International Journal of Scientific Research in Information Systems and Engineering (IJSRISE)
Volume 1, Issue 2, December-2015. ISSN 2380-8128

Energy Audit of Madonna University Akpugo Campus

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Abstract - This paper examines the energy use pattern of the staff lodges and student hostels of Madonna University Nigeria, Akpugo Campus in a bid to achieve energy efficiency. The electricity utility bills of 2 years (2013 – 2015) were extracted from the University to complement data collected from walk-through and comprehensive audits. Investigations show that 57% of the respondents are not aware of energy efficiency; 87.6% of the total number of the respondents sampled use incandescent light bulbs in their rooms while 12.5% use compact fluorescent lights. Out of the number, only 39.8% remember to turn off lights when leaving a room while 60.2% do not, thus suggesting the need for awareness creation for energy efficiency promotion in the hostels/lodges in addition to replacement of the inefficient incandescent bulbs with compact fluorescent lights. An internal energy policy, awareness creation and establishment of an energy management unit in the University system are some of the measures that can guarantee good savings.

Keywords *– Audit, Electricity, Energy, Energy efficiency.*

1. INTRODUCTION

Electricity is fundamental and inevitable to our daily living as it lightens our environment, powers our homes, schools, hospitals, offices, businesses, and promotes industrialization. Stable energy supply is of vital importance for the wealth of a country.

Electric energy availability, consumption and costs in universities with resident students and staff lodges can present a formidable challenge to any responsible administration. This is because its availability or otherwise can have profound effects not only on academic activities but also on the social and economic activities in the system.

In Nigeria energy is supplied to institutions from both the electricity utility companies and diesel generating sets. There is a high dependency on the latter as a result of inadequate and intermittent supply from the utility company. Unfortunately, this has been found to be very expensive and environmentally unfriendly. The consumption of energy in the form of fossil fuel combustion is the largest single contributor to anthropogenic greenhouse gas emissions in the world. The emission of these gasses into the atmosphere has resulted in what is now generally known as climate change or global warming. The large industries in Nigeria are energy intensive and depend on low and high pour fuel oils. These industries are now within big cities and highly developed urban areas. For the small towns and villages, the bulk of the small – scale industries is operated on diesel generators for bakeries, small - scale steel works, small - scale ceramic/pottery works etc.[1], [2], [3], [4], [5], [6].

Energy consumption is increasing worldwide as a result of increasing population, the quest for better standards of living and emphasis on large-scale industrialization in developing countries, thus sustaining positive economic growth rates [7], [8]. Precise energy projections provide the foundation for daily operations, market planning, and budgeting and risk management [9]. For this reason, the efficient use of energy is a worthy adventure.

Energy efficiency is the extent to which energy is used effectively in your business to deliver products and services to your customers. By becoming energy efficient, you avoid unnecessary consumption of energy. Achieving energy efficiency in your business, institution or home will involve a number of activities such as behaviour change, which may or may not be coupled with smarter equipment choices and use. Understanding how and where you use energy is an important first step, more important than just buying new equipment that consumes less power.

Therefore to effectively address the issue of rising energy bills, implementation of energy efficiency programs in all the universities in Nigeria presents the most reasonable and cost-effective means of achieving energy bill reduction while maintaining quality service

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delivery. Furthermore, engagement in energy efficiency measures in the university 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 0.44kg CO_2. Energy efficiency programs designed and implemented as part of the overall institutional development policy strategy will reduce energy bills as well as enhance environmental performance [11].

Energy audit defined as "a study to determine the quantity and cost of each form of energy to a building, process... over a given period" and energy surveys "a technical investigation of the control and flow of energy in a facility etc with the aim of identifying cost-effective energy saving measures" [10] are both essential components of an energy efficiency program. They provide data required to make informed decisions on which are the most cost-effective measures of an energy efficiency program to be implemented. Generally energy audit provides an institution with better means for learning from past experiences: a platform for proper planning, policy formulation, resource allocation and improving energy consumption [11].

2. BRIEF DESCRIPTION OF MADONNA UNIVERSITY

Madonna University is the first private university in Nigeria. Founded on 10 May 1999 in Okija, Anambra State, it was established by Rev. Father Emmanuel M. P. Edeh. The university offers various courses including Law, Management, Natural Sciences, Social Sciences, Medicine, Pharmacy, and Engineering [12]. Madonna University has three campuses, Okija Campus, Elele Campus and Akpugo Campus. Akpugo campus was established in 2010, which is Faculty of Engineering Campus and is located at akpugo in Enugu State, Nigeria, some kilometers away from its sister campus at Elele in River state. The campus has several staff lodges and students hostels.

3. ENERGY SITUATION AT AKPUGO CAMPUS

The primary energy types in use in the university are electricity from the national grid and diesel, used for electricity self-generation in diesel generating sets. The university buys electricity from the national grid and distributes same to offices, students' hostels, staff lodges and business units located within the community. Due to frequent power outages that often lead to frustrating disruptions in services, the university maintains diesel generators to provide electricity during such interruptions. The campus has a generator with a capacity of 250KVA and also a smaller one with a capacity of 60KVA.

4. METHODOLOGY

The methodology used in this work is the billing energy audit method for energy consumption analysis and facility walk-through for energy use survey. Electricity consumption data and costs for a period of about 2 years (2013- 2015) were extracted from the utility bills kept at the registration office of the University. The data indicated actual consumption within each month of the year.

The walk-through energy audit of the students' hostels and staff lodges was undertaken at night and during the day for physical observations of the different kinds of light fixtures. Electricity usage in the hostels and lodges is for lighting, fan cooling, ironing, and supplemental cooking with hot plates and for playing musical sets.

It is difficult to determine and isolate the exact quantity of electricity consumed by students and staffs from the overall consumption at any given period since the hostels and lodges are not metered.

An energy walk through of the students' hostels and staff lodges reveals that lighting is provided by mainly 60W incandescent bulbs and 13W compact fluorescent lights (CFLs) while cooking/heating is mainly done by a kerosene stove. Also, hot plates and electric stove and cookers of various ratings are 'unlawfully' used for supplemental cooking in staff lodges. In order to arrive at a good estimation of electricity consumption profile of resident students and staffs, 300 copies of questionnaires detailing the major areas of electricity use by students and staff were administered to about 300 rooms/persons across the hostels and lodges, out of which 241 person/rooms supplied answers to the questions posed. An aspect of the statistics relevant to study is shown in Table 1, showing the number of respondents and of those aware of energy efficiency. Figure 1 shows the percentage of respondents aware of energy efficiency. Since the University has only one maximum

demand meter that records consumption in the entire community, electricity consumption attributable to staffs and students living in the hostels and lodges was estimated from information in the questionnaire.

Table 1: Number of respondents aware of energy efficiency.

Hostel/lodges	No of rooms visited/respondents	No of respondents aware of energy efficiency
Female hostels	60	20
Male hostels	155	80
Staff lodge within female hostel	15	0
Old staff lodge	6	0
New staff lodge	5	3

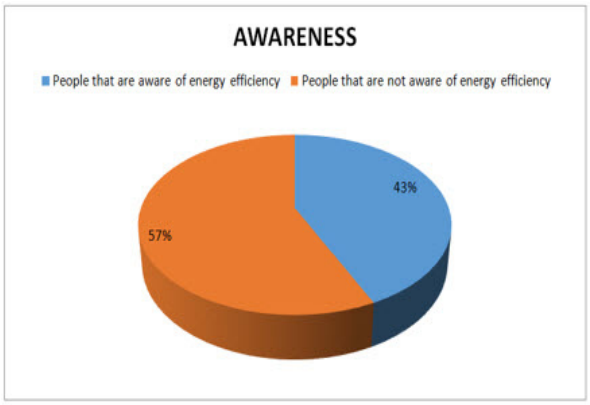

Fig. 1: Percentage of respondents aware of energy efficiency.

5. Historical Energy Consumption

Figures 2 and 3 shows the average monthly consumption and the annual cost profile in millions of Naira respectively. The decrease in electricity consumption in 2014 as compared to the previous year is attributed to increase in power failure, and in 2015, there is a relative increase in power supply within the campus from the national grid.

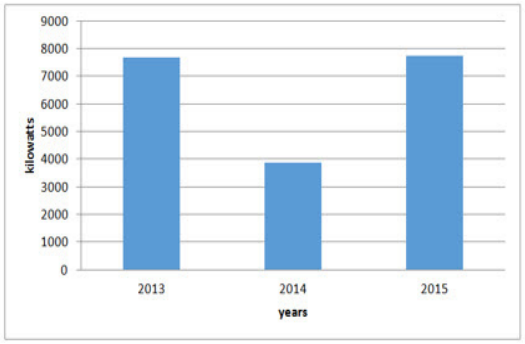

Fig. 2: Average monthly electricity consumption (2013-2015)

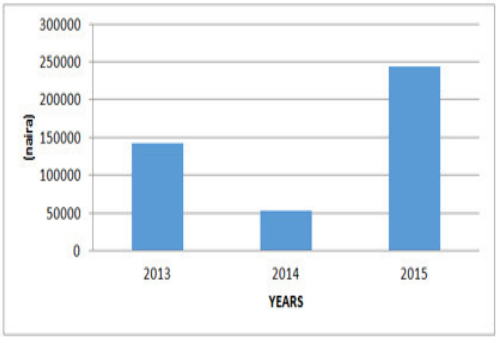

Fig 3: Annual Electricity Cost Profile (2013-2015)

6. ASPECT OF ENERGY CONSUMPTION

6.1. Lighting use analysis

From Table 2 it can be seen that 87.6% of the total number of the respondents sampled use 60W incandescent light bulbs in their rooms while 12.5% use 13W CFLs. Out of the number, only 39.8% remember to turn off lights when leaving a room while 60.2% do not, thus suggesting the need for awareness creation for energy efficiency promotion in the hostels/lodges in addition to replacement of the inefficient incandescent bulbs with CFLs.

Table 2: Light analysis.

Hostel/Lodge	No of rooms visited/respondents	No of incandescent light (60watt)	No of CFL (13watt)	No of people that switch off light while leaving their room
Female hostel	60	53	7	39
Male hostel	155	143	11	47
Staff lodge within female hostel	15	9	6	7
Old staff lodge	6	3	3	2
New staff lodge	5	3	3	1
Total	241	211	30	96
%		87.55	12.45	39.83

6.2 Electric appliance use analysis

Laptops, notebooks or netbooks generally use less power than desktop computers, because they are designed to run on a battery and to be more power efficient. The power consumption of a laptop depends on the screen size; typically you will find power consumption as low as 20 watts and up to 100 watts when running off the battery. When charging the laptop battery power consumption will increase 10 to 20 percent, we estimate that 60

watts is average power consumption for a 14-15 inch laptop when plugged in. Ceiling fans range in size from 36 inches to 56 inches using 55 to 100 watts, to avoid overestimation of results, we assumed 60 watts as the Ceiling fan rating. It is also assumed here that students and staff iron their clothes for an average of 15 minutes a day.

Table 3 shows the electric appliances and number of the appliances used by the respondents in each hostels and lodges. Using statistics from the energy use survey in the hostels and lodges, appliances energy consumption are estimated as shown in Table 4. From the estimation, 41% of the energy consumption is by Ceiling fans and 37% by Incandescent lights, thus suggesting the need for awareness creation for energy efficiency, while CFLs, electric irons, laptops consumed 1%, 5%, 16% respectively (Fig. 4).

Table 3: Electric appliances use.

Hostel/lodges	No of rooms visited/respondents	Electric appliances use		
		Ceiling fan	Laptop	Electric iron
Female hostel	60	60	48	15
Male hostel	155	145	132	40
Staff within female hostel	15	15	0	10
Old staff lodge	6	6	3	6
New staff lodge	5	5	3	4
Total	241	231	186	75

Table 4: Estimation of energy consumption of each appliance

Appliances used	No of appliances	Capacity (watts)	Duration (hrs/day)	Daily consumption (kwh/day)	Annual consumption (kwh/yr)	%
Incandescent light	211	60	12	151.92	55450.8	37.18
CFL	30	13	12	4.68	1708.2	1.15
Electric Iron	75	1000	0.25	18.75	6843.6	4.59
Ceiling Fan	231	60	12	166.32	60706.8	40.70
Laptops	186	60	6	66.96	24440.4	16.39
Total					149149.8	

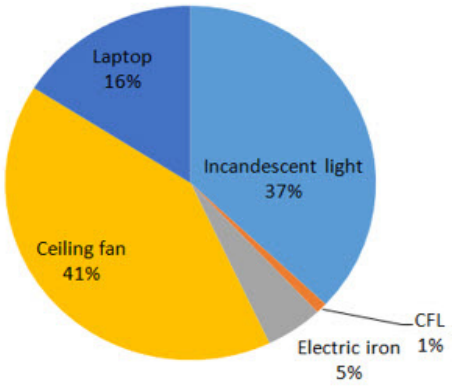

Fig.4: Percentage of appliances energy consumption

7. RECOMMENDATION

Based on the discussion and data from this audit survey, the following can be recommended as measures to conserve energy:

- The school management should ensure that CFLs is in use in all the building
- The management should implement policies regarding energy saving measures
- The management should employ an energy efficiency manager that will be responsible for the energy situation of the school
- Lights should be switched off when not in use especially during the day
- The management should implement an automated lighting system, which helps in switching off street lights automatically during the day.
- There should be proper documentation of electric energy consumption within the campus
- Electric meters should be installed in each of the Hostel/Lodges, to monitor/curtail power wastages and thereby reduce energy cost on electric power.

8. CONCLUSIONS

The need for energy supply, particularly electricity, has been on the increase in the last two decades in developing countries such as Nigeria. Thus, if universities are to achieve the goals of teaching, research and community service, then proper management of electricity supplied to the system is needed in view of its limited availability. Energy Audit should be seen as an effective energy management tool. By identifying and implementing the means to achieve energy efficiency and conservation, not only can energy savings be achieved, but also equipment/system services life can be extended. All these mean savings in money.

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