Global Journal of Researches in Engineering
Electrical and Electronics Engineering
Volume 12 Issue 10 Version 1.0 Year 2012
Type: Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals Inc. (USA)
Online ISSN: 2249-4596 & Print ISSN: 0975-5861

Energy Efficiency Awareness Programme: Challenges and Prospects. A Case Study of Akanu Ibiam Federal Polytechnic, Unwana

By E.I. Igweonu, B.J. Robert & C. V . Eguzo
Akanu Ibiam Federal Polytechnic Unwana

Abstract - The polytechnic as of today is not aware of energy efficiency and management measures but has the capability of at least saving 230.1 gallons of diesel per day. In other to further increase conservation capacity considering the economic and environmental benefits, this paper contains verifiable data to show that energy consumption capacity can be reduced by 70 percent if conservation measures are properly implemented hence reducing wastes and drastically saving cost that could be used in solving numerous needs of both staff and students.

Keywords : *Energy, Conservation, Efficiency, Consumption and Measures.*

GJRE-F Classification : *FOR Code: 090608*

Strictly as per the compliance and regulations of:

Energy Efficiency Awareness Programme: Challenges and Prospects. A Case Study of Akanu Ibiam Federal Polytechnic, Unwana

E.I. Igweonu [α], B.J. Robert [σ] & C. V. Eguzo [ρ]

Abstract - **The polytechnic as of today is not aware of energy efficiency and management measures but has the capability of at least saving 230.1 gallons of diesel per day. In other to further increase conservation capacity considering the economic and environmental benefits, this paper contains verifiable data to show that energy consumption capacity can be reduced by 70 percent if conservation measures are properly implemented hence reducing wastes and drastically saving cost that could be used in solving numerous needs of both staff and students.**

Keywords : Energy, Conservation, Efficiency, Consumption and Measures.

I. Introduction

Energy efficiency is simply defined as doing more with the same or less energy input or better still improving the ratio of energy outputs to energy inputs. It is an economic development factor. Experience has shown that in many situations it is cheaper to save a unit of say electricity or avoid using it than it is to produce it [1 and 4].

Institutions of higher learning in Nigeria are one of the greatest areas of challenges for energy efficiency. This is consequent upon the lack of energy awareness programme among the very large population of students and staff.

Energy efficiency is a vital component of any nation's energy strategy and benefit of improved energy efficiency are well documented since the first oil crisis in the early 1970's [2]. Such benefits as reported in [3] were grouped into social, environmental and economic sustainability.

Energy management and efficiency measures, made savings of 7 million kilowatt hours or roughly 33% of its electricity consumptions through energy management measures in 1974 for the community concourse [4] (six – owned buildings in San Diego, California).

To introduce energy efficiency awareness programme in Akanu Ibiam Federal Polytechnic, Unwana simply means to conserve energy or decrease energy consumptions in the Polytechnic community. This work highlights the challenges and prospects of energy efficiency awareness programme in the cased polytechnic.

II. Methodology

The research approach applied in this work includes the following:

- Interviews with the Head of Electrical Engineering works department of the polytechnic.
- Review of the polytechnic electrical load distribution and other operating data.
- Visit to the plant house/interviews with the plant operators on duty.
- Visit to all areas of polytechnic load demand.

a) Energy Wastages in the Akanu Ibiam Federal Polytechnic Unwana

Significant amount of energy is wasted through the following electrical appliances that consume energy.

- Air conditioners
- Immersion coils / Electric kettles
- Incandescent Bulbs

b) Air Conditioners

The polytechnic consumes a lot of energy in space cooling. There are 383 numbers; 2-horsepower air conditioners in the entire polytechnic (see Table 1). These space cooling units are operated 6 hours out of the 13 hours of the polytechnic plant logging. Hence the energy consumption of these air conditioners on daily basis is;

$$Energy = Current\ x\ Voltage\ x\ Time$$
$$E = ivt$$

Recall that $1.341022hp = 0.7457KW$

$$2hp = 0.7457x2$$
$$= 1.4914KW$$

Hence $E = 1.4914KW\ x\ 6hrs\ x\ 383\ Units$

$$= 1.4914\ x\ [6\ x\ 60\ x\ 60]x\ 383\ KJ$$

Author α : Department of Electrical/ Electronic Engineering, Akanu Ibiam Federal Polytechnic Unwana, PMB 1007, Afikpo, Ebonyi, Nigeria. E-mail : ieigweonu@akanuibiampoly.edu.ng

Author σ : Akanu Ibiam Federal Polytechnic Unwana, Afikpo, Ebonyi, Nigeria. (Corresponding Author)
E-mail : bjrobert@akanuibiampoly.edu.ng

Author ρ : Department of Electrical/ Electronic Engineering, Akanu Ibiam Federal Polytechnic Unwana, PMB 1007, Afikpo, Ebonyi, Nigeria. E-mail : chimaxcorporations@gmail.com

$= 12338053.92\ KJ$
$= 12338.05MJ$

Thus $12338.05MJ$ is the energy consumed by air conditioners on space cooling for 6 hours.

c) Immersion Coils

The polytechnic community population is about 3200students, with about 15 staff living in the staff quarters making a total of 3215 persons. These persons make use of immersion coils (for boiling water for various uses) which has its power rating to be 1500W. Assuming that every person in the polytechnic consumes on the average 15 litres of hot water every day; assuming also that it takes 35minutes to boil the water, then the energy consumed in boiling water alone in the polytechnic per day is;

E=IVt

$= 1.5KWx[35mins\ x\ 60s]x3215\ persons$
$= 10127.250MJ$

d) Incandescent Lamps

The outdoor incandescent lamps in the polytechnic are 260 numbers of 200W rating each. The indoor incandescent lamps and fluorescents are 1555 numbers of 60W rating and 1305 numbers of 40W rating respectively making a total of 3120 incandescent lighting points in the institution as shown in Tables 1. Though these lighting points provide illumination they are also sources of energy waste to the polytechnic. In other to reduce energy wastage, efficient energy saving fluorescent lamps and electronic ballasts are highly recommended.

III. Economic Prospects Of Introducing Energy Efficiency Measures In Akanu Ibiam Federal Polytechnic Unwana

The analysis of Akanu Ibiam Federal Polytechnic Unwana electrical load with and without energy efficiency measures is shown in table 1. Furthermore Figures 1, 2 and 3 indicate the polytechnic plant, yearly conservation quantity and approximate fuel consumption chart respectively. While Tables 2, 3 and 4 indicate, plant details, plant logging and consumption and conservation rate respectively.

Table 1 evaluates energy efficiency to be at a very low level at the polytechnic. The polytechnic has a total load demand of 816.474KW with a standby generator size of 400KW operated at generator full load capacity (continuous duty) and on load shedding technique with diesel consumption of four drums or 960litres (211.1712gallons) for thirteen hours plant logging.

From Table 1 with energy efficiency measures, the polytechnic would have a total load demand of 660.494KW with generator size of 750KW and an approximate diesel consumption of 53.4 gallons per hour and694.2 gallons per thirteen hours plant logging respectively on generator full load capacity.

With the polytechnic total load demand of 816.474KW and appropriate generator size of 1000KW, the approximate diesel consumption would be 71.1 gallons per hour and 924.3 gallons per thirteen hours plant logging respectively on generator full load capacity.

The very large potentials of energy efficiency measures are vividly portrayed in Table 4. From the table, it is clear that the polytechnic would conserve 17.7 gallons or 80.47 litres per hour and 230.1 gallons or 1046.1 litres (4.35875 drums) per day respectively on generator full load capacity. Figure 2 and Table 4 are in agreement with [1 and 4] which considers energy efficiency as an economic factor.

Fig.1 : The Polytechnic Plant

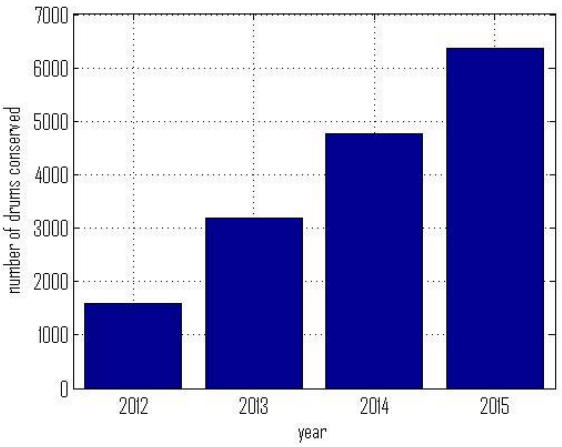

Fig. 2 : Yearly Conservation Quantity

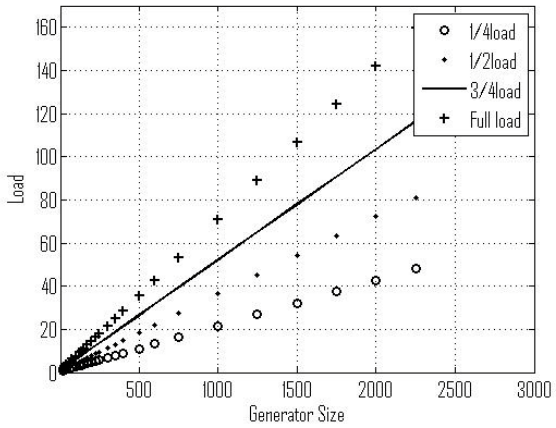

Fig. 3 : Approximate Fuel Consumption Chart of Diesel Service and Supply Inc

IV. Consequences Of Burning Fossil Fuels And Using Energy

Scientists studying the effects of energy use note that, as a result of burning of fossil fuels the environment and hence the human population is condemned to the cumulative effects of air pollution. Scientists now report that in the next twenty years we may see a decline in the earth's capacity to support life. There could be a steady loss of croplands, fisheries, forests and plant and animal species as the degradation of the earth's water and atmosphere continues. In fact, some scientists estimate that as many as twenty percent of all animal and plant species on earth could be lost by the early twenty-first century [1].

Most fossil-fuel combustion results in a mixture of nitric oxide (NO_X) and sulphur being released into the atmosphere. These two substances react with the air to form sulphur-dioxide, nitrogen-oxide, and sulphuric acid. These substances are irritants to the respiratory systems and their long term effects include increased frequency of respiratory infections in children and respiratory symptoms in children and adults.

Higher death rates have also been reported in polluted areas. It is also true that acid deposition (acid rain) with its adverse effects on the environment, results from chemical reactions involving sulphur-dioxide and nitrogen-oxide [5]. Thus any reduction in the burning of generator fuel will definitely contribute to the improvement of the quality of the environment and thus life.

V. Energy Efficiency And Management Measures That Could Be Employed In The Cased Polytechnic

The polytechnic could employ the following methods to conserve energy and protect the environment; first by improving various technologies to make them more efficient. For example, replacing all incandescent lamps with energy saving lamps as can be seen in Table 1. Introduction of an automatic setback thermostat in students' hostels, staff quarters and offices would save energy or using fans, air-conditioners with inbuilt setback thermostat. This would take care of the usage of fans and air-conditioners automatically by setting the thermostat back at various times through the day or night when cooling is not needed as most of the energy consumptions are through such appliances as can be seen in Table 1.

Furthermore the polytechnic would conserve great deal of energy by centralizing the heating system. For example;

- There are about 3215 students and staff living in the polytechnic.
- The specific heat capacity (c) of water is 4200.
- The boiling temperature of water is 100 °C
- Water at room temperature is 25 °C

Recall, $1\ Litre\ of\ water = 0.958Kg$

$$30000\ Litres\ of\ water = 0.958\ x\ 30000$$

The mass (m) of 30000 Litres of water $= 28740Kg$

$$E = IVT = mc\theta$$
$$= 28740\ x\ 4200\ x\ [100 - 25]$$
$$= 28740\ x\ 4200\ x\ 75$$
$$= 9053.1MJ$$

Recall that the polytechnic consumes 10127.3MJ of energy in heating water per day. Therefore the polytechnic could conserve (10127.3 - 9053.1) MJ = 1074.2 MJ. This would amount to conserving a whooping sum in monetary terms.

Secondly and more importantly students and staff should be educated in the proffered cost-saving ways of using energy. Then based upon their knowledge of how energy is used, they can take steps to conserve energy. Through education, they can understand the need to live more in harmony with other life forms.

Table 1 : Akanu Ibiam Federal Polytechnic Unwana Electrical Load Analysis with and without Energy Efficiency Measures

Load	Diversity factors	Wattage	Quantity	Load demand (kw)
13A (s) sockets	0.65	360	2244	323.136
13A (D) sockets	0.65	360	256X2	73.728
15A sockets	0.65	1500	383	57.450
Indoor 4ft Fluorescent	0.65	40 20 *	1052	75.744 37.87 *
Indoor 2ft fluorescent	0.65	40 20 *	253	18.216 9.11 *
Indoor Lamps	0.5	60 20 *	1555	93.3 31.10 *
Fans	0.5	100	1229	122.900
Outdoor Lamps	0.5	200 20 *	260	52 5.2 *
Total Load Demand				816.474 660.494*

** With energy efficiency measures.*

Table 2 : Akanu Ibiam Federal Polytechnic Unwana Standby Generator Details

Model	P500P1
Serial No	FGWRPESIALPS02900
Year of manufacture	2004
Rated power Prime	500.0KVA
	400.0KW
	0.80 COSΦ
Rated voltage	400/230V
Phase	3
Rated Freq.	50 Hz
Rated current	722 A
Rated RPM	1500
Maximum Altitude	1524m
Maximum Ambient Temperature	27c

Table 3 : Akanu Ibiam Federal Polytechnic Unwana Standby Generator Logging

Polytechnic plant logging	Hrs
6.00pm – 12pm	6
10am – 4pm	6
5.30am – 6.30am	1
Total logging	13

Table 4 : Akanu Ibiam Federal Polytechnic Unwana Consumption and Conservation Capacity

Gen. size (KW)	Full load consumption (1hrs) in gallons	Full load consumption (13hrs) in gallons	Quantity conserved per hr in gallons/litres	Quantity conserved per day in gallons/litres/drums
750	53.4	694.2	17.7/80.47	230.1/1046.1/4.35875
1000	71.1	924.3		

VI. Conclusion

Energy efficiency measures capable of reducing wastes and releasing scarce funds for the development of other areas in polytechnic have been discussed. These include the use of energy lamps shown to have the capacity of reducing considerably the quantity of fuel required to run the generators. All the energy efficiency measures adduced here working in synergy can reduce the generator fuel consumption by seventy per cent; reduce the plant logging time and the amount of pollution of the atmosphere. Also, the energy saving measures adduced here could be applied to any higher institution in Nigeria or even in the third world.

References Références Referencias

1. Schwaller, A.E, Energy Technology: Sources of Power London, Thomson Learning, 1996.
2. Okafor I.F, Odukwe O. A and Unachukwu G. O: Energy Efficiency in the Road Transport Sector in Nigeria. The 1st proceedings of the international workshop on renewable energy resources for sustainable development, pp 182-192, 2007
3. Malambo-Ngouka P: Energy Efficiency Strategy of the republic of South Africa, Department of Minerals and Energy South Africa 2005
4. Unachukwu G. O: Entrenching the Culture of Energy Management and Efficiency Measures for Sustainable Industrial Development in Africa. The 1st proceedings of the international workshop on renewable energy resources for sustainable development, pp 193-199, 2007
5. Igweonu E.I and Robert B.J: Environmental Health Hazards of Electric Power Generation from Fossil Fuel: The Nigeria Case. International Journal of Engineering Science, Vol 3, Number 2, 2011.