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Energy Efficiency Processes and Sustainable Development in HEIs

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Definition

HEIs are looked up to as the fulcrum for providing leadership in innovations. These include energy efficiency initiatives. This entails management and stakeholders managing energy to provide the same level of service by consuming less energy to conserve resources, safe cost, and mitigate CO_2.

Introduction

In recent times, HEIs in Ghana are under increasing pressure to manage electricity demand deficit, beat down cost of electricity, and reduce carbon emissions by becoming energy efficient (Asumadu-Sarkodie et al. 2016a). Residential energy consumption in Ghana has increased by over 60% from 1983 to 2017 with corresponding increase in electricity tariff by over 200% over the same period (Kumi 2017). The increasing energy cost faced by HEIs comes at a time when universities operating budgets face competing demands with very limited opportunities to income (Maistry and McKay 2016). In addition, Ghana's main source of energy supply (Hydro power supply) is unable to keep up with demand resulting in periodic load shedding (locally referred to as "Dumsor"). To supplement for such losses, a mix of thermal and diesel engines that burns fossil fuels are operated by HEIs. These sources tend to be highly disruptive and costly, and also contribute much more to carbon dioxide (CO_2) emission levels (Asumadu-Sarkodie and Owusu 2016b). Managing energy costs down and promoting a culture of energy saving on university campuses has become essential, especially, when HEIs are looked up to as the fulcrum for providing leadership in innovations and energy efficiency initiatives.

There is, generally, a high presence of HEIs in Ghana: public and private universities, vocational and polytechnics, and colleges of education (Nunoo 2018). All of them, in one way or the other are operational with energy and thus cannot remain unperturbed about the global and national drive towards energy efficiency, hence, sustainable development (Unachukwu 2010). According to IMANI Ghana (2014), close to over 70% of the bulk electricity generated in Ghana is consumed by households and institutions. This imply that strict adherence to sustainable energy management practices (SEMP) could greatly reduce waste in energy use (ECG 2015). Amos-Abanyie et al. (2016) recount that efforts by government

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and other relevant stakeholders to educate the public on the importance and benefits of efficient use of energy over the past decades have not yielded expected impact as the public, including universities, still exhibit poor attitude towards energy saving and conservation. This entry assessed EE policies, systems and consumption practices in two sectors; infrastructural designs and energy consumption in Central University's Miotso campus (CUM).

Overview of the World's Energy Demand and Energy Efficiency

The world's energy demand is expected to increase by 37% come 2030 with most of the demand envisaged from developing countries where energy consumption is driven by increasing economic and demographic growth (IEA 2014). With global energy consumption primarily still dependent on oil, the energy sector is still in danger, falling short of the hopes and expectations placed on it in three key areas: sustainability, emissions, and cost. It is expected that improvements in energy efficiency, reduction of waste, and subscribing to novel energy technologies (solar, wind, waste to energy, etc.) could pave way for relieving the stress on conventional global energy systems (ES). Hence a shift in global energy trends toward a decentralized low-carbon ES is inevitable to ensure access to affordable, reliable, and sustainable energy for all (Amos-Abanyie et al. 2016).

Efficient energy use, according to IEA (2014), is a calculated attempt to maximize the amount of energy required to provide products and services. For example, proper insulation of an office or lecture theater allows the building to use less heating and cooling energy to achieve and maintain thermal comfortable (Djamila et al. 2013; Peng 2010). In the same vein, installing LED lights, natural skylights, or fluorescent lights have a tendency to reduce the amount of energy required to attain the same level of illumination compared with using traditional incandescent light bulbs which still persist in some universities. Thus, moving towards a sustainable campus must be met with sustainable energy in HEIs, where energy consumption levels are at insignificant rates compared to its supply and with manageable collateral environmental effects (Koranteng 2010).

Energy Conservation and Efficiency Policies in Ghana

The Ministry of Energy, allied agencies, and stakeholders have rolled out and implemented three major sustainable policies since 2005 to manage inefficient distribution and use of energy, ranging from incentive-based to mandatory measures to regulate demand for energy products in the country (Ministry of Energy 2011). The Ghana energy and efficiency policy, with key initiatives mentioned below, are part of the broader National energy policies designed to address all issues in the energy sector of the economy. The goal of the policy was to ensure efficient energy production, transportation, and use of energy in Ghana (ECG 2005) by establishing appropriate pricing regime to induce domestic and industrial consumers to voluntarily manage their energy and also to support the education and awareness creation on the methods and importance of energy conservation.

Energy Efficient Standards and Labelling Regulation (LI 1815, 2005)

The energy efficiency standards and labelling regulation (LI 1815) was passed in 2005 to ensure labelling of all electric appliances such as non-ducted air conditioners and self-ballasted lamps (ECG 2005). The legal instrument mandated manufacturers, importers, and retailers of non-ducted air conditioners and self-ballasted lamps to abide by efficiency standards and to label their appliances with stickers showing the various efficiency rating of the various appliances sold in the domestic market.

The Efficient Lighting Project 2007

To achieve the policy directions of the energy efficiency and conservation policy (LI 1815), the Energy Commission of Ghana (ECG) implemented the efficiency lighting policy in 2007. Under this, the government was to procure and distribute for free, 6 million compact florescent lamps (CFL) to replace an estimated 6 million incandescent lamps (locally called onion bulbs) envisaged to be in the country. This was a load reduction strategy to reduce power outages in Ghana at the time. ECG (2013b) reported substantial reduction in the use of light crude to power thermal plants by 148, 000 barrel, saving about 112,320 tons of carbon emissions after a 3-year period of implementation.

The Energy Efficiency Regulation (LI 1932, 2008)

In 2008, the Energy Efficiency Regulation LI 1932 was passed to prohibit the manufacturing, importation, and sale of incandescent filament lamps, used refrigerators, used refrigerators-freezers, used freezers, and used air-conditioners (ECG 2013b). Following up on the prohibition, ECG introduced the refrigerator exchange and rebate scheme to phase out existing used refrigerators and freezers in homes and in the market to prevent further purchase and use (ECG 2017).

Promoting Energy Efficiency in Ghana

The core objective of energy management was to reduce cost and wastage envisaged to be achieved through energy efficient practices among users of the energy (Carbon Trust 2011). Energy management activities could range from relatively inexpensive and easily implementable actions, referred to as "low hanging fruits." This include turning off lights and switches when not in use, adhering to use of energy efficient appliances to expensive technology such as using electric submeters to monitor and improve consumption and alternative energy sources (Maistry and McKay 2016). Capehart et al. (2003) explain that it is advisable to work on the easier actions ("low hanging fruits") and use the benefits accrued to continue with higher levels until policy targets are attained and the gains sustained and improved on. In the same vein, the International Energy Agency (IEA 2014) also sees EE as "a critical tool to relieve pressure on an already over burdened energy supply in developing economies." Responding to this challenge, Ghana's energy sector assented to the Renewable Energy Act (832-ACT) in 2011 to accelerate and give legal backings to a novel project which started in 2005 to develop, manage, and judiciously utilize solar energy off-grid in remote towns.

The National Off-Grid Rural Electrification Program (OEP) targeted remote communities to provide reliable electricity through renewable energy technologies. The aim was to achieve a substantial level of penetration of solar electrification as a platform for the promotion of solar photovoltaic (PV) systems for basic lighting in rural off-grid communities. Solar battery charging service centers for the promotion of solar photovoltaics (PVs) were established to endorse ownership of solar home systems. The initiative also led to the establishment of a solar photovoltaic (PV) market in Ghana while improving the socio-economic conditions in rural communities as a result of the extension of electricity coverage in rural areas. Currently, there are more than 5,000 solar home systems in Ghana (ECG 2017). The National Off-grid Rural Electrification Program was scheduled for implementation in six phases throughout the country for a period of 15 years.

A total of 19,000 communities were targeted for electrification and 2,000 satellite solar battery charging centers were planned for installation to serve communities within a 5 km radius (ECG 2015). With over 2 million refrigerators and air conditioning units in Ghana consuming up to three times more energy than the maximum allowed due to inefficient appliances at the time (ECG 2017), the program replaced inefficient electrical appliances with efficient ones. Use of inefficient electrical appliances was translating into extra electricity bills every month making the cost of energy very expensive. Again inefficient appliances were generating over 0.7 tons of carbon emissions each year. When not properly discarded, it could release up to 2 tons of ozone-depleting substances into the atmosphere annually (Kumi 2017). To tackle this issue, the Energy Commission of Ghana (ECG), with support from the United Nations Development Programme (UNDP) and the Global Environment Facility (GEF), introduced a "rebate and turn in" program in 2012. The scheme encouraged consumers to exchange their old refrigerators for new and efficient ones at discount prices. A massive campaign was launched in the media (television and radio), reaching out to the general public on why the need to switch to energy efficient appliances. The scheme also set out standards of electricity required for air conditioners to operate in Ghana at Energy Efficiency Ratio (EER) 2.8 Btu/hr/watt or higher. This was because air conditioning was identified to be the largest energy consuming item in offices, including academic institutions. When air conditioning is not available, thermal discomfort is such that most buildings become unbearable. Outcome of this directive resulted in significant reduce in the importation of second hand appliances by 63% with beneficiaries of the scheme saving substantially on monthly electricity bills (ECG 2017).

Energy Efficiency in HEIs

University campuses were found to be large users of energy (Energy Client Organizations – ECO) because they contain all the major building purpose groups on the same physical site served by the same energy plants. This makes them unique from other establishments such local authorities, large industrial parks, and other commercial installations. Increasing growth in student population in Ghanaian universities, coupled with high energy demand against low levels of generation and high energy cost (Amos-Abanyie et al. 2016) thus, call for urgent effective energy management practices to cope with these challenges.

The Built Environment

Sustainable energy infrastructures are needed to promote energy efficiency in HEIs. Most HEI campuses in Ghana, until the turn of the millennium, were not designed for energy efficiency (ECG 2017). They were mostly constructed in an era when environmental concerns and energy optimization were not integral part of key management targets. It was seldom seen as a core university function. Integrating EE into mainstream university boards and council decision-making is an evolving concept in Ghana and therefore challenged with a number of conceptualization and implementation barriers (Krizek et al. 2012). They include: *inadequate expertise and information, misplaced priority, limited access to funding, and power struggle within academic freedom* (Eriksson et al. 2014).

Key building materials for university infrastructure have been cement, sand, water, and cement blocks. In recent times, use of burnt clay bricks and the partial or entirely glazing of buildings on university campuses is on the rise due to modern western culture. Infiltration of western designs (suitable for temperate weather) in HEIs built environment in the tropics, such as Ghana, does not take into consideration environmental damage and cost. For instance, it is now common to see poorly insulated university buildings in Ghana with sliding doors and windows, and heavily fitted air conditioners. These buildings tend to be a drain on energy consumption (waste) and contribute significantly to the high cost of electricity consumption in HEIs. To safeguard thermal comfort, large amount of energy is needed which invariably contribute to environmental damage.

With sustainable campus building infrastructures, energy consumption and thermal comfort is paramount. Thermal comfort is defined in this study to mean the state of satisfaction felt in a thermal environment-building. It is achieved when the body feels neither hot nor cold (Appah and Koranteng 2012). Building material properties play important role in thermal comfort. Thermal insolation in a building depends mainly on the thermal conductivity of materials. Dense and heavy materials will store the freshness of the night due to high inertia while low dense and light materials will not retain such freshness (Kartiwi et al. 2014). The two most important parameters of building materials, with respect to thermal comfort, according to Appah and Koranteng (2012), are thermal conductivity and the thermal inertia. Diffusion of heat which is the result of the two effects is called thermal diffusivity of the construction materials, which enhances the phase shift and damping of thermal wave in buildings.

Energy Efficient Culture in HEIs

To date, very few studies on energy efficiency culture exist in Ghanaian HEIs. Absence of data and university management with limited experts in environmental issues who wants to inculcate the culture by implement energy efficiency measures may not even know how to approach or get the process going. As a result, university management, personnel, and students are found to be completely disengaged with energy conservation dynamics. What pertains in some campuses has reached an extent where both students and HEI management are unaware of how much electricity is consumed, wasted, and how much it costs them monthly or annually. So it is not strange to, more often than not, see a university community fighting with the service providers (Electricity Company of Ghana) over electricity availability, intermittent supply, and billing.

Study Context and Methods

CUM was selected for the case study in this survey. It is Ghana's largest residential private university, with a student population of roughly over 7000 and personnel complement of approximately 360. Apart from the main Miotso campus, comprising 32 buildings or 76,719 m^2 of built environment, there are other three satellite campuses: Mataheko, Christ Temple, and Dansoman (Nunoo 2018). The study was limited to the Miotso campus based on the assumption that, as a private university, CUM does not receive any form of subvention from government and that University management and students were mindful of high utility bills (Adam 2015).

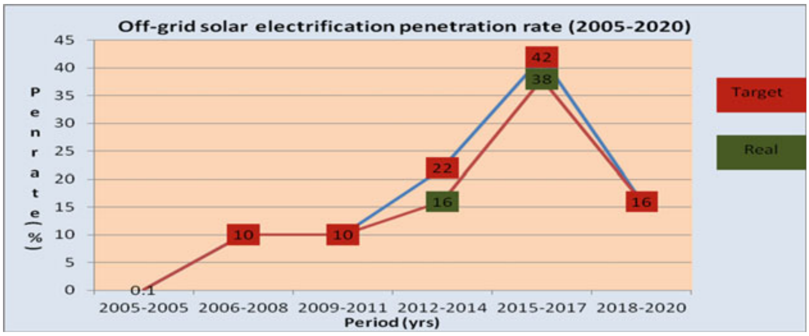
Employing the survey design for the study, first, semi-structured questionnaires were administered to key informants (University staff: $n = 25$) based on purposive sampling in Block G offices and the main administration blocks. Using a mix of simple random and cluster sampling methods, students ($n = 223$) were selected from four halls of residence to assess the sustainability of university buildings in terms of energy consumption and energy efficiency in the use of electrical appliances between April 2018 and June 2018. All ethical considerations were adhered to and consent from university management and the ethical committee were obtained. The narrow range and limited number of participants was, however, a shortcoming as the inclusion of more academic and administrative staff would have been preferred. Fifty-two questionnaires could not be analyzed because they could not be retrieved or completely filled out.

Based on Mehta's (2002) recount, one of the key input of Ghana's construction industry is the use of concrete mixed (cement, sand, stones water, gravel, etc.) material with high cement content. This material mix accounts for approximately 7% of carbon dioxide emissions into the atmosphere (Mehta 2002). A key finding the study sought to elicit from respondents (management, estate, students, and faculty) was to find out whether deployment of smart building materials and energy efficient technologies were considered in retrofitting university buildings. Respondents were asked to "strongly agree," "agree," "not sure," "disagree," and "strongly disagree" to the preposition: *"environmentally friendly building materials are not considered for the built environment*." To assess students' level of awareness in energy efficiency practices, the study conducted energy audit on use of electrical appliances in four selected students' halls of residence by inspecting the manufacturers' manual of the appliances on average daily energy consumption in Watts/hr and KWh. This was reconciled with the actual average energy consumed as registered on billing meters to estimate average total energy wasted (Table 2). In all, 300 electrical appliances were audited (Table 2).

Results and Discussions

Diffusion of Energy Efficiency Culture

A national energy efficiency program in Ghana started in the form of off-grid solar electrification penetration in remote towns and villages. It commenced with diffusion of energy efficiency culture in 2005, targeting 19,000 communities at an average penetration rate of 6.6% over a 15-year period. Scheduled for implementation in six phases, the program performed well in the first three phases, where off-grid solar penetration targets were achieved (Fig. 1), even though between 2006–2008 and 2009–2011, the targets peaked at



Energy Efficiency Processes and Sustainable Development in HEIs, Fig. 1 Diffusion of energy efficiency initiatives in Ghana. (Source: Based on ECG (2017) data)

10% and stagnated over the period. From Fig. 1, subsequent targets for phases 4 (2012–2014) and 5 (2015–2017) actually fell short by 27% and 10%, respectively. The poor performance, according to ECG (2017), could be attributed to a number of bottlenecks, including inadequate solar energy expertise, limited funding to service and replace installations, low level of knowledge in energy efficiency culture to embrace solar technology.

Energy Efficiency in Buildings

Energy efficiency in buildings, primarily, aims at minimizing the amount of energy required to maintain thermal comfort in buildings (Peeters et al. 2009). In the HEI built environment, it is merely about compliance to minimum requirements for building materials, or the installation of particular energy-efficient equipment. To design effective buildings for sustainable HEI campus in the tropics, one need to choose carefully materials that will reflect the sun's radiation, insulate the house from the external air heating, store the nocturnal freshness at night for daytime, and reduce indoor air temperature (Peeters et al. 2009). When participants were asked to respond to the statement: *"Energy efficient building materials were not considered for the HEI's built environment*," Table 2 shows the responses put forward. From Table 1, 76% of the respondents either "strongly agree" or "agree" that, *"Energy efficient building materials were not considered for the HEI's built environment."* Twelve percentage either "strongly disagree" or "disagree" and 12% were "not sure" as to whether "*Energy efficient building materials are considered for the HEI's built environmen*t."

Interestingly, whereas, all staff from management ($n = 5$) either "strongly disagree" or "disagree" to the statement, all estate facility staff ($n = 3$) were "not sure." On the one hand, staff from the teaching faculty, however, "strongly agree" or "agree" to the statement that: "*Energy efficient building materials were not considered for HEI's built environment*."

Responses from students were similar to that of key university staff. Some students (45%) either "strongly agree" or "agree" that *"Energy efficient building materials were not considered for the HEI's built environment."* There were some responses (37%) which "strongly disagree" or "disagree" to the premise and 18% were "not sure" of their opinions on the statement. The line of opinions, expressed by the respondents, confirm studies by a school of thought (Amos-Abanyie et al. 2016) that diffusion of energy efficiency culture in the built environment, especially in HEIs, will be better integrated into the system when university staff and students are well informed to become knowledgeable in sustainability measures.

Energy Efficiency Standards and Labeling Regulations

Ghana operates a mandatory appliance standards and labelling regime. Importers and retailers of electrical appliances, including room air conditioners and compact fluorescent lamps (CFL) are required to import and sell only products that meet minimum efficiency and performance standards approved by the Ghana Standards Authority

Energy Efficiency Processes and Sustainable Development in HEIs, Table 1 Level of agreement with energy efficient considerations in buildings

Responses to the statement: *"Energy efficient building materials are not considered for the HEI's built environment"*	Key university staff				Students			
	Male (Frequency)	%	Female (Frequency)	%	Male (Frequency)	%	Female (Frequency)	%
Strongly agree	7	54	6	50	23	24.5	24	19
Agree	2	15	4	33	22	23.4	30	23
Not sure	2	15	1	8.3	15	16	26	20
Disagree	1	8	0	0	11	12	24	19
Strongly disagree	1	8	1	8.3	23	24	25	19
Total	**13**	100	**12**	100	**94**	100	**129**	100

Source: Field survey, 2018

Energy Efficiency Processes and Sustainable Development in HEIs, Table 2 Selected building energy audit in Central University

	Average daily energy consumption				Average annual energy consumption		
Electrical appliances	Quantity (#)	Actual consumption (Watt hours)	Energy required (Watt hours)	Wasted energy (Watt hours)	Annual energy (KWh)	Wasted energy (KWh)	Waste (%)
1. Refrigerators	30	275,162	241,370	33,792	32,705	8110	24
2. Printers	25	1078	784	294	279	103	35
3. Computers	20	4916	1477	3439	1533	353	10.3
4. Kitchen appliances	5	43	271	315	75	10	3.2
5. Microwaves	15	527	2292	2819	677	126	4.5
6. Television sets	20	668	3338	4006	962	160	4
7. Phone chargers	25	189	418	606	146	46	7.6
8. Incandescent floor lamp	30	1928	11,340	13,268	3184	463	3.5
9. Incandescent desk lamp	10	402	2364	2766	664	96	3.5
10. Overhead light	24	444	2462	2906	698	106	3.6
11. Bathroom appliances	16	96	1072	1168	280	22	1.9
12. Ironing appliances	22	448	3444	3892	934	108	2.8
13. Sound systems	18	158	598	746	180	36	4.8
14. Air conditioners	11	352,000	440,000	88,000	84,480	21,120	24
15. Fluorescent desk lamps	5	94	551	645	155	22	3.4
16. Fluorescent floor lamps	24	350	2058	2408	578	84	3.5
Total	**300**	**39,906**	**27,916**	**10,067**	**7971**	**1935**	**8.7**

Source: Field audit, 2018

(ECG 2017). Per the energy efficiency standards and labelling regulations (LI1815), appliance manufacturers who export to Ghana, and retailers who sell in Ghana are obliged to display labels indicating the energy efficiency rating of the product before the first retail sale (ECG 2017). It becomes an offence under LI1815 to import, display for sale or sell air conditioners and compact fluorescent lamps in Ghana unless they meet the minimum performance standards. All residential buildings, including university accommodations are subject to these standards.

The minimum acceptable energy efficiency standard for non-ducted air conditioners in the country is those with energy efficient ratio (EER) of 2.8 watt of cooling per watt of electricity input or higher EER. The higher the EER is, the more efficient the product. The energy guide label affixed to the product provides important information on the model, manufacturer, and energy efficiency star ratings, from one star to five star, in which the ascending number of stars represents a higher EER. It also gives the estimated annual energy consumption, cooling output, and type of refrigerant (ECG 2005). These labels are expected to be on all gadgets displayed and inform authorities on the number of efficient air-conditioners available in the market for sale (ECG 2005). To enhance acceptability and penetration of ESLs, the government subsidized the products by waiving import duties and value added tax (VAT) to make them affordable to the general public as a measure to save energy and reduce electricity cost paid by consumers (ECG 2005). The energy guide label provide consumers with information on the lamp's wattage, average rated life in hours (a minimum service life of 6,000 h), and an estimate of the lamp's energy consumption for a year.

Energy Audit

The number of electrical gadgets, the rate at which they are used in residences and their efficiency level highly influences energy consumption. According to Sardianou (2007), these characteristics affect households' conservation behaviors that warrant in-depth studies to assess household energy conservation culture and practices, especially on university campuses. According to IEA (2014), household appliances such as refrigerators, freezers, washing machines, dish washers, and television sets, together with small miscellaneous appliances such as personal computers, mobile phones, personal audio equipment, accounts for over 65% of household's electricity consumption in developing countries. The more electrical appliances own by households, the more energy it will require to operate them unless they invest in energy efficient appliances which is environmentally friendly, conserves energy, and utilizes less energy for maximum energy services (ECG 2017). Based on the prudent energy efficiency initiatives in Ghana aforementioned, energy audit was performed in four students' halls of residence, selected offices of lecturers (Block G, Miotso), and key management offices (Administration block) to ascertain the specific energy-use patterns of CUM Miotso campus (CIPEC 2010). The gadgets were made up of basic daily office, kitchen, bathroom, reading and lightening electrical appliances, outlined in Table 2.

From Table 2, a total of 300 electrical appliances with cumulative average daily energy consumption level of 27,916 watt/h were audited. The appliances were however found to be actually consuming, averagely, 39,906 watt/h over the same period, representing 36.1% of energy (10,067 watt/h) loss. This translates into 8.7% of the actual annual average energy consumption level of 7971 KWh. This finding confirms ECG's assertion in 2017 that energy consumers using inefficient electrical appliances were spending between \$5 and \$18 more on electricity bills every month.

Appliances with outlier average daily energy waste were air conditioners (88,000 watt/h), refrigerators (33,792 watt/h) and incandescent floor lamps (13,268 watt/h). Percentage wise, the most inefficient gadget contributing to annual energy consumption waste was identified with printers (35%), followed by refrigerators (24%), air conditioners (24%), computers (10.3%), and mobile phone chargers (7.6%). Three, out of the four possible reasons that could account for the waste, were collaborated by Mensah and Adu (2013), IMANI Ghana (2014), and Koranteng (2010) to be, extensive use of second hand (old gadgets) appliances, fake star labels on appliances and substandard electrical gadgets in the buildings. The fourth reason was identified to faulty reading meters for electricity billing. The outcome of this study is to guide and inform management.

Conclusion and Recommendation

Ghana's energy efficiency initiatives have been acknowledged by the international energy community and energy experts to be laudable (Ofosu-Ahenkorah 2008). However, the policies lack capacity in human resource, finance, and the needed political will to effectively conclude implementation of energy conservation programs. This fundamental challenge permeates all sectors in Ghana, including HEIs. Managing university campus infrastructure systems, as business as usual, is fraught with inefficiencies within the energy units as campus infrastructures in Ghana have developed without thermal comfort and environmental considerations. Attempts to imbibe sustainable energy culture into campus operations are fraught with a number of challenges. As a result, management and students were found to be completely disengaged in energy conservation dynamics. From the audit (Table 2), CUM was wasting an average of 8.7% of their average annual energy consumption which translate to between US$5 and US$18 a month in energy bills. This is an indication there is a need to implement sustainable energy measures in the built environment including HEI. It also present a unique opportunity for HEIs to adapt smart energy technologies to improve efficiency and decrease energy costs to minimize cost, waste, and mitigate CO_2 by setting out realistic reduction targets.

The study recommends CUM to invest heavily in infrastructure upgrades to increase energy efficiencies. This should include innovative ways to renovate buildings to make them more energy efficient and developed an organizational structure that brings together all stakeholders to chart a new path towards a "Lean and Green" HEIs. These baseline changes can be achieved with consented effort amidst significant risks. HEIs, as resource-limited institutions, need to foster a practical attitude and the ability to develop creative strategies and partnerships to embrace the sustainable energy effort at all levels. To achieve these, HEIs need to outlaw incandescent lighting appliances, inefficient office, and residential electrical gadgets and ensure effective implementation of the policy by, for instance, instituting an "Energy Star" labels awards for residence halls and office buildings. HEIs may also empower their procurement units to establish purchasing agreement standards that requires Energy Star labels for all office and residential equipment and appliances. Last, but not the least, HEIs need to tackle the daunting task of educating all stakeholders and campus building users in how to embrace energy efficiency technologies and utilize the smart central controls in building facilities on campuses. This means installing electrical gadgets with sensors that give users limited level of personal control in the control of the appliances such that when there is no one in an office or building lighting systems will automatically go off and vice versa or an appliance can go to the standby mode. The most significant results of such an integrated effort will be realized in conserving energy, minimizing waste (higher electricity bills), and CO_2 mitigation, which are vital for sustainable university campus.

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