



Level of Electrical Energy Management Practice Awareness Among Residents in Niger State, Nigeria

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Abstract: The study investigated the level of electrical energy management practices awareness among residents in Niger State, Nigeria. The study adopted Cross Sectional Survey Research Design. The population of the study was made up of 191,416 heads of households in residential buildings that are connected to the distribution network in 25 Local Government areas of Niger State. The sample for the study consisted of 1,290 heads of households in residential buildings, drawn through Multistage Sampling Techniques. Three research questions were formulated to guide the study. The instrument used for data collection was a structured questionnaire. Statistical Package for Social Sciences (SPSS version 19) was used for data analysis. Mean and Standard Deviation were used to answer the research questions. The finding of the study shows that, residents in Niger State were somehow aware of electrical energy management practices in lighting, cooling and heating systems and the use of electric motors. Based on these findings, the following recommendations were made: Electricity Management Board in collaboration with Energy Commission of Nigeria and Center for Energy Efficiency and Conservation should jointly organize public enlightenment campaigns to promote awareness on electrical energy management practices in lighting, cooling and heating systems and the use of electric motors.

Keywords: Electrical Energy Management Practices, Awareness, Residents and Niger State

1. Introduction

Electrical energy management practices can be defined as a judicious and effective use of electrical energy to maximize profits and minimize costs, thereby enhancing competitive position in a global economy [1]. Electrical energy management plays an important role in every industry, since it is one of the items of major expenditures in industry. Its proper management reduces production costs and environmental degradation. Electrical energy efficiency and conservation is an intentional action taken to reduce electrical energy consumption by utilizing more efficient technological equipment, devices and processes. The impact of electrical energy conservation is that, electrical energy use and demand per capital will be greatly reduced, thus reduced energy supply needed and the cost of electrical energy used [2]. By electrical energy efficiency and conservation, electricity is used in a manner that will minimize the amount of electricity needed to provide certain services. Energy efficiency

therefore, entails improvement in practices and products that reduce the energy necessary to provide services.

[3] viewed electrical energy efficiency as the adoption of technology that requires the use of less energy to perform the same function or more while electrical energy conservation is the behaviour that is necessary in utilizing less energy. Technology and behavioural approaches are two common techniques in electrical energy management practices [4]. Proper electrical energy management practices reduce energy wastages, for instance [5] stated that, if Nigerians are using 10 million incandescent 60W bulbs per hour, the nation will be consuming 600 megawatts per hour, but if these 60W incandescent bulbs were changed to 5.20W Light Emitting Diodes (LEDs), the nation will be consuming 52MW This signifies that, 548MW will be saved and used in some other areas without necessarily building another power plant. Furthermore, [6] pointed out that there are abundant opportunities to save 70% to 90% of energy and cost for lighting, fan, pump systems; 50% for electric motor and 60%

in areas such as heating, cooling, office equipment and appliances through proper electrical energy management practices. There is a great opportunity of changing a person's behaviour towards electrical energy savings through awareness [7]

Awareness of electrical energy conservation and efficiency is an all-important element of electrical energy management practices, as lack of awareness may be the barrier for electrical energy wastages [4]. Awareness helps to change attitudes, thus encouraging users to seek out ways to save energy and also changes behaviours, making sure that energy users take energy-saving actions and continue to use and maintain energy saving equipment after it has been installed. Without the knowledge by the consumers on electrical energy management practices, it will be difficult to provide electricity users with better electrical energy conservation programmes. Awareness of electrical energy conservation and efficiency is an essential ingredient of electrical energy management practices, as lack of awareness is the main barrier for electrical energy wastages [3, 4]. Information diffusion is an effective communicative ways of activating electrical energy conserving behaviour. Awareness is the extremely important foundation for success in electrical energy management practices. Awareness helps in changing attitudes of people, thereby encouraging users of electricity to look out for ways to save electrical energy and also help in positive behavioural changes towards electrical energy. It ensures that the users of energy take action on electrical energy saving and habits to keep and continue to maintain electrical energy saving appliances/equipment when being installed. It is certain that the first step towards behavioural change is raising awareness, as awareness is the seed of tomorrow change without which there will be no accurate action to conserve energy [8, 9]. Lack of awareness or knowledge is always a barrier to energy conservation and efficiency. People will not be able to take steps to conserve energy if they are not properly informed on ways energy can be conserved and the importance of conserving energy. [2]. observed that employees or staff awareness on electrical energy conservation plays a crucial role in reducing utility bills and is a solution to energy savings.

There are several ways which information can be used to change resident's behaviour toward the use of electrical energy, such as public enlightenment campaign on television and radio. The enclosure of pamphlets that carry information on electrical energy conservation on utility bills, and the use of appliance carrying electrical energy-consumption labels can help in creating awareness on electrical energy management. The reason for information dissemination is to increase the resident's knowledge of electrical energy conservation. Electrical energy savings worth several billions of Naira may be realized through public enlightenment campaigns on electrical energy conservation. Awareness will certainly help the consumers to be aware of the financial and environmental impact of wasteful energy practices [10]. Electrical energy management practice awareness among consumers is very essential. Building can be well designed

and equipped with super green technology features, but if the users of that structure, lack awareness of energy management, the building itself would not operate efficiently and energy will be wasted [11, 2]. Awareness is the first and a reliable step among other electrical energy conservation techniques. Electrical energy awareness among the residents in Niger state are abstract. There is not clear evidence on the level of electrical energy awareness among residents that are using electricity in Niger State and Nigeria in general.

Building can be seen as residential building when significant portion of the floor area is used for dwelling purposes. Residential building uses electrical energy equipment and appliances such as electrical heater, cooker, lighting bulbs, washing machines, refrigerator and other items. These consume significant amount of energy while items such as radio, television and computer use less energy and, therefore, account for a small percentage of total residential consumption. Residential energy consumption has steadily grown over the years and it appears that this trend is increasing. Residential electrical energy consumption is measured in kilowatt-hours (kWh). In Nigeria and specifically in Niger State, residential buildings constitute large percentage of electrical energy usage. Households are responsible for a considerable amount of total greenhouse gas emissions. It typically accounts for approximately 15–20% of total energy-related CO₂ emissions and this residential share is expected to keep rising [12].

2. Statement of the Problem

The adoption of proper electrical energy management practices in residential buildings is necessary for effective utilization of available electrical energy; it offers practical means of achieving environmental sustainability and electrical energy security, these in turn enhance national development. It is sad to observe that, about 30 to 40% of electricity generated is being lost from point of generation to utilization in Nigeria [13 & 6]. [14] reported that, the then Minister of Power, Prof. Chinedu Nebo, said Nigerians have being wasting over 1,000 Megawatts of electricity generated which amounts to N400bn, these amount of electrical energy can be used for other useful purposes. Savings in electrical energy used worth millions of naira may be realized through public conservation campaigns that raise consumers' awareness of the financial and environmental impact of wasteful practices [15]. Against this backdrop, a need arouse for greater understanding of level of electrical energy management practices awareness among residents in Niger State for the purpose of planning appropriate interventions strategies.

3. Aim and Objectives of the Study

The aim of this study was to investigate the level of electrical energy management practices awareness among residents in Niger State, Nigeria. In specific terms, the objectives of this study were to determine:

1. The level of electrical energy management practices awareness in the use of lighting system among residents in Niger State, Nigeria.
2. The level of electrical energy management practices awareness in the use of cooling and heating systems among residents in Niger State, Nigeria.
3. The level of electrical energy management practices awareness in the use of electric motors among residents in Niger State, Nigeria.

4. Research Questions

The following research questions were formulated to guide the study:

1. What is the level of electrical energy management practices awareness in the use of lighting system among residents in Niger State, Nigeria?
2. What is the level of electrical energy management practices awareness in the use of cooling and heating systems among residents in Niger State, Nigeria?
3. What is the level of electrical energy management practices awareness in the use of electrical motors among residents in Niger State, Nigeria?

5. Research Methodology

This study adopted a cross sectional survey research design. This design enables the researcher to describe the attitudes, opinions, behaviours or characteristic of the population based on data collected from a sample of the users of electricity in residents on their practices of electrical energy management. The study was carried out in Niger State, Nigeria, Niger State has twenty five local government areas and divided into three geo - political zones namely, Zone A, B and C. The choice of this area is because residents in Niger State is highly indebted to Abuja Electricity Distribution Company (AEDC) and power supply is epileptic

for operating electrical equipment/appliances in residential buildings despite the fact that the state housed three hydro-electric generation stations, hence the choice of Niger State as the area of study.

The target population of the study was made up of 191,416 heads of households in residential buildings connected to the distribution network in 25 Local Governments of Niger State. The sample for the study consisted of 1,290 heads of households in residential buildings drawn through Multistage Sampling Techniques. Firstly, Stratified Sampling was used to draw 15 towns, five towns from each zone in the state and one town from each local government area. Proportional stratified random sampling was used to draw only 1% of head of household from each town.

The instrument used for data collection is a structured questionnaire. The questionnaire was designed to generate data for answering the research questions of the study. The data collected for the study was organized and analyzed on the basis of the research questions and hypotheses. SPSS version 19 was used for the analysis. Mean and Standard Deviation were used to answer the research questions, The decisions for the research questions were based on the resulting means score interpreted relative to the concept of real lower and upper limits of numbers as shown in Table 1.

Table 1. Five Point Scale.

| S/N | Scale | Point |
|-----|---------------|-------------|
| 1 | Highly Aware | 3.50 – 4.00 |
| 2 | Aware | 2.50 – 3.49 |
| 3 | Somehow Aware | 1.50 – 2.49 |
| 4 | Not Aware | 0.50 – 1.49 |
| 5 | No Opinion | 0.00 – 0.49 |

Research Question 1

What is the level of electrical energy management practices awareness in the use of lighting systems among residents in Niger State, Nigeria?

Table 2. Residents Mean Opinions on their Level of Electrical Energy Management Practices Awareness in the use of lighting systems in Niger State, Nigeria.

| S/N | ITEM | \bar{X} | S D | RMK |
|-----|--|-----------|------|-----|
| 1 | Switching off the lights when not in use saves energy | 2.38 | 1.08 | SA |
| 2 | Removing lamps when lighting level is high saves energy | 2.18 | 1.01 | SA |
| 3 | Regular usage of natural day lighting helps in energy saving. | 2.48 | 1.12 | SA |
| 4 | Regulate the light to illumination level needed using dimmer saves energy. | 1.74 | 1.12 | SA |
| 5 | Resetting light timers periodically to minimize energy wastages. | 1.70 | 1.14 | SA |
| 6 | Usage of appropriate colour for wall, ceiling and floor for better illumination saves energy. | 1.79 | 1.01 | SA |
| 7 | Utilization of minimum wattage lamp to provide required light saves energy. | 1.62 | 0.93 | SA |
| 8 | Replacing incandescent bulb with more efficient bulb saves energy. | 1.78 | 1.11 | SA |
| 9 | The use of automatic control devices such as motion sensors, infrared sensors saves electricity | 1.92 | 1.12 | SA |
| 10 | Usage of task lighting saves electricity | 1.70 | 0.93 | SA |
| 11 | Utilization of electronic ballast instead of Magnetic saves electricity. | 1.65 | 1.10 | SA |
| 12 | Compact Fluorescent lamp (CFL), Light emitting diodes (LEDs) saves 75% of energy more than Incandescent bulb. | 2.18 | 1.20 | SA |
| 13 | High Intensity Discharge Lamps and Induction lamps saves 70% of energy to Incandescent bulbs and Halogen lamps for outdoor lamps | 1.76 | 1.12 | SA |
| 14 | The use of dimmer switches saves significant energy when compared to manual switch. | 1.96 | 1.05 | SA |
| 15 | Lowering light fixtures saves energy. | 2.06 | 0.97 | SA |

\bar{X}_1 = Mean of Residents; SD = Standard deviation; A = Aware; SA = Somehow Aware.

Table 2 shows the means and standard deviation on level of electrical energy practices awareness on the use of lighting system. The respondents' mean of all the items ranges from 1.70 and 2.38 which signified that they are somehow aware of items listed. Standard deviation ranges from 0.93 to

1.20 this suggested that means are close.

Research Question 2

What is the level of electrical energy management practices awareness in the use of cooling and heating systems among residents in Niger State, Nigeria?

Table 3. Residents Mean Opinions on their Level of Electrical Energy Management Practices Awareness in the use of cooling and heating systems in Niger State, Nigeria.

| S/N | ITEM | \bar{X} | S D | RMK |
|-----|---|-----------|------|-----|
| 1 | Avoiding frequently opening of refrigerator door saves energy | 1.74 | 0.93 | SA |
| 2 | Allowing the hot foods to cool down to room temperature before refrigerating help in saving electricity used. | 1.54 | 0.72 | SA |
| 3 | Regular defrost freezing compartment saves energy used.. | 1.40 | 0.84 | SA |
| 4 | Covering of all food stored in the refrigeration saves energy. | 1.14 | 0.72 | SA |
| 6 | Ensuring refrigerator door's seal are properly tight saves energy | 1.30 | 0.81 | SA |
| 7 | Over loading refrigerator waste energy. | 1.52 | 0.83 | SA |
| 8 | Switching off refrigerator while nothing is inside saves energy. | 2.20 | 1.11 | SA |
| 9 | Use of second hand fridge waste energy, | 1.18 | 0.90 | SA |
| 10 | Use of second hand compressor waste energy. | 1.64 | 0.91 | SA |
| 11 | Closing of doors and windows while a.c is on save energy | 1.52 | 1.04 | SA |
| 12 | Using A.C and fan at the same time lead to waste of energy. | 1.37 | 0.84 | SA |
| 13 | Using curtains to shade against sun light saves energy | 1.51 | 0.83 | SA |
| 14 | Switching off the A.C when not in use saves energy. | 1.95 | 1.04 | SA |
| 15 | Application of dark colour on walls lead to energy waste. | 2.46 | 1.05 | SA |
| 16 | Use of split A.Cs instead of window types saves energy. | 1.70 | 0.81 | SA |
| 17 | Use of electronic devices with occupancy sensor to switch off A.C when necessary saves energy. | 2.07 | 0.65 | SA |
| 18 | Regular cleaning of A.C filter saves energy | 2.10 | 0.66 | SA |
| 19 | Ironing of many cloths at once helps to saves energy. | 1.64 | 0.84 | SA |
| 20 | Ensuring seal of oven door is well tight saves energy | 1.38 | 0.80 | SA |
| 21 | Pre-heating of oven for long time waste energy | 1.32 | 0.81 | SA |
| 22 | Avoiding unnecessary opening of oven saves energy | 1.74 | 0.90 | SA |
| 23 | Regular cleaning of cooker plate saves energy | 1.51 | 0.77 | SA |

Table 3 shows the means and standard deviation on level of electrical energy practices awareness on the use of cooling and heating system, the respondents' were somehow aware of all items, as the means ranges from 1.14 to 2.46. Standard deviation ranges from 0.65 to 1.11 this suggested that means

are close.

Research Question 3

What is the level of electrical energy management practices awareness in the use of electric motors among residents in Niger State, Nigeria?

Table 4. Residents Mean Opinions on their Level of Electrical Energy Management Practices Awareness in the use of electric motors in Niger State, Nigeria.

| S/N | ITEM | \bar{X} | S.D | RMK |
|-----|---|-----------|------|-----|
| 1 | Keeping the machine running at full load saves energy | 1.63 | 0.91 | SA |
| 2 | Switching off machine immediately after use saves energy | 2.20 | 1.17 | SA |
| 3 | Use of cool water (instead of hot) during washing with washing machine saves energy | 2.18 | 0.94 | SA |
| 4 | Leveling water to the capacity of the load of washing machine saves energy | 2.06 | 0.96 | SA |
| 5 | Use of outdoor sunlight for drying cloth instead of machine saves energy | 2.04 | 0.97 | SA |
| 6 | Cleaning of lint filter of washing machine before and after each load saves energy | 1.90 | 0.88 | SA |
| 7 | Removal of excess water manually before drying with drying machine saves energy. | 2.34 | 0.90 | SA |
| 8 | Separation of cloth base on fabric and dirtiness before washing with washing machine saves energy | 2.04 | 0.99 | SA |
| 9 | Running of the electrical motor when needed saves energy | 1.77 | 0.80 | SA |
| 10 | Regular lubrication of rotating parts helps in saving energy | 2.26 | 1.11 | SA |
| 11 | Rewinding of motor reduce it efficiency and waste energy | 1.12 | 0.80 | SA |
| 12 | Energy is saved when motor is not overloaded | 1.52 | 0.79 | SA |
| 13 | Adequate ventilation to electrical motor saves energy consumption. | 1.40 | 0.67 | SA |
| 14 | Operating motor at low power factor lead to energy wastages | 1.03 | 0.86 | SA |
| 15 | Operating motor at high power factor saves energy | 2.08 | 0.72 | SA |
| 16 | Shaping of cutting edge of equipment saves energy | 1.84 | 0.74 | SA |
| 17 | Improvement of power factor saves energy | 1.87 | 0.86 | SA |

Table 4 shows the means and standard deviation on level of electrical energy practices awareness on the use of electric motors; the respondents' mean of all the items ranges from 1.03 to 2.34 which signified that they are somehow aware. The 17 items had their standard deviation ranged from 0.67 - 1.17 each of these values was less than 1.96 indicating that the respondents were not too far from the mean and were close to one another in their responses. This adds value to the reliability of the mean.

6. Findings of the Study

1. The findings revealed that residents were somehow aware on electrical energy management practices awareness in the use of lighting systems, such as switching off the lights when not in use, regular usage of nature day lighting helps in saving electricity and utilization of the low wattage lamp to provide required light saves energy.
2. The findings revealed that residents were somehow aware on electrical energy management practices awareness in the use of cooling and heating systems, such as allowing hot food to cool down to room temperature before refrigerating help in saving electricity used and covering of food stored in the refrigerator saves energy.
3. The findings revealed that residents were somehow aware on electrical energy management practices awareness in the use of electric motors.

7. Discussion of Findings

The findings revealed that, they were aware that switching off the lights when not in use saves electrical energy. These findings were in consonance with the Norm activation model developed by [16] and supported by [17] which said electricity users were aware that switching off of appliances when not in use saves electricity. They further said that, wastages of electrical energy experiences in residential buildings are due to the sensation of guilt that is reducing among electricity users. The measures that can be used for improving electricity may be disregarded by the energy users. The findings were in contrast with the work of [18], which claimed that electricity users were not aware that switching off lights and other appliances when not in used saves electrical energy. They attributed it to major causes of electrical energy wastages in residential buildings. The idea that people who usually leave their light on during the daytime, most especially the outdoor lights is not due to lack of awareness of wastages that resulted from such act but the application of right behaviour towards electrical energy management practices. The finding revealed that the respondents were aware that regular usage of nature day lighting helps in saving electricity. The finding was supported by [19], which upheld the finding and said majority of electricity users were aware that usage of day light

environment helps in electrical energy savings. They further stated that the employment of day lighting decreases utility costs and improves the well being of building residents. The findings further revealed that, the respondents were somehow aware of electrical energy management practices such as; utilization of the low wattage lamp to provide required light saves energy, usage of appropriate colour on wall and ceilings for better illumination saves electricity and use of task lighting saves electricity. These were in-line with the study carried out by [20], which they observed that inadequate knowledge leads to electrical energy inefficiency. They further said low awareness of the management practices such as the use of minimum wattage, use of task lighting and application of appropriate colour on wall by residents contributed significantly to electrical energy wastages. Inadequate knowledge of minimum wattage leads to energy wastage, as the consumers will fix more bulbs than required for the illumination of the room. It is usual to see residents using 100 to 200 W bulbs in a room, where less than 30W bulb can provide needed illumination.

Finding revealed that people were somehow aware that, windows and doorways of the room need to be closed when air condition is on. [21] affirmed the finding, which he said residents often leave their door and windows open when air-condition is on. This may possibly as a result of low awareness toward that. As long as people are not well informed about these practices, it will often lead to energy wastages. Respondents further revealed that, they are somehow aware of theses; allowing hot food to cool down to room temperature before refrigerating help in saving electricity used and covering of food stored in the refrigerator saves energy. These were in consonance with the views of [22, 23 & 12] which they said that, residents are not much aware of the need to reduce the number of door openings and to pre-cool foods before refrigerating. regular checking of power factor and correction is very necessary to avoid excessive power usage. Somehow awareness of power factor correction measures is great lost to the power systems. When power factor is not corrected the power providers must provide the non- working reactive power in addition to the working active power. This resulted in the usage of larger transformer, bus bars, cable and other distribution system devices which otherwise may be unnecessary.

8. Conclusions

The shortage and wastages of electricity supply from AEDC and its high cost among residents in Niger State and Nigeria in general is disheartening and it drawback the economic and development of the nation. The shortage and wastages is also having negative impact to the environment. The study revealed that residents of Niger State, Nigeria are somehow aware of electrical energy management practices in lighting, cooling and heating systems and the use of electric motors and low awareness lead to energy wastages. Awareness plays an important role in changes behaviour

among consumers. It is therefore necessary to create awareness on electrical energy management practices in order to reduce electrical energy wastages associated to poor electrical energy management practices by residents in Niger State, Nigeria.

Recommendations

Based on the findings of this study, the following recommendations were made:

1. Electricity Management Board in collaboration with Energy Commission and Center for Energy Efficiency and Conservation should organize public enlightenment campaigns for residents' electricity users in Niger State on the use of efficient lighting, cooking and heating system.
2. The Board as a matter of urgency should make effort to organize seminar/workshop to enlighten residents' electricity user positive maintenance culture towards electrical appliances and equipment and behavioural changes on electrical energy management.
3. Residents should be well informed on the need to use efficient electric appliances/equipment and automatic control systems to avoid electrical energy wastages.

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