

## Impact of Green Campus Initiatives on Carbon Footprint of University Campus: Awareness of Students

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### KEYWORDS

Green Campus  
Initiatives  
Carbon Footprint  
Greenhouse Gas  
Emission  
GHG

### ABSTRACT

The focus of this study is to identify the suitable green campus initiative and to measure the reduction in carbon footprint that can be achieved at UNITEN's main campus. This study is conducted in UNITEN main campus to achieve the objectives set. A sample questionnaire survey was done to analyse impact of green campus initiative programs that can influence the carbon footprint of the campus. The survey identifies the knowledge and willingness of the student to participate in going green activities and contribute to emission reduction. The main green campus initiative areas targeted are litter and waste, energy consumption/implementation and transport and travel. From the survey, it has been identified that most of the students are well aware of carbon footprint and willing to contribute but they are not seriously practicing it. With mission to promote heightened awareness of environmentally sound practices in all of its management operation, activities, and curriculum UNITEN campus should look into practical means of forming a Green Campus Initiative teams to oversee all the activities and march toward reduction on carbon emission within campus with a firm target.

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### 1. INTRODUCTION

There are a lot of policies and legislations had been crafted in Malaysia to foster Green growth. Green growth includes four major areas namely, Energy, water and waste management, Transportation and building. Ministry of Energy, Green Technology and water has been established in April 2009 to undertake these responsibilities. Carbon emission reduction is one of their focuses in preserving the gift of Mother Nature to us human. Carbon emission or carbon footprint can be defined as the total set of greenhouse gas (GHG) emission that is caused by an individual, event, organization or product. GHG emission can be emitted through a lot of activities such as land clearance, transport, production and consumption of food, fuels, manufacturing goods, materials, wood, roads, building and services. Every action of human being leaves a mark upon the environment. These activities leave a carbon trail or carbon footprint. A lot of studies have been conducted on carbon footprint and ways to reduce it in several different levels, including societies, office, higher institutions and more. Ways of reducing carbon trail can also be termed as sustainable development. What is really meant when the term sustainable development is used? It is pursued so that we all can have a future with a cleaner environment, an unrelenting economic development and the protection of natural resources and biodiversity. A sustainable development also means there should not be excessive waste and pollution. Every human who lives on this earth should instill the social responsibility towards

sustainable future by delivery of quality education and as well empowering the communities to make their own decisions on the future that they expect for ourselves and our children. We may have gone through terms such as "going green", "Green building /office/campus", "green technology" or even "green economy", what it really meant is the roles and responsibilities of individuals or the group of people involved in each stage of all the communities as listed above contributing towards a better environment. The act could be as little as cycling, walking, using energy efficient items, recycling waste and as well as changing the lifestyle to reduce the carbon trail we leave on the environment.

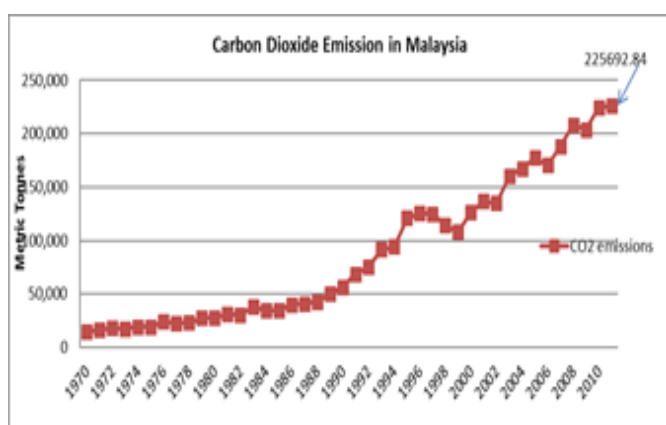
What better place than a college or university to ply this awareness or even practice? Rather than just cultivating theoretical and laboratory education, practical lessons like this should be given more importance. Universities are institutions that produce cutting edge knowledge and educate society's future leaders [1]. Many universities have been leaders in promoting sustainability by proposing reduction in GHG emissions. As an institution or an organization, Universities are large enough to rationalize detailed systems-level analysis and they also have the academic strength at hand to conduct them. For many universities, when the thought sustainability is in play, campus greening is their focus. A paper by [2] addressed sustainability practices has become response to key global concerns such as environmental degradation and social

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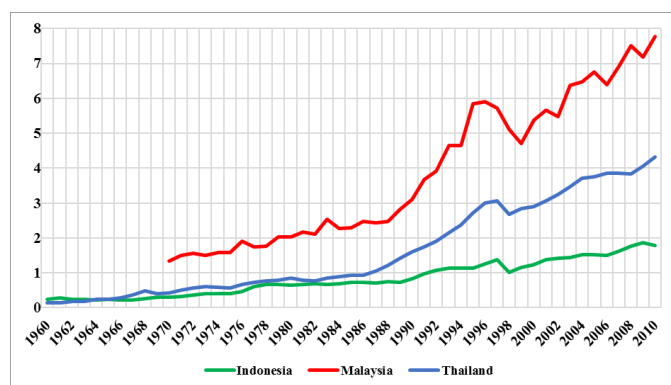
inequality. Greening the campus is defined as the higher education community that improves energy efficiency, conserve resources and enhances environmental quality by educating for sustainability and creating healthy living and learning environment. It also involves implementing an array of organizational and technical measures to improve the environmental performance of the campus; campus themselves often imposes considerable impacts on the environment [3]. Green campus initiatives are becoming vital part of today's university systems. The awareness however still remains slow and efficiency in the execution is rather limited or no scope. This scenario does not apply to all the universities in Malaysia.

Malaysia has pledged to cut Carbon dioxide emission intensity by 45 % by the year 2030. With this vision and the pledge taken, it shows that the carbon dioxide emission by our country is in a worrying condition. According to (Goh, 2015) Car ownership in Malaysia is the third highest in the world at a whopping 93percent with more than 54 % households having more than one car. The World Bank, releases data on the rate of carbon dioxide emission by our country and a very promising upward trend was observed. **Fig. 1** below shows the carbon dioxide emission by Malaysia in terms of Metric Tonnes. The graph was plotted based on the data obtained from the World Bank. **Fig. 2** describes the trend or comparison of carbon dioxide emissions among two other neighboring countries.

Both these figures below describe that its time Malaysia stricken the law and more practical and innovative measures should be executed to cut the Greenhouse gas emission. In our country power generation process still relies heavily on coal fired plants. This directly contributes to the GHG emission and explains the upward trend of the emission rate. Although Malaysia has taken gradual steps to decrease this emission rate, the efficiency is yet to be noticed. The vision is attainable by implementing sustainable best practices in every nook including energy, food, material, governance, investment, community and learning. This study is aimed to quantify the Impact of Green Initiatives in UNITEN campus on Carbon footprint.



**Fig. 1.** Malaysia's CO<sub>2</sub> Emission (Source: The World Bank)



**Fig. 2.** Malaysia's CO<sub>2</sub> Emission (metric tonnes per capita) as Compared to Neighboring Countries (source: The World Bank)

## 2. LITERATURE REVIEW

### 2.1 Greenhouse Gas and Global Warming

Greenhouse gas abbreviated as (GHG) is any gaseous compound in the atmosphere that is capable of absorbing infrared radiation, thereby trapping and holding heat or solar radiation in the atmosphere. Naturally the greenhouse gases are existing in the atmosphere, but due to the human activities, it increased globally the capacity of these gases in the atmosphere starting from the pre-industrial era to 2013 [4]. The increase heat in the atmosphere is what gives the greenhouse effect which ultimately leads to global warming. The largest source of greenhouse gas emission from human activities in Malaysia is from burning coals for the power plants for electricity, heat and even transportation [5].

Global warming studies dates' way back where there are constant changes and also innovative mitigation plans are drawn to sustain the environment for our future generation. The basic phenomenon of global warming was discussed by Svante Arrhenius in 1896 in his paper [6]. Arrhenius was the first to quantify the contribution of carbon dioxide to the greenhouse effect.

The light which is visible to the human eye is what we can see daily and it is blasted by the sun to the earth plus Invisible lights such as Ultraviolet (UV), Infrared (IR) and other types of radiation. However, according to NASA, only 30 percentage of the radiation striking the Earth's surface is reflected back out to the space by reflective surfaces like clouds, ice and more. The remaining 70 percentage is absorbed by oceans, the land and atmosphere [7].

The most substantial GHG are water vapour known scientifically as H<sub>2</sub>O, carbon dioxide (CO<sub>2</sub>), Nitrous oxide (N<sub>2</sub>O) and Methane (CH<sub>4</sub>). Although all these gases have always been present in the atmosphere, the fact that these gases are the cause of global warming is sometimes debatable. Statistics from World Bank and other reliable sources proves that the density of GHG had plummeted in the recent years. Other GHG which can be grouped as fluorinated gases are yielded through industrial processes. These gases have the fluorine element added to it and known as hydrofluorocarbons, perfluorocarbons and sulphur hexafluoride. Although the concentration of these gases is very small, there are known to be very high global warming potential (GWP) gases. The three

most identified factors that will influence global warming is the abundance of these gases; the duration of their stay in the atmosphere and its global warming potential. For this very same reason Carbon Dioxide (CO<sub>2</sub>) has a significant amount of impact on global warming. CO<sub>2</sub> gases occur naturally in the atmosphere and if the cycle is disturbed it creates an imbalance due to the human activities in different sectors like deforestation, mining, and coal burning [8]. CO<sub>2</sub> stays in the atmosphere for thousands of years. Since 1900 the global carbon emission increased about 90 % from burning the fossil fuels with the contribution of the industrial process with 78 %. The second largest contributors in carbon emission are agriculture, deforestation, and other land use [9].

## 2.2 GHG Protocol

The GHG Protocol is an international standard for GHG accounting. GHG accounting is very important as it will help measure and manage GHG emissions. This protocol is developed by the World Resources Institute (WRI) and World Business Council for Sustainable Development (WBCSD). This protocol has been developed to help organizational footprint efforts [10]. This protocol contained 3 levels of details about the carbon footprint that has been focused on companies. The three levels are emissions from sources under the jurisdiction of the company, offsite emissions from the purchase of electricity, offsite emissions from the company's supply chain or from products sold by the company [11]. The GHG Protocol also contained calculation for emission measurement. Those tools have been peer-reviewed and tested by experts and industry leaders. Anyhow, the tools do not give further information as to the source of the emission factors [12]. There is no input from the professional bodies and main architects of accounting standards in this protocol. Academics also have not contributed at all in this protocol. The process of engagement and those participating in the development of the GHG Protocol will influence the development of the protocol [13].

## 2.3 Malaysia and its Standing for Climate Change

The total population of Malaysia in the year 2011 was estimated to be 29 million. The population, however increased to 29.9 million in 2013 where this gave a whopping increased level of 24.9 % over three years from year 2000 to 2011. Population and carbon emission are directly related. The increase in population will surely increase the emission rate. There are also other factors that are expected to grow with population and economic growth such as demand for energy, the demand for adequate public transportation or even good infrastructure, agricultural, overall livestock, waste management and more.

Malaysia recently took part in the United Nations Framework Convention on climate change (UNFCCC). As a party, it's obligated to submit the Biennial update report on the elements that can cause GHG emission. Malaysia alongside other 192 countries has committed themselves to reducing their greenhouse emissions by being a part of the Kyoto protocol [14]. In the year 2009, Malaysia announced it would voluntarily reduce GHG emission intensity of Gross Domestic Product abbreviated (GDP) by up to 40 percentage by the year 2020 as compared to the levels recorded in 2005. However, it's

conditional upon receiving technology transfer and adequate financing from developed countries. **Table 1** below shows GHG inventory for Malaysia for the year 2011. The new pledge, according to a report in Channel News Asia in November 2015 has been set to achieve the 45 % reduction by the year 2030.

**Table 1** covers few sectors where the emission rate was measured, starting with Energy, Industrial processes, Agriculture, Land use, Land use change and Forestry (LULUCF) and ends with waste.

**Table 1.** Greenhouse Gas Inventory for the Year 2011 (Source: Malaysian Biennial Update Report to the UNFCCC, December 2015)

Sector	Emission (Mt CO <sub>2</sub> eq)	Sink (Mt CO <sub>2</sub> eq)
Energy	218.94	
Industrial Processes	18.166	
Agriculture	15.775	
LULUCF	2.490	-262.946
Waste	34.885	
Total	290.230	-262.946
Net Total (after subtracting sink )	27.284	

## 2.4 Greening the Campus

Campus sustainability or "Greening the Campus" is one of the contributions towards carbon dioxide emission reduction movement. Improving campus sustainability can take many forms, including education [1]. Greening the campus is about sweeping the wasteful inefficiencies and ushering in changes that addresses the daily, practical aspect of campus life which includes correct disposal, handling and storage of cleaning chemicals and materials, purchases of environmental friendly supplies, effective recycling programs and other changes. These are the initiatives identified as Green Campus Initiatives.

## 3. RESEARCH METHODOLOGY

The focus of this study is to identify the suitable green campus initiative and to measure the reduction in carbon footprint that can be achieved at UNITEN's main campus by implementing those activities. The flow chart in **Fig. 3** demonstrates the sequential activities of the research methodology.

### 3.1 Research Process

- Examine the campus's environmental impact to identify targets for Improvements. Benchmarking activities for Green Campus Initiatives, which had obtained the green campus certification and also use past researches as reference.
- A set of survey questions was prepared to measure student's awareness on carbon footprint and the green campus initiatives.
- An interview session was conducted with respondents to gauge the understandability and the commitment of the respondent in answering the survey question.

- A survey was conducted to quantify their willingness to contribute to the activities. Based on the results activity that contributes to higher emission rate within the campus can be analyzed and identified.
- Discussion on areas that can be improved and appropriate suggestion on activities that is feasible to achieve the emission reduction was given and that concludes the paper.

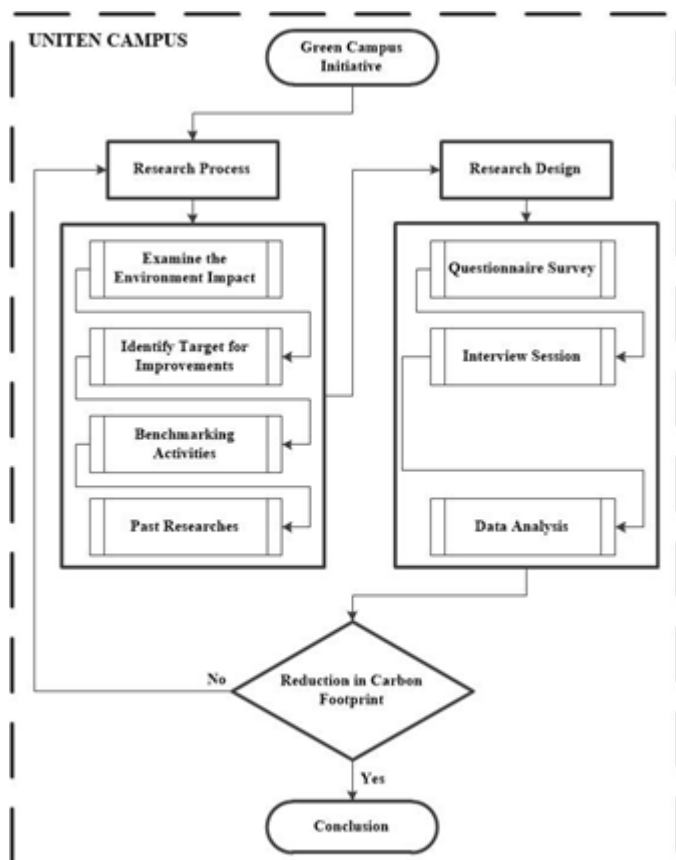


Fig. 3. Research Methodology Flow Chart

### 3.2 Research Design

This study is conducted in UNITEN main campus to achieve the objectives set. A sample questionnaire survey was done to analyze the impact of green campus initiative programs that can influence the carbon footprint of the campus. The correlation between the Green Campus Initiatives and how much reduction can be achieved is the focus of the study. The survey identifies the knowledge and willingness of the student to participate in going green activities and contribute to emission reduction.

The main green campus initiative areas targeted are litter and waste, energy consumption/implementation and Transport and travel. For each of this source mitigation steps or more environmental friendly questions were presented to them to analyze their answer. The respondent group targeted is the university's students from all the colleges in the main campus.

## 4. RESULTS AND DISCUSSION

The data obtained from the survey were tabulated into figurative information. This survey was carried out to test their awareness on environmental and sustainability practices in UNITEN campus. There were few mitigation steps were presented for each of the carbon emission sources around the campus as mention in the research design section above.

Litter and waste as the carbon emission source, students were presented with a question on their smart printing habit by either using recycled paper or printing on both sides of the paper. The survey results of smart printing habit and waste generation reduction habit are shown in Fig. 4. Another aspect of reducing paper waste was tested on their practice using electronic sources for editing and not on paper. Although technologically we were aided with so many apps and devices to perform this duty to reduce paper waste, self-preference still plays a role and it may differ from one individual to another. As for food waste, from the survey, it was found that the most of the students are aware of waste generation consequences. 80 % of students want to reduce the waste generated. Most of the dining outlets around the campus do not practice consumer food waste composting. Since food waste is the highest contributor of carbon emission in Malaysia, according to the Malaysia Biennial Update report to the UNFCCC, its best, that means of kick starting this composting food waste project can be explored. Plastic containers and Styrofoam are still widely used in this dining outlet. They may opt to biodegradable containers to help save the environment. Management can make this rule so that saving environment doesn't just remain a vision for the university. Students and staff can also bring their own meal containers to reduce the plastic and Styrofoam container usage in these outlets. This practice will definitely have some impact towards carbon footprint of the campus as the amount of food waste can be reduced comparatively at least by half in the initial stage of food composting project implementation.

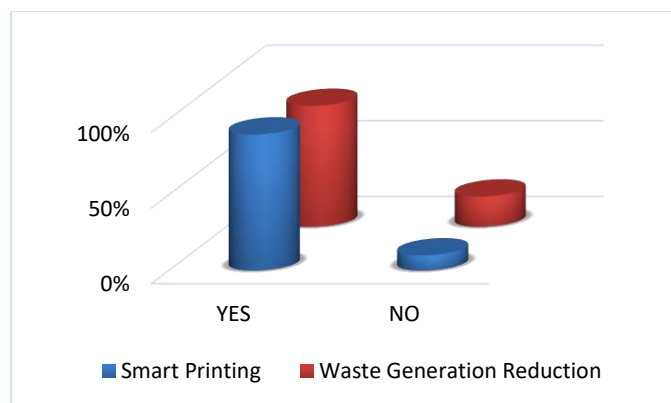


Fig. 4. Smart Printing and Waste Generation Reduction Habit

Another highest contributor of carbon emission in UNITEN campus is the transportation. The entire respondent whom took part in the survey possesses their own vehicle. However, when the survey was presented with one of the green initiatives that are newly implemented in the campus to reduce numbers of private vehicle entry, the students welcomes the initiative. There is a new parking system implemented within the campus to live the aspiration to become a holistic green campus. Students were asked whether they prefer green commuting or traditional commuting. Green commuting is a commuting mode that will reduce the carbon emission like

cycling, walking, carpooling and campus bus service while traditional commuting is a commuting mode where carbon emissions will increase like private car and motorcycle.

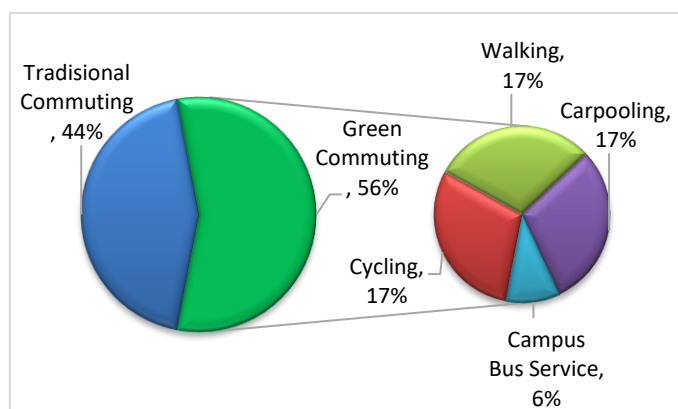


Fig. 5. Commuting Mode

Fig. 5 shows the survey result of commuting mode preferred by students. 54 % of students are well aware of carbon emissions and they prefer green commuting for transportation while 46 % of students prefer traditional commuting. The percentage difference between green commuting and traditional commuting is not much and this needs serious attention as this will increase the carbon footprint on campus. Carbon emission awareness, attitude towards exercise, time, convenience as well as safety are the reasons for students to prefer traditional commuting mode instead of green commuting mode. In other hand, students were asked for which green commuting mode they prefer for travelling within the campus. The green commuting modes are cycling, walking, carpooling or taking the campus bus service. The students prefer carpooling, cycle and campus shuttle service. They are not that keen on walking as the campus area is very wide and might tax on their time. They also prefer cycling within the campus if a designated parking bay is given for students.

## 5. CONCLUSIONS

With a mission to promote heightened awareness of environmentally sound practices in all of its management operations, activities, and curriculum UNITEN campus should look into a practical means of forming a Green Campus Initiative team to oversee all the activities and march toward reduction of carbon emission within campus with a firm target. As an institution of higher education, it has been progressively producing top notch graduates in every field with the high employability rate in Malaysia. Having these environmental

and sustainable practices and fulfilling its aspiration to be a full-fledged Green campus, more practical initiatives and campaigns should be explored and conducted. Although there is some awareness among students on the sustainability practices, many are still not strictly practicing. The cooperating among staffs, students and managements play a big role in this transformation towards reducing, recycling and reusing.

## ACKNOWLEDGMENT

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