5.5%) from business units and 1671 (35.4%) from staff in academic buildings while 605 (12.8%) were from households. In responding to the questionnaire, respondents were requested to indicate the level of significance of each attribute on a 5-point Likert scale where 5=extremely significant; 4=very significant; 3=moderately significant; 2=slightly significant; 1=not significant. The data collected was analysed using mean score, factor analysis and binary logistic linear regression. The data was analysed with the aid of Statistical Package for the Social Sciences (SPSS) 17.0. The Mean Score (MS) was used to identify the arithmetic average across the distribution of the data set [Blaikie, 2003] and computed based on approach adopted by Helen *et al*. [2015] as shown in equation 1.

$$M.S. = \frac{5X_5 + 4X_4 + 3X_3 + 2X_2 + 1X_1}{N} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Where,

N = total number of respondents, X_1 = frequency of not significant, X_2 = frequency of slightly significant, X_3 = frequency of moderately significant, X_4 = frequency of very significant and X_5 = frequency of extremely significant

Factor analysis was used to statistically identify a reduced number of factors from a larger number of items and, to explore and detect the underlying relationships among the identified CSFs. The essence was to reduce the factors to a few numbers. Binary logistic linear regression was employed to examine the relative influence of the few factors extracted from factor analysis on sustainable efficient electricity management and to control possible confounders. First, multivariate analysis was used to test the degree of association between independent and dependent variables which were assessed using odds ratio. For the models, significant values (p-value) were all less than 0.05 at α = 0.05 level of significance. The Logistic Regression was based on dichotomous response variable (successful/non-efficient electrical energy management strategy) and/or categorical explanatory variable(s) which are critical success factors for efficient electrical energy management.

$$g(\mu) = \log\left(\frac{\mu}{1-\mu}\right)$$

Response–successful/non-successful energy management characteristic; predictors are critical success factors of efficient electrical energy management observed for each case. Model - $p(x) \equiv$ Probability of presence at predictor level and probabilities were bounded between 0 and 1.

$$\pi(x) = \frac{e^{\alpha + \beta x}}{1 + e^{\alpha + \beta x}}$$

$\beta = 0 \Rightarrow$ P (Successful) is the same at each level of x
$\beta > 0 \Rightarrow$ P (Successful) increases as x increases
$\beta < 0 \Rightarrow$ P (Successful) decreases as x increases

Therefore, the Odd Ratio (OR) is determined by the equation:

$$\frac{odds\,(x+1)}{odds\,(x)} = e^{\beta} \qquad \left(odds\,(x) = \frac{\pi(x)}{1-\pi(x)} \right)$$

Thus e^{β} represents the change in the odds of the outcome (multiplicatively) by increasing x by 1 unit

- If $\beta = 0$, the odds and probability are the same at all x levels (e^{β}=1)
- If $\beta > 0$, the odds and probability increase as x increases (e^{β}>1)
- If $\beta < 0$, the odds and probability decrease as x increases (e^{β}<1)

Table 1 depicts the methodology for deciding the criticality index.

Table 1: Criticality index based on mean factor score

Mean factor score	Criticality index	Criticality level
0.5 – 1.25	1	Least significant towards efficient EM
>1.25 -2.5	2	Mildly significant towards efficient EM
>2.5 – 3.75	3	Moderately significant towards efficient EM
>3.75 – 5	4	Most significant towards efficient EM

The reliability of the 5-point Likert scale used in the survey was determined using Cronbach's coefficient alpha, to measure the internal consistency among the factors. The value of the test was 0.872, which was greater than 0.7. This indicates that the 5-point Likert scale measurement was reliable.

4.0 Findings and discussion

4.1 Socio-economic Characteristics of Respondents

Table 4.1 shows socio-economic characteristics of respondents sampled in three federal universities in Southwestern Nigeria viz-a-vis Obafemi Awolowo Universities (OAU), Ile-Ife, Federal University of Technology, Akure (FUTA) and University of Ibadan (UI). Four thousand seven hundred and twenty-eighty (4728) respondents were involved in the study. Slightly above half (50.7%) of respondents that participated in the survey were aged 20-29 years followed by age group 30-39 years (19.4%) while the least age group was 50 years and above (0.4%). Over half (59.2%) of the entire respondents that participated in the study were male and 40.8% of the remaining respondents were female. More than half (59.2%) of the respondents that participated in the survey were students, while members of academic staff were 18.9% of all the respondents sampled for the study; the non-academic staff members and business owners accounted for 16.5% and 5.5% respectively. Also, 60.6% of respondents have stayed on campus up to four years and one-quarter (25.7%) of respondents have stayed on campus between five and ten years; 7.1% had stayed on campus for 11-15 years while very few respondents have stayed on campus for 21 years and above. Meanwhile, respondents who resided in staff quarters were 12.8% while students who stayed in undergraduate hostels and post graduate hostels accounted for 32.0% and 22.8%, respectively. Among the one twenty management staff that participated in the study, there are twenty/nine top managers equivalent to 16.7% of the sample size, 33 middle level management positions, equivalent to 27.5% of the sample size, and 67 low management positions, equivalent to 55.83% of the sample size. Based on position, status, education, gender, age, residence, work experience and professional background, it can be inferred that the respondents (the electricity end users in the sector) had adequate knowledge and hence the information they provided will be suitable for identifying critical success factors for sustainable efficient electricity energy management in the sector.

Table 2: General information about respondents

Respondents	Frequency	Percentage
University		
Obafemi Awolowo University	1579	33.4
Federal University of Technology, Akure	1570	33.2
University of Ibadan	1579	33.4
Age Group (Years)		
20-29	2397	50.7
30-39	917	19.4
40-49	563	11.9
50+	19	0.4
Missing ages	832	17.6
Sex		
Male	2799	59.2
Female	1929	40.8
Status in University		
Academic staff	893	18.9
Non-academic staff	778	16.5
Student	2799	59.2
Business owner	258	5.5
Position Held		
Dean/Vice Dean	2336	49.4
HOD	643	13.6
Director/Deputy Director	1749	37.0
Academic Qualification		
HND	1295	27.4
PGD	293	6.2
B.Sc./B.Tech.	227	4.8
M.Sc./M.Tech.	213	4.5
PhD	1343	28.4
Others	1357	28.7
Numbers of Years Stayed on Campus		
0-4 years	2865	60.6
5-10 years	1215	25.7
11-15 years	336	7.1
16-20 years	208	4.4
21-25 years	66	1.4
26 and Above	38	0.8
Location of Stay on Campus		
Staff Quarters	605	12.8
Undergraduate Students' Hostel	1513	32.0
Post graduate Students Hostel	1078	22.8
Off Campus	1532	32.4

4.2 Identification of critical success factors

Central to this study is the identification of most significant attributes for achieving sustainable electricity management in the sector. Table 3 shows the Mean Score (MS) and Criticality Index (CI) of the attributes as highlighted by the respondents in the study area. The ranking of the attributes reveals that almost all the attributes are critical for achieving sustainable efficient EM in Nigerian Public Universities. All the attributes have criticality index of 4.0 (Most significant towards efficient EM) (Table 1) and mean score value ≥ 3.75. This finding is in line with Saleh *et al*. [2014, 2015a, 2015] studies in Malaysian Higher Education Institution. Their studies also showed that all the twenty-three (23) factors were important in achieving sustainability in EM.

Table 3: Critical success factors for efficient energy management

	Critical Success Factors	Mean Score	Criticality Index	Rank
A	**Top Management Support**			
1.	Develop energy policy and guideline	4.20	4	3
2.	Leadership	4.30	4	1
3.	Create initiatives by establishing an award	4.17	4	7
4.	Allocation of sufficient resources	4.19	4	4
5.	Training provision	4.16	4	8
B	**Comprehensive Energy Management Team**			
1.	Conduct energy audit	4.22	4	2
2.	Operations & maintenance	4.15	4	10
3.	Management review and verification	4.07	4	16
4.	Continuous improvement	4.16	4	8
C	**Stakeholders' Involvement**			
1.	Understanding of project vision and goal	4.19	4	4
2.	Good communication among the stakeholder	4.19	4	4
3.	Knowledge & skill	4.12	4	15
4.	Trust among stakeholders	4.01	4	18
D	**Risk Management**			
1.	Identify the risk	4.14	4	13
2.	Risk management	3.99	4	19
3	Develop response to the risk	3.98	4	20
4.	Develop a contingency plan or preventive measures for the risk	3.69	4	22
E	**Raising Awareness**			
1.	Understanding the issues	4.15	4	10
2.	Increase general energy awareness	4.14	4	13
3.	Improve facility energy awareness	4.15	4	10
4.	Education by research and development (R&D), teaching and learning	3.78	4	21
5.	Community engagement and partnership	3.68	4	23
6.	Energy information	4.05	4	17

Table 4 shows the ten (10) attributes with the highest mean score extracted from Table 3. In overview, the attribute 'leadership' one of the attributes in top management support cluster, was rated overall as the most important attribute for achieving better performance in EM in this sector (MS = 4.30). This means that the respondents noted that no improvement can be expected unless top management is in support and that their involvement in EM is critical for achieving consistent savings. Xu *et al.* [2011] identified leadership as a critical success factor in projects success. Therefore, it is not surprising that the attribute was ranked in first position. This was followed by the attribute 'conduct energy audit' (MS = 4.22). It is common knowledge that for any meaningful program in relation to energy efficiency measures, a baseline data generated through measurement is essential. The respondents believed that it will be difficult to manage something that cannot be measured and that conducting energy audit will reveal all necessary adjustments that should be made which could lead to energy saving and consequently reduce the energy bills. They also see energy audit as the key to a systematic approach to decision making in energy management. This was also the views of Unachukwu *et al*. [2015] that you can't effectively manage what you don't measure. According to Lozano [2006], Aderemi *et al*., [2009], Choong *et al*. [2012], Bakar *et al*. [2014] and Sodipo *et al*. [2015] being energy conscious can save substantial amount of electricity and money**.** The Carbon Trust [2011] reported that energy audit can typically deliver energy use savings of between 5% and 15%. So, it is not surprising also to see that the attribute was ranked in second position overall. The attribute 'developing energy policy and guideline' was ranked in third position (MS=4.20). This result shows that developing a clear and achievable energy policy and guidelines is important in energy management initiatives. They also believed that without a clear energy policy and guideline from top management the stakeholders might not understand the step to be taken and what to do; energy program will not be able to go far and perhaps, confront difficulties in gaining support from staff. This is in line with Choong *et al* [2012] and Yang [2013] findings as they reported that developing a clear and achievable energy policy and guidelines are important in energy management initiatives. The attributes, 'allocation of sufficient resources' 'understanding of project vision and goal' and 'good communication among the stakeholders' (stakeholders' involvement cluster) were ranked in fourth position (MS = 4.19). The respondents understood that resources are one of the CSFs to be given a special attention to ensure smooth operations and activities of the energy management team. Since without substantial budget, it may be impossible to invest in energy conservation activities. Akinbami [2003], Wai *et al*. [2011], Lo [2013] and Saleh *et al*. [2014] pointed out that resources are important to survive and function in a long time, and the results of the robustness of process in strategic facilities management depends on availability of resources [Malaysia National Higher Education Strategic Plan, MNHESP, 2007]. Xu *et al*. [2012] and Choong *et al*. [2012] and Yang [2013] noted that the availability of adequate resources is a significant factor in achieving success in EM. The respondents also believed that if university management expressly and explicitly shares energy management goals and visions with stakeholders, it is a crucial step for achieving sustainable electricity savings in the sector. This was also the views of Belassi and Tukel [1996], Lozano [2006] and Yang [2013] as they noted that a shared vision is an essential element towards achieving success in any programme. Saleh *et al*. [2014] noted that EM will not be successful if the stakeholders do not understand what they are doing and why they are doing it. Effective communication is an integral component of a sustainable efficient EM management programme. Communicating the energy management plan to energy users is very essential at every stage since all stakeholders rely upon it to achieve effective electricity savings. Allen and Janda [2006], Janda [2009], Jazizadeh *et al.* [2012] and Gram-Hansen [2014] noted that without full and sincere communication among electricity users in universities, the EM goal may not achieve better result. Manan [2013] also noted that good communication among the stakeholders ensures that stakeholders work together to implement energy management project. The UK Carbon Trust [2011] stressed that the stakeholders need to be informed of the benefits of saving energy in the university building. The result is also in tandem with Onyango and Ciaran [2014] who found out that failure in achieving better result in energy management is caused by lack of interaction between humans and the technology. The attribute 'Create initiatives by establishing an award' was ranked in seventh position (MS = 4.17). The attributes 'training provision' and 'Continuous improvement were both ranked in eighth position (MS = 4.16). They also realised that education is another way to establish a proper energy education scheme in the field of energy conservation by means of introducing new courses for both convention and renewable energy sources. This was also the view of Velazquez *et al*. [2006] and Yang [2013]. The respondents perceived seeking improvements as a never-ending process of achieving success. Manan [2012] argued that progress is most often incremental, thus delivering improvements over prolonged periods are vital. This was also the views of Saleh *et al*. [2014]. They stressed that it is always necessary to go through the cycle again for solving new challenges and problem. They also added that the implementation of the model must not be a static process for generating a particular initiative. According to Chase and Aquilano [2001], unless the model goes through the same cycle again to solve new challenges and problems, no improvement can be expected. The attributes 'understand the issues'; 'improve facility energy awareness' and 'operation & maintenance' were also ranked in the tenth position as they shared the same mean score (MS=4.15]. The respondents noticed that without understanding the current situation in a proper manner before trying to make out any action plan, the energy program will not be able to go far and perhaps, confront difficulties. This was also the views of Choong [2012] and Yang [2013] as they observed that understanding energy issues could stimulate efficient electricity management. Lozano [2006], Choong *et al*. [2012] and Yang [2013] argued that university management should obtain current energy consumption data and compare with past trends. This will assist the university management to make adequate inference and take necessary actions to enhance energy savings now and in the future. According to them, doing this will assist the university management to make adequate inference and take necessary actions to enhance energy saving now and in the future. Saleh *et al*. [2014] argued that the understanding of energy issues by stakeholders could stimulate efficient electricity management in public universities. The respondents felt also that it is important to gain support from the employees in saving energy. This means they understood that responsibilities to reduce the consumption of electricity in the sector should come from all, not only selected technical persons in charge. They noted that when individual electricity user has increased level of awareness of the energy performance of such facility and possible implications on the university, it could help build support for energy management. Janda [2009] argued that awareness-raising and education are the main tools to overcome the information deficit and "correct" peoples' behaviours. Furthermore, the respondents recognised the importance of continued operation and maintenance (O&M). This position is in line with Capehart *et al*., [2008], Yang [2013] and Saleh *et al*. [2014] as they revealed that gains in energy efficiency and cost savings could easily be lost when an organisation failed to support the continued O&M improvement.

Table 4: Top 10 significant attributes for achieving efficient EM in Nigerian Public Universities

Critical Success Factors	Various Categories	Mean Score	Criticality Index
Leadership	Top management support	4.30	4
Conduct energy audit	Comprehensive energy management team	4.22	4
Develop energy policy and guideline	Top management support	4.20	
Allocation of sufficient resources	Top management support	4.19	4
Good communication among the stakeholder	Stakeholders' Involvement	4.19	4
Understanding of project vision and goal	Stakeholders' involvement	4.19	
Create initiative by establishing an award	Top management support	4.17	4
Continuous improvement	Comprehensive energy management team	4.16	4
Training provision	Top management support	4.16	4
Understanding the issues	Raising awareness	4.15	4
Improve facility energy awareness	Raising awareness	4.15	4
Operation & maintenance	Comprehensive energy management team	4.15	4

Further assessment of Table 3 was carried out to also determine the clusters that the stakeholders considered most important to achieve sustainable efficient EM improvement in the sector. The result of this assessment is presented in Table 5. From Table 5, Top Management support was rated as the most important cluster for achieving better performance in EM in the sector. This means that the respondents realised that EM is first and foremost a management and organisation effort. This position is in line with Wai *et al*. [2011] and Saleh *et al*. [2014] as they pointed out that without proper attention from top management, the program will have only marginal success or fail altogether. Top management gives the policy direction to the firm, issuing a written comprehensive energy policy and goals, allocating resources, promptly reacting to suggestions and complaints [Akinbami, 2003; Aksorn and Hadikusumo, 2007; Brinkhurst *et al*., 2011; Lo, 2013], The success of any energy efficiency improvement programme depends on the commitment of top management. Tangible incentives, motivation and recognition are needed from top management [Yang, 2013]. According to Aderemi *et al*. [2009], the contributions of company owners in conserving energy are very vital as they could call for shut down to conserve energy and reduce cost of production to enhance profit. Thus, seeking top management support is critical for achieving efficient electricity savings in the sector. This was also the position of Bakar *et al*. [2014] that the successful implementation of sustainable energy management in organizations will depend on the commitment and cooperation at all management levels. It is not surprising to see that all the attributes of top management support cluster appear in the top ten most important attributes [Table 4]. In addition, the respondents also see the need for the establishment of comprehensive energy management team that will be responsible for long-term planning and creation of energy management office for managing daily operations and promoting energy efficiency in the sector. This is in tandem with the thoughts of Akinbami [2003] and Lo [2013] as they opined that for a successful implementation of an energy improvement programme, it may be wise to have institutional policy framework, design the overall authority and responsibility to an energy management committee or an individual energy manager who must be highly placed in the firm's organisation structure and familiar with the operational aspects of the sector. This was also the views of CREDC [2009] and Aderemi *et al*. [2009]. According to them**,** having institutional policy framework and establishment of an Energy Management Unit (EMU) and appointing energy experts, will reveal all necessary adjustments that should be made which could lead to energy saving and consequently reduce the energy bills. Sodipo, Oluwale and Jubril [2015] also noted the importance of engaging energy experts. This is similar to what Tony Blair did when he inaugurated the Advisory Group on Energy Management (AGEM) and confirmed the appointment of a full-time energy manager in 1993 to look into how it could reduce its energy consumption (EEMU, 2004). This might be the reason why the cluster was rated in second position. The respondents also felt that the inclusion and involvement of stakeholders in energy management pool of their facility is equally important. This was also the views of Allen and Janda [2006], Sorrel *et al*. [2009], Janda [2009, 2011], Masoso and Grobler [2010], Jazizadeh *et al*. [2012], Gram-Hansen *et al*. [2012], Carbon Trust [2012], Hori *et al*. [2013], Carter, 2014 and Graham-Hanssen [2014]. They made the argument that sustainable efficient EM improvement in buildings requires imparting proper training to, and securing the cooperation of the human work force in the plant. According to these studies, unless EM efforts are sustainable at individual levels, it may be difficult to reduce electricity and achieve sustainability and without sustainability, energy management efforts will not preserve. This could be the reason why this cluster was rated third. Besides, two attributes of this cluster were rated in fourth position overall (Table 4).

Although raising awareness cluster was rated fourth overall among the five clusters, however, the respondents see it as necessary because five of the attributes in this cluster were rated above 3.75. Respondents are also of the opinion that having users' ignorance and unaware users could lead to electricity wastage in the sector.

Table 5: Critical success factors criticality ranking – Various categories

Critical Success Factors		Total (n)	$\sum Xi$	Mean ($\frac{\sum Xi}{n}$)	criticality Index	Average mean	Criticality Ranking
Top management support							
1	Develop energy policy and guideline	1106	4672	4.20	4		
2	Leadership	1121	4692	4.30	4		
3	Create initiatives by establishing an award	1116	4692	4.19	4	4.20	1st
4	Allocation of sufficient resources	1117	4547	4.17	4		
5	Training provision	1109	4501	4.16	4		
Comprehensive energy management team							
1	Conduct energy audit	1107	4758	4.22	4		
2	Operations & maintenance	1109	4601	5.15	4		
3	Management review and verification	1097	4570	4.07	4	4.15	2nd
4	Continuous improvement	1111	4620	4.16			
Stakeholders' Involvement							
1.	Understanding of project vision and goal	1115	4670	4.19	4		
2.	Good communication among the stakeholder	1119	4608	4.19	4		
3.	Knowledge & skill	1117	4612	4.12	4	4.13	3rd
4.	Trust among stakeholders	1117	4507	4.01	4		
Raising Awareness							
1.	Understanding the issues	1109	4419	4.15	4		
2.	Increase general energy awareness	1110	4580	4.14	4		
3.	Improve facility energy awareness	1121	4458	4.15	4	3.99	2nd
4.	Education by research and development (R&D), teaching and learning	1113	4624	3.78	4		
5.	Community engagement and partnership	1117	4462	3.68	4		
6	Energy information	1102	4470	4.05	4		
Risk Management							
1.	Identify the risk	1117	4626	4.14	4		
2.	Risk management	1106	4428	3.99	4	4.13	3rd
3	Develop response to the risk	1102	4020	3.98	4		
4.	Develop a contingency plan or preventive measures for the risk	1117	4461	3.69	4		

4.3 Dimensions of CSFs

Factor analysis was also used to statistically identify a reduced number of factors from a larger number of items and to detect the underlying relationships among the identified CSFs. However, factor analysis has its statistical meaning when the following assumptions: Kaise-Meyer-Olkin (KMO), Bartlett's Test of Sphericity, eigenvalues, % of variance, scree plot, and rotated component matrix, are not violated. The first sets of tests conducted to indicate the suitability of the data set for factor analysis were KMO, Bartlett's Test of Sphericity and Communalities. The results in Table 6 shows that the KMO value of 0.935 is >0.70 and Bartlett's test for Sphericity was highly significant (χ^2 = 14964.155, p < 0.01). Following the recommendations of Field [2005] and Wiki [2007], it can be concluded that factor analysis is appropriate for the set of data used for this study.

Table 6: KMO and Bartlett's test for critical success factors

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.935
	Approx. Chi-Square	14964.155
Bartlett's Test of Sphericity	Df	253
	Sig.	.000

Table 7 depicts the communalities of the identified critical success factors. As shown in Table 7 a substantial proportion of basic communalities of all items were more than 0.5. This further confirmed that factor analysis was suitable for this data set.

Table 7: Communalities of critical success factors for efficient energy management

S/N	Critical Success Factors	Initial	Extraction
A	Develop energy policy and guideline	1.000	.572
B	Leadership	1.000	.495
C	Create initiatives by establishing an award	1.000	.488
D	Allocation of sufficient resources	1.000	.625
E	Training provision	1.000	.9472
F	Conduct energy audit	1.000	.639
G	Operations & maintenance	1.000	.674
H	Management review and verification	1.000	.630
I	Continuous improvement	1.000	.571
J	Understanding of project vision and goal	1.000	.637
K	Good communication among the stakeholder	1.000	.726
L	Knowledge & skill	1.000	.680
M	Trust among stakeholders	1.000	.657
N	Identify the risk	1.000	.777
O	Assess the risk	1.000	.825
P	Develop response to the risk	1.000	.793
Q	Develop a contingency plan or preventive measures for the risk	1.000	.734
R	Understanding the issues	1.000	.554
S	Increase general energy awareness	1.000	.684
T	Improve facility energy awareness	1.000	.686
U	Education by research and development (R&D), teaching and learning	1.000	.701
V	Community engagement and partnership	1.000	.671
W	Energy information	1.000	.640

The next test conducted was the total variance explained, which assessed how much of the variance has been explained by the extracted factors and how many factors can be extracted. Table 8 displayed the variance explained by the initial solution, rotated components. From Table 8, only four (4) attributes can be extracted. These four attributes had eigenvalues greater than 1 and explained 64.924% of the variability in the original twenty-three variables. The rotation maintains the cumulative percentage of variation explained by the extracted components, but that variation is now spread more evenly over the components.

Table 8: Total variance explained for CSFs for efficient energy management

Component	Initial Eigen values			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	10.277	44.683	44.683	10.277	44.683	44.683	4.679	20.344	20.344
2	2.094	9.103	53.786	2.094	9.103	53.786	4.145	18.024	38.367
3	1.470	6.391	60.177	1.470	6.391	60.177	3.387	14.726	53.093
4	1.092	4.747	64.924	1.092	4.747	64.924	2.721	11.831	64.924
5	.977	4.249	69.173						
6	.810	3.521	72.694						
7	.773	3.359	76.053						
8	.629	2.733	78.786						
9	.524	2.278	81.064						
10	.448	1.949	83.013						
11	.431	1.873	84.886						
12	.420	1.827	86.714						
13	.409	1.777	88.490						
14	.346	1.505	89.995						
15	.325	1.412	91.407						
16	.314	1.365	92.772						
17	.283	1.230	94.001						
18	.270	1.173	95.175						
19	.260	1.132	96.307						
20	.244	1.061	97.368						
21	.227	.986	98.354						
22	.215	.935	99.289						
23	.163	.711	100.000						

The scree plot was also used to decide on the number of factors that can be extracted (Figure 1) and based on the scree plot, only 4 attributes have been extracted. Each of these attributes had eigenvalue greater than 1.

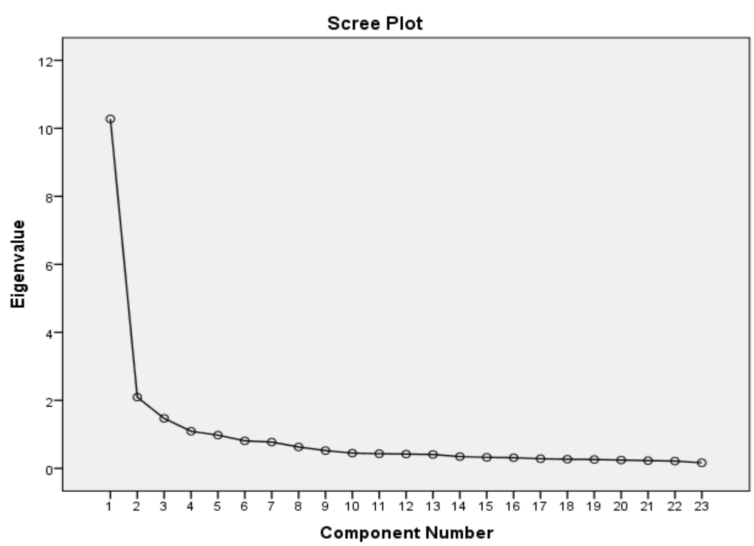

Figure 1: Scree plot for critical success factors for efficient EM

Finally, rotated component matrix test was conducted. After rotation, four items, namely develop energy policy and guideline, conduct energy audit, increase general energy awareness and good communication among the stakeholders with highest loading factors were extracted (Table 9). These four items had initial eigenvalues greater than 1.0 (Figure 1) and all together explained 64.924% of the observed variance. This result implies that the extracted attributes were the most significant which the university management must focus more attention on to achieve better result in EM.

Table 9: Rotated component matrix for CSFs for efficient EM

S/N	Critical Success Factors	Component			
		1	2	3	4
A	Develop energy policy and guideline	**.759**	-.220	.327	.206
B	Leadership	.523	-.269	.257	.176
C	Create initiatives by establishing an award	.509	-.311	.358	.070
D	Allocation of sufficient resources	.634	-.280	.360	-.111
E	Training provision	.675	-.274	.280	-.170
F	Conduct energy audit	.585	**.669**	.298	-.155
G	Operations & maintenance	.723	-.009	.210	-.328
H	Management review and verification	.731	-.112	.176	-.228
I	Continuous improvement	.744	-.060	-.009	-.117
J	Understanding of project vision and goal	.698	-.141	.028	.360
K	Good communication among the stakeholder	.715	-.097	-.098	**.442**
L	Knowledge & skill	.699	-.110	-.255	.339
M	Trust among stakeholders	.655	-.105	-.259	.387
N	Identify the risk	.574	.610	.243	.128
O	Assess the risk	.608	.655	.150	.066
P	Develop response to the risk	.582	-.131	.083	-.005
Q	Develop a contingency plan or preventive measures for the risk	.592	.612	.096	.008
R	Understanding the issues	.698	-.028	-.256	-.024
S	Increase general energy awareness	.711	-.050	**-.363**	-.218
T	Improve facility energy awareness	.735	.004	-.321	-.206
U	Education by research and development (R&D), teaching and learning	.652	-.011	-.286	-.209
V	Community engagement and partnership	.747	-.087	-.302	-.124
W	Energy information	.733	-.055	-.293	-.121

After applying Factor Analysis, the factors were reduced to 4 items. These items were grouped into: top management support, comprehensive energy management team, stakeholders' involvement and raising Awareness (Figure 2).

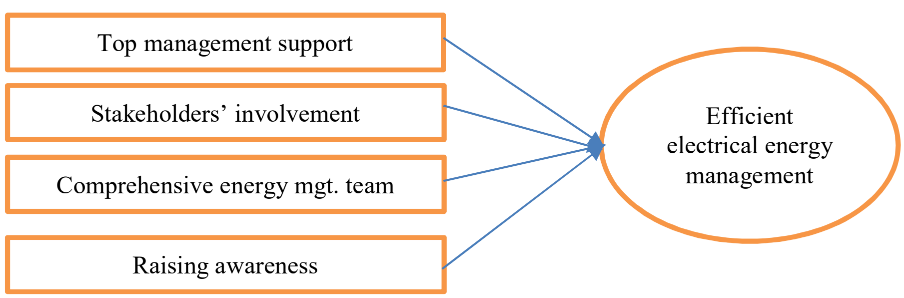

Figure 2: Dimensions of CSFs

Finally, the four attributes derived from factor analysis-were further tested using binary logistic linear regression to identify the highly significant attribute. In overview, the result in Table 10 reveals that good communication among stakeholders ($p \leq .005$) is the most influencing factor for achieving better result in EM in this sector. The result is in tandem with Onyango and Ciaran [2014] who found out that failure in achieving better result in energy management is caused by lack of interaction between humans and the technology. This was also the submission of Allen and Janda [2006], Janda [2009], Jazizadeh *et al.* [2012] and Gram-Hansen [2014]; they noted that without full and sincere communication among electricity users in universities, the EM goal may not achieve better result. Saleh *et al.* [2014] pointed out that good communication among electricity users in public universities is very relevant for no improvement can be expected unless people know what to do and realize the importance of electricity saving to the university community and the environment at large.

Table 10: Variables in the equation

	Beta Coefficient	Standard Error	Wald Statistics	Degree of Freedom	P-value	Odd Ratio (OR)
Constant	2.232	.234	90.637	1	.000	9.321
Develop energy policy and guideline	-.066	.086	.590	1	.442	.936
Good communication among the stakeholders	-.298	.104	8.154	1	.004	.742
Increase general energy awareness	.017	.098	.029	1	.865	1.017
Conduct energy audit	-.048	.103	..218	1	.641	.953

5.0 Conclusions

This paper has captured the perception of electricity users in three public universities in Southwestern Nigeria regarding the critical success factors for achieving sustainable efficient EM in the sector. Based on this, the study developed a set of CSFs for implementing EM in university sector with emphasis on sustainability. The findings of the study showed that all the attributes presented would enhance EM in this sector since all the attributes have criticality index of 4.0 and mean score value $\geq$ 3.75. However, the top five (5) attributes considered very significant are leadership (MS=4.30), conduct energy audit (MS=4.22), develop energy policy and guideline (MS=4.20), allocation of sufficient resources (MS=4.19) and understanding of project vision and goal (MS=4.19). This finding is in line with Saleh *et al.* [2014, 2015a, 2015]. The result of factor analysis led to the identification of four most important attributes namely develop energy policy and guidelines, conduct energy audit, increase general energy awareness and good communication among the stakeholders. The attributes accounted for 64.9% of total variance. Further test on the four attributes using binary logistic linear regression identified good communication among stakeholders as the most important attribute ($p \leq 0.005$). However, respondents in the study areas believed that, public universities aiming at stimulating and achieving sustainable efficient electricity savings need to seek top management support, establishment of a comprehensive energy management team and the inclusion of stakeholders in the energy management pool of their facility.

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