

CARBON FOOTPRINT ASSESSMENT AT UNIVERSITI TEKNOLOGI MARA SERI ISKANDAR CAMPUS, MALAYSIA

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ABSTRACT

The purpose of this study is to assess the carbon footprint emission at UiTM Perak, Seri Iskandar Campus. The assessment focuses on electrical power and transportation usage. Questionnaires were distributed to the staffs and students to survey their transportation usage in the year 2014 while for electrical consumption, the study used total energy consumed in the year 2014. Data was calculating with the formula by Green House Gas Protocol. Total carbon footprint produced by UiTM Perak, Seri Iskandar Campus in the year 2014 is 11842.09 MTCO₂. The result of the study is hoped to provide strategies for the university to reduce the carbon footprint emission.

Keywords: *global warming, carbon footprint, greenhouse gas, emission*

INTRODUCTION

It is well known that greenhouse gasses emission is the main effect of global warming and climate change. Global warming caused the ice to melt, natural disaster and critical weather changes that affect human, animals, and environment. Nowadays, our environment becomes worst with the phenomenon of climate change and global warming due to the greenhouse gas (GHG) emission. Evidence showed that one of the main factors that contribute to this phenomenon is the impact of carbon footprint. The GHG occurred when some gasses trap heat in the atmosphere. The GHG emission includes the gasses which occur naturally in the atmosphere, such as carbon dioxide, methane, nitrous oxide and fluorinated gasses which comprise of hydrofluorocarbons, perfluorocarbons, sulfur hexafluoride, nitrogen trifluoride and chlorofluorocarbons. These fluorinated gasses are synthetic and emitted from a variety of industrial processes and human activities. They are also referred to as powerful Green House Gas, and some of the fluorinated gasses cause the ozone depletion even though the amount of emitted gasses is small. Carbon footprint is one of the measurements of greenhouse gas emission that is released directly and indirectly to the atmosphere. Direct emissions of carbon footprint come from heating activities and transportation. Meanwhile, indirect emissions occur during the electricity generation and the production of good and services.

In Kyoto protocol, this main issue had been highlighted, and most of the international countries including Malaysia give support to fight the global warming. According to Tao Gao. et al., 2013, the concept of low-carbon economy, low-carbon city, low-carbon life, carbon trade, carbon tax, is global strategies to reduce the carbon emissions. After all, many countries managed to provide greenhouse gas reduction policies and successfully reduce their total carbon footprint emission in their country.

Malaysia also the one that is facing the global warming effect as there were prolonged drought seasons and raining seasons within the country. To this effect, Malaysian is now suffering from the water crisis and somehow worst floods in several states. As Malaysia is concern about global warming issues, policies for green growth and resilience will be carried out under the 11th Malaysia Plan (2016-2020). The plan covers the aspects of green growth environment, implementation of sustainable

consumption and production, and improves the resilience against climate change and natural disaster. This plan also one of the solutions to combat the carbon dioxide emission from fuel combustion as the data by the United Nations showed that Malaysia was at 26th ranked worldwide in the year 2012.

Towards the global warming issues arisen in Malaysia, the implementation of sustainable design and solution are widely implement at all levels including the government sectors, private sectors and also in institutional.

After we get through for some literature review, we found that electricity, transportation, and solid waste are the major contributions to the carbon emission in university and college. The previous study done by several campuses revealed that the highest level of carbon emission that contributes to the global warming came from the electricity purchased and the second tier was the transportation usage. Those studies were proven the statement by Thapelo et al., 2010 when he stated that electricity consumption is the major contributor of the emission through university activities. He also mentioned that transportation emissions account for about 10 percent of the total emissions generated in a campus from vehicles owned by university departments and student bodies. Assessing the key factors of carbon emission within the university is required to prepare the green and sustainable strategies for the campus as to reduce the carbon emission. As far as Malaysian concern in mitigating the global warming, University Teknologi MARA (UiTM) Seri Iskandar also put initiatives in implementing the green and sustainable campus. Therefore, the aim of the study is to identify the total carbon emission within UiTM Seri Iskandar regarding electricity and transportation usage as both of the aspects are the major factor affecting the carbon footprint emission on several campuses. The objectives of this study are to assess the electricity consumed and the transportation usage by staff, student, and vehicles owned by the campus. The result from this study is hoped to provide some suggestion and strategies by the management for reducing the carbon emission in UiTM Seri Iskandar.

LITERATURE REVIEW

The concept of carbon footprint is also widely used in the community as there was a debate on accountability and abatement action against the threat of global climate change. The main source of increasing GHG emission in the atmosphere comes from human activities. There are a lot of human activities that responsible to the increasing GHG that trap the heat in the atmosphere. For example, the uses of electricity, transportation, industry, commercial and residential, and agriculture. The emission of carbon dioxide is the largest amount of gas which had been calculated in the atmosphere and burning fossil fuel is the primary source of this gas. Besides that, the emission of carbon dioxide is also derived from natural sources which include decomposition, ocean release, respiration, and volcanoes. Carbon dioxide levels are quite balanced from this natural process. However, the human activities have influenced the growing of GHG emission in the environment and give an impact towards carbon footprint.

Today, the reductions of carbon emissions and global warming are at the top of the environmental policy agenda (Weidema. et al., 2008). The climate change is related to the human production or consumption activities, and it will produce carbon footprint with an amount of gaseous emissions (Wackemagel, 1996). According to Grub and Ellis (2007), the meaning or definition of carbon footprint is a measure of the amount of carbon dioxide emitted through the combustion of fossil fuels. The amount of CO₂ emitted either directly or indirectly as a result of its everyday operations. In-depth, Thomas W. and Jan M. (2010) mentioned that, the carbon footprint is a measure of the exclusive total amount of carbon dioxide emissions that is straight and not directly caused by an activity or is accumulated over the life Stages of a product. Besides, a direct measure of greenhouse gas emissions resulting from a defined activity. The carbon footprint also refers to the amount of carbon dioxide emitted due to your daily activities such as from washing a load of laundry to driving a carload of kids to school (BP, 2007) and also caused by business activity (Energetics, 2007). According to Patel (2006), the carbon footprint is calculated by measuring the CO₂ equivalent emissions from industrial sectors, vehicles, business travel and waste to landfill and also every stage of development. In fact, as stated by Forster et al. 2007, the daily life cycle, process or product potentially releases greenhouses gas causes which are carbon dioxide, methane, and nitrous oxide that contribute to the global warming.

In the state of United Kingdom, the Climate Change Act 2008 required the net greenhouse emission to be at least 80% lower compared with the level in the year of 1990. Several countries implement the carbon tax in preventing a mass emission for carbon. The fee is for the fossil fuels pay as it damages the climate by realising the carbon dioxide to the atmosphere. It is also to motivate the country to set the clean energy.

The Causes of Carbon Foot Print in a Campus

Studies of carbon footprint were done on several campuses. In establishing the environmentally sustainable campus, the comprehensive carbon footprint calculation in a campus or the whole university needs to be conducted. The primary cause or effect of carbon footprint at the campus is campus energy consumption through transportation usage and direct emissions through electrical usage. The energy and transports consumption at the campus are related to the students and staff.

Transportation emissions

In 2010, almost 14% of global greenhouse gas emissions were the transport emissions (IPCC, 2014). Carbon dioxide makes up 95% of all transportation-related greenhouse gas emissions. Cars, SUVs, and pickup trucks running on conventional gasoline, diesel, and other fuels emit carbon dioxide (U.S. Environmental Protection Agency, Inventory of Greenhouse Gas Emissions and Sinks: 1990-2007, April 2009). The indicator of transport emissions calculations is based on the numbers of the vehicle taken by staff and students, kilowatt hour per meter square, liters of fuel for transportation and types of fuels (Heijungs & Suh, 2002, Suh & Huppes, 2005). Another study conducted by Chaurasia Sadhana et al., (2012) in Banaras Hindu University showed that, carbon emission from transportation contribute 0.017 percent caused by Fleet and commuting within the campus. In University of Redlands', the largest among all sub-components of the energy print, gasoline use, can be identified into 438 acres attributable to campus related automobile and truck use, and 1,414 acres for air travel (to and from campus during mid-semester breaks); for a total of just over 1,850 acres (749ha). Duke, University (including the School of Medicine and School of Nursing, including the School of Medicine and School of Nursing) shows that transportation emissions which includes employee commuting, air travel paid for by the University, and

the campus fleet about 34% of greenhouse gases which are: (i) Commuter travel (13%), employees commuting from their home to work; (ii) Air travel (20%), faculty/staff work travel, sports team travel, and school-related student travel; and (iii) Fleet (1%), all bus and university vehicles operated for directly work-related purposes. Besides, the motor vehicle emissions also contribute to Malaysia's urban air pollution (Awang et al., 2000). An assessment study on carbon footprint was also conducted by Zeynab Yazdani et al., (2013) at University Technology Malaysia (UTM) for transportation emission. The study proposed the reduction and elimination of unnecessary travel as the total carbon footprint produce were 7,284 MTCO₂ which contributed to 12.5 percent of carbon respectively in UTM. Moreover, there was also study of carbon footprint to proposed framework as to reduce the environment impact at the UCSI University. The result showed that, transportation emission in UCSI University Malaysia cover 825 MTCO₂ in the year 2008. Referring to Green House Gas Protocol (GHG) Guidelines, there are several categories of mobile sources that address the direct carbon emission which is road, rail, air and water transport. Therefore, the operation sectors that involved the combustion of fossil fuel in mobile sources should apply all these cross-sectoral guidelines.

Electricity emissions

The electricity consumption of operating machines and transportation fuels in campuses also results in a high emission of carbon dioxide and giving serious implications on the campus environmental quality (Alshuwaikhat, H.M., & Abu bakar, I., 2008). According to Norelyza (2011), the main contributor to greenhouse gas emission in a campus is the purchased electricity. The statement was proven when her studies showed that electricity consumption was about 78 percent for UTM in the year 2009. Further study was done by Zeynab Yazdani et al., (2013) within the same campus in the year 2011 to measure the electricity consumption. The electrical consumption was measured by referring to the utility bills, and the result showed that electricity purchased is 84 percent from the total carbon emission in UTM. Again, a study done by the Chaurasia Sadhana et al., (2012) in Banaras Hindu University showed that, the major contribution of the carbon emission is from electricity purchased covered 99.88 percent from February 2010 to January 2011. Others, University of Redlands, USA also finds that electricity is one of the main factors contributing to the carbon footprint. It is about 10.4 million kilo-Watt-hours equals to 3,810kWh per

campus community member (Jason Venetoulis, 1998). The findings show that electricity emissions are associated with the energy prints.

METHODOLOGY

This study refers to the GHG Protocol model for the assessing criteria. The model had established three scopes, (a) First scope : direct GHG emission that consist of fuel use of heating and transportation, fugitive emission (b) Second scope : Indirect GHG emission that consist of electricity purchased, steam or chilled water (c) Other optional : Indirect GHG emission that consist of waste, flights, travel, purchased good or services. This study is limited to the several emission factors which necessary for the carbon emission in the campus. Therefore, this study is focusing on calculating the carbon footprint emission from two scopes which are electricity purchased and transportation usage. The study has the limitation data in solid waste produced by the campus as the data was not recorded. Thus, waste production is not including for this study.

As the emission factors and activity data was needed to calculate the carbon dioxide emission, data related to electricity purchased was based on twelve-month utility bills that had been collected from the Transportation and Facilities Department for the year 2014. The carbon emission for electricity usage of the year 2014 was calculated by multiplying the electric consumption in kilowatt-hour (kWh) for twelve-month with the emission factor. The emission factor for electricity was referred to Malaysian Energy Centre which is for the peninsular region is 0.672 MT CO₂/MWh.

To estimate the carbon emission regarding transportation usage, one can apply the fuel based or distance based methodology from any calculation driven from any related organisation. Next, to calculate the total carbon emission for the whole year of 2014, this study use distance based equation developed by the GHG Protocol as presented below:

$$\text{Co}_2 \text{ emission} = \text{Distance travel} \times \text{Emission factors}$$

The emission factor for the vehicle type is provided by Department of Food and Rural Affairs 2012 (DEFRA) as shown in Table 1 as it a standard factor for several countries including in Asia. Equations used as written below:

Table 1: List of Emission Factor for Vehicle Type

Vehicle type	Emission factor
Petrol	0.24234 kgCO ₂ e/km
Diesel	0.22428 kgCO ₂ e/km
Hybrid	0.16170 kgCO ₂ e/km
Motorcycle	0.14238 kgCO ₂ e/km
4x4	0.31529 kgCO ₂ e/km
Sports	0.29024 kgCO ₂ e/km

Therefore, the calculation for transportation used by staff in the year 2014 was driven as below:

- Average distance per person x the number of type of the staff vehicle in UiTM Seri Iskandar x total working days in the year 2014 x the emission factor.

The calculation for transportation used by staff in the year 2014 was driven as below:

- Average distance per person x the number of the type of student's vehicle in UiTM Seri Iskandar x total day of classes attend in 2014 x the emission factor.

The calculation for transportation by the vehicle owned by University in the year 2014 was driven as below:

- Total distance used by vehicle x the emission factor .

Total numbers of staff work in the year 2014 is 840, and total student traveling by transport is 1035. The questionnaire had been distributed to 80 staffs and 100 students to assess their average mileage and the type of car they are using. The survey was divided into two sections that consist

of Section one: (a) Demographic data, Section two: (a) number of person travels in the car (b) distance from home to university (c) vehicle type. Then, a number of the registered car by staff and students was collected from the Auxiliary Police Office to calculate the total carbon emission for the campus. The information on the total distance usage of buses and vehicles owned by the campus was collected from the Transportation and Facilities Department. Total working day in years 2014 was estimated as 210 days per person without considering the annual or medical leaves and for the student. For students, the total day of classes attend in 2014 was given from the Academic Affairs Department for Diploma's student as 130 days without considering the medical leaves by a student and cancellation of the class. Another limitation, student might also do not have the class for one or two days per weeks.

RESULTS AND DISCUSSION

The study showed that the carbon footprint for electricity purchased by UiTM Seri Iskandar, for the year 2014 is 10463.77 MTCO₂. The amount might be the reason for the usage of the air conditioner in the whole campus blocks and rooms except in student hostels. Each of the classrooms, administration department, and lecturer's room, use the air conditioner and caused the electricity purchased the main contribution to the highest carbon emission in UiTM Seri Iskandar. Besides, from the observation, the student always switch on all the air conditioner inside the class even though the numbers of the student in that particular time is less than three people.

The electricity saving is an excellent practice because it will reduce the amount of fossil fuel used which also reduces the emission of carbon dioxide to the atmosphere. The easier action to save electricity is by switching off all the electrical products such as televisions, fans, lamps, computers, and air conditioners when they are not in use. This action not only reduces electricity bills, but also it will reduce thousands of pounds of carbon dioxide release within a year. Now, the circular on the consistent setting off air conditioner temperature between 24 to 25 degree Celsius in the government's building shows the awareness of the Malaysian government to control the climate change. Furthermore, the campaign of using green technology is one of the innovation ideas towards sustainable living such as through the use of

solar panels, Light Emitting Diode (LED lamps), green walls, eco-friendly materials (bioplastic, recycling materials) and many others.

Meanwhile, the total carbon emission for transportation in the year 2014 is 1378.32 MTCO₂ as shown in Table 2. Figure 1 illustrates the percentage of transportation sources that contributes to the carbon emission in UiTM Seri Iskandar, in the year 2014. The primary factor that affects the carbon emission for the transportation aspect is the total mileage for travel from home to campus itself. Staffs are the main contributor as they contribute 85 percent of the carbon footprint for transportation. The numbers of staff who work in UiTM Seri Iskandar, Perak might be the factors that the result showed the highest ranking of carbon emission in transportation as this might because of the 82.5 percent of them own a personal vehicle. Plus more, they were also traveling alone from home to the campus as stated in the questionnaire. The second largest carbon emission factor for transportation is coming from the students. The total number of students using 1062 units' vehicles also contributes to the main reason of carbon emission even though the majority of them are carpooling and live nearby to the University. However, the result of transportation might not be accurate for the students because they might not have classes for one or two days per weeks. They might also take medical leaves or class had been canceled for any acceptable reason.

The action that we need to take into consideration to reduce carbon dioxide is by reducing our transport dependency. Transportation is one of the main sources that contribute to the carbon dioxide released through the burning of fossil fuel. There are a few actions that can be practiced to reduce our transport dependency, for example through car sharing, biking and using public transport. However, some people might grow tired of waiting for public transportation because of its inefficient services. In this situation, carpooling is the best way to get people out of their cars. The more people share their cars, the lesser the usage of fossil fuel. As a result, this will help our environment to sustain for a long time.

Therefore, the total carbon footprint for the UiTM Seri Iskandar, Perak in the year 2014 is 11842.09 MTCO₂ as stated in Table 3. Figure 2 shows the percentage of each source of carbon emission. It can be concluded that electricity purchased is the major contributor of the greenhouse gas

emission in UiTM Seri Iskandar, Perak in the year 2014 as it covered 92 percent of overall emission followed by transportation. The same result also showed by the study at UTM in 2011 and Banaras Hindu University in 2012 whereby the electricity purchase was the major factor contributes to the greenhouse gasses in their campus. Both universities also share the same result with UiTM Seri Iskandar, Perak as transportation is the second highest contribution to carbon emission in the campus. Therefore, the study found that average total carbon emission released per capita in UiTM Seri Iskandar is 2.43 MTCO₂ which covered all student and working staff in 2014. The number is slightly higher compared to the previous study done by UTM in 2011 as they found that carbon emission in their campus was 2.1 MTCO₂. However, there might be a reason for the year of the study and total amount of student and staff in the campus. Furthermore, the total carbon emission per capita in UiTM Seri Iskandar may be increasing if the assessment of solid waste is included.

Table 2: Total Carbon Emission for Transportation in UiTM Seri Iskandar, Perak for the Year 2014

Vehicle owned by	Carbon emission MTCO ₂
University	47.87
Staff	743.78
Student	172.80
Total	964.45

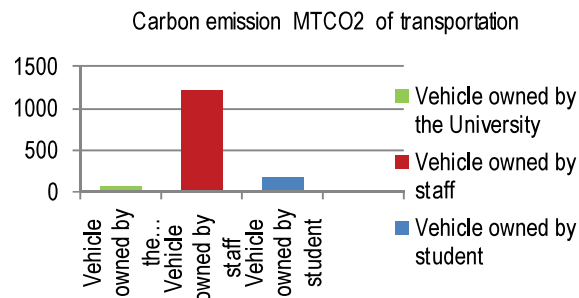


Figure 1: Total Carbon Emission for Transportation in UiTM Seri Iskandar, Perak for the University in the Year 2014

Table 3: Total Carbon Footprint in UiTM Seri Iskandar, Perak for the Year 2014

Sources of emission	Carbon emission MTCO ₂
Electricity consumption	10463.77
Transportation	1378.32
Total	11842.09

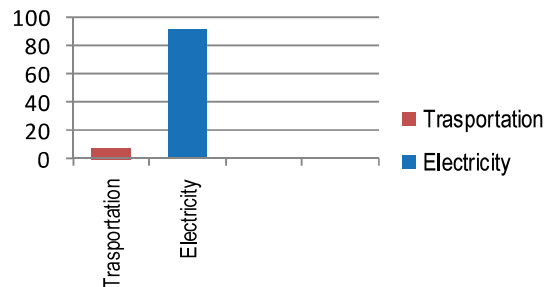


Figure 2: Percentage of the Total Carbon Footprint for the UiTM Seri Iskandar in the Year 2014 for each Contribution Source

CONCLUSION

As a conclusion, the study found that the total carbon footprint emitted from UiTM Seri Iskandar, Perak is 11842.09 MTCO₂ and average carbon emission released per capita is 2.43 MTCO₂. The contributing aspect of carbon emission comes from the electricity purchased that covers 92% from the total emission. Therefore, the result of this study will direct to encouraging the campus to be more sustainable as the concerns towards environmental issues and achieve the green campus initiatives. Thus, energy saving management should be established to reduce the electricity purchased. Besides, the study on existing tree planting as carbon storage in UiTM Seri Iskandar also need to be done to calculate the adequate carbon absorption by the plant for balancing the carbon emission output within the campus. It also suggests planting a local tree species that can absorb

more carbon emission in the campus. The study might be more interesting if the other factor of carbon footprint emission such as solid waste disposal comes into account. Solid waste disposal is also another factor for indirect sources of greenhouse gas emission in the institution. Thus, the aspect of solid waste disposal can be recommend for the next study.

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