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Adapting Green Technology on the Minimization of Carbon Emission in a Higher Education Institution

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Abstract*: The study aims to evaluate the contributors to Carbon Dioxide emission considering the operational activities in the Higher Education Institution and use this as a basis for adapting green technology. This research utilized the mixed method to determine the biological and operational contributors, corresponding scope, kilograms of Carbon Dioxide emitted, and awareness of students, faculty members, and non-teaching personnel about the policies on contributors of Carbon Dioxide. Results showed that human respiration, electricity consumption, liquefied petroleum gas consumption in canteen, restaurant, food stalls and laboratories, University-owned vehicles gas combustion, four-wheel vehicle and motorcycles entering and exiting the campus gas combustion, materials and supplies consumption emitted Carbon Dioxide corresponding to 11,672,742.0792; 1,873,456.92352; 342,224.464, 43,063.8; 24,326.155; and 14,458.80155 kilograms with a total of 13,970,272.234 kilograms annually. The perceptions of students, faculty members, and non-teaching personnel about the Carbon Dioxide contributors and policies in the University campus were summarized as follows: The respondents are aware and involve in the Policy on Clean and Green of the University which is being manifested through recycling of plastic, papers and other biodegradable and non-biodegradable wastes; submission or forwarding of reports or memoranda through online; use of water tumbler and food containers which respond to the policy of No Plastics; segregation of solid wastes; planting native and fruit-bearing trees; saving measures were posted in classrooms and laboratories; water conservation; wider dissemination through discussion of topics about climate change, environmental laws and principles, waste management, air and water acts, and green technology in classes; Garbage in Garbage out policy; imbibing discipline in terms of cleanliness and orderliness in the campus; and using solar energy in lighting electric posts.

Keywords: Biological and Operational Contributors, Carbon Dioxide Emission, Green Technology, Scope

I. INTRODUCTION

The increase in the Higher Education Institution population has a direct relation to its increase in operational activities. The Higher Education Institution stakeholders composed of students, faculty members, non-teaching personnel, administrators, suppliers/contractors, alumni, parents, and others are aware of global warming or climate change. But the relation of global warming and carbon emissions had not been given attention through social surveys or studies in the Higher Education Institution. Every day, all stakeholders can feel the heat of the environment, some commented that because of the many concrete buildings, concrete roads and small areas of soil with planted trees and ornamental plants.Oftentimes, people heard that the emission of Carbon Dioxide into the air is a major contributor to greenhouse gasses that cause global warming. There is a need to be conscious or observant of what are these contributors to carbon emissions in the Higher Education Institution. Although the Higher Education Institution included in its strategic plan 2016-2020, its sub-goal of ensuring environmental protection and management through a reforestation project, still there is a need to establish baseline data that the effects of the carbon emission contributors can be used as inputs for adopting green technology.The researchers aim to assess various elements that contribute to the carbon emissions of the Higher Education Institution and consequently use the results of this study as the basis of positing green technology which can neutralize the carbon emissions. Green Technology is a technology utilized in industries and academes to keep the process of sustainable development. In other words, green technology is used to reverse or mitigate the effects of human activities on the environment. This ensures that the environment remains protected. Also, the objectives of green technology are to conserve nature and to remedy the negative impacts of human activities on it. The most important benefit of green technology is it offers benefits not only to the environment but also for a clean and greener human lifestyle. People need a healthy earth to live and continue existing.

The major activity of the Higher Education Institution is the teaching-learning process where it involves faculty members and students. In the process, ceiling fans in the classrooms or laboratory room, air-conditioning units, electric fans, electrical lighting fixtures, television sets, laptops, and liquid crystal display are also being used which consumed electricity. The support services provided to the cited process consumed electricity and used supplies, materials, and printing/copying equipment. Food services and food laboratories utilized liquefied petroleum gas. Transportation service of faculty members, non-teaching personnel, students and Higher Education Institution-owned vehicles consumed fuel petroleum products that emit Carbon Dioxide. Solid wastes are being produced which emit Carbon Dioxide too into the air.

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Statement of the Problem

The general problem of the study is "How may the Carbon Dioxide emitted into the air by the Higher Education Institution's operational activities be evaluated and consequently used as inputs in adapting green technologies?" Specifically, the study sought answers to the following questions:

1. What are the different contributors' sources and scopes of carbon dioxide emissions from the operational activities of the Higher Education Institution?
2. How much is the total carbon dioxide emitted by all the contributors?
3. What are the perceptions of the students, faculty members, and non-teaching personnel about their awareness and policies on the contributors to Carbon Dioxide emissions?
4. What green technologies may be adapted to neutralize carbon dioxide emissions in the Higher Education Institution?

II. RESEARCH METHODOLOGY

A. Methods and Techniques of the study

The study used mixed methods. The research instrument was locally constructed considering the direct and indirect sources of carbon emissions. The direct sources are: the quantity of office supplies like paper and printer/photocopier ink delivered, diesel, liquefied petroleum gas and other petroleum product used by the University taken from the supply office, quantity of office supplies used by the different offices, population of students obtained from the Registrar's office, also the population of faculty members and non-teaching personnel taken from the Human Resource Management Office; and solid wastes generated from the Facilities Management and Maintenance Office. While the indirect sources are: electric consumption taken from the Accounting Office and the volume of vehicles entering and exiting the campus requested from the security guards. Also, interviews were conducted among the faculty members, students, and non-teaching personnel about their awareness of the carbon emission contributors present in the University and what green technology may be adapted to lessen carbon emissions. The researchers calculated the carbon emissions through the use of Carbon Footprint formulas.

B. Respondents of the Study

Selected students, faculty members, and non-teaching personnel were interviewed to determine their awareness on carbon emission contributors in the University and green technology existing in the premises and policies which may be adapted to minimize Carbon emissions

III. RESULT AND DISCUSSION

A. Tables

Table I: Carbon Inventory Released through Human Respiration

Month	Population	Days of Operation	Time	Total Time	Density CO_2	mCO_2 kg
January	25,531	25	8	200	0.2297	1,172,894.14
February	25,539	25	8	200	0.2297	1,173,261.66
March	25,479	21	8	168	0.2297	983,224.4184
April	25,481	24	8	192	0.2297	1,123,773.2544
May	25,482	26	8	208	0.2297	1,217,468.8032
June	995	25	9	225	0.2297	51,424.0875
July	989	25	9	225	0.2297	51,113.9925
August	27,788	26	8	208	0.2297	1,327,643.9488
September	27,953	26	8	208	0.2297	1,335,527.2528
October	27,956	26	8	208	0.2297	1,335,670.5856
November	27,956	25	8	200	0.2297	1,284,298.64
December	27,955	12	8	96	0.2297	616,441.296
					Total	**11,672,742.0792 kg**

Table I presents the carbon inventory released through respiration of the usual stakeholders such as students, faculty members and non-teaching personnel shown in the table. The twelve months and correspondingly the population, i.e. the number of students, faculty members, and non-teaching personnel entering, performing operational activities and exiting the University campus; the number of operational days and average time in hours per day spent by the population in the University campus; the total time in hours per month; density of carbon dioxide per person in performing normal work; and the total mass of Carbon Dioxide released through respiration in kilogram per month and the entire year of 2018. It is noticeable that in the first semester of the school year which is from August to December the highest mass of Carbon Dioxide released was equivalent to 1,335,670.5856 kilograms, while during midyear break from June to July the lowest mass of Carbon Dioxide released was 51,113.9925 kilograms, and in the second semester which is from January to May the highest Carbon Dioxide released was 1,217,468.8032 kilograms. The grand total of Carbon Dioxide released for the entire year of 2018 was 11,672,742.0792 kilograms.

It was observed that the mass of Carbon Dioxide was in its peak during the first semester, this was due to many students enrolled as compared with the second semester, and during midyear break, although there were some students enrolled but they were outside of the campus for the On-the-Job Training Program.

Table II: Annual Carbon Inventory due to Electric Consumption of the University

Month	Kilowatt per Hour	Factor	mCO_2 kg
January	252,450	0.6032	152,277.84
February	287,279	0.6032	173,286.6928
March	277,813	0.6032	167,576.8016
April	327,234	0.6032	197,387.5488
May	262,047	0.6032	158,066.7504
June	178,453	0.6032	107,642.8496
July	237,582	0.6032	143,309.4624
August	325,827	0.6032	196,538.8464
September	318,923	0.6032	192,374.3536
October	284,345	0.6032	171,516.904
November	199,236.6	0.6032	120,179.51712
December	154,674	0.6032	93,299.3568
Total			1,873,456.92352

Table II presents the annual Carbon inventory due to the electric consumption of the University. It can be observed from the table that the highest Carbon Dioxide emission occurred in April which is equal to 197,387.5488 while the lowest Carbon Dioxide emission that happened in December equals to 93,299.3568 and the total Carbon Dioxide emission is equal to 1,873,456.92352. From these results it can be deduced that during dry season there is too much electric consumption, thus, it caused too much Carbon Dioxide emission, while the first semester operational activities end after the second week of December the faculty members and students are on semestral break, the electric consumption was reduced, therefore, lesser Carbon Dioxide emission.

Also, the table revealed that the average Carbon Dioxide emission for the first semester which is from August to December is equal to 154,781.795584, while in the second semester which is from January to May is 169,719.12672, and during midyear which falls on June and July equals to125,476.1569. The electric consumption that emitted Carbon Dioxide is higher and lower during the dry season and wet season, respectively.

Table III: Annual Carbon Inventory due to Liquefied Petroleum Gas Consumption of the University

Description	LPG kg/day	LPG li/day	Daily CO2 kg	Annual CO2 kg
Food Stalls	339.2928	665.28	1,004.5728	253,152.3456
University Canteen	42.41	83.16	125.57	31,644.04
University Restaurant	6.2832	12.32	18.6032	4,688.0064
Food Laboratories	70.686	138.6	209.286	52,740.072
TOTAL			**1,358.032**	**342,224.464**

As shown in Table III, the following facilities used the liquefied petroleum gas in their cooking activities inside the University campus: food stalls, University Canteen, University Restaurant, and food laboratories. The highest annual Carbon Dioxide emission was contributed by the Food stalls equal to 253,152.3456 kilograms while the lowest was contributed by the University Restaurant equal to 4,688.0064 kilograms. It can be observed that the Food laboratories and University Canteen were the second and third highest contributors to Carbon Dioxide emissions in the University. Data revealed that the produced Carbon Dioxide emission by the food stalls was due to the big number of consumed liquefied petroleum gas, these food stalls served foods to more than fifty percent population of the students, faculty members, and non-teaching personnel of the University. The University canteen and restaurant has limited spaces to cater the food services for the stakeholders of the University, thus, emitted only seven percent of the Carbon Dioxide while the food laboratories were only handful in quantity, this was set-up to complement the lecture part of the curricular program, hence, about five percent of the Carbon Dioxide was emitted.

Table IV: Annual Carbon Inventory due to Diesel Consumption of University-Owned Vehicles

Month	L fuel	Constant	CO2 kg
January	1,339.05	2.68	3,588.65
February	1,339.05	2.68	3,588.65
March	1,164.01	2.68	3,119.55
April	671.85	2.68	1,800.56
May	1,170.08	2.68	3,135.81
June	1,317.63	2.68	3,531.25
July	1,402.28	2.68	3,758.11
August	1,339.05	2.68	3,588.65
September	1,806.35	2.68	4,841.02
October	1,411.3	2.68	3,782.28
November	1,768.88	2.68	4,740.6
December	1,339.05	2.68	3,588.65
Total	16,068.6	2.68	43,063.8

Table IV presents the annual Carbon inventory of fuels consumed by the seven vehicles owned by the university. The highest fuel consumption happened during September which was 1,806.35 liters while the lowest fuel consumption occurred in April equals 671.85 liters. The average fuel consumption was 1,339.05 liters. It can be gleaned from the table the corresponding Carbon Dioxide emissions every month and the total Carbon Dioxide emission of 43,063.8 kilograms. The fuel consumption was at its peak during September because of the many mobile activities participated by the University students, faculty members, and non-teaching personnel, while it was lean in April because most of the year ending activities were held within the campus. Hence, lesser fuel consumption produces lesser Carbon Dioxide emissions.

Table V: Annual Carbon Inventory of Four-Wheel Vehicles and Motorcycles entering and exiting the University Campus

	Ave. Vehicles/day	Ave. Dist.(m)	Constant	Daily CO2kg	Annual CO2 kg
Four Wheel Vehicle	231	642.45	0.00024	35.617	13,000.205
Motorcycle	345	642.45	0.00014	31.03	11,325.95
			Total	66.647	24,326.155

Table V shows the annual Carbon inventory of four-wheel vehicles and motorcycles entering and exiting the University campus. The four-wheel vehicles and motorcycles emitted Carbon Dioxide equal to 13,000.205 kilograms and 11,325.95 kilograms, respectively. Thus, the total Carbon Dioxide emitted was 24,326.155 kilograms. It can be observed from the table that the average distance traveled from the gate to another gate by the four-wheel vehicles and motorcycles was only 642.45 meters which were too short.

Table VI: Annual Carbon Inventory due to Office Supply Consumption

Building	Mass, kg			CO2, kg		
	Plastic	Paper	Metal	Plastic	Paper	Metal
Building A	13.044	319.3484	103.0083	78.264	223.54388	195.71577
Building B	12.67	835.83	11.89	76.02	585.081	22.591
Building C	14.12	334.52	9.94	84.72	234.16	18.89
Building D	2.7353	169.21	24.649	16.4118	118.447	46.8331
Building E	16.24	1,283.95	21.27	97.44	898.765	40.413
Building F	2.19	295.37	15.66	13.14	206.76	29.75
Building G	5.21	539.31	25.42	31.26	377.52	48.30
Building H	41.05	615.04	39.10	246.3	430.528	74.29
Building I	81.03	10,928.69	367.78	486.18	7,650.083	698.782
Building J	9.11	477.34	19.65	54.66	334.138	37.335
Building K	59.19	854.93	25.76	355.14	598.45	48.94
Total	256.5893	16,653.5384	664.1273	1,539.5358	11,657.47588	1,261.83987

Table VI presents the annual Carbon inventory due to office supplies consumed the last year 2018. The office supplies are made up of plastic, paper, and metal with a corresponding constant value of 6, 0.7, and 1.9, respectively. The office supplies consumed by the different colleges and offices housed in the buildings of the University were considered. It can be observed from the table that most of the office supplies are made up of paper where the amount corresponds to 16,653.5384 kilograms and emitted Carbon Dioxide equal to 11,657.47588 kilograms. It was followed by office supplies made up of metal with a mass of 664.1273 kilograms which emitted Carbon Dioxide equal to 1,261.83987 kilograms. Lastly, those office supplies out of plastic with a mass of 256.5893 kilograms that emitted Carbon Dioxide equal to 1,539.5358 kilograms.

It can be surmised that office supplies made out of plastic can produce higher Carbon Dioxide emissions, which can be attributed to a higher constant value. In most transactions of the University, papers are always used, thus, the highest office supplies consumed are from paper,

although in the current era paperless transactions are encouraged. Since a lesser amount of office supplies were made from metal, it follows that a lesser amount of Carbon Dioxide was emitted.

B. Carbon Inventory due to Solid Wastes Generated by the University

Interviewed was conducted among the Utility workers, non-teaching personnel, and Heads of IEG and FMMO about solid wastes. The Head of IEG cited the different policies and projects like, Trash to Cash Program, dissemination of information campaign materials on conservation of energy, planting of fruit-bearing trees like guava and citrus, urban gardening, inclusion in the Program Project Management Plan the payment for the collection and hauling of solid wastes, Zero Waste Management Program, Garbage In Garbage Out, Bring Tumbler or food container and jug in taking out food and water, Ban the selling of Plastic Bottled water and juices. The Head of FMMO mentioned the implementation of the Zero Waste Management Program through the installation of three trash bins on steel frames with a proper label of Biodegradable, Non-biodegradable, and Recyclable, these are located in every floor of all the buildings, and at conspicuous places where there are many students. There were signs installed within the campus, like: YOU are in a NO SMOKING UNIVERSITY, SPEED LIMIT 10KPH, NO PARKING, NOISY MUFFLER NOT ALLOWED, NO SMOKING, NO LITTERING, etc. The Utility workers cited due to the issuance of the different policies on environment preservation and conservation of energy, the accumulated solid wastes were put in white plastic bags with a volume equal to fourteen cubic meters per day, less than fifty percent lower compared with the previous year's collected solid wastes. Every day, after the scheduled classes in the evening, the solid waste collector hauled and transported it in the sanitary landfill located in another province. There was no Carbon Dioxide emitted due to solid wastes because of its practice of everyday collection.

C. Awareness of students, faculty members, and non-teaching personnel about Carbon Dioxide contributors and policies in the University campus

There were interviews conducted among the stakeholders of the University as follows:

Student A. The University's information campaign on its goal as "Clean and Green University" is very visible with its practice of proper waste segregation, installing a wire mesh container where empty bottles can be thrown for selling and recycling; biometric scanner machines were installed in entrances of the campus for logging in and out of faculty members and non-teaching personnel, students submitted reports through online instead of printing hard copies, where it manifests paperless transaction; students bring their drinking bottles and food containers.

Student B. I believe that the preservation of trees and greenery areas in the campus has a positive impact on reducing the Carbon Dioxide emission, the Administration maintains the line-up of trees from the main gate, heroes park, and open quadrangle in the campus; also, ornamental flowers, outdoor plants with many leaves are observable in parks, study areas, and corridors, while, indoor plants on pots are evident in offices.

Student C. I am just a new student of the University, during my first lunch break, I was surprised when the seller of fruit shake asked for my identification card in exchange of the product, upon inquiry, I found out that doing so assured them that the paper cup will be thrown in the designated trash bin; I've observed on the following week, that there was no bottled water available in any of the stores, hence the need to bring personal tumbler, and those who wanted to take-out food or bring in their office, have to bring own food container and utensils, seeing those people practice the use of reusable food containers, trying to lessen the use of single-use plastic, as if its already a part of the school culture, already gave me the idea in the school's campaign for green technology.

Students from the College of Science. I am aware of the Clean and Green policies of the University. To minimize carbon emissions, encourage students and faculty who resides nearby the University to use bicycles and the University should provide Bicycle parking areas, require every College to develop a mini or vertical garden using pots hanging on bamboo/wire mesh frames, conduct tree planting as a final requirement every end of the semester per college, totally ban the use of plastic bottles as container for soft drinks, juices and other liquid, punish the students charging their gadgets in the classrooms/ laboratories.

Group of students from the College of Information and Communications Technology. We were informed by our teachers about the green technologies, we agreed to plant more trees and plants within the campus for us to feel fresh and lessen the hot temperature, prepare an e-waste management plan including its procurement to disposal, strengthen the information dissemination about technologies which will reduce Carbon Dioxide emissions, and buy a recommended environmentally friendly electronics/ gadgets.

Faculty Member A. The effects of climate change have been very obvious and evident in these present days, like the extreme heat of the sun, heavy typhoons, and floods being experienced in the University. As part of our responsibility, topics on climate change, environmental laws, waste management, and Green Technology were discussed in classes. The National Service Training Program (NSTP) students were involved in maintaining the cleanliness of the school's surroundings, promote and assist the administration in implementing the policies on Garbage In Garbage Out, planting fruit-bearing trees and edible plants, and supporting the attainment of "Clean and Green University".

Faculty Member B. The University campus affirms discipline in terms of the cleanliness and orderliness in different departments. It can be observed from the corridors, inside the classrooms, where it is conducive to learning, facilities like comfort rooms were properly managed. The University was certified by the International Organization for Standardization (ISO 9001:2015) Total Quality Management and Institutionally Accredited level 2 by the Accrediting Agency of Chartered Colleges and Universities of the Philippines. The different policies to attain the goal of "Clean and Green University" may soon be realized.

Faculty Member from the College of Science. As an agriculturist, I am aware of the benefits and effects of CO_2 in humans and the environment. CO_2 benefits all the trees and plants in the environment as it is the major component of chlorophyll which enables them to produce their food. However, too much CO_2 has also a deterrent effect on the environment.

A tremendous amount of CO2 in the atmosphere without enough plants to absorb it makes the atmospheric air hot and humid, thus affecting humans. Hence, if plants benefit from this problem, then greening the environment is one good solution. While we are trying to focus on solid waste management and regulating the entry of vehicles, we must also consider planting trees in open spaces, make mini gardens in between buildings and potted plants in some areas of the building. Create a balanced ecosystem within the University premises.

Non-teaching Personnel A. The University, being known for its first-rate academic performance is a true advocate of a good image on safety, security, preservation, and conservation of the environment. The extensive and large size of the population of the institution needs to concretize the love for mother earth and make all its stakeholders aware of its goal of "Clean and Green University". Posting of simple signages on turning off lights and Air Conditioning Units, segregation of waste, ban of bottled water, prohibition of vehicle loud muffler inside the campus, food concessionaires compliance with the policies of the University, and use of solar energy in lighting electric posts in the parks and roads are manifestation of supporting the goal of "Green Campus".

Non-Teaching Personnel B. The University stakeholders work hand in hand for awareness regarding climate change. It's very evident as you walk through the University premises, the presence of trash bins labeled Biodegradable, Non-biodegradable, and Recyclable for waste segregation; signage on how to prevent a clutter of garbage inside the campus and implementation of programs for green technology in the University. The improvement of an institution is connected with its policies, those policies on environment preservation and conservation contributed to the amelioration of the University. As a member of the University, I commit myself to follow and practice those policies as a manifestation of our core values Service to God and the community, Order and peace, Assurance of quality and accountability, Respect and Responsibility.

Non-Teaching Personnel C. Carbon Dioxide emission is an emerging problem worldwide. No one is spared from its ill effects. In our University where thousands of people who come and go who produced a large number of wastes from plastics and other non-biodegradable materials, and where hundreds of vehicles park and leave, emission of the dense amount of CO2 emissions is inevitable. Despite the University policy on solid waste management introduced by Institute of Environmental Governance such as non-use of single-use plastics and other disposable kitchen utensils and the likes, still makes CO2 emissions a major pollutant in the atmosphere, because there are no stricter policies on vehicles coming in and out of the University. This must be looked into.

D. Proposed Green Technologies for Adaptation to Neutralize Carbon Dioxide Emission

The following green technologies were proposed for the University to minimize Carbon Dioxide emissions:

1. Planting of the different outdoor plants like Japanese bamboo, perfume tree, hardwood trees, fruit-bearing trees, and insect repellant and air purifying indoor plants. Develop a vertical garden per building, where wire mesh frames with plants may be hanged that will serve as green blinds and protect the internal area of the building from extreme hot temperature.
2. The Project Management Office may consider designing a green roof system, a special type of roof arrangement over a building that is either fully or partially covered by vegetation. This is planted over a specially designed waterproofing membrane which ensures protection to the traditional roof system of a building. Also, install rainwater harvesting facilities in all buildings to conserve energy. Further, consider paints free from Volatile Organic Compound (VOC).
3. Install solar panels on top of the roof of every building to reduce the consumption of electricity sourced from power plants, initially, prepare as-built plans of a building which could be piloted as generating electricity from the sun's rays, invest on purchasing batteries, solar panels and other fixtures then install in that building the solar panels and batteries and connect to the breakers of the electrical system.
4. Prepare an e-waste management plan and comply with the green procurement policies and guidelines inclusive of the proper disposal of electronic waste.
5. Regularly condemned properties/equipment/supplies which are no longer in use and if these are still functional, donate to the school/community or auction and continue the daily collection of solid wastes in the disposal area.
6. Strengthen the information dissemination campaign about the reduction and minimization of carbon dioxide emission in all the University operations like paperless communication, optimize the use of digitization or information communication technology, for the teaching and learning process- instead of printing handouts, send the soft copy for the students to study anywhere where the internet can be accessed.
7. Formulate policies to save energy, lessen the consumption of energy through replacement of old air conditioning units which consume too much electrical energy, instead use appliances with an inverter. Purchase and install Light Emitting Diode (LED) fixtures for the electrical system of the buildings. It is practical to use a laptop instead of a desktop, specifically in the consumption of electricity.
8. Provide water dispenser per College for the students to be obliged to bring their tumbler and drink water instead of soft drinks and bottled juices.
9. It is observable that in every program being conducted, a tarpaulin is being used, better use the available LED Television/ screen hanged in the Audio-visual room, lobby, halls, and gates.
10. Use white plastic trash bags instead of black trash bags in the collection of wastes from the trash bins distributed in the whole campus to the disposal area

IV. SUMMARY, CONCLUSION AND RECOMMENDATION

A. Summary of Findings

Based on the answers to the questions raised in this study, the major findings of the study are as follows:

1. Different contributors' sources and the scope of the carbon emission from the operational activities of the Higher Education Institution.

The major contributors are classified into two such as the biological and operational which belong to scope 1 and scope 2. Scope 1 includes the respiration released by the population/stakeholders of the University, liquefied petroleum gas used in cooking and laboratory experiments, fuel/gas used by motorcycles and four-wheel vehicles, and supplies consumed, while Scope 2 considered the electricity consumption of the University.

2. The biological contributor in terms of human respiration emitted 11,672,742.0792 kilograms of Carbon Dioxide while the operational contributors which were in terms of electricity consumption, liquefied petroleum gas consumption, University-owned vehicles gas combustion, four-wheel vehicles and motorcycles gas combustion, and office supplies consumption emitted 1,873,456.92352, 342,224.464, 43,063.8, 24,326.155, 14,458.80155 kilograms of Carbon Dioxide, respectively. The total Carbon Dioxide emissions of 13,970,272.234 kilograms, annually.

B. Conclusions

The following conclusions were drawn based on the findings:

1. The biological and operational contributors under scope 1 are the human respiration from the population of the University; liquefied petroleum gas consumption; University-owned vehicles gas combustion; four-wheel vehicles and motorcycle gas combustion entering and exiting the campus; and office supplies consumption; while the operational contributor under scope 2 is the electricity consumption.
2. The biological contributor which is the human respiration of the population emitted more Carbon Dioxide than the summation of the operational contributors.
3. The students, faculty members, and non-teaching personnel are all aware of the contributors to Carbon Dioxide and policies to minimize the Carbon Dioxide emissions.

C. Recommendations

The following recommendations were drawn based on the conclusions:

1. Other biological and operational contributors which were not considered in this study may be included for the next conduct of a similar study and it can be replicated in other campuses of the University.
2. Develop a mobile application or program where the data on biological and operational contributors of Carbon Dioxide inclusive of formulas used in the study may be encoded to generate efficient results.
3. Strengthen the dissemination and implementation of policies on minimization of Carbon Dioxide emission and adaptation of Green Technologies

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AUTHORS PROFILE

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