ENERGY EFFICIENT PRACTICE: A FOCUS ON RESIDENTIAL HOUSEHOLDS

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Abstract

Energy efficiency interventions could lead to significant energy and operational costs through the replacement of old technology and appliances. Nigerian homes require a lot of energy to take care of this and operation of electrical appliances. Power generation and distribution is however a major constraint to this; hence they resort to other sources of energy which at times may not be environmentally and economically sustainable. This situation is not helped by poor energy efficiency practice in the country which places much pressure on the already inadequate power infrastructure available in the country. In the context of this paper, energy efficiency is the use of energy in a manner that will minimize the quantum of energy required for the provision of services. By implication, it is all about using less energy to achieve same or better result.

This paper is aimed at investigating the level of compliance to electricity energy efficiency practice (end-use efficiency) by households in Lagos Metropolis.

The study is based on a survey (use of structured questionnaire) of 500 households selected from three (4) local government areas in Lagos out of which 402 were retrieved, but only 355 were found useful for analysis . The paper looks at the technology and behavioral approach to energy efficiency. The technology approach deals with the type of appliances used by households and their compliance to energy efficiency while, the behavioral approach is an enquiry into households' attitudes and energy practice as they affect efficiency. The paper also investigates the factors that influence households' energy efficiency practice.

The result from the data analysis showed that households have poor attitude towards energy efficiency practices both behaviorally and technologically.

The paper concludes that energy efficiency is not practiced in majority of households while government's policies seem not to recognize it's important in the economic and environmental sustainability of the power sector. The paper recommends that an appropriate energy policy that will encourage energy efficiency awareness should be formulated in order to lead the country to economic development

Overview

As rapid urban growth continues, energy use in cities and associated levels of green home gas (GHN) emission are projected to continue unabated. The demand for energy in cities is a function of energy dependent activities by both commercial and non-commercial users

The quantum of energy demanded in cities can however be modified by the level of energy efficient practice adopted by energy users and providers. Cities themselves are inherently vulnerable to the risk associated with changing climate given their high population densities, extensive physical and financial assets and concentrated entrepreneurial activities within a relatively limited geographical area (Nandi and Bose in Bose 2010). Risk associated with climate change can be ameliorated with efficiency in the use of energy under it EECI (Energy Efficient Cities Initiative) program, ESMAP (energy sector management assistance program) has identified six sectors as critical to the implementation of energy efficiency measures: transport, buildings, water and waste water, public lighting, solid waste, and power heating (Bose 2010). However adoption of energy saving measures in developing countries like Nigeria has been highly hindered by lack of access to appropriate technology and resources constraints. This is however compounded by the apparent lack of awareness of the need to adopt energy efficient measures. There is therefore an urgent need to introduce measures that will serve as an incentive to a change in behavior towards efficient practices. Despite the fact that potential climate impacts have been recognized strongly within the energy sector, the focus has mainly been on the responsibility for green homes gas mitigation rather than the management of energy services (Ebinger and Vergara 2011). According to a 2009 report by the

Community Research and Development Centre (CREDC) energy efficiency does not mean that we should not use energy, but rather, that energy should be used in a manner that will minimize the amount of energy needed to provide services. This is possible if we improve in practice and production of the energy that we use. The use of energy efficient appliances will reduce the energy required to provide services like lighting, cooling, heating, manufacturing, cooking, transportation, entertainment, etc. (CREDC 2009). Most Nigerian homes use appliances that are not energy efficient compliant and appear to see no need to use energy efficiently through their practice. Household put light and other appliances on when they are not serving any purpose. This paper will therefore focus on behavioral and technological approach to energy efficiency among household in selected areas of Lagos.

Literature

Voluntary actions that individuals are taking to improve energy efficiency in their homes vary in extent, and are, collectively sparse and far less than required. It has been pointed out that rather than lack of technological solutions, the key barriers to energy efficiency improvement in exiting building are the knowledge, motivation, and financial barriers (Yik and Lee 2002) cited in (Yik, Lee and Ng 2002). According to the authors, the knowledge of barriers include: a lack of awareness of how energy efficient buildings has become, a lack of the required knowledge and skill to properly operate and maintain services system, to identify any existing cause of inefficiency , and to devise and implement mitigation measures. In Nigeria, a lack of motivation arises as a result of inefficient billing and collection system in addition to corrupt practices on the part of utility workers and consumers. In areas where meter-cards have been introduced, residents are conscious of their energy consumption level and are likely to adopt energy efficient measures. In developed countries escalating cost are forcing consumers to seek ways of increasing energy efficiency and reduce consumption (Elliot and Gueggemos 2010).

Household energy consumption and efficiency practices

Energy consumed by households includes electricity, gas, diesel, kerosene, inverters, candles, lanterns etc. However, consumption is dominated by electricity and this paper will look at energy efficiency in the homes in relation to house lighting habits and use of appliances. According to ABS data (2010) cited in Bord (2011), despite efforts to reduce energy consumption in homes, household electricity use per person has been on the increase. Larger dwelling size, decreasing average household size, more appliances and IT equipment per households as well as the increased use of heaters and coolers, have contributed to the increase. Efforts to improve energy efficiency by government can be frustrated by complexity of human behavior including “take back” Howden- chapman et al (2009).

The enormity of Nigeria’s energy problem creates a greater need for energy efficiency practice to be adopted by residential households as electricity demand in Nigeria far outstrips the supply which is epileptic in nature (Sule, Habeeb, Ajimotokan and Garba 2011). Energy efficiency has become the key driver for sustainable development. If we use energy more efficiently it will lead to saving of personal income and reduce the need for more power stations in the country (Otegbulu 2011, CREDC 2009). In the last few years more stringent environmental laws and souring energy prices has increased the need for household to react and participate in energy reduction and housing sustainability (Eves and Kippes 2010). The potential for efficient energy utilization and conservation amongst residential households as it accounts for approximately one third of overall delivered energy use and carbon dioxide emissions (Business Enterprise and Regulatory Reform 2008, Sambo 2005). In the past 20 years, there has been a growing awareness and focus on energy efficiency in residential house design, construction materials and equipment heating and cooling. Much of this work commenced in the USA in the mid 1980’s with the introduction of Home Energy Rating Schemes (HERS) and demand side management programs, as well as rating for construction and energy use in property (Ding 2008) cited in (Eves and Kippes 2010).

Household appliances and energy efficiency

In most Nigerian homes, it is evident that energy efficiency is not factored in the choice of household appliances and electrical fittings. It could therefore be argued that electrical energy utilization in Nigeria is far from being efficient as in most homes, filament bulbs of wattages ranging from 40 watts to 120 watts per hour are still used. Electrical appliances and fittings incorporated into buildings designs should be energy efficient. There is therefore the need to get the most useful output from energy sources. In the present situation, it becomes necessary to explain that energy efficiency of a device is a comparison or ratio of the useful energy output. This ratio is always related to the particular circumstance (the season, timing, desired end result etc.). For example, a typical incandescent bulb converts 10% of input electricity energy into light energy, the rest goes into heat. The efficiency in this case is ten

percent. If many light bulbs are turned on at the same time, there will be need to turn on the air conditioners to provide cooling effects in the room, which implies more inefficiency (DeGunther 2008, Otegbulu 2011). The use of compact florescent lamps (CFL) that utilizes less energy or electricity than incandescent bulbs, can last 10 times longer, cost little upfront and provide a quick return on investment is desirable and recommended (Sule et al 2011, Energy Star 2008). There are therefore two ways in which energy efficiency can be put into practice; technological and behavioral approach. Technological approach implies a change in the type of technology we use to a more efficient type. A typical example is a change from the use of incandescent bulbs to CFLs. Behavioral approach on the other hand implies a change in the ways we do things, like switching off appliances when we have no need for them.

Research method

A field survey was carried out between February and March 2011 to assess the level of energy efficient practice and awareness among household in about four metropolitan local governments areas of Lagos state. The local governments include Surulere, Mainland, Shomolu, and Eti-osa local government areas. The survey was based on a structured questionnaire distribution to about 500 households out of which 402 were retrieved, but only 355 were found useful for analysis. The targeted respondents are heads and spouse of the households. The study population comprises of high, low and middle income. The research instrument is designed to elicit information on household's socio-economic characteristics, electricity infrastructure condition and other sources of energy in the area, household averting expenditure, impact of poor electricity condition, awareness of energy efficiency practice, type of appliances among others. Analysis was carried out with the use of descriptive statistics.

Results

TABLE 1 SOCIO ECONOMMIC VARIABLES OF THE RESPONDENTS

Variable	Frequency	Percentages
Household Position		
Head of household	228	64%
Spouse of the household	124	35%
Others	3	1%
Years in the House		
1-3yrs	93	26%
4-6yrs	121	34%
7-10yrs	65	18%
11-15yrs	34	10%
Above 15yrs	42	12%
Type of Accomodation Occupy		
Tenement house	64	18%
2-3 bedroom flat bungalow	168	47%
4bedroom flat/bungalow	29	8%
3bedroom Duplex/Detached House	43	12%
4-5 bedroom Duplex or Detached House	51	14%

Source: field survey 2011

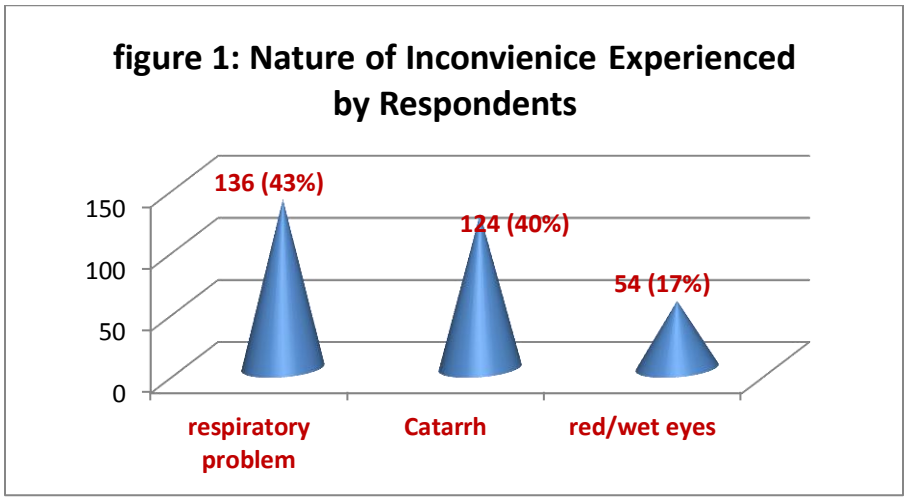
Results from table 1 shows that the respondents are mainly heads and spouses of the households which are in good position to provide useful information for the purpose of this study. Majority of the respondents have also lived in the area for a period of between 4-15 years and above. Power situation in the study area is very poor as 42% of the respondents have light for 1-5 hours a day, while 39% enjoy mains electricity for 6-10 hours per day.

TABLE2: OTHER SOURCES OF ENERGY USE APART FROM MAINS ELECTRICITY (POWER FROM PHCN)

	Very Often	Often	Rarely	Very Rarely	Never	RII	Rank
Generator	242(68%)	75(21%)	22(6%)	4(1%)	12(3%)	0.90	1
Cooking gas	121(52%)	43(19%)	16(7%)	12(5%)	40(17%)	0.77	2
Torch Light	70(28%)	81(33%)	53(21%)	19(8%)	26(10%)	0.72	3
Rechargeable Lamp	60(23%)	100(38%)	49(18%)	33(12%)	24(9%)	0.70	4
Kerosene Stove	76(32%)	42(18%)	30(13%)	21(9%)	69(29%)	0.63	5
Inverter	49(21%)	33(14%)	21(9%)	8(3%)	124(53%)	0.49	6
Candle	24(11%)	40(18%)	33(15%)	30(14%)	93(42%)	0.48	7
Lantern	27(12%)	36(16%)	18(8%)	28(13%)	110(50%)	0.46	8
Coal/charcoal	11(6%)	6(3%)	10(5%)	11(6%)	158(81%)	0.29	9
Wood	5(3%)	3(2%)	8(4%)	11(6%)	161(86%)	0.26	10

Source: field survey 2011

From the table 2 above household use other sources of energy apart from electricity. Some of these sources have negative environmental implication. These include generators, kerosene, candle, coal, and wood. The last two leads to deforestation, while generators fumes are the cause of many untimely deaths due to suffocation from fumes. It also defaces the walls of buildings. There have also been cases where kerosene explosion in homes and candles causing fire incidents in buildings.



Source: field survey 2011

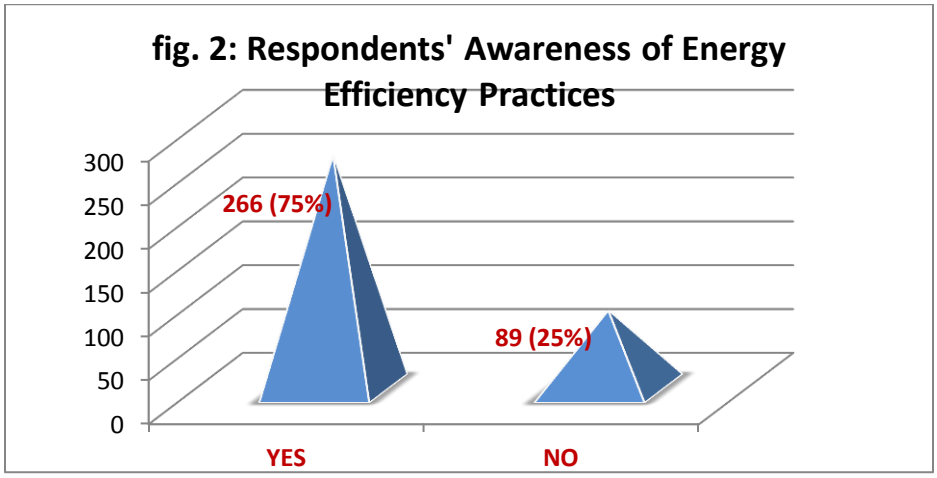
About43% of the respondents suffer respiratory problems, 40% suffer catarrh while 54% suffer red/wet eyes as a result of electricity generator fumes. Some of the generators are really substandard with consequent environmental hazards.

TABLE 3: AVERAGE COST OF TREATMENT PER MONTH

	Frequency	Percentage	Average
$0.70 - $13.00	107	49	$20.174
$13.10 - $27.00	66	30	
$27.10 - $40.00	13	6	
$40.10 - $67.00	17	8	
Above $67	14	7	
Total	217	100	

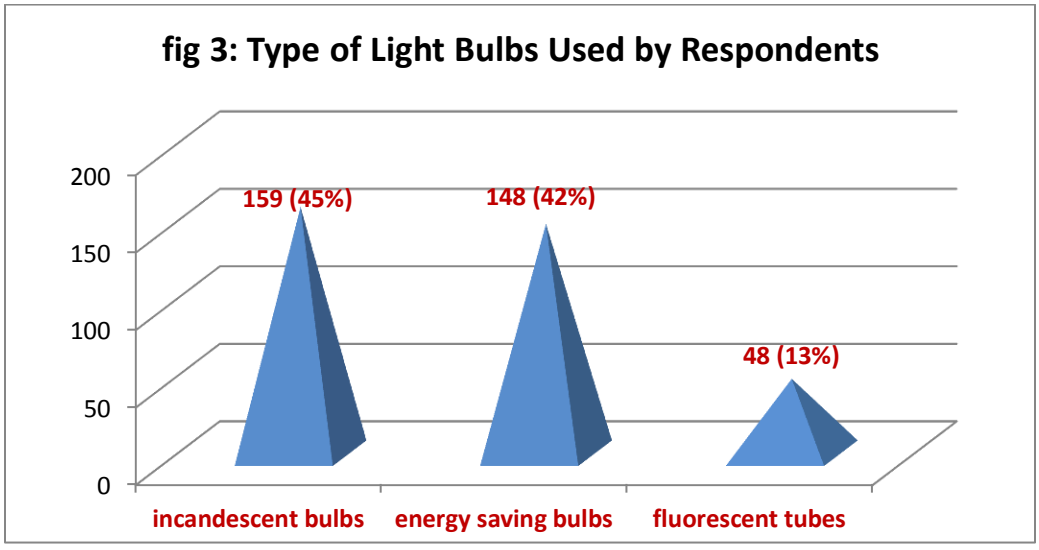
Source: field survey 2011

The respondents also complained of incurring cost from treating illness arising from generator fumes. The average expenditure is about $20 (US) per month or $240 per annum.



Source: field survey 2011

Majority (75%) of the respondents claimed awareness of the need of energy savings at home. There is need to find out if their attitude towards energy efficiency is in line with this expression



Source: field survey 2011

Result from figure 3 above shows that many households (45%) still use incandescent bulbs. By implication, their claim to be aware of the need of energy efficiency in their homes, exist only in contemplation or mere figment of

their imagination. The use of incandescent bulbs adds pressure on the energy demand as most of the electricity produced from power stations is not efficiently utilized

TABLE 4: AVERAGE NUMER OF BULBS IN RESPONDENTS HOME

No of bulbs	Frequency	Percentage	
1-5	71	20	
6-10	108	30	
11-20	137	39	Average of 12bulbs per household
21-30	29	8	
Above 40	10	3	
Total	355	100	

Source: Field survey 2011

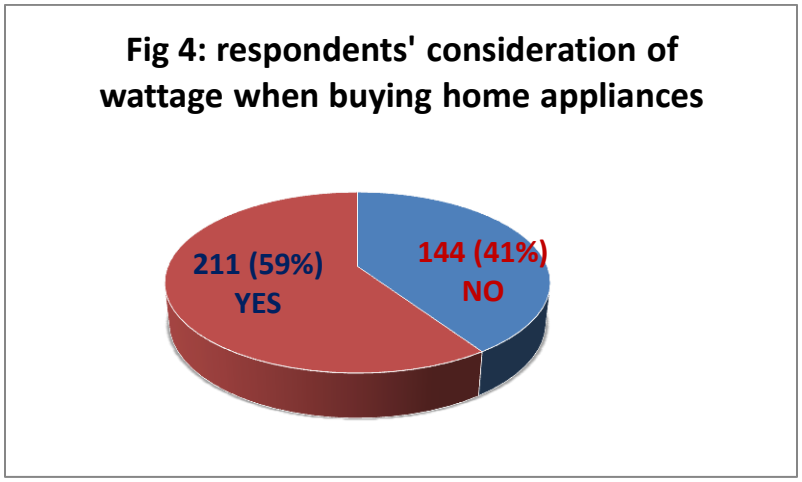
From table 4 above 20% of the respondents have about 20 bulbs, while 30% have 6-10 bulbs and 39% have 11-20 bulbs. 8% have between 21-30 bulbs. On the average, there are 12 bulbs per household. Based on the average of number of 12bulbs per household, and the fact that 10% efficiency level is achieved from each bulb there is wastage of 54 X 12 watts per hour or 648watts/hour assuming they all use 60watt bulbs

TABLE 5: HOW OFTEN RESPONDENTS FORGET TO PUT OFF GADGETS WHEN THEY ARE NOT IN USE

	Very Often	Often	Rarely	Very rarely	Never	RII	Rank
Electric bulbs	108(31%)	93(27%)	72(21%)	37(11%)	36(10%)	0.72	1
Electric fans	68(21%)	91(28%)	60(18%)	50(15%)	58(18%)	0.64	2
Television	71(22%)	71(22%)	60(17%)	42(13%)	84(26%)	0.60	3
Multimedia devices	41(15%)	60(22%)	55(20%)	33(12%)	87(31%)	0.55	4
Air conditioners	51(18%)	45(16%)	51(18%)	46(16%)	89(32%)	0.55	5
Electric cooker	58(20%)	33(11%)	28(10%)	29(10%)	143(49%)	0.49	6
Micro-wave oven	53(20%)	23(9%)	34(13%)	24(9%)	134(50%)	0.48	7

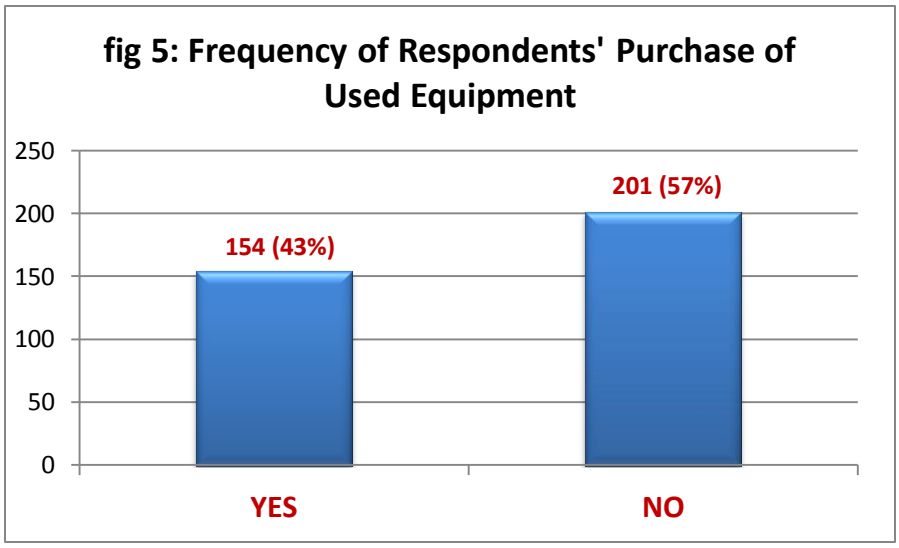
Source: Field survey 2011

Results from table 5 above shows that, the behavior of households towards energy use is counter-efficient, as majority forget to put their appliances off when they have no need for them. This applies to all the electricity appliances, electricity bulbs ranked highest, followed by electric fans, televisions, multimedia devices, electric cooker, and microwave. Apart from leading to high energy consumption and cost, it also provides the risk of giving rise to fire incidence as have happened in many case.



Source: field survey 2011

Based on data derived from fig 5 above, most of the respondents do not consider wattage/hour when purchasing appliances. This also leads to high energy consumption.



Source: field survey 2011

TABLE 6: REASON FOR BUYING USED APPLIANCES

	RII	Rank
It is cheaper	0.87	1
It is more durable	0.80	2
Look stronger in appearance	0.74	3
It is energy efficient	0.66	4

Source: field survey 2011

Data from figure 5 and table 6 shows that 43% of the respondent buy used appliances which in most cases have high energy consumption. Majority of the respondents that patronize used equipment do so on the belief that they are cheaper, while others belief that they are stronger and more durable. Some of these used appliances are discarded in Europe and USA as junks. Most importantly some of them are not environmentally friendly. Items like refrigerators and air conditioners may still contain CFC (chlorofluorocarbon) which has been banned.

Conclusion

The documentation of good practices in a structured manner is vital to energy efficiency practice among households. The study has carried out a thorough assessment of energy efficiency practice in behavioral and technological terms in Lagos metropolis as the quantum of energy required by any country is a summation of the quantity of energy consumed by its citizens both at the household level and the productive sector. Based on finding of this study household sources of energy include: Generator, cooking gas, touch light, rechargeable lamp, kerosene stove, inverter, candle, renter, coal and wood. All of these have adverse environmental implication as most of them contribute to global warming and climate change majority of the respondents acquire old appliances which may not be energy efficient and hence contributes unnecessarily to energy demand. This is a technological problem.

In addition household behavior towards energy efficiency contradicts their assertion to be aware of the need for energy efficiency as most of them switch on electrical appliances even when they are not needed. This is a behavioral problem or constraint to energy efficiency. By implication, there is an urgent to embark on a comprehensive education of households on energy efficiency practice to bring a change to their behavioral tendency.

Adoption of energy efficiency policy by government with adequate incentive to motivate consumers to embrace it will help in reducing Nigerians energy problem. This is possible as energy loss through inefficiency will be highly reduced. The government should also place a ban on the importation of used appliances that are not in compliance to

energy efficiency practice considering the importance of energy to both urban and national development. Energy is intrinsic to urban-settlement, directly used to power socio-economic activity, transport and communication as well as enable the provision of municipal services. This is in addition to the direct energy need of urban households energy efficiency practice will help in releasing more energy for public use.

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