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# Understanding Energy Practices in Ghanaian Higher Education: Lessons from Academic City University

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**Abstract**

This study investigates energy management practices within Academic City University, Ghana, highlighting critical gaps between awareness and the implementation of sustainable energy strategies. Universities, as energy-intensive institutions, face unique challenges due to outdated infrastructure and behavioural inefficiencies, particularly in developing regions. The study addresses these gaps by analysing energy consumption patterns and opportunities for sustainable interventions. A mixed-methods approach was adopted, integrating qualitative and quantitative methodologies to collect and analyse data from 400 participants, including 300 students (150 hostel residents and 150 non-residents), 50 faculty members, 30 non-academic staff (cafeteria workers), and 20 facility managers (lab personnel). Stratified random sampling ensured representation across key groups. Data collection encompassed structured interviews, surveys, and on-site observations conducted over a six-month period. The findings reveal that, while 95% of participants demonstrated high familiarity with energy management principles, only 65% actively practised sustainable behaviours. Behavioural inefficiencies, such as failing to turn off appliances when not in use, and reliance on outdated infrastructure emerged as significant contributors to energy waste. The study also underscores the potential for up to 20% energy savings through strategic interventions that combine behavioural change programmemes and infrastructural upgrades. By leveraging insights from global frameworks like the African Green Universities Initiative (AGUI) and adapting them to the local context, this study emphasises the importance of fostering a culture of energy stewardship. It concludes that a comprehensive energy management strategy, addressing both technical and behavioural dimensions, is essential for Ghanaian universities to achieve sustainability and cost-efficiency while contributing to the global fight against climate change.

**Keywords:** *behavioural energy practices, energy efficiency, higher education, energy conservation, sustainable development*

## INTRODUCTION

In an era of growing environmental concerns and an urgent need for long-term solutions, energy resource management has emerged as a critical imperative. This need is most pronounced on university campuses, which are bustling hubs of activity where energy consumption intersects with education, research, and community life. We must recognise the profound impact that our decisions can have in regard to energy management (Laporte & Repiso, 2024). Most universities house a variety of facilities, from energy-intensive laboratories and research centres to residence halls with fluctuating occupancy. This diversity creates a complex energy landscape, with lighting, heating, ventilation, and air conditioning (HVAC) systems being major contributors to overall energy use. A 2019 study by Statistics Canada revealed that university campuses have an energy use intensity (EUI) of 1.47 GJ/m², which is higher compared to colleges and technological institutes. This translates to substantial financial burdens. Thus, each kilowatt-hour saved helps so much in reducing annual spending on energy bills (The Association for the Advancement of Sustainability in Higher Education, 2023).

Faced with these challenges, universities have a unique opportunity to emerge as leaders in sustainability. By implementing effective energy management strategies, they can not only reduce their environmental footprint but also reap significant financial benefits. Studies have shown that universities can achieve energy savings of 10-30% through strategic interventions (Mohammadi et al., 2023). The issue of energy management on university campuses is not unique to the United States. It is a global challenge demanding international solutions. A 2021 report by the International Energy Agency (IEA) revealed that the education sector accounts for a significant portion of global building energy consumption, with universities being major contributors (IEA, 2008). This trend is particularly concerning in rapidly developing countries like Ghana, where new universities such as Academic City University College are being built at an accelerated pace.

A 2022 study by the Global Universities Network for Innovation (GUNI) found that over 70% of universities surveyed have implemented at least one energy-saving strategy, with initiatives ranging from infrastructure upgrades to behavioural change programmes (Vakulchuk, 2024). This positive trend demonstrates a global commitment to sustainability within the higher education sector. By sharing best practices and collaborating on research efforts, universities can accelerate progress towards a more sustainable future for campuses around the world. While data on energy consumption in African universities is not as readily available as in developed regions, there are emerging trends that highlight the significance of energy management. According to a 2020 World Bank report, Sub-Saharan Africa's tertiary education enrolment ratio stands at 9.4%, significantly below the global average of 38%. This low enrolment rate, coupled with the region's rapidly growing youth population, suggests a substantial increase in student enrolment by 2025. While specific projections for 2025 are not detailed in the report, the current demographic trends indicate a potential doubling of tertiary enrolment figures, which would have significant implications for educational infrastructure, resource allocation, and policy planning (Ibrahim et al., 2021). However, many African universities face unique challenges in implementing energy-saving measures.

A 2004 study found that a significant portion of university buildings in Africa rely on outdated infrastructure and inefficient equipment (Sawyer, 2004). Additionally, limited access to reliable and affordable energy sources can further hinder efforts towards energy management. Despite these challenges, there are positive developments. A growing number of African universities are recognising the importance of sustainability. The African Green Universities Initiative (AGUI), launched in 2021, is a promising example. This continent-wide initiative aims to support universities

in implementing renewable energy solutions, promoting energy efficiency, and fostering a culture of sustainability within the African higher education sector (Ntoubia, 2023). Furthermore, a focus on energy management fosters a culture of sustainability within the entire university community. Students, faculty, and staff become more aware of their energy consumption habits and are encouraged to adopt environmentally conscious practices. This awareness can extend beyond the campus walls, influencing personal behaviours and promoting sustainability in the broader community. Universities that prioritise sustainability can attract environmentally conscious students, faculty, and research partners, further enhancing their reputation.

Recent studies have shown critical gaps in energy management awareness and practice within Ghanaian universities. For instance, although approximately 95% of Academic City University's stakeholders among students, staff, and faculty demonstrate knowledge of energy management principles, only 65% actively implement these practices. This disconnect between awareness and action underscores the need for targeted behavioural interventions alongside technological upgrades. Furthermore, the reliance on outdated infrastructure, such as inefficient HVAC systems and lighting, exacerbates energy inefficiency and highlights the urgency for infrastructural modernisation. Behavioural energy practices have a significant impact on overall energy use on campuses. Observations at Academic City University show that a sizable proportion of hostel tenants fail to turn off air conditioning units, fans, or other appliances when they leave. Similarly, in the classroom, some students forget to turn off projectors or fans after use, resulting in excessive energy loss. Such actions imply an opportunity for structured awareness campaigns focusing on energy-conscious activities. With an emphasis on Academic City University's energy management practices, this study provides information on behavioural trends, consumption patterns, and the possibility of energy saving measures. It finds workable ways to close the awareness to action gap by utilizing both qualitative and quantitative approaches, allowing organizations to maximise resource allocation and promote a sustainable culture. Other Ghanaian colleges hoping to combine academic success with energy sustainability should use the findings as a guide.

## LITERATURE REVIEW

The study of energy management and efficiency in higher education institutions is both urgent and vital, especially given the growing environmental concerns and the need for long-term solutions. University campuses are known for their energy-intensive activities, which range from laboratory operations to residential facilities and contribute significantly to overall energy consumption. This high energy demand creates significant financial pressures, emphasizing the significance of effective energy management initiatives (AASHE, 2023). Similarly, the International Energy Agency (IEA, 2008) indicated that educational institutions account for a significant portion of global building energy use, a trend that is similar across rich and developing countries.

Global initiatives and trends in higher education reflect a growing commitment to energy efficiency and sustainability. Such efforts are mirrored by universities in Sub-Saharan Africa, where institutions like Academic City University College face unique challenges, including outdated infrastructure and unreliable energy supplies (Sawyerr, 2004). The African Green Universities Initiative (AGUI), launched in 2021, emphasizes renewable energy adoption and energy efficiency within the continent's higher education sector (Ntoubia, 2023). These initiatives showcase a continent-wide focus on reducing environmental footprints and promoting sustainability through both technical interventions and cultural shifts.

Behavioural change programmes play an important role in encouraging energy-efficient habits among university stakeholders. Developing an energy-aware culture among students, instructors, and

staff improves the success of technical energy management methods. For example, according to Mohammadi et al. (2023), universities can cut energy use by 10-30% by implementing strategic interventions that combine behavioural and technological techniques. Despite advancements, putting sustainable energy management into practice at African institutions is fraught with challenges. According to Sawyer (2004), energy waste is exacerbated by the fact that many university buildings still use antiquated, inefficient technology. Furthermore, current infrastructure is under more stress due to the rapid growth of institutions in Sub-Saharan Africa, where student enrolment is expected to double by 2025 (Ibrahim et al., 2021). Adoption of renewable energy sources and contemporary energy management techniques is required to address these issues.

One important step toward sustainability has been acknowledged as the incorporation of energy management techniques in higher education. In addition to lowering energy use, efficient energy management techniques also increase operational efficiency and promote an environmentally conscious culture. According to a study by Mohammadi et al. (2023), universities can become more sustainable by combining strong management systems with pro-environmental behaviour. In a similar vein, Vakulchuk (2024) highlights the necessity of integrating energy management techniques into the curriculum in order to raise students' understanding of sustainable energy practices. Universities in fast emerging countries, such as Ghana, provide a particular case for these initiatives due to their rising energy needs. As Ibrahim et al. (2021) point out, the implementation of renewable energy systems in African colleges is critical for addressing energy reliability challenges while lowering carbon emissions. Furthermore, programmes such as the African Green Universities Initiative (AGUI) lay the groundwork for promoting energy efficiency and renewable energy solutions in higher education across the continent (Ntoubia, 2023). Universities can position themselves as global sustainability leaders by leveraging technology and behavioural change programmes.

A significant challenge for African universities, as noted in the literature, is the reliance on outdated infrastructure and inefficient equipment, such as HVAC systems and lighting. This infrastructure not only increases energy consumption but also limits the feasibility of adopting modern, energy-efficient technologies. The study explores this issue by assessing the extent of infrastructural inefficiency and proposing targeted upgrades. The manuscript identifies an underexplored opportunity to integrate renewable energy solutions, such as solar power, into campus energy systems. Additionally, it highlights the potential of leveraging advanced monitoring technologies, such as smart meters, to optimize energy use. These opportunities are contextualised for African universities, where energy reliability and cost reduction are pressing priorities. While global studies often emphasize technical interventions, the literature review points to a lack of focus on cultural and behavioural dynamics that influence energy consumption. The study contributes by examining the behaviours of specific campus groups, such as hostel residents and teaching staff, to understand their impact on energy use and to design targeted interventions.

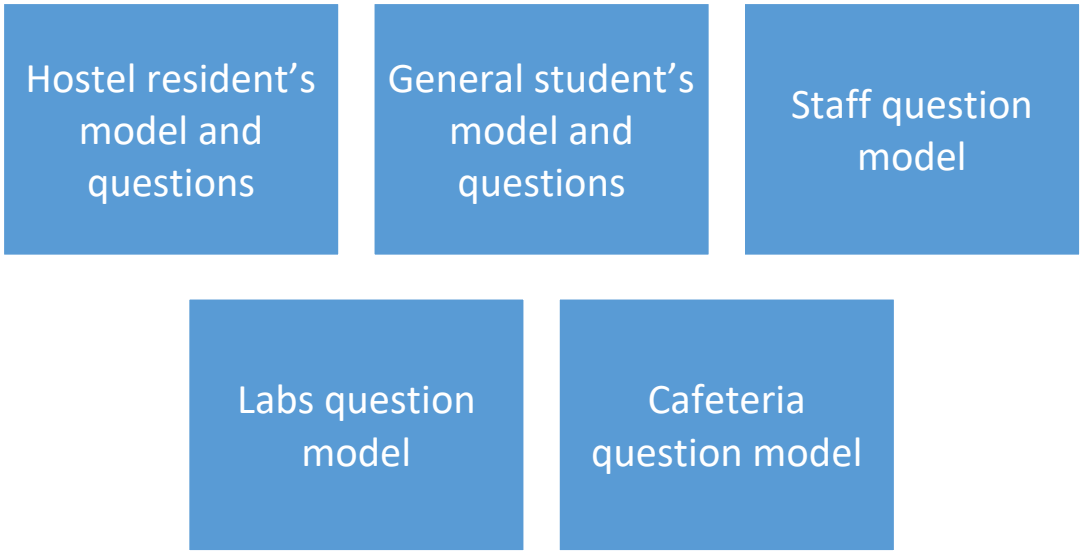
The highlighted gap between energy awareness and actual energy management practices in universities is established. While many stakeholders (students, staff, and faculty) are aware of energy management principles, the translation of this awareness into actionable practices remains limited. The study addresses this gap by exploring how behavioural change programmes can complement technical solutions for energy conservation, particularly in the Ghanaian university context.

## METHODOLOGY

The data presented in this report originates from Academic City College, where we implemented a systematic approach to gather comprehensive insights. Using a meticulously designed database, we crafted standardised inquiries tailored to various stakeholders, including students, faculty, and staff

members. This ensured that responses were both structured and anonymous, fostering openness and honesty.

**Figure 1**
*Data Question Models*




A database was modelled to contains selective technical questions aimed to assess the knowledge of campus dwellers including the hostel residents, general students, staff, lab officers and cafeteria workers. Where Hostel Resident Model contains 6 questions, General Students Model contain four questions, Staff Model contains five questions, Lab Model contains five questions, and Cafeteria Model contains four questions respectively. Elaborated below are the summary questions derived for each group based on their interaction with energy systems on campus;

**Table 1**
*Questions according to Type of Respondents*

| No. | Type of respondents | Questions to assess energy use |
|---|---|---|
| 1 | Hostel Residents | These questions assess energy use within residential settings:<br>• Do you turn off your air conditioner or fan when leaving your room?<br>• How often do you unplug unused appliances, such as chargers and kettles?<br>• Are you aware of the energy consumption of your personal electronic devices (standard laptops and gaming laptops, TVs etc.)?<br>• Do you leave lights on when not in the room?<br>• Do you use energy-efficient appliances (LED bulb, energy-star-rated refrigerator) in your room?<br>• How frequently do you discuss energy-saving practices with other residents? |

**Table 1 (Cont.)**

| No. | Type of respondents | Questions to assess energy use |
|---|---|---|
| 2 | General Students | These questions focus on energy practices in shared spaces:<br>• Do you turn off lights and fans when leaving a classroom or study area?<br>• Are you aware of who is responsible for turning off projectors or other classroom equipment after use?<br>• How often do you report malfunctioning energy-consuming devices (fans, lights and projectors)?<br>• Are you familiar with campus energy-saving policies or guidelines? |
| 3 | Staff Members | These questions explore energy use in office settings:<br>• Do you switch off the air conditioner and lights in your office when leaving for the day?<br>• How frequently do you use energy-efficient lighting or appliances in your workspace?<br>• Do you avoid using multiple appliances simultaneously if not necessary (kettles, printers)?<br>• Are you aware of energy management policies implemented on campus?<br>• Do you often use elevator or stairs to your office? |
| 4 | Lab Officers | These questions evaluate energy practices related to laboratory equipment:<br>• Are you aware of the energy consumption of laboratory equipment (workshop machine and lab equipment)?<br>• Do you ensure that equipment not in use is turned off or put in standby mode?<br>• How often do you maintain laboratory equipment to ensure energy efficiency?<br>• Do you use energy-efficient alternatives for lab operations when possible?<br>• Are you trained in energy-saving protocols for laboratory operations? |
| 5 | Cafeteria Workers | These questions assess energy use in food preparation and storage areas:<br>• Do you ensure that refrigerators and freezers are closed properly when not in use?<br>• How often do you turn off ovens, stoves, or other appliances when they are not needed?<br>• Do you use energy-efficient appliances (energy-star-rated refrigerators or ovens)?<br>• Are you familiar with the impact of energy management practices on operational costs? |

**Data Collection**

A total of 400 participants were selected using stratified random sampling, ensuring representation across the identified stakeholder groups.

The sample included are:

- 300 students: 150 hostel residents and 150 non-residents.
- 50 faculty members.
- 30 non-academic staff members: Cafeteria
- 20 facility managers: Lab

Our methodology involved physically navigating the school environment, engaging individuals in meaningful conversations, and recording their responses directly into the database. This personalized approach not only facilitated data collection but also fostered a sense of inclusivity and community engagement within the college. The study was conducted over a 4-month period, allowing sufficient time for data collection through surveys, interviews, and on-site observations.

**Table 2**
*Sample Demography*

| Demographic Category | Subcategory | Percentage (%) | Frequency (n) |
|---|---|---|---|
| **Participant Distribution** | Students (Hostel Residents) | 37.5% | 150 |
| | Students (Non-Residents) | 37.5% | 150 |
| | Faculty Members | 12.5% | 50 |
| | Non-Academic Staff (Cafeteria) | 7.5% | 30 |
| | Facility Managers (Lab) | 5% | 20 |
| **Gender** | Male | 58% | 232 |
| | Female | 42% | 168 |
| **Age Range** | 14–24 years | 50% | 200 |
| | 25–34 years | 30% | 120 |
| | 35–50 years | 15% | 60 |
| | 50+ years | 5% | 20 |
| **Academic Levels (Students)** | Undergraduate | 95% | 285 |
| | Postgraduate | 5% | 15 |
| **Duration of Association** | < 1 year | 20% | 80 |
| | 1–3 years | 50% | 200 |
| | 3+ years | 30% | 120 |
| **Familiarity with Energy Practices** | Highly Familiar | 65% | 180 |
| | Moderately Familiar | 30% | 120 |
| | Unfamiliar | 25% | 100 |

The study included a total of 400 participants, selected using stratified random sampling to ensure representation across key stakeholder groups at Academic City University. The majority of the participants were students (75%), equally divided into 150 hostel residents (37.5%) and 150 non-resident students (37.5%). Faculty members accounted for 12.5% (50 participants) of the sample, while non-academic staff from the cafeteria contributed 7.5% (30 participants). Additionally, facility managers from the labs comprised 5% (20 participants). In terms of gender distribution, the sample included 58% males (232 participants) and 42% females (168 participants), reflecting a relatively balanced gender representation. The age of participants ranged across different brackets, with 50%

aged 18–24 years (200 participants), 30% aged 25–34 years (120 participants), 15% aged 35–50 years (60 participants), and the remaining 5% aged 50 years and above (20 participants).

Among the students, the majority (95%) were undergraduates (285 participants), while 5% were postgraduates (15 participants). Regarding their duration of association with the university, 20% had been part of the institution for less than a year (80 participants), 50% had been associated for 1–3 years (200 participants), and 30% had been involved for more than three years (120 participants). When it came to familiarity with energy management practices, 65% of participants were highly familiar (180 participants), 30% were moderately familiar (120 participants), and 25% (100 participants) were unfamiliar with energy management principles and strategies.

**Theoretical Equations for energy consumption and cost reduction**

The following analysis introduces a set of equations designed to medel and quanitfy energy consumption reduction, energy cost savings, and energy-saving percentages.

- **Energy Consumption Reduction:**

$$E_{aft} = E_{cu} \times (1 - R_{red}) \quad (1)$$

Where $R_{red}$ is between 0.10 (10%) and 0.30 (30%) as suggested by the case study.

- **Energy Reduction Cost:**

$$C_{aft} = C_{cu} \times \frac{Eaft}{Ecu} \quad (2)$$

Simplifying the above equation using $E_{aft}$ from Equation 1:

$$C_{aft} = C_{cu} \times (1 - R_{red}) \quad (3)$$

- **Energy saving percentage:**

$$S_{per\%} = R_{red} \times 100 \quad (4)$$

**Test for system formulation**

Current energy consumption, $E_{cu}$ = 1,000,000 kWh
Current energy cost, $C_{cu}$ = 500,000 cedi units
Expected reduction in energy consumption, $R_{red}$ = 0.20 (20%)

**Data formulation variables**

- $E_{cu}$ : Current energy consumption (in kWh)
- $C_{cu}$ : Current energy cost (in cedi units)
- $R_{red}$ : Expected reduction in energy consumption (percentage)
- $E_{aft}$ : Energy consumption after implementing strategies (in kWh)
- $C_{aft}$ : Energy cost after implementing strategies (in cedi units)
- $S_{per\%}$ : Energy savings as a percentage

Applying the equations:

$E_{aft} = 1{,}000{,}000 \times (1 - 0.20) = 1{,}000{,}000 \times 0.80 = 800{,}000$ kWh

$C_{aft} = 500{,}000 \times (1 - 0.20) = 500{,}000 \times 0.80 = 400{,}000$ cedi units

$S_{per\%} = 0.20 \times 100 = 20\%$

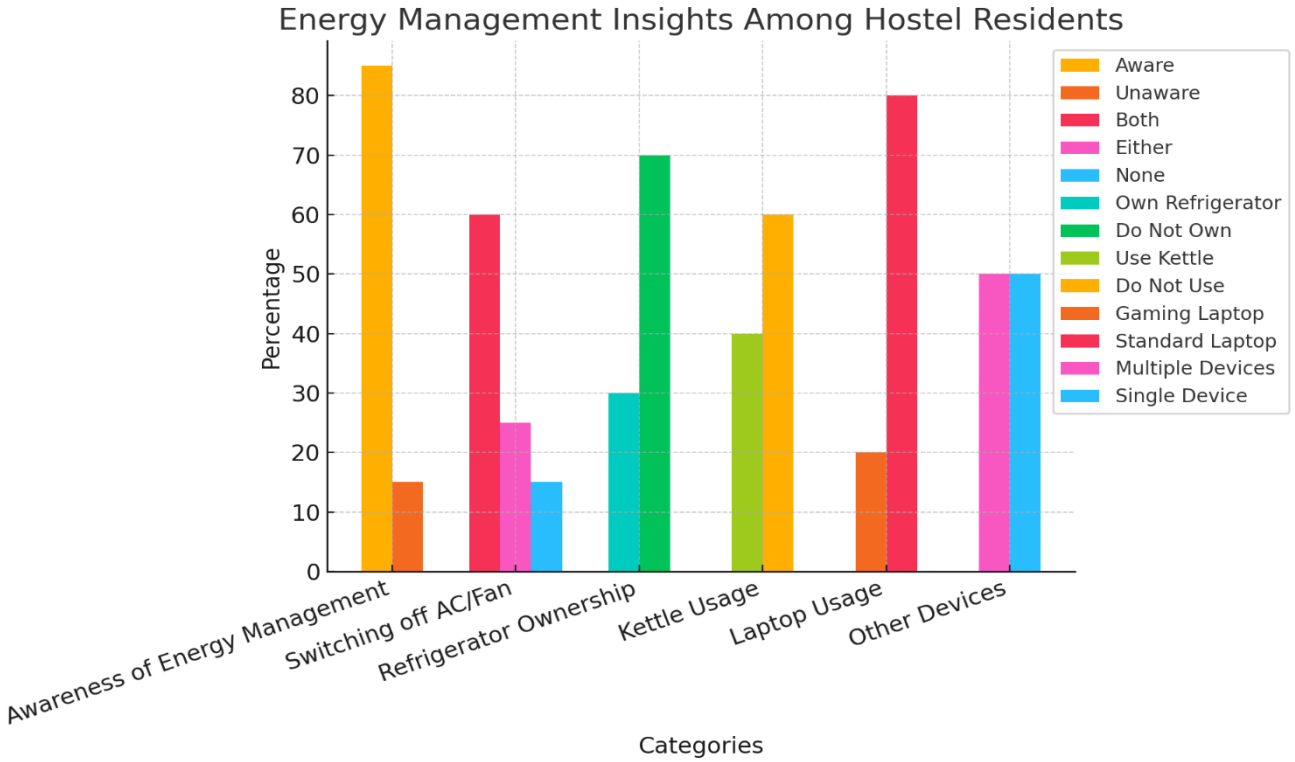
By implementing complete energy management techniques and raising awareness, the university may cut its energy use by 20%, reducing it from 1,000,000 kWh to 800,000 kWh. As a result, energy costs will be reduced by 20%, saving 100,000 in cedi units per year. This highlights how effective energy management and enhanced knowledge can help reduce energy usage and expenditures.

## RESULTS

### Hostel Residents

This data set was sourced directly from students residing in the campus hostel, providing invaluable insights into their energy consumption patterns while not attending classes. By gathering this data, we aim to gain a comprehensive understanding of the power usage dynamics among students living on campus, thereby informing targeted energy management strategies and fostering a culture of sustainable living within our residential community.

**Figure 2**
*Output Response Devices used by Hostel Residents and Energy Awareness Level*




This Figure 2 represents the percentages of 300 students' energy management implementation abilities and awareness in the hostel.

The data reveals the practices of individuals regarding the management of air conditioning units and fans when they leave their rooms for an extended period. It encompasses those who deactivate both, either, or none of these appliances, as well as those who do not engage in any deactivation at all. Additionally, the data illustrates the proportion of individuals who possess personal refrigerators in their rooms compared to those who do not.

The proportion of individuals who possess personal electrical kettles in their rooms compared to those who do not are also shown in the figure. The figure also reveals a high reliance on personal electrical appliances among hostel residents. A substantial proportion of students own personal refrigerators and kettles, contributing to higher energy consumption. The availability and usage of these appliances indicate the need for targeted awareness campaigns about energy-efficient usage. A notable percentage of residents deactivate both air conditioning units and fans when leaving their rooms, reflecting a degree of energy-conscious behaviour. However, there is still a subset of residents who either deactivate only one type of appliance or fail to deactivate any.

This inconsistency suggests a lack of habitual energy-saving practices, likely influenced by convenience or insufficient enforcement of energy policies. Beyond the primary appliances, residents frequently use secondary devices such as smartphones, tablets, televisions, and gaming consoles. These devices, especially gaming consoles and high-performance laptops, are known for their high power consumption. The figure underscores the need to address the energy impact of such devices in residential settings. The observed trends point to a mix of cultural habits and infrastructural factors. While awareness campaigns have had some impact, the lack of routine practices, such as turning off appliances, indicates that deeper behavioural change is needed. Additionally, outdated infrastructure, such as non-energy-efficient appliances, exacerbates energy consumption

**Figure 3**
*Other Devices used by Hostel Residents*

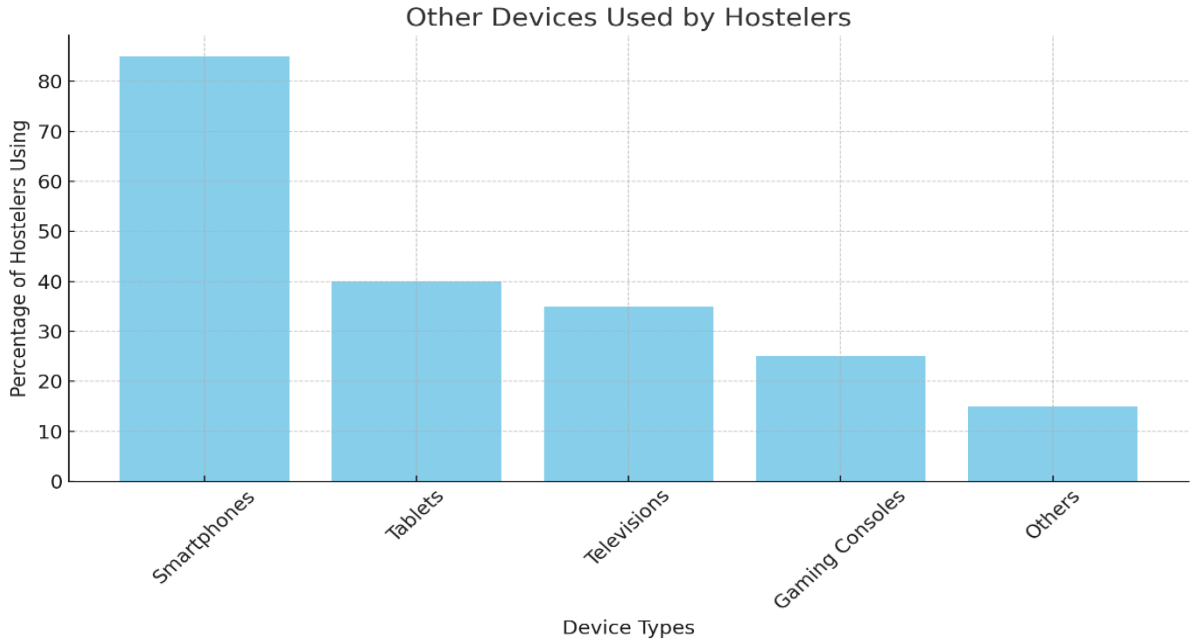



Figure 3 highlight other devices used by hostel residents which include smartphones, tablets, televisions and gaming consoles. The survey showed 85% of hostel dwellers use extra smartphones, 40% use tablets, 35% use televisions in their rooms and about 20% use gaming consoles, knowing that gaming laptops have higher power consumption, in comparison to those who own standard personal computers. Also established in the figure are the additional devices owned by each hostel resident, beyond those explicitly queried in the database questionnaire expanded in Figure 2.

Contextually, nearly all hostel residents own and actively use smartphones, making them the most common device. While individual smartphones consume relatively low amounts of energy, their widespread usage, combined with frequent charging, contributes significantly to aggregate energy consumption. The high reliance on smartphones suggests an opportunity to promote energy-saving practices, such as avoiding overcharging and using energy-efficient chargers. Tablets rank as the second most common device. Their usage is often linked to academic activities like reading and note-taking. While less energy-intensive than laptops, their contribution to overall energy usage cannot be overlooked, especially when used alongside other devices.

A notable percentage of residents own personal televisions in their rooms. TVs are a significant energy consumer, particularly older or non-energy-efficient models. The presence of televisions emphasizes the need for awareness regarding energy-efficient options like LED TVs and encouraging reduced screen time. A smaller subset of hostel residents owns gaming devices, such as gaming laptops or consoles. These devices are known for their high power consumption due to their

performance requirements. This highlights a niche but critical area of energy consumption that requires attention. The figure suggests that most residents own multiple devices, which, when used simultaneously, create substantial energy demand. The concurrent use of smartphones, televisions, and gaming consoles can lead to spikes in energy consumption, especially during peak hours.

**Staff**

This dataset, meticulously compiled, originates from the valuable input of our esteemed teaching staff members. Their insights and perspectives offer a rich and comprehensive understanding of various aspects pertinent to our academic environment.

**Figure 4**
*Output Results for Staff Energy Management Culture*

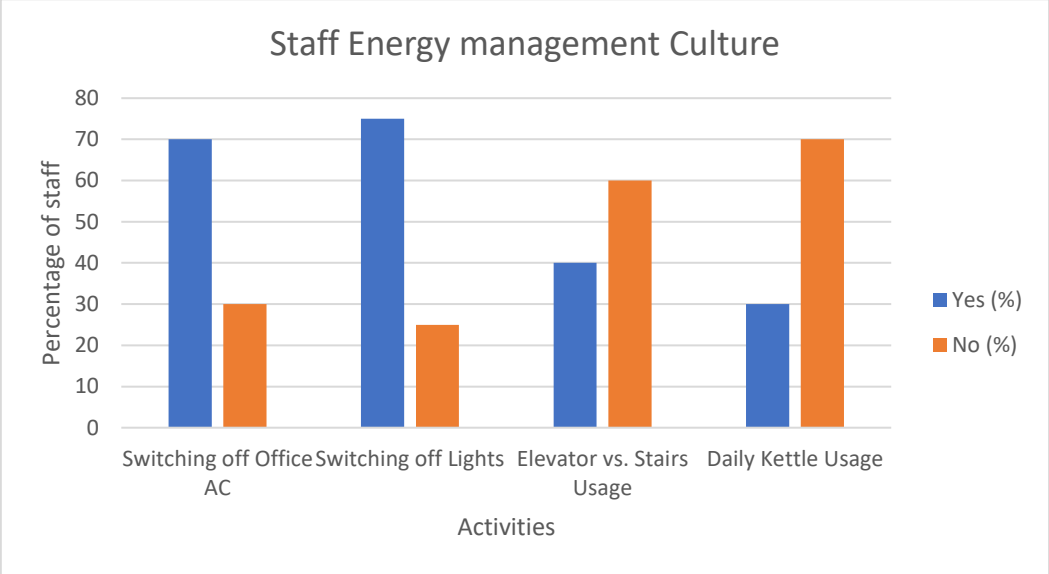



Figure 4 shows 50 staff members and their energy management culture. Those who opt not to switch off the air conditioner typically depart from the office before their colleagues; thus, they are not the last to leave the premises. Similar to the preceding query regarding the deactivation of air conditioning units, individuals who choose not to switch off lights do so because they typically depart the premises before becoming the last to leave. The majority of teaching staff members prefer using the stairs over the elevator for vertical movement within the campus premises.

The majority of the teaching staff members refrain from utilizing kettles on campus, opting for alternative methods or sources for their refreshments. Some of the teaching staff members had some input concerning energy management.

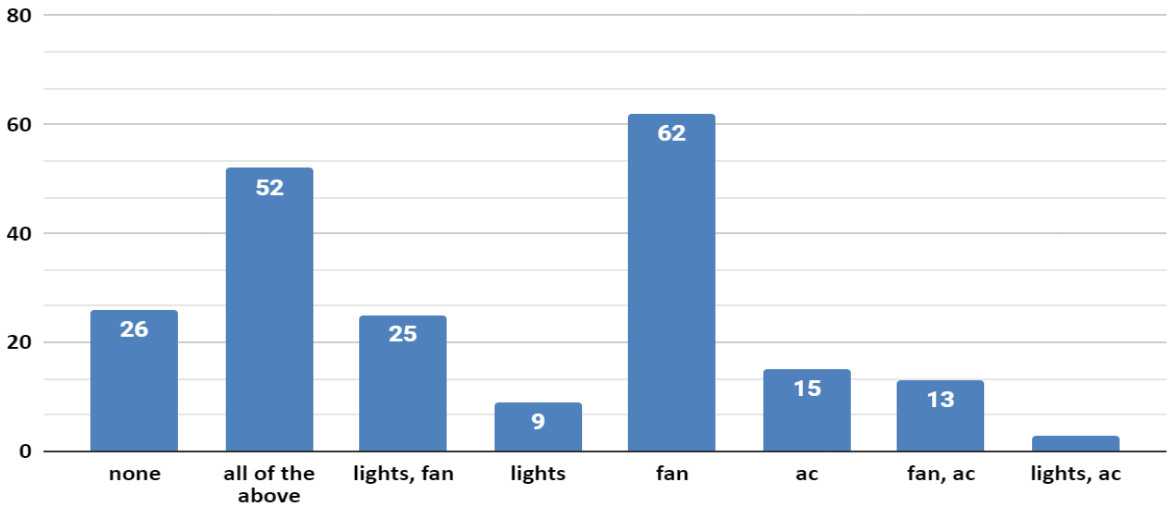
They have observed a trend among students where fans and lights are left on upon vacating classrooms, a practice that warrants reconsideration and adjustment. They believe that people should learn how to be more energy conscious and preach more about energy management to the school.

They have also brought to attention the concern of students needlessly consuming energy by operating multiple appliances simultaneously in a classroom setting. An instance of this would be activating all the fans when only one individual is present in the room. They have emphasized the importance of students being more conscientious about switching off air conditioning units when encountering unoccupied spaces.

***Non-Resident Students***

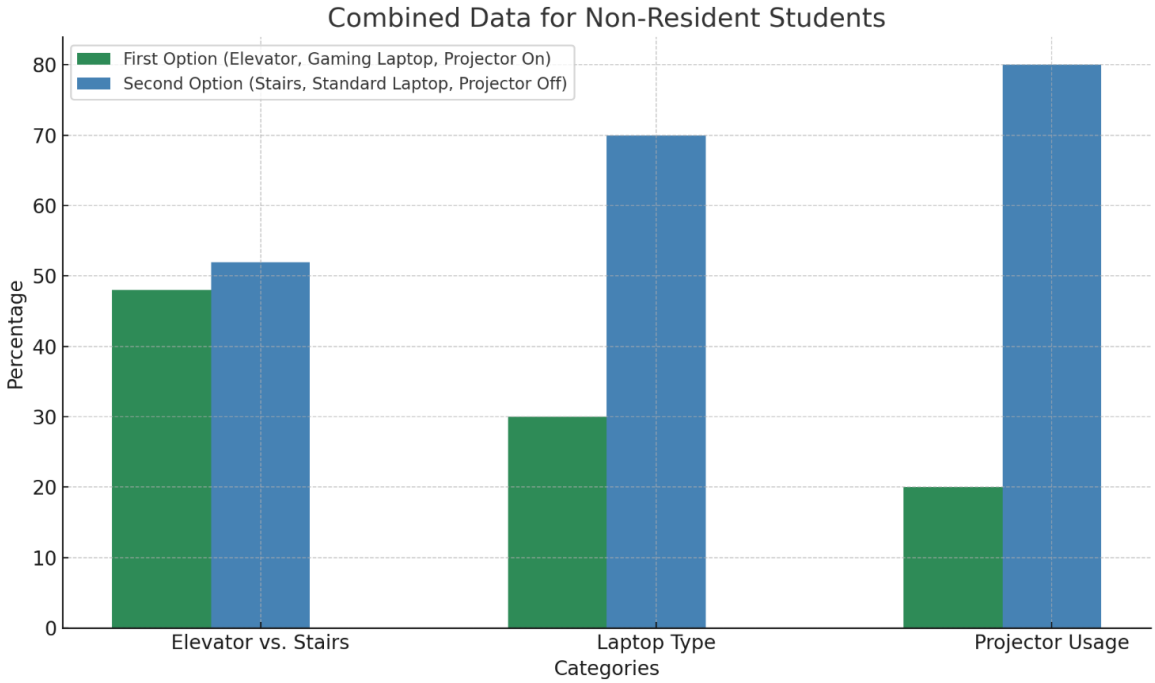
This data is gathered from students who live off-campus but commute to attend classes during the day. Their perspectives and behaviours offer valuable insights into various aspects of campus life and academic experiences.

**Figure 5**
*Whether Students Switch Off Electrical Gadgets before Leaving Classroom after Lectures*




This dataset offers valuable insights into the behaviour of students regarding the operation of appliances when they find themselves as the final occupants of a classroom. Understanding these practices sheds light on energy consumption patterns and opportunities for promoting more sustainable habits within the academic environment.

**Figure 6**
*Output Response from Non-Resident Students*



This figure indicates that there is no significant disparity between the numbers of students who opt for the stairs versus those who choose the elevator. The ratio of individuals who own gaming laptops, known for their higher power consumption, in comparison to those who own standard personal computers are also shown in Figure 6. Additionally, Figure 6 clearly shows that students generally do not switch off the projector, as its primary usage occurs during lectures, typically with a designated individual responsible for its operation. Outside of lecture hours, the projector sees limited use among the majority of students. Overall, this dataset serves as a valuable resource for informing evidence-based policy decisions, implementing targeted interventions, and fostering a culture of energy consciousness and stewardship among students residing on campus. Through proactive engagement and data-driven initiatives, we endeavour to create a more sustainable and environmentally conscious living environment within Academic City College.

## DISCUSSION

The outcomes of this study highlight the crucial relevance of energy management in higher education institutions, particularly Ghanaian universities. The study shows that energy management is not only a technological task, but also a behavioural and cultural one that requires the active participation of all stakeholders. This dual focus on technical solutions and behavioural modification provides an integrative strategy to lowering energy usage while also increasing sustainability.
The study found considerable differences in energy usage trends among several university groups, including hostel residents, academics, and staff. While a large proportion of stakeholders (about 95%) are aware of energy management, only 65% actually practice it. This demonstrates disconnection between awareness and action, which is frequently driven by convenience, a lack of desire, or inadequate enforcement of energy management policies.

The behavioural aspect of energy management appeared to be an important factor in this investigation. For example, data collected from hostel residents suggests that a considerable majority of students forget to turn off electrical appliances like air conditioners and fans when they leave their rooms. Similarly, staff members reported seeing students using multiple appliances at once or failing to turn off gadgets in unoccupied classrooms. These actions highlight the need for enhanced awareness and targeted behavioural change programmes to promote energy-conscious habits across campus. The report also emphasizes the limitations of implementing energy-efficient techniques in Ghanaian universities. Outdated infrastructure and inefficient equipment continue to be significant impediments to meeting energy conservation targets. Furthermore, the limited availability of dependable and economical energy sources limits the use of renewable energy technologies. These issues, as noted in the literature, are comparable with developments in Sub-Saharan Africa, where institutions struggle with aging infrastructure and limited resources (Ibrahim et al., 2021; Sawyer, 2004).

The study additionally reveals that comprehensive energy management measures, such as advanced statistical modeling and evidence-based policy suggestions, can result in significant energy and cost savings. For example, the implementation of energy-saving methods at Academic City University College has the potential to save up to 20%, demonstrating the value of strategic planning and monitoring. These findings are consistent with global studies that indicate 10-to-30% energy savings from similar strategies (Mohammadi et al., 2023). International programmes like the African Green Universities Initiative (AGUI) have established standards for integrating renewable energy sources and encouraging energy conservation in the higher education industry. These programmes offer technological foundations and behavioural tactics for promoting a sustainable culture, making them useful examples for Ghanaian universities. Ghanaian universities could overcome their obstacles and make a significant contribution to the global sustainability agenda by implementing these best practices.

Beyond only lowering energy costs, this study has wider institutional ramifications, such as better resource allocation, improved campus reputation, and environmental sustainability. Universities that put an emphasis on energy management can become leaders in sustainability and draw in teachers and students that care about the environment. To guarantee a sustained dedication to energy saving, policymakers want to think about including energy management into college courses and campus regulations. The study concludes by pointing out that energy management in Ghanaian colleges necessitates a multipronged strategy that combines activities for behavioural change with technical solutions. These institutions can achieve notable energy savings and sustainability objectives by utilizing global best practices to address the issues of obsolete infrastructure and restricted energy availability. Building a more sustainable future in higher education ultimately requires cultivating a culture of energy stewardship and consciousness among stakeholders.

## IMPLICATION/SUGGESTIONS AND RECOMMENDATIONS

The Academic City University College study on energy management offers insightful information about the benefits and difficulties of introducing energy-efficient practices in Ghanaian academic institutions. The following conclusions, ideas, and recommendations are presented in light of the findings; the gap between awareness and practice indicates that behavioural change programmes are essential to closing the gap, even though a sizable majority of stakeholders are aware of energy management ideas. To guarantee long-term sustainable practices, universities must foster an energy-conscious culture. Energy savings of up to 20% have been demonstrated, resulting in considerable cost reductions and environmental benefits. This demonstrates the possibility of tailored energy management actions to minimize operational costs while promoting sustainability. The findings reflect global trends in higher education, with increasing emphasis on sustainability.

To encourage energy-conscious behaviours among students, professors, and staff, it is therefore suggested that universities should establish structured awareness campaigns and training workshops. These programmes could include practical recommendations for lowering energy use as well as the environmental and economic benefits of energy efficiency. Advanced monitoring and analysis technologies should be used to detect high-consumption areas and improve energy use. Smart meters and energy management software can provide real-time data, allowing for more informed decision-making. Incorporating sustainability and energy management topics into academic programmes can enhance students' knowledge and instil a culture of sustainability. This approach will prepare future graduates to prioritise energy efficiency in their professional and personal lives.

Universities should prioritise replacing old infrastructure with energy-efficient technology. This includes improving HVAC systems, using LED lighting, and adding renewable energy alternatives like solar panels. Implementing campus-wide energy management strategies with clear standards for lowering energy consumption is critical. Incentives, like awards or recognition for departments or individuals that meet energy-saving goals, can encourage stakeholders to adopt sustainable practices. Ghanaian colleges should consider forming collaborations with the government and private sector to participate in renewable energy initiatives such as solar and wind energy. These methods can lessen reliance on grid electricity while also encouraging sustainability. To ensure compliance with energy management rules, university administrators should implement accountability systems such as energy champions or monitoring committees, as well as smart initiatives such as smart home technology which can enhance continuous evaluation and feedback mechanism to improve energy-saving measures.

Universities should collaborate with worldwide programmes such as the African Green Universities Initiative (AGUI) to learn from and share best practices. Collaboration can improve local solutions by providing access to funds, technical experience, and research possibilities. Regular energy audits should be carried out to evaluate existing usage trends, uncover inefficiencies, and update energy management methods. These audits can help guide data-driven decision-making and promote continuous improvement. Ghanaian colleges may maximize energy use, cut expenses, and foster a sustainable culture in their classrooms by putting these suggestions into practice, thus aiding in the worldwide fight against climate change.

## CONCLUSION

This study emphasizes how crucial it is for Ghanaian colleges to have thorough energy management plans and raise staff and student knowledge of energy conservation. Campuses of universities utilise a lot of energy because of their varied amenities and activities. There are several chances to lower consumption and operating expenses while advancing sustainability by strategically addressing these energy demands. According to the findings, institutions can save 10–30% on energy costs by integrating behavioural change initiatives with infrastructural improvements. But issues like outmoded infrastructure, restricted access to renewable energy, and inconsistent stakeholder behaviour need to be addressed.

Universities should make investments to replace inefficient systems with more energy-efficient ones, such LED lighting, contemporary HVAC systems, and renewable energy sources like solar panels, in order to achieve these energy savings. Adopting energy-saving practices, including turning off lights, air conditioners, and projectors when not in use, can also be encouraged by putting behavioural change programmes into place. Some Ghanaian institutions have piloted incentive schemes, such as providing recognition or rewards to individuals or departments demonstrating energy-conscious behaviours. Several universities, including the University of Ghana, have implemented campaigns encouraging students and staff to turn off lights, air conditioners, and other appliances when leaving rooms and Energy Commission of Ghana has organized workshops targeting schools and institutions to educate students and staff on energy-saving habits, such as using energy-efficient appliances and turning off lights.

By offering real-time data to inform decision-making, the incorporation of smart technology, such as energy monitoring systems, can further improve energy usage. To evaluate and enhance energy management procedures, regular energy audits must be carried out as well. Universities in Ghana and comparable areas can cut expenses, drastically cut energy use, and establish themselves as industry leaders in sustainability by implementing these strategies.

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