

# **AWARENESS OF DEMAND-SIDE MANAGEMENT PRACTICES AMONG STAFF OF AN EDUCATIONAL INSTITUTION**

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**Abstract:** Awareness of demand-side management practices among staff of educational institutions is critical for energy savings. This paper presents the results of a survey to determine the extent to which staff of the Kwame Nkrumah University of Science and Technology are aware of measures for energy efficiency and also assess their preparedness to support efforts towards reducing energy wastage. Questionnaires were administered to Senior members, Senior staff and Junior staff of the institution. The questionnaires were designed to collect data on their level of energy efficiency awareness in the use of refrigerators, airconditioners, light bulbs and electronic devices. The extent to which staff are engaged in energy saving activities and their preparedness to get involved in energy saving activities were also determined. The analysis of the collected data was done using the Statistical Package for Social Sciences (SPSS) software. Analysis of responses received show that more than seventy-seven percent of staff are ignorant of the fact that keeping refrigerators close to walls resulted in energy wastage. About fifty-seven percent of them are aware of the fact that when airconditioners are not cleaned regularly, much energy is wasted. Almost eighty-five percent of staff indicated awareness of the fact that keeping electronic devices on standby for long periods could be a source of significant energy wastage. Over eighty-three percent of staff indicated that they had been switching light bulbs off when there is adequate illumination from the sun so as to conserve energy. About thirty-six percent of staff are already engaged in at least one form of energy conservation. Lastly, over 94% of them expressed willingness to take part in energy saving activities.

## **1. INTRODUCTION**

Development of national economies and improvements of people's quality of life have resulted in high electrical energy consumption. The rapid growth in world energy demand

has raised concerns over supply difficulties, exhaustion of resources, and impact on environment [1]. To address challenges associated with the rise in energy demand, a number of strategies have been put in place. One of such strategies is Demand-side management (DSM). DSM is a leading strategy employed to reduce energy demands. It refers to technologies, actions and programmes on the demand-side of electric meters that seek to manage or decrease electricity consumption. The benefits of DSM include reduction in electricity consumption, overall electricity system expenditures and carbon emissions [2]. Activities under DSM include (a) promotion of high efficiency building practices, (b) use of energy-efficient products, (c) shifting of non-critical usage of electricity from peak periods to off-peak periods, (d) institution of programmes that provide limited utility control of customer equipment such as airconditioners, and (e) promotion of energy efficiency awareness [1], [3], [4].

A key target for education on energy efficiency, with the view of cutting down energy wastage, is educational institutions. Educational institutions; particularly universities, are high energy consumption sectors across the globe [5], [6]. Also, their products take up responsibilities in other sectors where energy efficient practices are required. Gains in energy conservation in educational institutions cannot be achieved without the active involvement of staff and students. The extent to which staff and students are aware of energy efficient practices and their preparedness to support efforts towards reduction in energy wastage are critical.

Studies conducted in [7]-[9] show that the inefficient use of electricity in educational institutions is largely due to the lack of energy efficiency awareness among staff and students. Behavioural changes to reduce energy consumption, while technological and policy considerations are taken into account, significantly contribute to reduction in energy wastage [10], [11]. Providing energy awareness and conservation measures to staff will equip them with useful and relevant information to modify the way they use energy and build their capacity to educate students to do same. This will go a long way to promote energy conservation in institutions [12]-[15].

Efforts toward educating staff on energy conservation, for onward transfer to students may yield minimal success if the education does not consider their current levels of awareness of energy conservation issues. Knowledge of their level of awareness will determine the issues to stress on as well as the overall approach to use. Additionally, the preparedness of staff to support energy conservation activities will affect the success of energy savings efforts, and this must be determined. Thus, there is the need for research into the electric energy conservation perspective of staff [16], [17]. This need has not been adequately addressed in literature.

This paper presents the results of a survey which sought to determine the level of energy conservation awareness among staff of the Kwame Nkrumah University of Science and Technology. The study determined their levels of knowledge in the efficient use of

various consumer appliances found in offices. Also, the extent to which they are already engaged in energy conservation activities was determined. Furthermore, their preparedness to support efforts by the University to conserve energy was assessed. The study was carried out through the administration of questionnaires. The results of the study provide useful input for any policy aimed at conserving energy in educational institutions.

## 2. METHODOLOGY

The survey was conducted by distributing questionnaires to teaching and non-teaching staff of the Kwame Nkrumah University of Science and Technology. The survey questions were chosen carefully with simple and understandable terms. The research questions partly focused on awareness of energy conservation measures related to the use of various electrical appliances found in offices. The loads considered were: electronic devices, refrigerators, air-conditioners and light bulbs. With regards to the preparedness of staff to engage in energy saving activities, questions were asked to determine if they were already performing any energy saving activity and whether they were willing to participate in energy saving activities. In both cases, a list of energy saving activities was presented for them to select from. Additionally, staff were asked about their willingness to participate in energy awareness campaigns and whether their involvement in such campaigns will hinge on the provision of incentives.

The sample size for the survey was determined using the population of staff of the University. The population of staff was obtained as 3435 from the Quality Assurance and Planning Unit (QAPU) of the University. Using equation (1) [18], the sample size was obtained as 346. However, 350 questionnaires were printed and distributed. The z-score, estimated proportion of attribute, and margin of error values used in the computation of the sample size using equation (1) were 1.96, 0.5, and 0.005 respectively.

The analysis of the collected data was done using the Statistical Package for Social Sciences (SPSS) software. The descriptive statistics model in SPSS was employed to summarize the data into figures, tables and charts.

$$n_0 = \frac{\left( \frac{Z^2 pq}{e^2} \right)}{1 + \left( \frac{Z^2 pq - 1}{N} \right)} \quad (1)$$

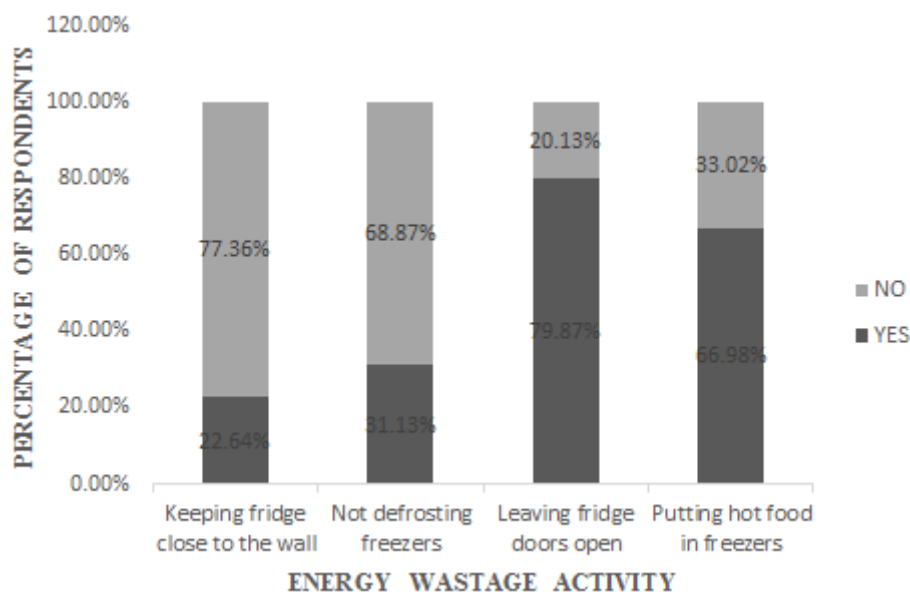
where  $n$  is the sample size,  $z$  is the z-score,  $p$  is the estimated proportion of an attribute that is present in the population,  $q = 1 - p$ ,  $e$  is the margin of error or confidence interval and  $N$  is the population.

### 3. RESULTS AND ANALYSIS

Out of the 350 questionnaires distributed to both academic and non-academic staff, 318 were completed and returned. The response rate of the survey is thus 90.86%, which is high for a survey of this kind [19]. In the sub-sections that follow, the results of the study and analysis done are presented.

#### 3.1. Energy efficiency awareness in the use of refrigerators

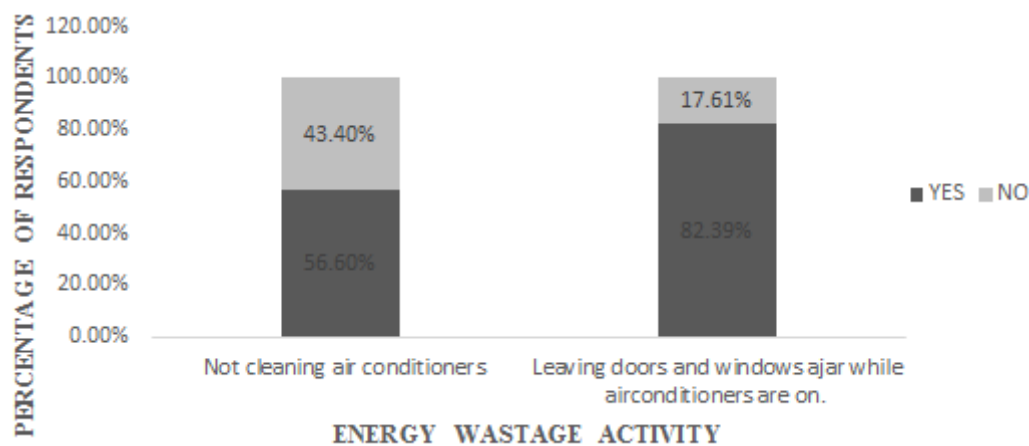
The respondents were asked whether they knew that leaving fridge and freezer doors ajar, keeping refrigerators close to walls, not defrosting freezing compartments, and putting hot foods in refrigerators, lead to energy wastage. Three hundred and eighteen staff gave responses to all the questions. *Figure 1* shows details of the results obtained. Close to twenty-three percent (22.64%) of them indicated knowledge of the fact that keeping refrigerators close to walls results in energy wastage. The remaining staff, constituting more than seventy-seven percent (77.36%), were ignorant of this. With regards to energy wastage due to not defrosting freezer compartments, about thirty-one percent (31.13%) of respondents knew about this while the rest, constituting almost sixty-nine percent (68.87) were unaware of this. Also, 79.87% of staff knew that leaving refrigerator doors ajar lead to them consuming more energy than required. Finally, close to sixty-seven percent of staff indicated knowledge of the fact that putting hot foods in refrigerators cause them to draw more energy than required.



*Fig. 1. Energy efficiency awareness in the use of refrigerators*

### 3.2. Energy efficiency awareness in the use of airconditioners

Airconditioners contribute largely to the energy bills of educational institutions. Not closing doors and windows properly when airconditioners are switched on amount to energy wastage. Also, not cleaning airconditioners regularly make them consume more energy than required. The respondents were asked about their knowledge of these facts. *Figure 2* shows results obtained. About fifty-seven percent (56.60%) of them were aware of the fact that when airconditioners are not cleaned regularly, much energy is wasted. The rest did not know that. With regards to knowledge of the fact that leaving doors and windows not properly closed result in energy wastage, a little over eight-two percent (82.40%) of the respondents indicated knowledge of this fact. Thus, majority of staff are aware of energy wastage issues relating to the use of airconditioners.



*Fig. 2. Energy efficiency awareness in the use of airconditioners*

### 3.3. Energy efficiency awareness in lighting

Lighting is critical in educational institutions and contributes significantly to energy bills. Keeping bulbs on when there is adequate illumination from sunlight amounts to energy wastage. It is common to find electric bulbs in corridors and other areas switched on even when they are not needed. In the absence of automatic lighting control devices, the involvement of staff in switching such bulbs off will bring about significant energy savings. The staff were asked if they had been switching light bulbs off when there is adequate illumination from the sun. *Figure 3* shows the results obtained. Two hundred and sixty-five staff representing over 83% of respondents indicated that they had been doing that. The rest constituting less than 17% of respondents indicated they were not doing that. The high number of staff already involved in putting light bulbs off when not required is encouraging.

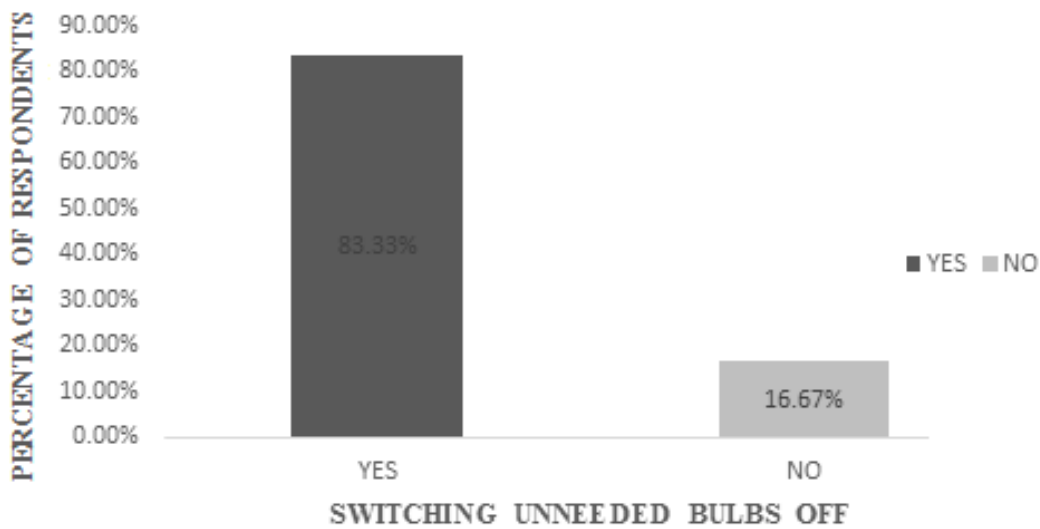


Fig. 3. Energy efficiency awareness in the use of light bulbs

### 3.4. Energy efficiency awareness in the use of electronic devices

Electronic devices on standby consume a small amount of energy. However, keeping several of them on standby for long periods could be a source of significant energy wastage. Knowledge of this fact could bring about significant energy savings. Staff were asked whether they knew about this fact. The result obtained is shown in *Figure 4*. Almost 85% of the staff indicated knowledge of this fact. Less than 15% were ignorant of this.

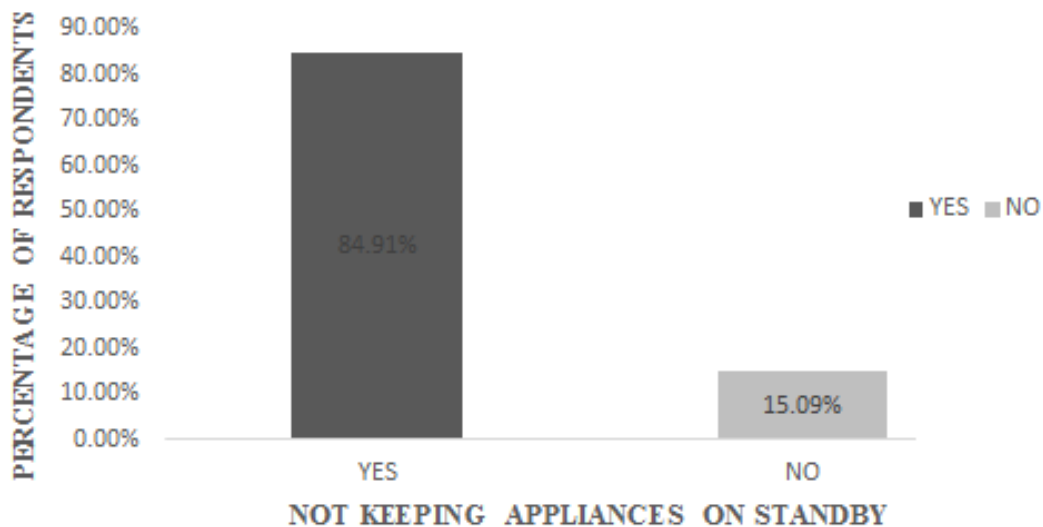


Fig. 4. Energy efficiency awareness in the use of electronic devices

### 3.5. Engagement in energy saving activities

Involvement of staff in energy saving activities is critical if significant gains are to be made in energy conservation. Respondents were asked whether they were already engaged in

energy saving activities. Those who indicated involvement in energy saving activities were asked to select from a list of energy saving activities, the specific activities they were engaged in. Two hundred and eighty-eight staff representing over 88% of respondents indicated that they were already involved in energy saving activities. *Table 1* shows details of the number of staff engaged in specific energy saving activities. It is noted from *Table 1* that majority of staff close doors and windows when airconditioners are on. However, less than 37% percent of staff switch off their airconditioners when leaving the office for more than 10 minutes. It is also noted that most staff prefer to use airconditioners instead of allowing natural ventilation. Thus there is the need to install devices to automatically turn off airconditioners during periods when staff are not in their offices, to cut down on energy wastage.

Table 1. Energy saving activities currently engaged in by 288 staff

No.	Activity	No. of staff engaged in activity	Percentage (%)
1	Turning off printers, photocopiers and computers after use.	240	84.81
2	Putting off airconditioners and fans when leaving the office for more than 10 minutes.	106	36.81
3	Turning off unnecessary light bulbs during and after work.	223	77.43
4	Turning off fridges after close of work on Fridays.	168	58.33
5	Not leaving chargers on and not keeping electronic devices on standby.	226	78.47
6	As much as possible, using natural ventilation and fans instead of airconditioners.	115	39.93
7	Keeping doors and windows closed when airconditioners are on.	181	62.85

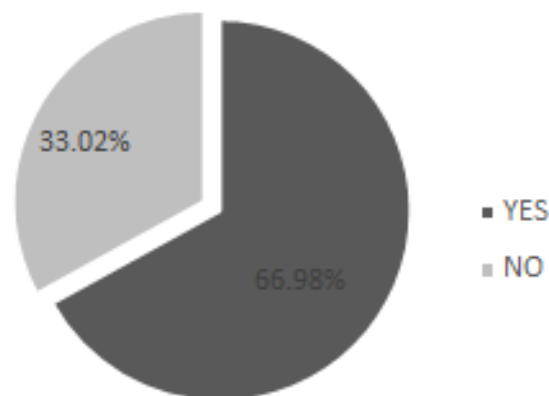
A question was also asked to know whether staff were prepared to continue to engage in or now begin to take part in energy saving activities. Out of the 318 respondents, 299 staff representing a little over 94% expressed willingness to take part in energy saving activities. Details of the specific activities that the 299 staff are prepared to engage in are presented in *Table 2*.

Table 2. Energy saving activities to be engaged in by 299 staff

No.	Activity	No. of staff engaged in activity	Percentage (%)
1	Turning off printers, photocopiers and computers after use.	280	93.65

No.	Activity	No. of staff engaged in activity	Percentage (%)
2	Putting off airconditioners and fans when leaving the office for more than 10 minutes.	176	58.86
3	Turning off unnecessary light bulbs during and after work.	271	90.64
4	Turning off fridges after close of work on Fridays.	247	82.61
5	Not leaving chargers on and not keeping electronic devices on standby.	265	88.63
6	As much as possible, using natural ventilation and fans instead of airconditioners.	280	93.65
7	Keeping doors and windows closed when airconditioners are on.	259	86.62

Again, staff were asked whether it was necessary for incentives to be provided to encourage them to continue or start energy saving activities. *Figure 5* shows the results obtained. Nearly 67% of staff were of the view that the provision of incentives was necessary. Thus, it is important for educational institutions to provide some form of incentives to staff to whip up the interest of many to get involved in energy saving activities.



*Fig. 5. Responses to the provision of incentives for energy savings*

### 3.6. Willingness to join energy efficiency awareness campaigns

Education on energy efficiency brings about significant gains in energy savings. Here, staff were asked about their willingness to take part in educational campaigns on energy efficiency. *Figure 6* shows the responses obtained. Over 77% of respondents indicated willingness to join such educational campaigns. This is very encouraging, considering the fact that staff of educational institutions can contribute significantly to behavioural change in students.



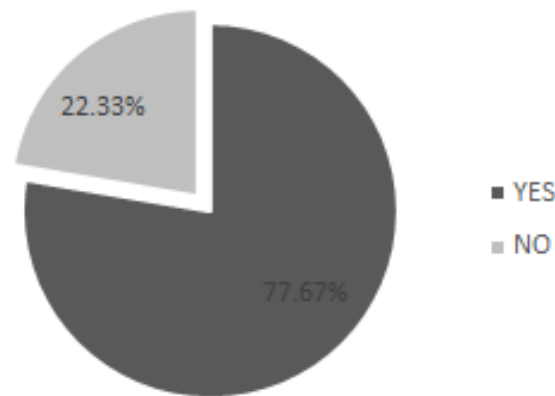


Fig. 6. Willingness to join educational campaigns on energy efficiency

#### 4. CONCLUSION

This paper has presented and discussed the results of a study conducted to determine the level of energy efficiency awareness among staff of the Kwame Nkrumah University of Science and Technology, and also assess their preparedness to engage in, as well as promote energy saving activities. It was realised that at least fifty-seven percent of staff have significant knowledge about measures employed to conserve energy. Not less than Eighty-eight percent of staff are already engaged in at least one form of energy saving activity. Over ninety-four percent of staff expressed willingness to take part in energy conservation activities. Also, more than seventy-seven percent expressed interest in participating in educational campaigns that focus on energy conservation. However, nearly sixty-seven percent of staff wanted the institution to provide incentives to encourage them to conserve energy. The results of this study will be a useful input in formulating energy conservation policies in educational institutions.

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