ENERGY EFFICIENCY AWARENESS AND PREPAREDNESS IN NIGERIA: FEDERAL POLYTECHNIC ILARO AS CASE STUDY

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Abstract

In the Federal Polytechnic Ilaro campus, electrical energy is utilized in many areas and it's insufficient in distribution. Thus it should be ordinarily used judiciously. However, it is found to be expended extravagantly within the community. This study is an awareness campaign on energy efficiency on the Federal Polytechnic, Ilaro campus. A survey of the Federal Polytechnic community was carried out to identify areas where energy can be saved. Energy efficiency opportunities were identified on the polytechnic campus and this includes offices, corridors, walkways, water pumping centres, lecture rooms and theatres and so on. Practical suggestions were proffered on achieving energy efficiency. These include use of human efforts and application of technical devices such as occupancy sensors, float switches and replacement of certain energy-inefficient devices. Energy policy is suggested to be put in place in the Federal polytechnic Ilaro community. People should be involved in implementing the policy. This will greatly reduce the total energy consumption on the polytechnic campus. The practices suggested in this study can be extended to residential and commercial areas around the country.

Keywords: Energy efficiency, Federal Polytechnic Ilaro, energy devices, energy wastage, energy policy.

INTRODUCTION

To the common man in Nigeria electrical energy is produced almost free and can be utilized as one desires. As you move about and check our environment, you see many reasons to conclude so. Too low value has been placed on the generation of electricity. The Nigerian electricity consumers seem to be ignorant of what it costs to produce energy. Admittedly, how modern society runs demands that electrical energy becomes an indispensable part of daily living. Thus, the man in today's world nearly cannot exist without electric energy. The scarce resource is used virtually in all human activities today. It is used in industrial, commercial, domestic and even academic environment. In the modern societies, important facets of human existence such as healthcare, water supply, education, environmental cleanliness, job creation, food security etc. are now hinged on the availability and access to electric energy (Kanagawa & Nakata, 2007; Sokona, Mulugetta, & Gujba, 2012).

In Nigeria, electricity is a very scarce commodity (Nwachukwu, Ezedinma, & Jiburum, 2014). Power demand forecast for 2016 was put at 17,520MW, but the current actual supplied power dangerously fluctuates between 3817 and 4228 MW with an all-time peak of 5,375 MW (Nwachukwu et al., 2014). Currently, the total generation capacity is about 12,000 MW out of which only 3,500 MW (NERC Q1 Report, 2019) is generated for a population of over 200 million ("Nigeria Population," 2019; United Nations, 2019). Much of the distributed energy is wasted through avoidable means (Aderemi, Aderemi, & Akinbami, 2015; Adetona & Ajibodu, 2016). Needless to mention, the epileptic electric power supply in the country has hampered the socio-economic and technological development of the nation. This had also compelled many industries to either shut down or relocate to neighbouring West African countries (Akhator, Obanor, & Ezemonye, 2016). It is interesting to note that one major energy driver in Nigeria is her population. Nigeria's present population has exceeded 200 million and it is predicted (as shown in Fig. 1) that, if the annual growth rate is sustained, the population will surpass 440 million by the end of the year 2050. Thus it is crystal clear that the matter of energy efficiency(EE) should be a paramount issue in the country.

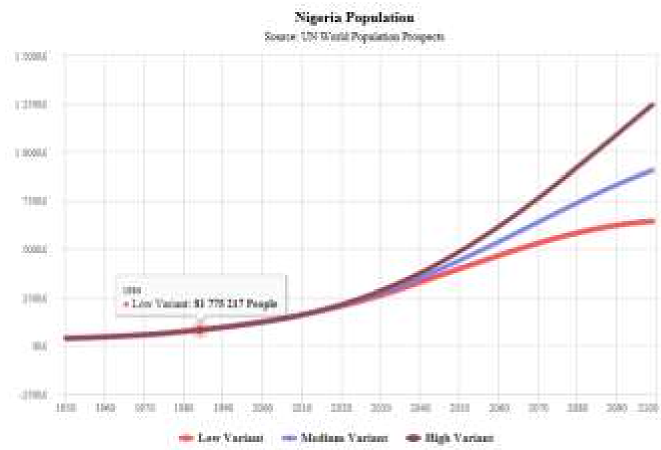

Fig. 1 Nigeria population projection for 1990 to 2100

Generation of electric energy comes at great cost to the environment. It causes the unwanted generation of greenhouse gases (GHG) and other gaseous effluents (CO, CO2, NO, NO2) thereby contributing in no small measures to environmental pollution and climate change problems. The concentration of CO2 in the atmosphere as monitored since the 1950s is increasing every year and was highest (413.93 ppm) in June 2019. Shown in Fig. 2 is a record of increase of CO2 in the earth atmosphere over the years while Table 1 shows the CO2 10-year growth rate from 1959 to 2014 (ProOxygen, 2019). For safe habitation of the planet earth, according to experts, the CO2 concentration needs to be maintained below 450 ppm (≤450 ppm).

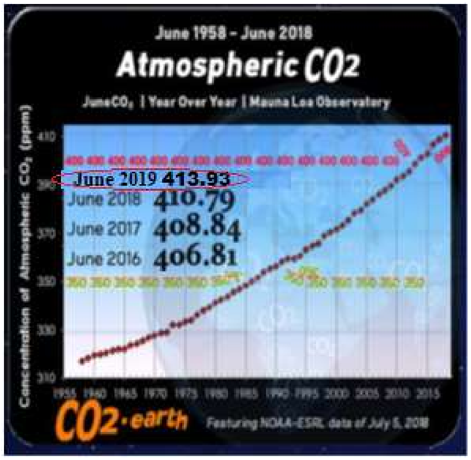

Fig. 2 CO_2 concentration in the earth's atmosphere (ProOxygen, 2019)

Table 1 Decadal CO_2 growth rate

Decade	Atmospheric CO_2 Growth Rate
2005 - 2014	2.11 ppm per year
1995 - 2004	1.87 ppm per year
1985 - 1994	1.42 ppm per year
1975 - 1984	1.44 ppm per year
1965 - 1974	1.06 ppm per year
1959 - 1964 (6 years only)	0.73 ppm per year

ppm = parts per million

Decadal changes calculated by CO_2.Earth

Studies have shown that the industrial sector contributes much to GHG emissions. Thus, to mitigate environmental pollution and climate change problems, energy EE measures have to be adopted both in industrial and other sectors of the economy. It has been estimated that 10-30% reduction can be achieved at little or no cost by improving the efficiency of energy use in the sectors (Oyedepo, 2012).

The global community has put many efforts in place to mitigate the effects of the environmental impact of GHG on climate change. The effects of GHG emissions and climate change have become a global concern as the GHG emissions are recognized to come primarily from electrical energy generation. Such efforts tailored at mitigating the negative impacts of energy production include the United Nations Framework Convention on Climate Change (UNFCCC) in Rio de Janeiro in

1992 where strategies for reducing GHG emissions were considered; the December 1997 third conference of parties (COP-3) of the UNFCCC held in Kyoto in Japan that resulted in the so-called Kyoto Protocol and the developed countries committing themselves to reduce emissions of carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O) by 6–8% compared with 1990 emission levels in the period 2008–2012 (Kramer, Moll, Nonhebel, & Wilting, 1999).

This paper is aimed at creating an awareness campaign in Federal Polytechnic Ilaro and alert the Polytechnic Management and the community at large of the need to develop and stick to an EE policy that will make the polytechnic greatly conserve energy and curb wastages. Thus, the authors have carried out an on-the-spot assessment of the energy usage on the polytechnic campus.

OVERVIEW OF ENERGY EFFICIENCY MEASURES IN FEDERAL POLYTECHNIC ILARO

Electric energy is utilized in various aspects of businesses on the polytechnic campus. It is used in the offices, lecture rooms, lecture theatres, reading areas, laboratories, workshops, corridors, walkways and on the streets. Other areas of use include commercial centres, water packaging factory, the staff primary and secondary schools, the banks and ATM points, ICT centres, water pumping centres and in the staff residences. In all of these locations, energy is used for lighting purposes. Electric power is also used in the offices and classrooms to power air conditioners and electric fans. Power is consumed at the ICT centres and in the offices for powering all computers, servers, printers and other ICT equipment. In the offices also, there is a minor usage of power to charge mobile phones and other such devices.

At the water-packaging factory and water pumping locations, electric power is utilized to drive small electric motor that power the mechanical pumps. Further, the processing and packaging equipment at the factory also make use of electric power.

Many departments of the polytechnic have laboratories, workshops, studios and the likes where several equipment are situated for training students. Those equipment range from small, medium to large capacity and are mostly powered by electric energy. All the main streets of the polytechnic are installed with street lighting systems that are powered with electric energy. Fig. 3 gives a few of the areas where electric power is utilized on the campus. Many corridors and walkways are lit with electric power. Electric power is necessary for the typing and production of examination papers during the period of examinations.

With the many applications of electric power on the polytechnic campus, there are several observable ways in which energy is being wasted. Thus it is necessary to bring to the attention of the polytechnic community such areas of energy wastage that are hitherto not addressed. A certain amount of energy is being wasted in virtually all sections of the polytechnic community. There has been in place little EE measures. The EE observed are in replacing some of indoor and security lamps with LED (light-emitting diode) of CFL (compact fluorescent lamp) types.

(a) Street light

(b) Lecture room

(b) Security light

(d) Laboratory equipment

Fig. 3: Some of areas of electric power utilisation on the polytechni campus

OPPORTUNITIES TO ACHIEVE ENERGY EFFICIENCY

Energy conservation measures can be put in place in the office, lecture rooms and theatres, residential buildings and many other buildings on the polytechnic campus. All old damaged fluorescent lamps can be replaced with energy-efficient lamps such as LED or CFL types. Many of such fluorescent not working is still connected to power. By doing this, the fluorescent ballast continues to be connected to power and consumes 10% of the total power rating of the lamp even though the lamp is not working. Many of the old fluorescent lamps have been replaced with LED or CFL without disconnecting or removing the fluorescent lamp. This practice ensures that both the fluorescent and its replacement continue to consume power continuously.

In many lecture rooms and theatres, corridors and walkways, the electric lights are always seen turned on during the day when the sunlight is fully available. Also, many unoccupied lecture rooms and theatres have their lights always turned on. Similarly, electric fans always work in many unoccupied lecture rooms and theatres day and night thereby wasting a huge amount of energy continuously for no purpose. In a few locations inside and outside some buildings, incandescent lamps are still in use. Such lamps are among the most energy-inefficient among all available on the polytechnic campus. Likewise, most street lights use high-pressure sodium and mercury vapour lamps. These are among the least energy-efficient lamps. Only a few street lights utilize CFL and LED lamps on the campus. Some of these observable wastages are given in Fig. 4.

Many overhead water tanks are supplied with water from electric pumps. On countless occasions on the polytechnic campus, such water tanks are overfilled and water is pumped into them after being filled wasting the water and electric power for several hours in several locations. The immediate environment is also turned water-logged because of the excessively pumped water into the tank. The water pumps themselves are not the energy efficient types. During normal operation, a large portion of the energy consumed is actually being wasted because their efficiency is poor.

In many offices on the polytechnic campus, certain office equipment are always put on standby when not in use. Such equipment include computers systems, printers, photocopiers and the likes. When on standby each of these equipment consume small energy which when put together for all offices, is a substantial amount of energy. When compared to the time these equipment are put to use, the period of standby is more. Thus these equipment continuously waste energy when not in use and in standby mode.

Many buildings in the polytechnic premises are not efficient in their construction. Modern buildings are now being designed with the background of EE. Modern buildings are now designed for daylighting and such buildings use 40-60% less electricity for lighting needs than do conventional buildings. Enough windows are provided for cross ventilation in especially in very hot climates as in Nigeria. This will go a long way in reducing the use of air conditioners at homes and offices. Energy-efficient buildings are also constructed to avoid glare and overheating (Oyedepo, 2012). Many of the existing buildings on the polytechnic campus fail in many of these requirements of energy-efficient buildings.

(a) Unoccupied lecture hall lit up during the day

(b) High Pressure sodium light as street light

(c) Security light turned ‘on” during the day

(d) Bad ballast/starter fluorescent

(e) Fluorescent still connected after being replaced with CFL.

(f) Incandescent lamp in use

Fig. 4: Some of the observable energy wastages in Federal Polytechnic, Ilaro

RECOMMENDATIONS

Giving the state of EE awareness in the Federal Polytechnic, Ilaro, many measures can be put in place to achieve it. Firstly, there is a need for EE policy. The Nigerian national Energy Policy masterplan has as one of its goals as the promotion of EE and conservation in industrial, residential and transport sectors (Oyedepo, 2012). Thus a local EE policy in the polytechnic community will be a starting point in achieving a plan of action that will lead to energy conservation. Developing an EE policy will require technical, organizational and people-oriented plan of action. Consider the diagram in Fig. 4. It is seen that the three aspects of energy policy involve organizational, behavioural and technical inputs. It is to be noted that developing the energy policy must put people into consideration. People tend to get complacent, retire to their current daily environment and resistant to change. Thus a re-orientation of our value system is very important. People need to be informed why there should be certain changes in the use of energy and others must take charge of stopping the energy wastages. The polytechnic management must get people into the EE policy structure.

Second, it is necessary to stop as a matter of urgency energy wastages highlighted in this study. Stopping most of these wastages does not cause any resources to be expended other than putting people into action. For instance, people should be assigned to stop the following wastages:

- outside/security lights turned on during the day;
- excessive water being pumped into overhead tanks;
- electric fans and lights turned on in unoccupied lecture room and theatres;
- bad fluorescent lamps still taking power;
- certain office equipment on standby mode;
- street light turned on in the daytime;
- old fluorescent lamps that have been replaced with LED or CFL to be disconnected;
- electric lights always turned on during the day on corridors and walkways when the sunlight is fully available.

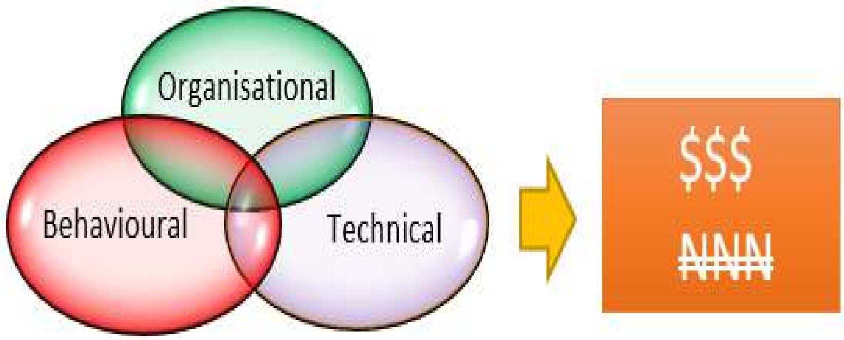

Fig 4: Elements of EE policy

The other major area to achieve the EE savings is technical inputs. Technical inputs can save a whole lot of energy wastages. The following technical inputs are suggested for certain observed wastages on the polytechnic campus:

- occupancy sensors should be introduced to certain areas such as rest rooms, some classrooms and offices, laboratories, etc. to control the electric lamps;
- all working fluorescent lamps should be replaced with LED lamps and CFL lamps should be gradually phased out;
- all high pressure sodium and mercury vapour lamps in street lights and incandescent lamps in certain areas should be replaced with LED lamps;
- float switches can be installed to all overhead tanks to stop overfilling;
- timers can be installed to control the street lighting system.
- all water pumps should be replaced with energy-efficient types;
- old air conditioners should be replaced with modern energy-efficient lamps.

Conclusions

Presently, the Polytechnic rely heavily on diesel generators to produce the scarcely available power on campus. To ensure a judicious use of the scarce resource, there is the need to identify potential areas of the campus to eliminate wastes. This would be achieved through a holistic energy audit of the various areas on campus. Further, an energy policy should of necessity be put in place. That is what will guide to check and prevent wastages of energy.

Now that the polytechnic wishes to install renewables, there is the more need to carry out a thorough energy audit of the whole institution to cut wastages and ensure an efficient use of the prospective energy.

Members of staff need to be trained on the practice of energy audit ant the need for it. As mentioned earlier, people need to be involved. Thus, all members of staff need to be aware of the need for energy efficiency. When certain changes need to be made in general manner of carrying out day-to-day activities, all members of staff involved and that might be affected ought to be duly informed and told what is expected of them.

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