ENERGY DEMAND & UTILISATION IN TERTIARY INSTITUTION: A CASE STUDY OF THE FEDERAL POLYTECHNIC ILARO

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Abstract: This paper presents the results of an investigation into energy consumption at The Federal Polytechnic Ilaro in Nigeria. The aim of the study was to investigate energy demand of the polytechnic. The study was carried out in the west campus of the institution. Necessary data on installed capacity as well as operating capacity were obtained by direct inspection of some of the studied areas. Descriptive statistics such as percentages, pie charts and bar charts were used in the analysis of data obtained. The knowledge gained through the study will be of help in energy planning.

Keywords: Energy consumption, retrofit measures

I. INTRODUCTION

The global energy demand has been on steady increase. Energy demand is the total energy required for useful work by the end-users. The energy consumption of a country is an index of its development. For instance, the highly developed countries such as USA, China and Japan have high energy consumption. The International Energy Agency (IEA) has estimated the global investment required in energy sector between 2003- 2030 to be around $16 trillion (European Smart Grid Technology Platform, 2006). In a situation where electricity does not meet demand, it is common economics that demand must be reduced by adopting suitable energy-saving/conservation practices at homes and industries (Ogunyemi & Okoye, 2009). The need to conserve energy as part of measure to combat electricity crisis in Nigeria is vividly captured in the word of Oyedepo (2012) when he stated that:
In Nigeria today, a lot of energy is wasted because industries, power companies, offices and households use more energy than is actually necessary to fulfill their needs. The reason is because they use old and inefficient equipment and production processes; buildings are poorly designed; and because of bad practices or habits. With energy efficiency practices and products, the nation can save over 50% of the present energy consumed in the country.

One way to help limit energy consumption is through energy saving. One important issue of energy consumption is energy wastage in the institution which leads to an increased cost of electricity. For instance, if appliances that are not currently in use are switched on, then electricity that could be put to other use is wasted. Energy saved is energy generated (Ekpenyong, 2010). The problems from power crisis in Nigeria have been observed to be the stumbling block to national development (Obadote, 2009). In a bid to enlighten people about the need to do away with the wastage; the government has tentatively mandated the Nigerian Electricity Regulatory Commission to promote Demand Side Management (DSM) in the country, pending the establishment of a substantive institution to carry out the responsibility().Other measures and policies include energy management systems, insulating materials, energy efficiency lighting. A number of recommendations emanated from the various presentations and during the discussion sessions towards promoting energy efficiency in all sectors of the economy in Africa.

Climate change has been called the greatest environmental and economic challenge facing the world today – one that calls for action on many fronts. Green technology promotes the use of non-fossil fuel for energy production to minimize global warming. Emissions of CO_2 due to fossil fuel burning are said to be the dominant influence on the trends in atmospheric CO_2 concentration during the 21st century (Microsoft Encarta, 2008).Energy efficiency measures are being put in place to this effect. Adopting energy efficiency in the workplace can help in environment (Energy Innovators Initiative). In addition to saving money, becoming more energy efficient reduces harmful greenhouse gas emissions that contribute to climate change.

1.1 OBJECTIVES.

The main objective of this project is to study the energy consumed in West Campus of Federal Polytechnic Ilaro with the aim of providing measures to reduce excess energy consumption and to minimize cost of electricity. Cost Reduction becomes increasingly important as energy cost rises. Energy consumed is directly proportional to the cost of electricity and so the morethe energy consumed, the higherthe cost of electricity and vice versa. Health Hazard Reduction (carbon monoxide CO), since carbon monoxide is harmful to the health; and almost all generating plants emits carbon monoxide including domestic generators. Hence, the higher the

energy consumed the higher the carbon monoxide and vice versa

There are different approaches that can be taken when trying to determine the power consumption of appliances. Energy has been used traditionally to monitor energy consumed. With the advance in technology, electronic power meter can be used to measure the total consumption of power because it keeps a running total of KWh consumed as well as indicating instantaneous consumption and several other parameters. The meter is connected in line between the power outlet and the appliance being measured.

II. LOAD CHARACTERISTICS OF A TERTIARY INSTITUTION

In tertiary institutions, such as the polytechnic environment, common loads can be grouped as lighting (lamp), heating ventilating and air conditioning (HVAC), and machine/laboratory equipment.

2.1 LIGHTINGS

During the installation of buildings, lighting is one of the most important sections which cannot be left out. Lightings consume 17 to 30 percent of energy in commercial buildings; it is also a primary source of heat gain. Energy can be considerably reduced by implementing energy efficient lighting system. Upgrading lighting system can also improve lighting quality. Lighting is useful in almost all aspects. Lighting is useful to human beings because it directly affects the comfort, mood, health and safety of people. Also lighting is the most visible building system, it affects the aesthesis and image of a building while aiding brightness. More so, lighting is useful to business because it aids productivity. In companies, lighting is important because it ensures the safety of workers by illuminating the working arena. Lighting is also useful to the environment because it aids security of the environment; for instance, security fittings will expose any hideout of burglars.

Table 2.1: Average life of common lamp

	STANDARD INCANDESCENT	**FULL SIZE FLUORESCENT**	**MECURY VAPOR**	**METAL HALIDE**	**HIGH PRESSURE SODIUM**
Wattages	15 – 1500	4 – 215	40 – 1250	32 – 2000	35 – 1000
Average Rated Life (hr)	750 – 2000	7500 – 24000	24000+	6000 – 20000	16000 - 24000

2.2 HEATING VENTILATING AND AIR CONDITIONING (HVAC)

Heating and cooling systems are the largest single consumers of energy in buildings. These systems condition the air within the building to improve the occupants' comfort. Heating and cooling systems consist mainly of chillers, boilers, cooling towers and pumps. The ventilating and air conditioning system used in the school are fans and air conditioners. Air conditioners use a chemical that easily convert from its gaseous state to its liquid state and then back again. Air conditioners have three main parts. They are the compressor, condenser and evaporator. The compressor and condenser are usually located on the outside portion of the air conditioner. The evaporator is located on the inside part of the air conditioner, sometimes as part of the furnace. The compressor squeezes the working fluid and increases its temperature and pressure and flows to condenser. The condenser changes its temperature by cooling it and converts it to liquid under high pressure. The liquid is then passed to the evaporator where it is being changed to gas and evaporates and extracts heat from the air around it. The advantage of heating, ventilating and air conditioning is that it increases comfort, mood and health.

III. METHODOLOGY

The methodology used involves estimation of the existing loads. The West campus of Federal polytechnic Ilaro was divided into seven different sections as follows: (i) Lecture Rooms (ii) Multimedia Centre (iii) Engineering Building (iv) Administration Block (v) Departments (vi) Library (vii) Laboratories/Workshops.

Various loads in each office and building were counted; the data were also collated and analyzed to estimate the total energy that can be savedby replacing the inefficient appliances with efficient ones.

Each group has different types of loads in them, though they have some common loads such as lightings, fans, and socket outlets. The lecture rooms consist of fans, lightings and sockets and so on. The lecture-rooms consume less than the engineering buildings where practical classes are carried out. A typical engineering building consists of lightings, fans, air conditioners and heavy machines which are used to carry out practical. The machines consume more energy. They work for longer periods of time unlike other buildings.

Administrative blocks are generally offices of staffs. It consists of computers, laptops, air conditioners, lightings, printers, fridges, fans and so on. It consumes more energy than lecture rooms due to the equipment. It is also used for one third of the day (8 am – 4 pm).

The departmentsare more like the administrative block; each comprises of the office of the head of

department and the office of some lectures. It contains lightings, fans, air conditioners, printers and so on.It consumes less energy when compared to the administration block but is equally used for one third of the day.

Library is a place where information is stored for studying and also for reference making. It contains lightings, fans, air conditioners, scanners and computers. It is also used for eight hours of the day.

The laboratory is just like the engineering building, it is also a place where practical are being carried out. It contains lightings, sockets, machines, and fans. It also consumes more energy compare to lecture rooms.

IV. RESULT ANALYSIS

4.1 CONSUMPTION TABLE

The table below shows the result of power consumption in each building in watts and the graphical representations of the data.

Table 4.1: Total energy consumed of installed and operating capacity.

	INSTALLED CAPACITY(W)	OPERATING CAPACITY(W)
AF Block	6160	4600
AE Block	5530	4090
AH Block	6095	4415
AJ Block	6615	5095
AG Block	6510	3310
BA Block	4570	4570
BB Block	4570	4570
Library	16909	16909
B.Tech Dept.	7119	7119
Arch Dept.	7119	7119
URP Dept.	7119	7119
Est Management Dept.	7119	7119
QS Dept	5034	5034
Civil Workshop	7641	7641
Engr. Building Ground floor	19745	10545
Machine Shop	103000	2400
Engr. Building 1st Floor	8444	7444
Engr. Building1st Floor extension	3040	1440
Engr. Building 2nd Floor	12882	9202
Engr. Building 3rd Floor	6280	3240
S&G Dept	5034	5034
Civil Dept.	11136	11136
Sch. Of Engr.	5770	5770
Mech/Elect. Dept.	11772	11572
Elect pract. Lab	8414	6314
Arch Studio	8322	7922
Multimedia	44430	40130
Admin ground floor	19127	19127
Admin 1st Floor	29196	29196
Central admin annex snr.	3828	3828
Central admin annex jnr.	3002	3002
ILPO	6276	5956
Admission Unit	6110	6110
Bursary dept annex	4544	4544
Record and Data	5069	5069
Mech. Practical lab.	5316	4816
Total	428847	292507

Table 4.2: Power Consumption of appliances

Appliances	**Consumption (KW)**
CFL	55.9
FL	70
Fan	40
AC	115
Computer	48

Table 4.3: Installed and Operating Capacity in various buildings

Building	**Installed capacity (KW)**	**Operating Capacity (KW)**
Lecture Room	40	30
Departmental Office	65	65
Multimedia	44	40
Library	18	18
Administrative block	78	78
Engineering Building	155	35
Workshop	30	25

4.2 Graphical Representation of Results

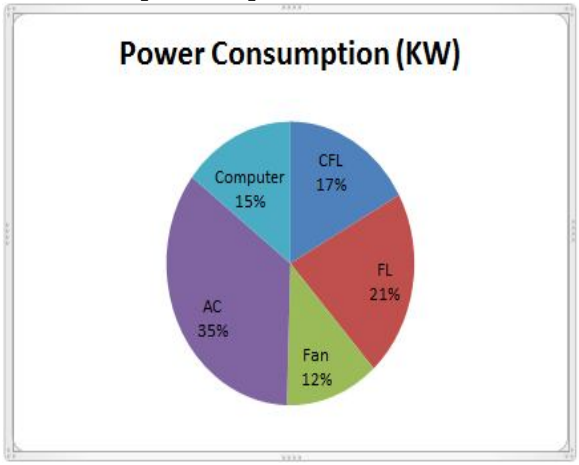


Figure 4.1: Power Consumption of appliances

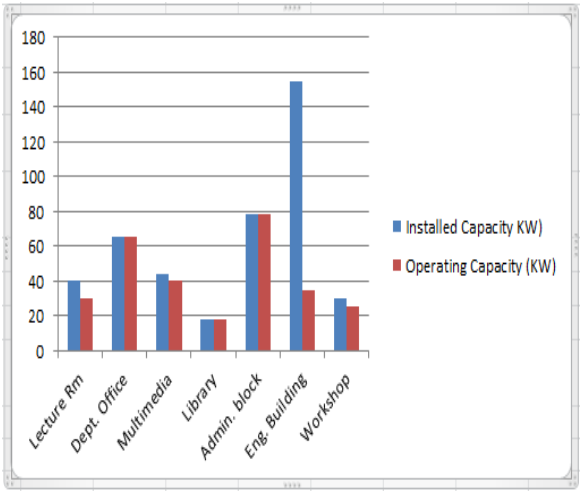


Figure 4.2: Installed and Operating Capacity in various buildings

Figure 4.3: Comparison of power consumption of Incandescent and CFL

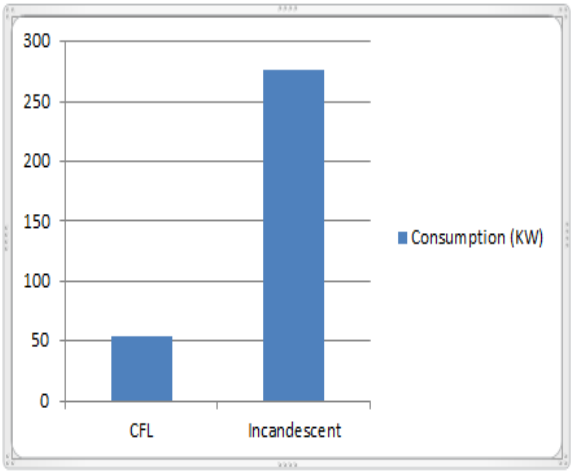
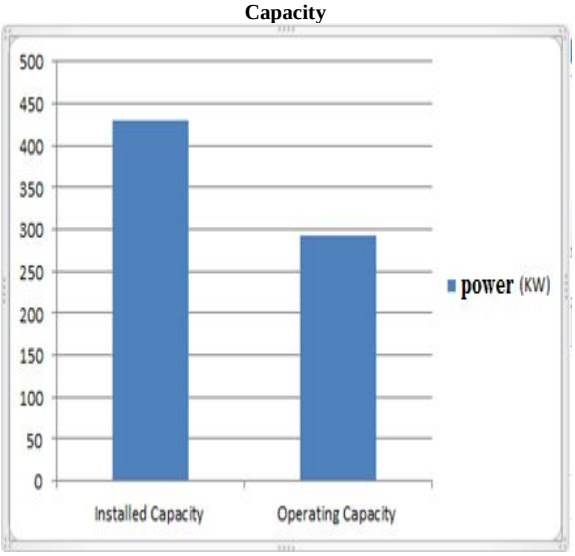


Figure 4.4: Comparison of Installed Capacity and Operating Capacity



4.3 Calculation

From Table 4.1:

Total load installed=428.85kW

Total operating power =292.51kW

The present tariff for electricity is N12.30 per kWh, with a working day of 8 hours:

Total cost of energy per day = $292.51kW \times 8hrs \times N12.30/kwh = \mathbf{N28,782.98}$

Total cost of energy per month (30 days) = $N28,782.98 \times 30 = \mathbf{N863,489.40}$

Total cost of energy per year = $N28,782.98 \times 365 = \mathbf{N10,505,787.70}$

CONCLUSION

This project has shown electrical energy consumption in West Campus of Federal Polytechnic Ilaro and also provides measures to reduce the energy consumption and to minimize cost of electricity. The total installed capacity in the west campus Federal polytechnic Ilaro and the operating capacity has been analysed.

The knowledge of the true picture of energy utilization will help in adequate planning of energy utilisation.

5.1 RECOMMENDATION

Based on the outcome of this project work, the following are hereby recommended

- Enlightenment of people on how to save energy and cost by switching all appliances off when not in use. All lecturers and student should be given orientation on energy saving methods.
- Appliances should be changed to their energy saving counterparts, for instance a 23WCFL can be used to replace 100W incandescent bulb.
- Depending on the location, mechanisms can be designed to switch off light in the day and automatically switch on at night, for instance lamp dimmer or to turn on light when human motion or heat is sensed.
- Furthermore, the schools' spending can still be reduced further by upgrading all air conditioners in the school. The current air conditioners (rated 746W) can be replaced with new ones (rated 200W) to achieve same output. If this is done, about 73% of current energy consumption would be saved by the school. Therefore, N8,435 would be saved by the school per day and N2,193,100 per year (260 working days).

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