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AN INVESTIGATION INTO ENERGY CONSUMPTION PROFILE OF UNIVERSITY OF LAGOS STUDENTS' HOSTEL

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The task of resource management is tougher in public tertiary institutions especially in Nigeria where government allocation to education continues to dwindle. A major cost centre for public institutions is the cost of providing energy for classrooms, offices and residences. Expenditure on energy sometimes account for up to 35% of the overall annual budget of most organisations, the percentage is most likely to be higher in most developing and under-developed countries especially in countries where power supply from the national grid is epileptic and have to be heavily complimented by diesel power generating sets. The study investigates the energy consumption profile of students' hostel at the University of Lagos Nigeria with a view to making recommendations for energy conservation and optimization practices. Through a cross-sectional survey, purposive sampling of 130 students living in the hostels was conducted. Electrical appliances and gadgets used by the respondents were also audited. The audit assessed the power ratings and duration of use of the appliances and gadgets. The data collected were analysed using descriptive and inferential statistical tools comprising frequency tables, bar chart, sum and mean scores, correlation and ANOVA analysis respectively. The results indicated that electric hot plates, pressing irons and fans are the topmost energy-consuming appliances in the students' hostels. The study shows a significant correlation between hostel characteristics and energy consumption profile. The study concludes that the annual energy consumed in the students' hostel is approximately 35GW. The study recommends that the university management should define power wattage threshold for appliances to be used by students in the hostels as a major active energy optimization drive.

Keywords: consumption, energy, hostel, students

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INTRODUCTION

Globally, energy is very vital in driving the growth and development of any economy as it is an important input to a nation's growth and development. Energy equally plays a major role in increasing the competitiveness of any nation among the committee of nations (Alege, 2014). In Nigeria, the provision of energy remains epileptic despite several reforms and the government's huge investment in the energy sector (Somefun, 2016). Buildings account for between 20 to 40 per cent of global energy demand (Ürge-Vorsatz et al., 2012). Olaoye, Ajilore, Akinluwade, Omole, and Adetunji (2016) explain that energy inadequacy crises have been a concern for both the Nigerian government and the people for the past four decades. Despite the gross inadequacies in the provision of energy from the national grid, a significant proportion of available energy especially in public buildings is poorly utilized with a significant amount of waste.

Large institutions, such as universities, consume a large amount of energy on a daily basis (Oyedepo, Adekeye, Balogun, & Akhibi, 2015). Improving the energy practices at post-secondary institutions can directly decrease the environmental impact associated with the use of energy and equally act as an example for a change of people's attitude in the use of energy across the country. Therefore, energy availability, optimization, consumption and its attending costs in public buildings often constitute a major challenge to administrators and top management of public buildings (Oyedepo, Adekeye, Balogun, & Akhibi, 2015). Much can, therefore, be achieved towards improving energy availability if energy is conserved in public buildings with a significant level of occupancy such as the university students' hostel.

Adetunji (2005) posits that energy conservation aims at the reduction in the consumption of non-renewable resources. It is the practice of reducing the amount of energy used for different purposes rather than the use of energy efficient appliances (Iguchi, 2005). Typically, university campus consumes a large amount of energy in providing essential services such as lighting, water supply, ventilation, and air conditioning (Oyedepo et al., 2015).

The task of meeting the demands for energy comes at a significant cost to universities and contributes to the reduction of natural resources. It is therefore important that energy conservation practices be identified and promoted in universities students' hostels. Energy conservation practices result in low energy consumption in buildings, such practices should include estimations about energy cost savings and the payback time (Stewart et al., 2016). The problem of this study, therefore, is to investigate the energy consumption profile of universities students' hostel and energy conservation practices that could improve the use of energy within the study area. Furthermore, studies investigating energy consumption and practices by which energy can be conserved in hostel buildings are rare as previous studies relating to energy and buildings such as Olaoye et al. (2016), Stewart (2016), Forsström et al. (2011) and Nielsen (2002) focused on the use of renewable sources of energy and energy optimization practices in commercial buildings.

The aim of the study is to investigate the energy consumption profile and the extent to which energy conservation practices are implemented in universities students' hostel. The specific objectives for the study include:

To evaluate the energy consumption profile of University of Lagos students' hostel.

To recommend practices for improving energy conservation in University of Lagos student's hostel.

The hypotheses postulated for the study are:

Ho: There is no statistical correlation between hostel characteristics and energy demand for appliances in student hostels.

Ho: There is no statistical difference in the perception of respondents on practices for conserving energy across the various student hostels.

LITERATURE REVIEW

The Concept of the use of Energy in Buildings

The energy consumption of a building refers to the quantity of energy used for driving systems and services in the building during the building operation (Guan, Nord, & Chen, 2015). Buildings in modern times are becoming more action driven and as such, there is an increase in energy demand with a corresponding increase in energy costs. Abdulkareem (2016) posits that energy consumption in Nigeria has increasingly experienced an upward trend with over 23% increase in energy demand between 2000 and 2008. Canada Natural Resources (2013) reveals that commercial and institutional buildings account for 62 per cent of the total energy consumed by the Canadian housing sector. The energy demand for institutional buildings varies from one building to another depending on a number of factors ranging from the age of the building to the level of activities requiring the use of energy in the buildings (Stewart et al., 2016).

The ever-increasing demand for energy and the attendant challenges of meeting these demand remains a challenge, especially in developing countries such as Nigeria (Olaoye et al., 2016). In most developed countries, attempts are been made to reward people for conserving energy, for example, some of the cities have tax regime on energy and also regulate the energy performance of buildings through the enforcement of Building Codes and Standards (Nielsen, 2002). According to Bryant and Eves (2012), reduction in energy consumption can range from simple plans to complex and high capital investment projects. Lowering energy consumption in public buildings can also have added the positive effect of releasing public resources to other purposes (Stewart et al., 2016). Sakina, Azizi and Wilkinson (2015) posit that for office buildings in developed countries, energy conservation practices are oftentimes influenced by the concern for environmental issues rather than the consideration for reduced energy cost.

Guan, Nord, and Chen (2015) explain that energy use in university buildings varies as building occupancy levels influence electricity and water use in buildings. Therefore, different campus buildings have varying energy profiles. Woo and Cho (2018) argue that the insulation of walls, roofs or windows, the shape of the building and allied household characteristics, such as family size and income are significantly associated with residential buildings' energy consumption.

Energy Consumption and its Environmental Impact

The huge quantity of energy consumption has contributed significantly to climate change and constitute a severe threat to further environmental pollution and adverse impact on human health (Alege, 2014). Chun-sheng, Shu-wen and Xin (2012) explain that a lot of noxious waste from household energy consumption is harmful to human health, particularly for women and children in rural areas. Excess energy consumption also affects the economic growth of a nation due to the impact of energy on social, economic and welfare development in the country (Onakoya & Odedairo, 2015).

Akpan and Akpan (2012) also point out that energy consumption contributes to pollution, environmental deterioration, and global greenhouse emissions. They further opine that the increase in energy consumption is driven by population growth and economic development that tends to increase energy use per capita. Lowering energy consumption in public buildings would, therefore, contribute significantly to freeing public resources for other purposes (Stewart et al., 2016).

According to Panwar, Kaushik and Kothari (2011), the primary environmental effect of energy overuse is an increase in the carbon footprint. A common poor energy utilisation practice in buildings include keeping devices plugged in and running when not in use, which results in an increase in electrical use and, consequently, a bump in the number of greenhouse gases that goes into the atmosphere. A natural consequence of excess energy use is increased cost which comes in the form of fuel and energy bills. This also increases the risk of a low expected lifespan of home appliances and other electronics in buildings (Abbakyari & Taki, 2016).

Energy Optimization in Buildings

Optimization is often used interchangeably with improvement (De Boeck, Verbeke, Audenaert, & De Mesmaeker, 2015). Optimization of Energy Systems comprehensively describes the thermodynamic modelling, analysis and optimization of numerous types of energy systems in various applications. It provides a new understanding of the system and the process of defining proper objective functions for the determination of the most suitable design parameters for achieving enhanced efficiency, cost-effectiveness and sustainability (Carabin, Wehrle, & Vidoni, 2017). Examples of objective functions for energy systems include maximization of efficiency, minimization of fuel consumption, maximization of the net power density, minimization of emitted pollutants, maximization of the internal rate of return (IRR), minimization of the payback period (PBP), among others.

Various energy optimization methods have been discussed in the literature with specific emphasis on energy efficiency and energy performance of buildings. De Boeck, Audenaert, and De Mesmaeker (2013) argue that the energy performance of buildings can be improved by modifying different building characteristics with a view to minimizing energy consumption and accompanying costs. Guerra Santin, Itard and Visscher (2009) conducted a survey on the impact of occupant behaviour on space heating energy consumption in Dutch residential stock by controlling the building characteristics. The study concluded that the occupancy behaviour of building users changed the building's energy use by about 4.2%. The heating or cooling of space to maintain thermal comfort is a highly energy-intensive process accounting for as much as 60 -70 % of total energy use in residential buildings. Omer (2018) asserts that nearly half of the world's energy use is associated with providing environmental conditioning in buildings and about two-thirds of this is for heating, cooling, and mechanical ventilation. The typical high energy demand for heating and cooling of buildings is due to the heat gained through windows and walls when it is sunny which is stored in a masonry wall for night time release (Gellings, 2009). According to Adalberth (2000), a double pane window would have consumed more energy in the course of manufacturing due to additional process, but the initial higher cost of production would be compensated for through future cost savings due to the low energy demand from extracting heat radiation through such window panes during the occupation phase of the building.

The main focus in the development of energy efficient buildings has been on the application of a few technical solutions comprising super-insulated and airtight envelopes combined with high efficiency heat recovery and passive solar heating as well as the renewable energy technologies such as passive and active solar heating and solar cells (Aa, Heiselberg, & Perino, 2011). A passive solar design consists of an assembly of primarily non-mechanically driven architectural components that convert solar energy into usable heat (Gellings, 2009). Stewart (2016) explains that there are several ways to maximize passive solar heat gain. For instance, window placing can be planned to harness as much of the solar heat radiation during the day as much as possible. Also, advanced window glazing technologies make it possible to make windows larger without affecting the heat gain or loss.

According to Aa et al. (2011), there are several techniques and concepts that help to passively utilize the thermal mass of buildings. Such techniques include the use of passive cooling systems, such as night flush cooling and earth cooling, as well as thermal storage heating system. In many green buildings in Europe and the United States, the role of passive design strategies is overshadowed by that of efficient energy systems (Casey et al., 2011). In addition, Shahidan, Jones, Gwilliam and Salleh (2012) recommend the consideration of building modifications through cooling strategies as a technique for adding external obstacles that could create valuable shade for buildings. The building envelope must balance the needs for passive strategies such as daylighting and natural ventilation that require the climate to permeate the interior with the need for integrity and performance from a thermal energy perspective (Smith, 2017). Achieving active energy management starts with the collection of data to monitor and measure how and where energy is used (Schneider & Selvaggio, 2010). According to Smith (2017), energy efficient lighting should be the first consideration in the approach for active optimization practices in buildings. This can greatly reduce energy consumption without significant incremental cost. The study adopts the various energy optimisation strategies discussed in this section as part of the variables for this study.

RESEARCH METHODOLOGY

The study focuses on students' hostels at the University of Lagos. The University is located in the South-Western geopolitical zone of Nigeria. A cross-sectional survey research design was adopted for this study. The study was carried out on the University of Lagos students' hostels at the main campus, Akoka, Lagos State. The choice of the University of Lagos as the study area was influenced by its population of over 44,602 and 12,581 undergraduate and postgraduate students respectively. The University has a total of eighteen halls of residences comprising; thirteen halls of residence for undergraduate students and three halls of residence for postgraduate students respectively.

The population of the study comprises of the entire 8,000-bed space owners across the eighteen hostels. Using the simplified formula for proportions (Israel, 2013) at a 90% confidence level, a sample size of 90-bed spaces was determined for the study. A structured questionnaire was developed as an instrument for collecting primary data for the study. The questionnaire consists of open and close-ended questions which were categorised into three sections. Section A consists of questions relating to the demographic data of the respondents. Section B consists of questions on the type and number of each of the electrical appliances been used by respondents in the hostel, the power rating of each of the appliances as stipulated on the specification data sticker on the appliance and the average daily duration of use of each appliance. Section C consists of questions on potential measures for conserving energy in the hostels.

A total of 150 questionnaires were self-administered randomly to the respondents in their respective hostel rooms. All administered questionnaires were retrieved but twenty of the retrieved questionnaires were poorly completed and were discarded for use for the study. A total of 130 questionnaires were adequately completed and used for the study representing 87% response rate. Furthermore, the dimensions of the floor and window area of each of the respondents' room were measured to represent the characteristics of each of the hostel rooms.

Using the Statistical Package for Social Sciences (Version 23) and Microsoft Excel, the data collected for the study were analysed. Tables, bar-chat, mean and sum were used as tools of analysis for the descriptive statistics while Person correlation and Analysis of Variance were used as the tools of analysis for the inferential statistics respectively.

RESULTS OF ANALYSIS

The following focuses on the analysis of various responses from the administered questionnaires and deductions made from the analysis:

Table 1 shows the characteristics of respondents for this study. The analysis shows that the population of male respondents was marginally higher than that of female respondents with 52% and 48% respectively. This implies that both genders were adequately represented in the study and thus eliminating the tendencies for gender bias, Also, the majority of the respondents are above 19 years and are old enough to provide adequate responses to the questions of the study.

Table 1: Respondents Characteristics

Respondents Characteristics	Frequency	Percentage
Gender		
Male	67	52%
Female	63	48%
Total	130	100%
Age		
16 – 19	45	34%
20 – 23	78	60%
24 – 27	5	4%
28 & above	2	2%
Total	130	100%

Table 2 shows the characteristics of the hostel rooms. The analysis shows that the hostels vary in sizes ranging from rooms with 9 Sq.m to 48 Sq.m floor area. The analysis further shows that the window areas are in proportion to the floor area sizes. This implies that the hostel rooms are not of the same bed space capacities nor are all the hostel prototype in design.

Table 2: Hostel Rooms Characteristics

Hostel Room Characteristics	Frequency	Percentage
Rooms Floor Area		
9 m2	24	19%
18 m2	90	69%
48 m2	16	12%
Total	130	100%
Rooms Window Area		
1.44 m2	89	68%
1.62 m2	25	19%
3.24 m2	16	12%
Total	130	100%

Furthermore, the average daily energy consumption of each of the electrical appliances, fittings and fixtures used by each of the respondents were computed. The summary of the analysis of the audit is shown in Figure 1.

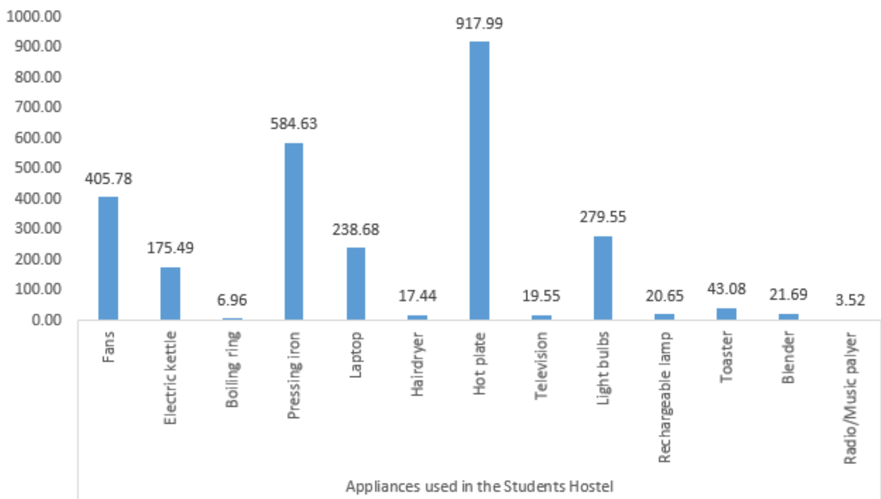

Figure 1: Average daily energy consumption profile (kWh) of the students' hostel
Source: Field Survey (2018)

Figure 1 shows that the use of electric hot plate cooker in the student's hostel consumes the highest quantity of energy, consuming about 918 kWh of energy daily. This was followed by the use of pressing iron, Fans, Light bulbs and Laptops with daily kWh consumption of 584.63, 405.78, 279.55 and 238.68 respectively.

The study also examined the type of electrical appliance(s), the number of appliances, the power rating and the average daily duration of use of each of the appliances in the course of the study. The respondents were equally asked questions on the pattern of use of energy in the hostel. The result is presented in Table 3.

Table 3: Breakdown of Appliances and their Energy Demand

Appliances	Number	AV. Power Rating (W)	AV. Power Rating (kW)	AV. Daily Use (Hr.)	AV. Daily Consumption (kWh)
Fans	141	131	0.13	22	405.78
Electric kettle	57	1785	1.78	2	175.49
Boiling ring	3	1160	1.16	2	6.96
Pressing iron	136	2000	2.00	2	584.63
Laptop	306	65	0.07	12	238.68
Hairdryer	11	1245	1.25	1	17.44
Hot plate	87	1449	1.45	7	917.99
Television	34	115	0.12	5	19.55
Light bulbs	192	70	0.07	21	279.55
Rechargeable lamp	46	161	0.16	3	20.65
Toaster	14	2000	2.00	2	43.08
Blender	7	1971	1.97	2	21.69
Radio/Music player	8	220	0.22	2	3.52
Cumulative daily energy consumption (in kWh)					2,734.99

Table 3 reveals that appliances with high power ratings include pressing iron, toaster, blender and electric cooking hot plate. Although the average power rating of the electric hotplate was 1449 watts it accounts for the highest energy demand (917.99kWh). The result shows that the cumulative daily energy consumption for the 130-bed spaces that were surveyed was 2,734.99 kWh. This implies that the average daily energy consumption per bed space in the hostel is 21.04 kWh. The result further implies that each of the hostel bed spaces utilises about =N=595.00 worth of energy on a daily basis at the residential tariff rate of =N=28.28K.

The respondents were asked to assess 16 hypothesised practices that could improve energy optimization in a student's hostel. The respondents were asked to evaluate 16 active energy optimization practices. The result of the analysis is presented in Table 4.

Table 4 shows some of the practices that could improve the energy performance of students' hostels. The highly ranked practices include; reducing heat generated in hostel rooms (M=3.68), routine energy audit exercise (M=3.52), use of large window sizes to aid ventilation (M=3.40) and better energy management practices in the hostels (M=3.38). Furthermore, in the course of the interview session, the hostel managers are of the opinion that there is the need for the University management to establish wattage threshold for the various categories of appliances to be used in the students' hostels. They claim that with such standardization regime, the use of energy inefficient appliances would be curbed in the students' hostels.

Table 4: Practices for improving energy consumption in students' hostels.

Energy Conservation Practices	1	2	3	4	5	N	Sum	Mean	Rank
Reducing heat generated in hostel rooms	9	14	20	54	33	130	478	3.68	1st
Routine energy audit exercise	10	24	37	55	4	130	451	3.52	2nd
Use of large window sizes to aid ventilation	7	18	31	64	10	130	442	3.40	3rd
Better energy management practices	10	19	35	44	22	130	439	3.38	4th
Upgrade of light bulbs to efficient light bulbs	16	6	35	65	8	130	433	3.33	5th
Enlightenment by school authorities on energy saving practices	8	19	30	69	4	130	432	3.32	6th
Turning off appliances, switches and sockets after use	10	10	49	52	9	130	430	3.31	7th
Routine maintenance and servicing of fixtures and fittings in the hostel	6	25	36	51	12	130	428	3.29	8th
Use of highly efficient appliances in hostels	6	33	38	32	21	130	419	3.22	9th
Reducing cooling demand	6	15	71	20	18	130	419	3.22	9th
Periodic audit of students' appliances	8	31	23	60	8	130	419	3.22	9th
Use of appliances with lower wattage	13	6	59	44	8	130	418	3.22	9th
Reduction of miscellaneous loads on electrical systems	9	14	62	38	7	130	410	3.15	13th
Awareness of wattage for electronic appliances brought in by students into the hostel.	14	20	42	52	2	130	398	3.06	14th
Frequent replacement of damaged or faulty electrical appliances by management	7	27	62	23	8	130	379	2.98	15th
Adequate supervision on the overall running of electrical systems in the hostel by management	15	27	54	33	1	130	368	2.83	16th

Test of Hypotheses

Test of Hypothesis One:

Ho: There is no statistical correlation between hostel characteristics and energy demand for appliances in student hostels.

The floor area and window area of the hostel rooms were used as the unit of analysis for the hostel characteristics. The test of correlation was done using the Pearson correlation test. The analysis of the hypothesis shows that a weak positive correlation exists between hostel floor area and energy consumption of fans ($r= .181$, $p= .046$). There is also a weak positive correlation between window area and energy consumption of fans ($r= .198$, $p= .028$). Therefore, the null hypothesis was rejected. The results imply that hostel rooms characteristic partially influence the energy consumption of the fans in the hostels as hostel rooms with the smaller floor and smaller window areas use fans for longer time duration and consequently consume more energy than hostel rooms with larger floor area and window area.

Test of Hypothesis Two:

Ho: There is no statistical difference in the perception of respondents on practices for conserving energy across the various student hostels.

The second hypothesis was analysed using ANOVA. The result of the analysis is shown in Table 6.

Table 6: ANOVA on practices for energy conservation across the various student hostels

Energy conservation practices	DFb	DFw	DFt	F	*p.*	Remark
Awareness of wattage for electronic appliances brought in by students in the hostel.	10	119	129	2.648	.006	S
Turning off appliances, switches and sockets after use	10	119	129	1.728	.082	NS
Periodic audit of students' appliances	10	119	129	3.334	.001	S
Enlightenment by school authorities on energy saving practices	10	119	129	1.221	.285	NS
Routine maintenance and servicing of fixtures and fittings in the hostel	10	119	129	5.383	.000	S
Reduction of miscellaneous loads on electrical systems	10	119	129	1.011	.438	NS
Adequate supervision on the overall running of systems in the hostel by management	10	119	129	4.728	.000	S
Frequent replacement of damaged or faulty electrical appliances by management	10	116	126	7.164	.000	S
Routine energy audit exercise	10	117	127	2.409	.012	S
Use of appliances with lower wattage	10	119	129	2.525	.009	S
Use of large window sizes to aid ventilation	10	119	129	8.459	.000	S
Upgrade of light bulbs to efficient light bulbs	10	119	129	9.093	.000	S
Better management practices	10	119	129	7.213	.000	S
Reducing cooling demand	10	119	129	4.687	.000	S
Use of highly efficient appliances in hostels	10	119	129	8.217	.000	S
Reducing heat generated in hostel rooms	10	119	129	1.602	.114	NS

Note: p is significant at $p \leq 0.05$. DFb= Degree of Freedom between groups, DFw= Degree of Freedom within groups, S= Significant difference exist, NS= There is no significant difference.

From the results in Table 6, there are significant differences in the perception of respondents, based on the hall of residence, on 12 out of the 16 hypothesised energy conservation practices.

Energy conservation practices for which there are significant differences and for which the null hypothesis is rejected include; awareness on wattage for electronic appliances, periodic audit of students' appliances, routine maintenance and servicing of fixtures and fittings in the hostel, adequate supervision on the overall running of systems in the hostel by management, frequent replacement of damaged or faulty electrical appliances by management, routine energy audit exercise, use of appliances with lower wattage, use of large window sizes to aid ventilation, upgrade of light bulbs to efficient light bulbs, better management practices, reducing cooling demand and use of highly efficient appliances in hostels.

Whereas, energy conservation practices for which there are no significant differences and for which the null hypothesis is accepted include; turning off appliances, switches and sockets after use, enlightenment by school authorities on energy saving practices, reduction of miscellaneous loads on electrical systems and reducing heat generated in hostel rooms. The results of the hypothesis imply that there are no standardised energy conservation practices across the students' hostel. The result suggests that the lack of standardised energy conservation practices could promote a significant level of energy waste in the student hostels.

DISCUSSION OF FINDINGS

The positive significant correlation between hostel characteristics and energy demand shows that there is an association between hostel characteristics and energy consumption. The findings corroborate the position of Santin et al. (2009) that building demographics and dwelling characteristics are key components of energy demand forecasting.

In addition, the study revealed that a significant amount of energy is consumed in students' hostels daily amounting to about 21 kWh per bed space. This aligns with the results of Finch, Burnett, Knowles and Eng, (2010) that approximately 30% of all secondary energy is consumed in buildings, with institutional buildings accounting for approximately 14% of the consumption. Silva and Sandanayake (2012) explain that institutional buildings oftentimes record significantly high energy consumption due to occupants related factors.

The study emphasised that building users play a critical role in influencing the quantity of energy a building consumes. However, building users, especially those of institutional buildings often overlook the fact that they have to play a role in the energy performance of the buildings they occupy. Furthermore, the study revealed that hostel occupants are unconscious of the need to conserve energy. They undermine their role as very influential in the energy performance of the hostels.

CONCLUSIONS AND RECOMMENDATIONS

Following the results of the analysis for the study, the following conclusions are drawn:

The average annual energy consumed in the students' hostel is approximately 35GW. This translates to an annual energy expenditure of =N=1bn (One Billion Naira), at the residential tariff rate of =N=28.80, by the University management on the provision of energy to the students' hostel.

The daily cumulative energy consumption of all appliances, fittings and fixtures across the hostels amount to 168,306.86 kWh. Energy conservation practices are unstandardized in the students' hostels. This suggests that there is ample wastage in the amount of energy consumed in the students' hostel.

Hostel characteristics impact on hostel energy consumption. Hostel floor area and hostel window area are the essential characteristics that influence hostel energy consumption. Students activities in the hostels that require the use of energy include; charging of students' appliances and devices, lighting, cooking, ventilation with fan, ironing of clothes, hair drying, blending, water heating, refrigeration among others.

The study recommends practices for improving the energy performance of the students' hostel. Topmost recommended practices include; reducing heat generated in hostel rooms, routine energy audit exercise, the use of large window sizes to aid ventilation and the use of daylight to complement the artificial lighting systems in students' hostel. The study further recommends that the University management should standardize appliances to be used in the students' hostels. The standardization should define the power rating (in wattage) for appliances to be brought in for use by students in the hostels. This would be a major active energy optimization drive at improving the energy performance of hostels.

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