

# Minimizing Energy Waste: Solutions for After-Hours Electrical Consumption in University Campuses and Impact on Dentistry

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**Abstract**— Ajman university is a collaboration of multiple colleges segregated into two main buildings J1 and J2, and each of them contains various labs, clinics, halls, and amenities. The primary objectives of this research are to conduct a literature review on consumption of energy in various universities, along with that to conduct a detailed investigation to find out the sources of energy wastage in Ajman university after the working hours and to provide solutions to counteract those issues and to also discuss the impact that energy conservation has in the field of dentistry. Data collection is done by physical observation of the facilities and identifying the potential sources of energy wastage from 10pm to 8am which corresponds to the closed hours of the university during normal working days. Wattage for each component was found and used to calculate the total wattage and to estimate the total cost for the energy being used. It was found that despite multiple appliances utilizing energy, the vending machines present in the corridors were utilizing the highest amount of energy while the washrooms were among the secondary factors. There are various solutions to resolve these issues from using LED lights to incorporating light sensors as well as incorporating solar technology. Despite various limitations, the study proves the hypothesis, and it can be concluded that significant changes need to be made to conserve the wastage of energy.

**Index Terms**— Energy, Electricity, University, Green dentistry.

## I. INTRODUCTION

Considering the increase of fuel prices, decline in fossil fuels, and rise in global warming has all led to a surge of interest in alternative energy sources and a growing interest in energy efficiency, not only does it have an impact on the environment, but it also creates a positive cash flow as expenses on energy bills are reduced(6).

On university campuses the major consumption of energy takes place within its buildings, with a considerable population thus maintaining operations on the campus for research and teaching and to be able to provide service in its residential and hostel areas requires a considerably large amount of energy. (6). There are multiple ways in which energy wastage can occur in universities, such as through inefficient HVAC systems, outdated lighting fixtures, and insufficient building insulation. Furthermore, research facilities and data centers often require significant amounts of energy, contributing to overall energy consumption. The impact of energy wastage in universities can be severe,

resulting in heightened greenhouse gas emissions and financial costs, which can be detrimental to universities with limited budgets. Energy expenses can make up a substantial proportion of a university's operating budget, but by reducing energy wastage, resources can be freed up for other essential initiatives(3).

Fortunately, there are various solutions that universities can implement to minimize energy wastage. These include upgrading infrastructure and building systems, adopting energy-efficient technologies, and encouraging energy conservation behaviors among students, faculty, and staff. By actively managing energy usage, universities can significantly decrease their carbon footprint, support sustainability, and save money.

Overall, addressing energy wastage in universities is critical for attaining sustainability objectives and minimizing the environmental impact of these institutions. This study will delve into the underlying causes of energy wastage in universities, the associated consequences, and methods that can be implemented to promote energy efficiency and sustainability.

University campuses usually house multiple buildings, labs, halls, machinery, and all sorts of various electrical appliances, so to reduce energy consumption it becomes necessary to evaluate energy usage patterns before deciding on reduction strategies.

Ajman university consists of four main buildings J1, J2, Student hub and Sheikh Zayed hall. The student hub consists of the library, administrative offices, and the food court, while the lecture halls, labs, clinics, studios, and lecturer's offices are in the J1 and J2 buildings. The sheikh Zayed hall consists of lecture halls and labs for the medicine department and multi-purpose halls.

Literature review was done for energy conservation in university settings and areas of energy wastage was found, along with this identification of areas of energy wastage was done in Ajman university in J1 and J2 buildings after the working hours. Physical observation was implemented to find out the appliances where energy is being used after working hours. Based on these findings, evaluation of the total energy wastage is done, and solutions are then strategized to reduce this energy usage to minimize cost and reduce its environmental hazards.

The primary objectives for this study were.

1. To conduct a literature review on energy consumption and wastage in universities and discuss their impact in the field of dentistry.
2. Find out potential sources of energy wastage in Ajman university after working hours.
3. Recommend remedies to counteract the wastage.

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## II. LITERATURE REVIEW

The unnecessary increase in consumption of energy may lead to devastating effects in terms of both the environmental and financial aspects, and one of the most common examples related to this is the unnecessary consumption of electricity. Electricity is generated by the combustion of certain hydrocarbons like oil /gas / coal causing the spreading out of countless emissions of Carbon Di-oxide, affecting our dear planet, and worsening the popular conflict which is global warming(7).

There is a specific term that is called 'Vampire power/energy'. It is termed this way since 'Vampires' are mythical creatures that are well known for their blood sucking abilities;therefore, energy is continuously getting absorbed by numerous types of electrical devices and appliances particularly when placed in Standby mode or even when switched off completely. This issue is surprisingly common yet so problematic since excessive amounts of unnecessary energy is getting consumed, more than 100 billion kilowatt-hour yearly, forming more than 80 million tons of carbon dioxide, leading to drastic changes to our environment. In addition, this issue is widespread in buildings, affecting people's electricity bills. Vending machines and refrigerators and freezers are common examples of electrical machines that are based on this concept of 'vampire power', where drug developmental companies face so many issues in energy consumption and wastages since they require placing their pharmaceutical supplies, therefore absorbing extensive amounts of energy. It is especially important to control and regulate this issue and by monitoring the specific amount of energy that is getting consumed, and to use certain equipment that will allow us to reduce the amount of energy consumed, examples of this may include sensors, certain smart plugs and monitors that are based on wireless energies(7).

According to the 'University of Wollongong in Australia' and Harvard University, they formulated several tips to conserve energy around its campus. They advise to implement certain initiatives to save energy across the campus, including facilities and machines and several other equipment by constructing several rules and instructions that should be followed by all individuals, staff members and students which includes switching off machines, lights, computers, and other appliances when not in use. Informing staff members that are responsible for several laboratories in taking care of the machines being used and to take careful consideration of the risks that are associated with the switching off of these machines. In addition, implementation of unique systems that can manage the air conditioners present in the university. Moreover, these systems are uniquely known for their ability to switch off automatically after working hours(4)(8).

There is a certain rating that is applied to products from specific governments, and these ratings are called 'Energy Ratings'(1). These energy ratings are from the Australian government, and it allows different type of people and consumers to understand and recognize how efficient the product is in terms of energy. These ratings are in the form of stars, and these stars are present in the product itself. The more stars that are present in the product, the more efficient the product is in terms of energy. It is very advantageous since it will allow us to reduce energy consumption and prevent the

emission of harmful gases. These energy ratings come in different labels, and they can come in as either a 6-star label or even a 10-star label showing the consumption of energy every year. Most of these energy rating labels can be seen in several types of electrical appliances, most commonly include Fridges, Freezers, TV, Air conditioners. There are certain appliances that do not have star ratings, in this situation you will need to find the usage of energy and compare the result with the other products.

According to Harvard University, their sustainability group provided people with certain tips on how to save energy when present in your own household or when present in facilities. These tips are to replace any compact fluorescent lamps with a light emitting diode since they are very efficient, and present with no harmful gases, and last up to 20 years. Another way of saving energy is to unplug and switch off any device that is not in use to prevent wasting energy(4).

There are certain educational institutes/universities from Australia, Canada, and the United States where they aim for reducing the amount of greenhouse gases formed and to provide a solution in which carbon emissions can be reduced significantly, and to minimize the energy consumption. According to their study, they found out that 90% of energy consumption is from the excessive use of electricity in buildings like the research and teaching buildings. Research buildings usually consume more electricity and energy due to their laboratory equipment and machines running continuously throughout the entire year. This is an issue since carbon will be formed and emitted, so the concept of renewable energies and the continuous reminding and awareness is very critical regarding energy conservation and the stoppage of harmful carbon emissions(5).

Moreover, there are other approaches in stopping carbon emissions. They include the specific design of the building and the presence of smart equipment, and the quality of the indoor environment and the behavior of the staff members and students present on the campus. These behaviors can be in the form of switching lights off or the use of air conditioning. Regarding their main objective in stopping carbon emission and conserving energy, what they are focusing on is buildings services, renewable energy, insulation and to spread awareness of the importance of saving energy(5).

According to Covenant University, they depicted a study where they needed to produce certain energy saving approaches in different buildings inside their campus. Their focus was to educate staff members and users about behaving and working in a more sustainable approach such as switching off lights when not in use. They noticed that the temperatures inside buildings were higher than normal temperatures leading to unnecessary heating leading to waste of energy, so they decided to lower the temperature by using valves that control the temperature, these valves are on the radiator. The heating systems that are present are one of the ways where energy may be wasted if used in a careless manner, however turning it off when not in need particularly during the afternoon timing or even setting up different temperature setting can be a fruitful solution in producing vast savings. Sometimes energy can be consumed when buildings are vacant. This energy that is being consumed accounts for about 30%, reaching its peak and this consumption of energy is termed as the 'ghost consumption'(6).

This happens when certain rooms need to be conditioned indelibly or when staff members or people lack awareness

which leads to the wasting of energy, so a specific training involving the building maintenance is crucial since it may provide us with consistent and accurate details on the energy being consumed at all times to refine the management of resources at all time(6).

Developing unique systems that will provide accurate knowledge of the active data of buildings and the energy consumed with all the facilities and equipment monitored. In addition, the installation of systems that deal with sensors detecting any form of movement and the installation of sensors detecting light, where they can provide an efficient energy saving plan. According to Curtin University, certain energy audits were assessing the HVAC systems, and found out that it consumed excessive amounts of energy compared to any other office equipment. Another way of improving energy usage in buildings and other facilities is using energy certification which shows us how efficient the equipment or the product is in energy consumption. Other ways that conservation of energy is done by renewing energy and making sure to install and get an appliance that consumes less energy. According to Southeast European university, they produced the plan to reduce the gas emissions and any carbon emissions by using solar panels and thermals and the replacement of specific types of lamps. In this study there was the formulation of an energy audit focused on solving obstacles related to energy efficiency and comfort related to temperatures in buildings. Energy consumption increased more in higher institutions rather than schools, and more in winter than in summer since heating systems are required in winter and consume more energy than cooling systems. In higher institution buildings, management systems with regards to energy are poor, leading to unnecessary wastage of energy. They found out that the power saving energy mode was not applied when the buildings were vacant, leading to less thermal comfort and less energy efficiency(6).

According to the study made at Covenant University, they had certain objectives that needed to be followed. They had to understand and figure out the pattern of energy consumption , and they had to determine the specific areas that contribute to the energy wastage across the campus buildings (including the mechanical engineering buildings, cafeterias, halls, etc.) , they had to figure out any technique to save energy in the university campus and to decide its effectiveness, and the use of a software that models the energy using to measure the energy efficiency.

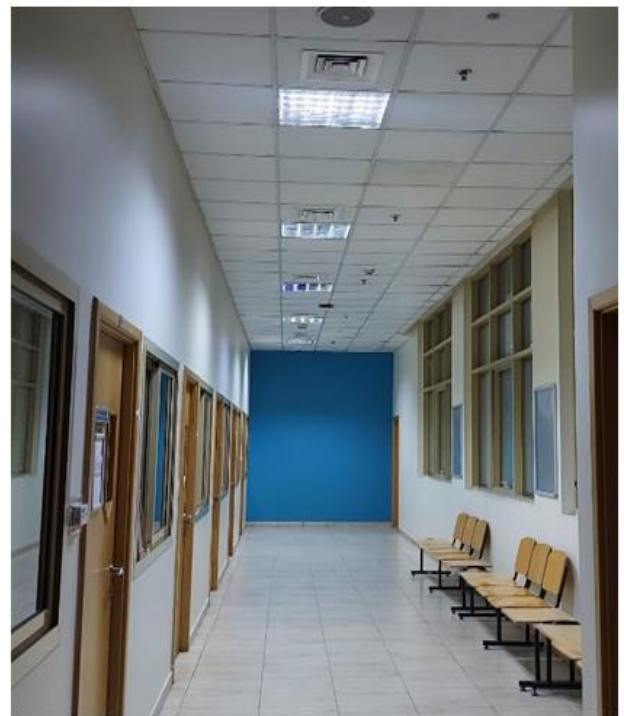
Observations around the campus weremade and the assessment of different kinds of electrical appliances were done, most commonly the HVAC systems and the lightning. These were then followed by the analysis and measurement of the energy consumption and the inspection of the costs every month in regard to energy consumption. The cafeteria inside the campus contains refrigerators which is the highest consumer of energy, this is figured out by the energy modelling software known as eQUEST. The second highest consumer of energy is due to lightning, since they use compact florescent lamps which consume much more energy. These can be solved by the application of LED since it is more energy efficient and lasts for an extended period of time. Moreover, the use of insulation, to trap the thermal energy inside the room, keeping everything cool as usual. The mechanical engineering building consumes energy due to the air conditioning and the open space corridors in which

lightning is used by using the compact florescent lamps which consume a lot of energy.

The library and the health center are other facilities where energy usage was checked and thoroughly analyzed by the software, and it turned out that the highest energy consumer in these facilities are the air conditioner followed by the lightning used by the compact florescent lamps, solutions are based on providing a solar panels since they generate electricity from sunlight, and to replace the CFL with LED lights to reduce energy consumption. Residential halls for students are another facility where their personal equipment including laptops consume the most energy followed by the lightning with CFL instead of LED lights. The solution is to educate all of the students in regard to energy consumption and replace all the CFL withLED lights(6).

### III. METHODOLOGY

In order to collect the information required to accomplish this research, certain methods and equipment had been used. The main approach was to physically observe and identify multiple electrical and illumination appliances that were used after the university’s working hours from 10 pm to 8 am for 30 days consecutively. After accumulating all the data, multiple measurements and calculations were done in an effort to acquire how much electricity is consumed during these hours. Achieving that will help inutilizing the data for the purpose of providing possible electricity saving measures and strategies.



*Fig 1 Corridor light in J2*

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*Fig 2 Washroom in J1*



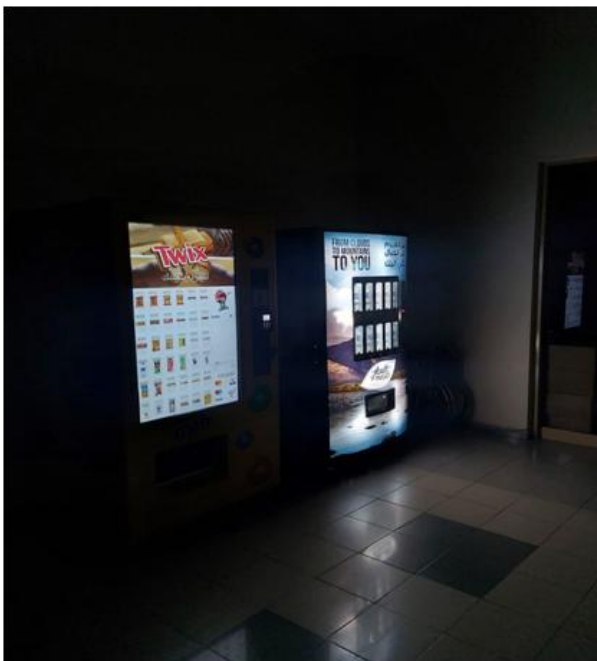
*Fig 5 Vending machines in J2.*



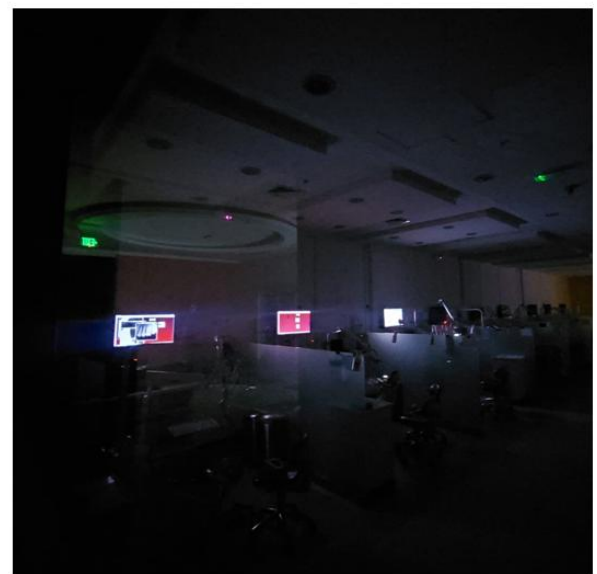
*Fig 3 Corridor light in J2*



*Fig 6 Tv's in clinics in J1*



*Fig 4 Vending machines in J1*



*Fig 7 Computers in labs in J2*

Data was collected from J1 and J2 Buildings  
 J1 has a total of three floors which include multiple lecture halls and a total of 5 clinics on the ground floor and 4 clinics on the first floor and a total of 4 clinics on the second floor in addition to a sterilization room, trolley parking and disinfection room. Each clinic contains 15 dental units which includes a dental chair and a computer screen. J1 also has many labs including the pharmacy labs and the technician labs. During observation, multiple display screens and vending machines in the corridors were noted after the university's closing time. Multiple office lights, corridor lights and most of the washroom lights were also the main focus during the surveillance.  
 J2 includes lecture halls and multiple computer labs, media studios, engineering labs, and architecture labs. J2 also has a significantly larger number of faculty offices than J1 building because it contains more colleges than J1.

One of the examples of electricity wasting factors is the amount of electricity wasted by lighting fixtures, especially in the university's restrooms. To figure the amount of energy wasted away the type of light bulbs being used needed to be known, which was either LED or regular light bulbs, in order to know the amount of energy needed for each light bulb. After that the number of light bulbs turned on after work hours was collected every night for a consecutive 30 days. The University has two semesters in addition to the summer semester which are in total approximately 10 months. So, the equation established is:

$$\text{Electricity used by 1 light bulb} \times \text{number of light bulbs switched on} \times \text{number of hours} \times \text{number of days each month} \times \text{number of months.}$$

This equation will provide the total electrical wastage by light bulbs in watts which will be finally multiplied by cost of electricity per kWh according to FEWA. This method of

calculation was used for all the devices considered in this study.

The use of measuring devices was required in some instances to measure the electricity used in appliances.

IV. RESULTS

The period of observation lasted for one month ranging from February 20th to March 20th, during which physical observation was done to note down the appliances that were utilizing energy after working hours. It was noticed that in both buildings the washroom lights were switched on for both male and female sides. Along with this, the lift lights were on, but it accounts for a very small percentage when compared to other appliances. It was also found that there were many office lights which were switched on, often even laptops would be switched on.

Throughout the corridors of the university there are many vending machines in the boys' section as well as the girls' section, it was found that despite them being only twelve in number they utilized the most amount of energy.

The J1 building consists of twelve clinics and in each of these clinics there are many TVs which are required for viewing radio graphs and other applications, on average at least seven TVs would be switched on and running even after the clinics were closed. Other than the clinic TV's there are also around 12 TVs in the corridors of the J1 building and fifteen in the J2 building, even these 27 TVs would be switched on throughout the observation period. When it comes to the J2 building there are no clinics but instead there are computer labs, studios, and other halls, and on average at least 10 computers would be switched on.

In the following tables, the devices which contributed to the majority of energy being utilized are mentioned along with their number and wattage. It should be noted that the duration mentioned is 10 hours, which corresponds from the closing time to the opening time of the university (i.e., 10pm to 8am).

Table 1 Appliances in J1 building along with total kWh.

J1							
s.no.	Device	Number	Watts/hr	Total watts/hr	hours	Wh	kWh
1	clinic TVs	7	70	490	10	490	4.9
2	Display TVs in corridor	12	100	1200	10	12000	12
3	vending machines	12	550	6600	10	66000	66
4	office lights	5	11	55	10	550	0.55
5	Washroom lights	480	11	5280	10	52800	52.8
6	corridor lights	20	11	220	10	2200	2.2
							138.45

Table 1 Appliances in J2 building along with total kWh.

J2							
s.no.	Device	number	watts	Total watts	hours	Wh	kWh
1	lab computers	10	150	1500	10	15000	15
2	Display TVs in corridor	15	200	3000	10	30000	30
3	vending machines	18	550	9900	10	99000	99

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4	office lights	25	11	275	10	2750	2.75
5	Washroom lights	214	11	2354	10	23540	23.54
6	corridor lights	60	11	660	10	6600	6.6
							176.89

As shown in the tables the majority of energy wastage was through the vending machines which utilized 550 watts per machine, this energy is mainly required to maintain the temperature and functioning of the machine.

The next major wastage of energy is due to the washroom lights since there are twenty-five washrooms in the J1 building and twenty-one in the J2 building, adding up to a total of 694 lights.

The total kWh for the J1 building estimates to 139kWh while for the J2 building estimates to 177 kWh, although this does not amount to a significantly large number it should be noted

that we can use this estimate to evaluate an estimation for 10 months, which is the period pertaining to two semesters and excluding the summer vacation.

Table 3 estimated kWh for J1 and J2 during weekends.

s.no	Building	Kw	hours	kWh
1	J1	134	48	6432
2	J2	162	48	7776

Table 4 Estimated total cost for J1 building for 10 months.

J1						
kWh during weekdays	kWh during weekends	Total kWh in a month	Months	Total kWh for 10 months	cost per kWh	total cost
139	6432	28786	10	287860	0.33	94993

Table 5 Estimated total cost for J2 building for 10 months.

J2						
kWh during weekdays	kWh during weekends	Total kWh in a month	Months	Total kWh for 10 months	cost per kWh	total cost
177	7776	34998	10	349980	0.33	115493

Considering the weekends, since the clinics and labs are closed there will be a difference in the kWh per day, but the number of hours will increase to 48 hours.

Since Ajman university is based in the emirate of Ajman the electricity and energy are provided by FEWA, which is the energy provider for all the northern Emirates excluding Abu Dhabi, Dubai and Sharjah. The cost per kWh exercised by FEWA is 0.33, thus when the estimated cost for 10 months is calculated it amounts to a significantly large value.

In the tables above it can be seen that the total cost amounts to an estimation of AED210,486, where the J2 building has more cost than the J1 building due to the additional vending machines and TV's.

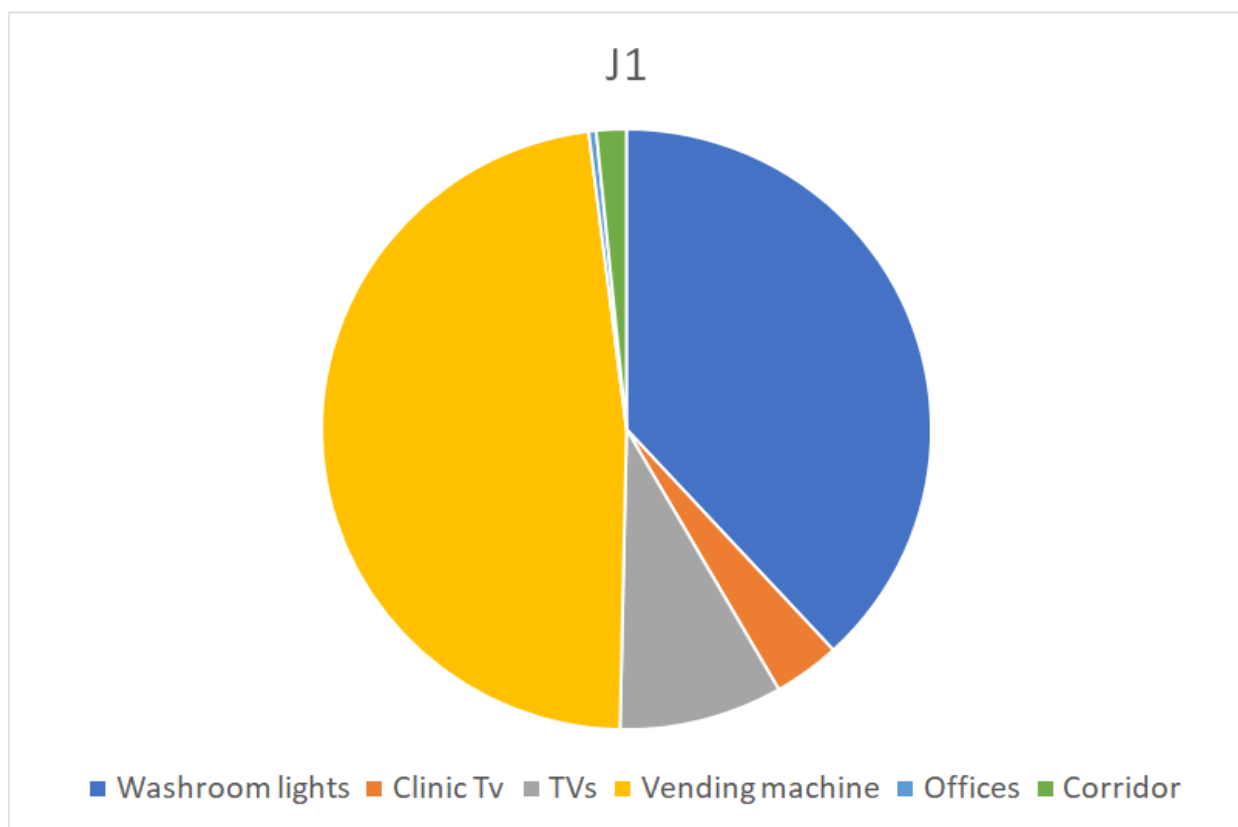


Fig 8 Appliances in J1 building.

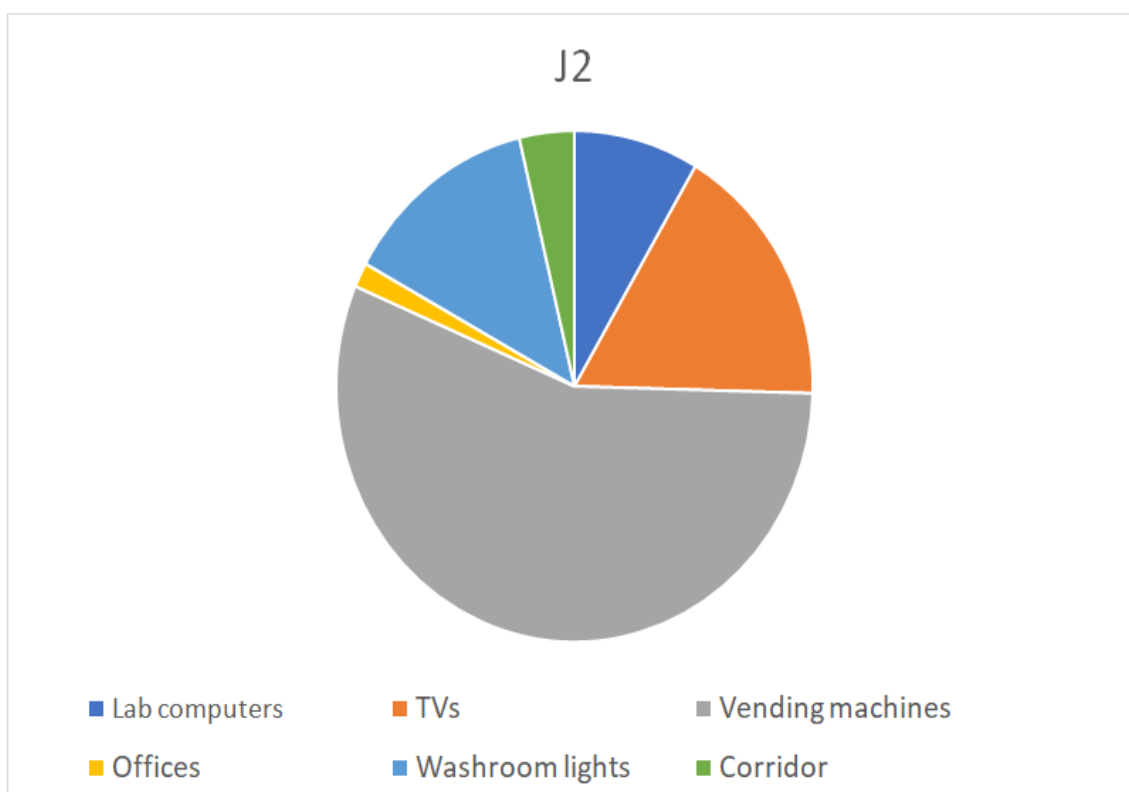


Fig 9 Appliances in J2 building.

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It can be seen in the graph above that in the J1 building almost 50% of the energy is utilized by the vending machines while the washroom lights take up more than a quarter of the remaining energy. The other appliances are almost less than 20% of the total.

Compared to the J1 building, since J2 building has more vending machines it is noticeable that the energy utilized is more than 50% while the second major energy utilizer are the TVs followed by washroom lights, both of which are at almost an equal percentage.

### V. DISCUSSION

Our specific study mainly revolved around measuring the amount of energy that was being consumed from every facility that is present in the Ajman University campus. This study was conducted thoroughly, every day after working hours by visiting different buildings present in the university campus, these buildings were the J2, J1 and the student hub facilities. It was noticed that there were several unnecessary equipment, machines like the vending machines, TV, and lights that were left switched on, especially in offices, hallways and all of the bathrooms in both female and male compartments.

Several dental clinics and some of the dental units were left switched on with their associated monitors that is also a major source of unnecessary energy consumptions which leads to environmental and financial constraints on the university. Certain dashboards were left switched on, which was extremely unnecessary and refrigerators in the student hub building at the food court section were also on. In addition, the light design of the student hub logo stayed switched on for an extended period of time.

Several solutions needed to be noted down, to reduce the amount of energy consumption and the electricity usage which can help us reduce the emission of harmful emissions of carbon and other harmful gases. Most of the light bulbs present in the bathrooms were presented with compact fluorescent lamps. These lamps are very inefficient and proved to be non-lasting and not as conservative in maintaining energy. The implementation of LED light bulbs all around can be a very advantageous solution in maintaining and conserving energy. They last for more than 20 years and are very efficient and provide no harm to our environment and can reduce the financial cost significantly.

The most important aspect of energy conservation is raising awareness. Without raising awareness about how important energy conservation is can led to devastating effects in both the environmental and financial aspect. Implementing strict rules and regulations should be necessary for both the staff members and students in switching off lights and machines whenever not being used. Providing signs all around university campus in maintaining energy can also help people to understand. To incorporate a 20-minute lecture about how the wasting of energy can lead to many emissions of harmful gases affecting our planet and how it can worsen the condition of the long-term conflict of global warming.

Vending machines and TVs around the university campuses were also found to be a problem that needed to be given the right and accurate solution. Vending machines and

TV's present in the university campus consume energy especially when they are put in standby mode. This is based on the concept of vampire power or energy leading to excessive amounts of financial cost and has a drastic effect on our environment. We can provide several solutions, like the implementation of sensors that can be attached to these machines. Sensors can come in the form of either photo sensors or light sensors or even heat sensors. Moreover, photo sensors are sensors that detect light or any form of energy, most commonly electromagnetic energy. Light sensors are sensors that detect light and heat sensors are sensors that can detect heat or an increase in temperature. Sensors can be installed in the TV's present in the dental units in the dental clinic, switching the TV's off whenever the student or the dentist will not use it. It can also be installed on all of the vending machines present in both the female and male sections, switching them off whenever not used, thus saving more energy.

A software system can be applied and implemented to understand and determine the energy efficiency as well as its consumption. These systems can also help users to find a way in reducing these unnecessary energy consumptions and can also identify the cost it might take for the energy usage either monthly or even yearly. This system can identify energy consumptions of every different building in the campus.

Instead of switching lights on or off or forgetting to turn off the lights, certain motion detectors can be used since these types of detectors can understand whether an individual is present inside the building or not, therefore automatically switching the lights on or off. Regarding the student hub building, it is a more advanced building where there is the presence of heat sensors, sensing the temperature of the human body, therefore automatically turning on the lights all around when it detects the temperature of a human body. However, the refrigerators remain on at all times therefore allowing it to be the highest consumer in the building. There is a solution to this matter, however it might be a temporary solution and the problem might be inevitable. Installing a type of insulating material may aid in keeping the cool temperature inside the area, therefore keeping any essential goods or food products cool and usable for cooking. Insulating materials that may help in keeping temperatures as it is, are Aerogels, Fiberglass, and many more materials. Aerogels are used mainly in refrigerators, keeping the same temperature. Fiberglass is also a quite common type of material where it consists of minute filament of glass. Exceptionally good material for providing an insulating effect. Both of these insulating materials are inexpensive, reliable, and efficient. The lights that surround the refrigerator consumes unnecessary energy and should not be turned on for no specific reason for a long period of time. A solution to this is to place different kind of sensors that can detect light, or motion, allowing it to be turned on only when the refrigerator is in use.

Air conditioners are found everywhere in each and every building on the university campus, they consume a lot of energy and electricity. In some cases, air conditioners may be used in a permanent manner, especially in specific laboratories found in the pharmacy section of the campus. This is related to the phenomena of 'Ghost consumption',



which is the continuous consumption of energy or electricity when people are not around. To provide an effective solution for this matter, the use of solar panels can be used to reduce the cost of generating electricity. It uses the rays of the sun to generate electricity. Its use is greatly beneficial to our environment since it decreases the formation of harmful gases like carbon and reduces its emissions. If solar panels get damaged, it may be easy for it to be repaired. In addition, solar panels produce electricity in any climate making it less of a problem. However solar panels themselves are expensive to position and it does not really suit all roof types, only some. For this reason, we proposed the usage of a solar panel to generate as much electricity possible for the continuous supply of certain equipment or products that should be turned on.

Assigning certain staff members in the university to serve as an energy audit. This role may be especially important since they have the task of controlling the system software designed to measure the consumption of energy, and to assess or analyze the monthly or yearly cost of electricity consumption. Not only do they have the task of controlling the system software, but they also have the task of raising awareness and making sure that every staff office light is left turned off without any leakage and wasting energy. Dashboards that were present in both the pharmacy and dental section, were left turned on when it was unnecessary, especially during nighttime. A solution proposed to this was either to unplug the cables required for turning these dashboards off, this is done by the staff member present at that time or the placement of sensors to automatically shut off these dashboards that are left on for no reason.

Elevators present in all campuses consumed the lowest amount of energy due to the lightning that is on, although a solution must be made in order to preserve energy. Solutions can be made by installing motion detectors, therefore detecting the movement of any human being inside the elevator in which it can then turn the lights on or off. Another solution is installing photo sensors or light sensors detecting any form of light, therefore turning the elevator on or off, preserving more energy.

#### A. Limitations

During the time period that the study was being performed, issues were faced including limitations that were inevitable. We were restricted in gaining access to certain offices, and the pediatric master's room, since it was locked. Some of the laboratories were locked and were not allowed for us to enter and examine the equipment available there, whether it was turned on or off thus causing a difficulty in identifying the amount of energy consumed in those facilities.

#### B. Recommendations

Eventually this study mainly revolved around how unnecessary energy were consumed in a daily basis in Ajman University campus, and how accurate solutions were provided in each and every situation, including the implementation of different kind of sensors such as the photo or light sensors and motion detectors, the raising of awareness and education of staff members and students regarding energy consumption, installation of solar panels leading to renewable energies, applying different types of insulating materials to maintain

thermal energy inside the room, unplugging cords, assigning different staffs as energy audits and using software to measure energy efficiency and consumption. Limitations were there in our study; however, this shows that most of our results were achieved in minimizing energy consumption.

#### C. Impact on dentistry

The aim of green dentistry is to provide a safe environment that is free from all the harmful carbon emissions generated from unnecessary wasting of energy. In previous generations, dental clinics had a more positive impact in the environmental and financial aspect compared to the modern dental clinics due to them being smaller in size with less air conditioning and limited numbers of meeting rooms.

In dental practices, there are two sources of energy that is widely used. Energy that is used to heat water and energy that is used for heating the main facility. These energies are provided by certain amounts of electricity, where this electricity is formed by a combination of fossil fuels like coal with renewable energies like the solar panel. The solution to decrease the harmful effects that is made to our environment is by using green energy that is supplied by companies which produce energy from renewable sources thus providing energy with decreased levels of carbon emission. If dental consumers purchase from these suppliers, it'll increase the demand which will increase use of green energy benefiting the environment.(2)

Heating is an action where it consumes good amounts of energy. In dentistry, the ideal source of heat should provide the least amount of carbon emission and air pollution. Wood pellets are one source of providing heat since they have least amount of carbon emission however it is a risk since it causes air pollution making it less desirable in the practice of dentistry. Most effective way is through the use of renewable energy.

Air conditioning is an intensive consumer of energy, consumes 31-42 kWh per year per meter square. It will have an effect on the financial aspect if used in an unnecessary manner. Solutions to this in the dental clinic can be as follows: Closing the doors to areas that are air conditioned, the use of Blinds to reduce the scattering of heat around the dental clinic, and the use of natural techniques in regard to ventilation.(2)

Maintaining the water heat can be done by the insulation of the tank that is responsible for maintaining the water. This insulation can save costs and energy. The usage of blinds/curtains can sustain a significant amount of energy, keeping heat in or out. This depends on the type of season (summer or winter) and the time of the day.

Timers and thermostats are useful ways to decrease consumption of energy in the dental clinic. Timers are made in such a way that they are set to a specific specification during winter and summer seasons to control the heating system if whether they should be turned on or off. Thermostats can be used in the room to regulate the temperature and can provide an effective way of reducing costs and saving energy.

Closing doors and shutting off radiators can be implemented in a routine manner. This can cause the amount of heat to decrease or increase. Some specific areas may be overheated, and this should be reported by staff members so

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that a solution can be found as soon as possible. Almost all of the electrical equipment in the dental clinic consumes energy, and the energy that is consumed depends on the electrical power and the duration of use per day. Electrical equipment can have an impact on the environment, and this is due to their life cycle and how long it has been used. It also depends on the number of materials it took to construct and dispose of this equipment.(2)

In Dental clinics, appliances can be categorized into three groups:

1. Low energy appliances; amalgamators, curing lights, X-Rays, WIFI. These electrical appliances consume the least amount of energy. Light curing equipment uses light emitting diode (LED) therefore reducing energy consumption.

2. Moderate energy appliances; Fridges, Dental lights, kettles.

3. High energy appliances: Computers- costing 12 to 50 pounds of energy yearly when used 8 hours daily. A solution that can be made is to replace the hard drives with a smaller version, or the usage of a laptop (consuming less energy, costing around 3 to 9 pounds yearly). Another effective solution is to get them turned off at night instead of leaving them on overnight yielding a cost of 50 pounds yearly. The usage of software that aims to place computers in power saving mode can be done to reduce the consumption of energy.(2)

Water coolers should be placed on standby mode after leaving clinics and the use of LED TV's can be a strategic way in saving energy. Lightning is one of the sources of high energy consumption. The use of LED's can yield a higher intensity and use 8-10 W therefore reducing carbon emissions and costs. Other solutions are to harvest daylight or the use of a control system that can dim the lights whenever daylight is entering a specific space. Turning of the lights when not in use and providing a label onto the switches for people to understand that this switch should not be turned off (especially at night to avoid the switching off of critical appliances).(2)

Fridges, depending on their size, and the fridges' location based on the temperature, how often the door of the fridge is open and how occupied it is. In dental practice the energy consumption of fridge can be decreased by not placing it next to any source of heat, not occupying it fully and providing it with sufficient space for cooling. Suctions used little amounts of power (almost costs 7 pounds per year.)

Autoclaves, washer disinfectants and ultrasonic cleaners are equipment used in dental practices. Autoclaves consume a good amount of energy, almost equivalent to the consumption of energy in air conditioning, costing around 181-242 pounds per year. Ultrasonic devices high consumers of electricity only when they're used, although they are used for a short period of time. (Can cost 20 pounds per year).(2)

To generate electricity in dental clinics, there are several ways:

1. Solar panels
2. Solar thermal systems – to heat water it usually uses solar energy.
3. Heat pumps – Distributes heat from the ground into dental practice.
4. Biomass heating- CO2 emissions released taken up by

the trees in the forest in the same rate. Done by the use of small or large chips of wood.

## VI. CONCLUSION

In conclusion, the hypothesis is confirmed that indeed there is a substantial amount of electricity being utilized needlessly. This should push Ajman University to develop more green approaches and practical solutions to reduce energy wastage and unnecessary usage of the university's electrical equipment and facility resources in both campus buildings J1 and J2.

A huge part of preventing this negative expenditure is to spread awareness concerning saving electricity between faculty members and the students that use the various facilities of the university. Achieving that will in turn lead to a significant reduction in electricity needless depletion. The results illustrate significant financial losses that the university endures every two semesters because of the lack of electricity saving efforts and the lack Promoting sustainability culture amongst students, and faculty members.

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Use

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