

Energy Conservation Metrics: Knowledge, Attitude and Practice among Students in ATBU, Bauchi, Nigeria

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Abstract

The study examined the level of knowledge on energy conservation among students of Abubakar Tafawa Balewa University (ATBU), Yelwa Campus, Bauchi; their attitudes towards energy conservation and the practices involved in energy conservation. Energy conservation awareness does not only bridge the widening gap between energy demand and availability, it helps to ingrain an energy saving consciousness among the society. This study used proportionate random sampling. The questionnaire for this study contains 4 section: socio-demographic characteristics, knowledge, attitude and practices toward energy conservation. The outcome of this study indicated that majority of the students have knowledge on energy conservation with a good attitude and practice toward energy conservation. The finding of this study is expected to be of significant importance to the appropriate authorities and all other agencies in their efforts to enhance the effectiveness and application of energy conservation. The outcome of this study will help in reminding and enlightening the students on their role towards increasing the level of energy to be conserved. The average age of the respondents was 23 years and 57% of the respondents were between the ages of 16-23 years. This average age indicates that most of the respondents were in their active age, which makes them suitable for this study as they responded to the questions objectively. Majority of the respondents (83.0%) know that wasteful use of energy can be avoided through energy conservation. It was also observed that 59% used energy saving appliance in their rooms, 72% of the respondents switch off the light during the day time and 56% switch off most electrical appliances which are not in used. The study recommends that equipping the students with an in-depth knowledge on energy conservation is a key factor toward energy conservation.

Keywords: energy, knowledge, attitude, practice and conservation.

Introduction

Energy is seen as a critical component of progress and has always been an essential and indispensable contribution to the current civilization's economic needs. It is the driving force of industrialization (Njoku *et al.*, 2017). It is such a strong engine of economic and social potential that no country has progressed far beyond a subsistence economy without guaranteeing that a large portion of its people has access to energy services (Kuzemko *et al.*, 2019).

Energy demand is one of the most important issues within universities' sustainability efforts, for a lot of reasons. Whenever energy is saved or conserved, not only money is saved, there is also a reduction in the demand for energy. Energy happens to be among

students' most necessary demand and costly expenses (Petratos & Damaskou, 2015). Increase in energy demand is driven by economic growth but it is expected to be offset by significant improvement in energy intensity (Petratos & Damaskou, 2015).

As institutions expand, more energy is needed to keep up with the increased level of students' activities. According to (Sambo, 2010), population is a primary driver of energy consumption, with the degree of economic activity and its structure assessed by total gross domestic product being the most important variable. At the same time, energy saving reduces costs. Electricity is one of the most often utilized forms of energy on campus for a variety of daily activities such as ironing clothes, boiling water with a heater, cooking with an electric stove, and charging computers and phones (Zehner, 2012). It can be seen that electricity, the greatest quality of energy, is necessary for economic progress, national development, and higher living standards (Khan, 2018).

Efficiency improvements in the residential sector, which make up around 25% of total final energy consumption and 29% of all electricity usage (Bertoldi & Atanasiu 2009), are anticipated to have a significant role in deciding whether or not a nation fulfils its efficiency objectives. The adoption of affordable domestic energy efficient technology and conservation practices might result in residential energy savings of 27% by 2020 when compared to baseline growth, according to the European Council Action Plan for Energy Efficiency (European Council, 2006). Fraunhofer ISI *et al.* (2009) predict that with further measures to remove obstacles to the adoption of existing technologies, the residential sector may cost-effectively save around 19 percent of final energy compared to the baseline in 2020. The adoption of energy-efficient household appliances is anticipated to provide 7% of this energy savings, with increased thermal insulation accounting for the majority of the remaining 80%. (including lighting). The contribution of energy-efficient home appliances to overall energy savings, as compared to business as usual, can rise to roughly 17 percent in the future with further legislative measures to promote adoption (Fraunhofer ISI *et al.*, 2009).

Energy saving is a good thing for the environment. A pro-environmental behaviour is one that a person adopts and that society perceives as protecting the environment (Krajhanzl, 2010, p. 252). It entails taking a number of steps to minimise the damage that is done to the environment as much as possible (Steg & Vlek, 2009). Studying the determinants of this real behaviour is crucial to ascertain why some people conserve energy while others do not, much like with other pro-environmental behaviours.

Generally speaking, residential energy policies can be used to increase adoption of both energy-efficient technologies as well as improved energy-saving practises (e.g., turning off lights when leaving a room, adjusting indoor temperature at night, turning down the heat in unused rooms, only running the dishwasher and washing machine when it is fully loaded) (e.g. insulation of outer walls, attic, window glazing; energy efficient heating system; purchase energy efficient household appliances, office equipment or light bulbs) (Mills & Schleich, 2012). The formulation of effective and well targeted residential energy policies

to increase both conservation and technology adoption must be based on a sound understanding of how technology adoption, conservation practices, energy use knowledge, and attitudes towards energy conservation are associated with household characteristics (Oh *et al.*, 2010). In a diverse regional organization, it is also essential to identify country-specific differences in energy-saving technology adoption and energy conservation practices in order to generate an appropriate combination of common and country-specific policies (Allcott & Mullainathan 2010).

Energy conservation awareness does not only bridge the growing gap between energy demand and supply, it also instills in the society an energy-saving attitude and a mindful approach (Liu *et al.*, 2019). It is critical to examine the current level of knowledge, attitude, and practice (KAP) on energy conservation across various sectors in order to carry out energy conservation initiatives (Mills & Schleich, 2012).

The term "knowledge" refers the information, understanding, and skills that you gain through education or experience (Oxford Dictionary, 2022). Attitudes regarding energy conservation are referred to as behavioural patterns towards conservation of energy. Individuals' practices are the methods in which they display their knowledge and attitude via their behaviour. Understanding among KAP institutions will allow for a more efficient method of creating awareness since it will allow for the development of failure-based programs in accordance to institution needs (Liu *et al.*, 2019). It is against this background that this study seeks to study KAP on energy conservation in the study area.

Methodology

Characteristics of Study Population

Abubakar Tafawa Balewa University is a federal university of technology located in Bauchi, north eastern part of Nigeria. The university was named after the first prime minister of the federal republic of Nigeria, Sir Abubakar Tafawa Balewa. The university's motto is "Doctrina Mater Artium", which means "education is the mother of arts". The university was established in 1980 as a federal university of technology, Bauchi, Nigeria. At its inception the university inherited the site of the former Bauchi College of arts and science (BACAS) at Yelwa.

The population for this study are the students on campus in ATBU Yelwa campus. The university comprises of six different faculties: Faculty of Environmental Technology, Science, Engineering, Education, Agriculture Technology; and different departments, which make it a heterogeneous environment with students from diverse field of study. As such, the level of knowledge, attitude and practice on energy conservation among students in the university is expected to vary. The campus consists of male and female hostels, where there is hall I to III in male hostels with 8 blocks (A-H) and hall I to III in female hostels namely (Babylon, Zion and Bethel).

Sample and Sampling Techniques

The sampling technique used in this study was multi-stage stratified proportionate random sampling. Considering the number of halls and blocks, having 3 halls for the male students and 3 for the female students, by breaking ATBU halls into strata. Hence, the number of samples considered from each stratum was based on its proportion in the total population. Numbers were picked at random from each stratum.

Determination of Sample Size

For the purpose of this research, Yamane's formula for calculating sample size was used in this study (Yamane, 1973)
$$n = \frac{N}{1+N(e)^2}$$

Where

n = the sample size

N = the size of Population

e = Margin of error (10%)

By using the Yamane's formula for sample size determination with an error of 10% and with a confidence coefficient of 90%, the calculation arrived at 165 samples. Therefore, 165 samples of respondents were considered to represent the entire population in the study area.

Data Collection Instrument

The instrument for this study was a structured designed questionnaire which was designed by the researcher. It contains four sections (A-D) comprising socio-demographic factors, knowledge on energy conservation and attitude towards energy conservation and practices towards energy conservation. The energy conservation practice was divided into self-reported and observational.

Administration of Questionnaires

The face to face method of interviewed was adopted during the data administration by the researcher and trained enumerators. It was administered within ATBU Yelwa campus.

Procedure for Data Analysis

The data for this study were exported coded and analysed using Statistical Package for Social Sciences (SPSS). This study used descriptive feature of SPSS in describing the statistics of the surveyed respondents. The responses on the respondents' characteristics, current practices, attitude and knowledge towards energy conservation were all summarized and reported in form of frequencies, charts, percentages and mean distributions.

Results and Discussion

Socio-Demographic Characteristics

Table 1 presents the socio-demographic characteristics for this study. During the survey, it was observed that the male gender was majority of the sample population, amassing a total of 57%. This clearly indicates that male students have more enrollments in the university than the female students who constitute 43% of the study population. This may be due to the fact that the male gender are involved in educational systems more than their female counterparts in northern Nigeria; Abubakar Tafawa Balewa University (ATBU) Bauchi inclusive.

The average age of the respondents was 23 years and 57% of the respondents were between the ages of 16-23. This average age indicates that most of the respondents were in their active age and this makes them suitable for this study as they responded to the questions objectively. Those from the age of 24-31 had a percentage of 40.6%, followed by those above the age of 31 with 2.4%. From the findings above, it is observed that most of the respondents were between the ages of 16-23.

Table 1. Socio-Demographic Background of the Respondents

Variables	Frequency (n=165)	Percent
AGE		
Average	29	
16 – 23	36	40.6
24 – 31	2	
Above 31	214	63.0
GENDER		
Male	94	57
Female	71	43
MODE OF ENTRY		
UTME	126	76.4
Direct Entry	31	18.8
Transfer	8	4.8
FACULTY OF RESPONDENTS		
Science	44	27
Engineering	32	19
Agriculture	10	6
Environmental	47	29
Management Technology	18	11
Education	14	8
LEVEL OF RESPONDENTS		
100	49	30
200	36	22

300	22	13
400	9	5
500	49	30
MEMERSHIP OF ENVIRONMENTAL SUSTAINABILITY GROUPS		
Yes	18	10.9
No	147	89.1

Source: Field Survey, 2021.

The findings also revealed that among the mode of entries UTME has the highest percentage of 76.4%. This finding coincides with the fact that the university itself has acknowledged that it admits students through UTME than others. Direct entry (DE) has (18.8%) and transfer students has 2.4% of the study population. We can also deduce from this result that, only a few students transfer from one university to another.

When the respondents were asked about their faculties, it was found that Environmental Technology has the highest percentage of students with 29%. This may likely because it has the highest number of students in the university. Followed by Faculty of Science with 27% and 19% for the Faculty of Engineering. Faculty of Management has 11%, Faculty of Education having a percentage of 8% while Faculty of Agriculture has a percentage of 6%. The respondents were asked about their various levels in the university and it was found that the students of 100 level and 200 level had 30% and 22% respectively. Followed by 300 level with 30% and 400 level, with a percentage of 5. Students of 500 levels had a percentage of 30. The results show that 100 level and 500 level have the highest percentage because they were set of students that were allocated hostel officially by the school authority.

Among the respondents, 89.1% do not belong to any association advocating for environmental sustainability, as such, only 10.9% were members of some associations advocating for environmental sustainability. Among such association are SEMTA, BIOSA, NITEC, NICESA, NITES.

Number of Students per Room

From the outcome of the analysis, as shown if figure 1, it was observed that the mean number of students in a room was 5.61 and the range of students living in a room was from 2-9 with (81.8%), 10-17 number of students in a room had 17.6% and 18-25 had 0.6%. This clearly shows that the students are living within the range of 6 which is the normal allocation range.

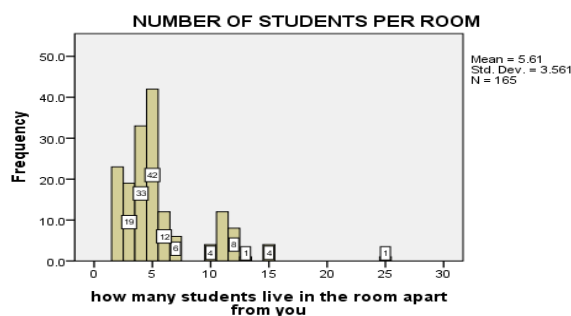


Fig 1: Number of Students per Room (*Source:* Field Survey, 2021).

Knowledge on Energy Conservation

During the survey, the respondents were inquired to assess their level of knowledge on energy conservation with the aid of one to two Likert Scale for each of the ten statements. The scale was designed based on “AGREE” and “DISAGREE” options, so as to rank their level of agreement.

Table 2. Respondents’ knowledge on energy conservation

Statement	Agree	Disagree
Energy is scarce and expensive yet needed for growth and development	146 (88.5%)	19 (11.5%)
The issue of energy conservation becomes extremely important	143 (86.7%)	22 (13.3%)
Energy conservation bridges between demands and availability	118 (71.5)	47 (28.5%)
Concurrent use of same energy type among colleagues helps in energy conservation	91 (55.2%)	74 (44.9%)
Wasteful use of energy can be avoided through energy conservation	137 (83%)	28 (17%)
Switching off electrical appliances when not in use reduces energy consumption	135 (81.8%)	30 (18.2)
The use of energy saving appliances help in conserving energy	131 (79.4%)	34 (20.6%)
The use of daylight during the day reduces energy consumption	127 (77.5%)	38 (23%)
Energy conservation brings about reduction in energy bills	118 (71.5%)	47 (28.5%)
Energy saved is energy generated	121 (73.3%)	44 (26.7%)

Source: Field Survey, 2021.

According to table 2, several statements were presented to the respondents about knowledge on energy conservation. 88.5% of the respondents agreed that “Energy is scarce

and expensive yet needed for growth and development", 86.7% also agreed "The issue of energy conservation become extremely important and 71.5% agreed that "Energy conservation bridges between demands and availability." Also, a greater number of the respondents (55.2%) agreed that "Concurrent use of same energy type among colleagues helps in energy conservation" while 83% agreed that "wasteful use of energy can be avoided through energy conservation." The respondents were also presented this statement: "Switching off electrical appliances when not in use reduces energy consumption" and 81.8% agreed to the statement. 77.5% of the respondents agreed that "The use of daylight during the day reduces energy consumption", 71.5% agreed that "Energy conservation brings about reduction in energy bills" and 73.3% of the respondents agreed that "Energy saved is energy generated."

It can conclusively be inferred that the students of ATBU, Bauchi have a good knowledge of energy conservation, for the fact that majority of the respondents have positively agreed to the statements provided on energy conservation knowledge.

Table 3. Attitude towards energy conservation

Statement	Strongly disagree	Disagree	Neutral	Agreed	Strongly agree
I consider energy conservation as my responsibility	26 (15.8%)	42 (25.5%)	33 (20%)	15 (9.1%)	49 (30.1)
I have passion for conserving energy	26 (15.8%)	60 (36.4%)	33 (20%)	15 (9.1%)	29 (17.6%)
I feel more comfortable using energy saving appliances	17 (10.3%)	40 (24.2%)	35 (21.2%)	30 (18.2%)	43 (26.1%)
Learning about energy conservation is my desire	23 (13.9%)	56 (33.9%)	35 (21.3%)	18 (10.9%)	33 (20%)

Source: Field Survey, 2021.

Attitudes Toward Energy Conservation

The study questionnaire inquired the respondents on their attitude towards energy conservation with the aid of one to five likert scale for each of the five statements. The scale was designed based on strongly disagree, disagree, neutral, agree, strongly agree options so as to know their attitudes toward energy conservation.

According to table 3, the two statements with the most agree and strongly agree responses are "I consider energy conservation as my responsibility" (9.1% and 30% respectively) and "I feel more comfortable using energy saving appliances" (agree 18.2% and 26.1% respectively). The statements about attitudes toward energy conservation that has least

positive responses was "I have passion for conserving energy", with 36.4% (disagree) and 26% (strongly disagree).

The findings generally revealed that the respondents have negative attitude towards energy conservation. This could be easily observed because disagree and strongly disagree responses were the majority.

Energy Conservation Practices

From table 4, 86.7% of the respondents "switch off their electrical appliances when not in use". Only 13.3% of the respondents do not "switch off their appliances when not in use." The respondents that "mostly use energy saving appliances" are 63.6%, followed by 36.4% that "do not use energy saving appliances."

Among the respondents 65.5% "don't use light during the day time, only 34.5% use light during the day time. In addition, 38.8% of the respondents leave their electrical appliances on even while sleeping with a frequency of 64; 61.2% of the respondents switch off electrical appliances while sleeping.

82.4% of the respondents "minimize the use of electrical appliances as much as they can" have a frequency of 136, the remaining 17.6% having a frequency of 29, do not "minimize the use of electrical appliances as much as they can."

The results however showed that the respondents have a good practice toward energy conservation in the study area.

Statement	Frequency (165)	Percentage (%)
I switch off electrical appliances when not in use		
YES	143	86.7
NO	22	13.3
I mostly use energy saving appliances		
YES	105	63.6
NO	60	36.4
I don't use light during the daytime		
YES	108	65.5
NO	57	34.5
My electrical appliances are always on even while sleeping		
YES	64	38.8
NO	101	61.2
I minimize the use of electrical appliances as much as I can		
YES	136	82.4
NO	29	17.6

Source: Field Survey, 2021.

Observation on Energy Conservation Practices

Energy saving appliances used by the respondents

To support the quality of the self-reported practices, the survey includes observation of energy conservation practices among the respondents. This was done by the enumerators to ensure accuracy. From fig 1, it was observed that 59.79% use energy saving appliance in their rooms, only 41.21% use other form of appliances.

energy saving appliances are mostly use by the students

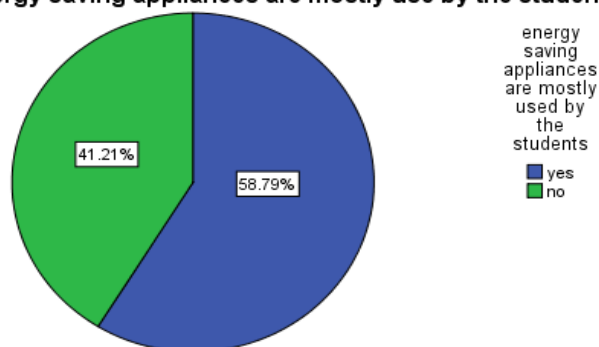


Fig 1. The percentage of students that use energy saving appliances (**Source:** Field Survey, 2021).

Respondents that turn off the light during the day

According to the observation, 72.12% of the respondents switch off light during the day time and 27.88% do not practice that. This is obtainable in fig 2.

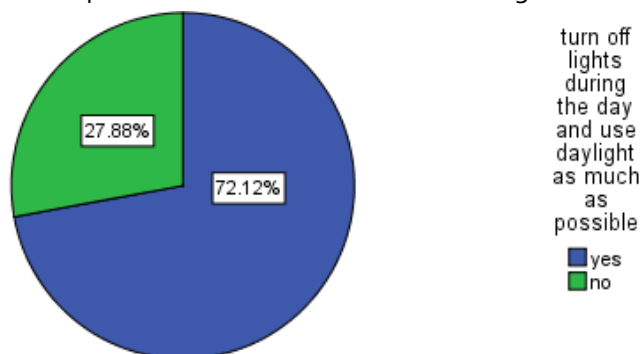


Fig 2. The percentage of students that switch off their light during the day (**Source:** Field Survey, 2021).

Respondents that switch off electrical appliances when not in use

From fig 3, It can be observed that 56.36% of the respondents switch off most electrical appliances which are not in used. Meanwhile, 43.64 of the respondents do not switch off their electrical appliances when not in use.

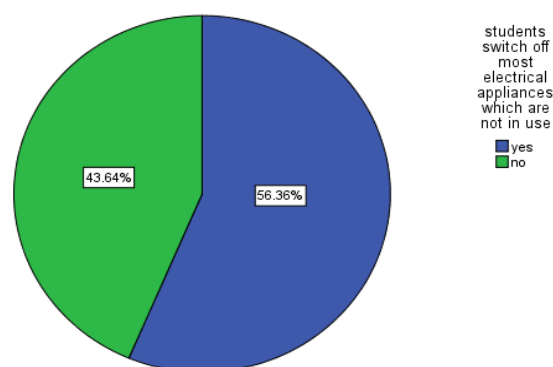


Fig 3. Distribution of students who switch off their electrical appliances when not in use (Source: Field Survey, 2021).

From the foregoing, the observation results clearly indicate that the respondents had a good energy conservation practice.

Conclusion

This study began with an effort to assess the students' knowledge, attitude and practices on energy conservation in ATBU, Yelwa Campus, Bauchi, with a view to reduce electricity bills and encourage the students toward energy conservation practices. Through investigations, it was observed that majority of the respondents know that wasteful use of energy can be avoided through energy conservation. It was also observed that a fair majority of the respondents use energy saving appliance in their rooms and also switch off most electrical appliances which are not in used. The perceptions of the students about energy conservation were measured based on three main factors; knowledge on the significance of energy conservation, attitudes towards energy conservation, and energy conservation practices. The responses recorded from the respondents regarding the positive statements presented about perceptions were generally positive. Thus, equipping the students with more knowledge on energy conservation is a key factor toward energy conservation. Descriptive statistics was employed to gather useful information on the current knowledge, attitude and practices regarding energy conservation. Hence, the sole aim of the study was achieved.

Policy Implication

Saving energy, increasing efficiency and conservation are the terms used to describe ways we can reduce our overall energy consumption. The findings of this study will contribute to literature, policy and guide relevant stakeholders in ATBU. To save money by reducing electricity bill and lower the stress put on the environment by using less energy. The outcome of this study is expected to be of significant importance to the appropriate authorities in their efforts to enhance the effectiveness and application of energy conservation. It is expected to guide them on the necessary intervention needed and in coming up with strategies to ensure strict enforcement of energy conservation practices by the students. Both students and the university authority will be the beneficiaries of this

study. It will reduce the amount of money spent on electricity bills, and there is going to be an increase in the energy supply to the students due to reduction in the amount of energy used. The outcome of this study will help in reminding and enlighten the students on their role towards increasing the level of energy to be supplied. Thus, seeking support from the students to contribute their quota is crucial.

Recommendations

- The only way to combat ignorance is through education. Therefore, the idea of energy saving should be promoted throughout all structures of the university. This could be achieved through the organization of training programmes, personal advice, one-on-one engagements, demonstrations, benchmarking, commitment, goal-setting, labelling, modeling and feedback on energy conservation strategies, periodically, to refresh employees and students on energy conservation behaviors.
- Promotional campaigns should be developed which takes into consideration specific behaviors associated to energy consumption. Also, incentives and disincentives policies for energy conservation should be framed when considering how people's behaviors are formed and how they could be influenced. Energy audit is an effective instrument in advancing energy efficiency in the university. Energy audits should be considered as part of directives on energy performance of buildings in connection to the issuance of building permits.
- Management of the university needs to promote energy audit activities on all the Campuses of the university and also make energy audits mandatory and provide feedback to employees in the various offices. Energy audits will provide detailed information on energy use and saving potential. An energy audit would normally include an evaluation of the thermal characteristics of the building, its existing infrastructure and the appliances in use. Even though an energy audit reports may not directly address behavior change. Typically, energy audits tend to focus more on measures that require investment in a specific technology.

Recommendations for Further Studies

The limitations of this study should be noted with a positive view towards extending the current study, by offering some useful recommendations for future research.

- The major limitation at the early stage of this study was its inability to cover all the two campuses and the other various sources of energy. This problem was resolved by considering only Yelwa Campus of ATBU and focusing on only electrical appliances usage. Looking at the amount spent on electricity, the study was worth it and it has the highest dependency ratio compared to other sources. Thus, it is suggested that future studies should conduct related studies to cover the other campus, that is, Gubi Campus and the remaining sources apart from electrical appliances.

A comparative study with different populations at other universities would help to gain better understanding and make us to generalize our findings. Authorities responsible for

monitoring energy conservation program will benefit from future studies with different populations apart from ATBU Bauchi.

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