

An Assessment of Carbon Footprint at Universiti Teknologi MARA Seri Iskandar Perak, Malaysia

Nor IzanaMohd Shobri¹, Wan Noor AniraHj Wan Ali @ Yaacob², Norizan Mt Akhir³, Siti Rasidah Md Sakip⁴
^{1, 2, 3, 4}Department of Landscape Architecture, Faculty of Architecture, Planning and Surveying, Universiti
Teknologi MARA (Perak), Malaysia,

Email: izana980@perak.uitm.edu.my, wannoor367@perak.uitm.edu.my, noriz102@perak.uitm.edu.my,
sitir704@perak.uitm.edu.my

Abstract

Climate change and global warming have worsened since over the past year due to the greenhouse gas emission. Evidences show one of the main factors that contributes to global warming is the impact of carbon footprint. Human activities are the causes of a great deal of carbon footprint. Therefore, the purpose of this study is to assess the carbon footprint emission at Universiti Teknologi MARA (UiTM) Seri Iskandar, Perak. The study focuses on two categories specifically on electrical power and transportation usage that contribute to carbon footprint emission. A survey on transportation was conducted by distributing questionnaire to the staff and students within the university. Meanwhile for electrical power consumption, the study used monthly electricity bills to measure the amount of energy consumed. Data was collected and calculated with the formula developed by Green House Gas protocol, resulted in the total carbon footprint produced by UiTM Seri Iskandar Perak for the year 2014. The result of the study is hoped to provide guidelines and strategies for the university to reduce the carbon footprint emission at UiTM Seri Iskandar, Perak.

Keywords: global warming, carbon footprint, greenhouse gas

1.0 Introduction

It is well known that greenhouse gases emission is the main effect of global warming and climate change. Global warming caused the ice to melt, and 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 gases trap heat in the atmosphere. The GHG emission includes the gases which occur naturally in the atmosphere, such as carbon dioxide, methane, nitrous oxide, and fluorinated gases which comprise of hydrofluorocarbons, perfluorocarbons, sulfur hexafluoride, nitrogen trifluoride and chlorofluorocarbons. These fluorinated gases are synthetic and emitted from a variety of industrial processes and human activities. They are also referred to as powerful GHG and some of fluorinated gases cause the ozone depletion even though the amount of emitted gases is small. Carbon footprint is one of the measurements for greenhouse gas emission that is released directly and indirectly to the atmosphere. Direct emissions of carbon footprint come from heating and car use. Meanwhile indirect emissions occur during the generation of electricity and the production of goods and services. In Kyoto protocol, this main issue had been highlighted and most of the international countries including Malaysia give a support to fight the global warming. According to Tao Gao. Et. al, 2013, the innovative concepts of low-carbon economy, low-carbon city, low-carbon life, carbon trade, carbon tax, means to reduce carbon emissions become the important development strategy of the whole world. After all, many countries managed to provide greenhouse gas reduction policies and successfully reduce their total carbon footprint emission in their country. As Malaysia is concerned about global warming issues, studies in green and sustainable campuses have been done widely and extensively in Malaysia and other countries. Therefore, the aim of this study is to identify the factor affecting the carbon footprint emission in Universiti Teknologi MARA (UiTM) Seri Iskandar, Perak in 2014. This had been done by assessing the carbon emission from electricity consumed and the transportation usage by staff, student and vehicles owned by the campus. The simple reason of the study is to reduce the environmental effect caused by the campus operation. The result is hoped to promote the campus to be more sustainable as concerns towards environmental issues rise.

2.0. Literature Review

2.1. Definition of Carbon Footprint

Carbon footprint has become the main issue in the world and a threat to our climate. The concept of carbon footprint is also widely used in the community. They debate on accountability and abatement action against the threat of worldwide climate change. The emission of carbon dioxide is the largest amount of gas which has been calculated in the atmosphere and burning fossil fuel is the primary source of this gas. There are many human activities related to burning fossil fuel such as deforestation, electricity production, fuel used for transportation and many others. Besides that, the emission of carbon dioxide is also derived from natural sources which include decomposition, ocean release, respiration and volcanoes. Yet, 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 with the human production or consumption activities and it will produce carbon footprint with an amount of gaseous emissions (Wackemagel, 1996). According to Grub & 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. & 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 caused by a defined activity. The carbon footprint also refers to the amount of carbon dioxide emitted due to your daily activities – 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 greenhouse gas causes which are carbon dioxide, methane and nitrous oxide that contribute to the global.

2.2. The Causes of Carbon Foot Print in a Campus

In establishing the environmentally sustainable campus, the comprehensive carbon footprint calculation in a campus or the whole university needs to be conducted. The main cause or effect of carbon footprint at campus is campus energy consumption through transportation usage and direct emission through electrical usage. Electricity consumption is the major contributor of the emission through university activities as stated by Thapelo et.al, 2010. The energy and transport consumption at campus are related with the students and staff.

2.2.1. Transportation emissions

Thapelo et.al, (2010) 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. The indicator of transport emissions calculations is based on the numbers of 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). In addition, the motor vehicle emissions also contribute to Malaysia's urban air pollution (Awang et al., 2000).

2.2.1. Electricity emissions

According to Norelyza (2011), the main contributor to greenhouse gas emission in a campus is the purchased electricity. The electricity consumption in 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. and Abubakar, I., 2008). In this study, the emission for electricity was estimated based on the electricity meter reading as given by the Department of Facilities and Transportation, UiTM Perak.

3.0 Methodology

The study focuses on calculating the carbon footprint emission from two scopes which are electricity purchased and transportation usage. Data related to electricity purchased was based on monthly utility bills that had been collected from the Transportation and Facilities Department for the year 2014. Meanwhile for transportation, a questionnaire had been distributed to 80 staffs and 100 students who travel from their home to the university using a vehicle to assess their average mileage and the type of car they are using. The total number of registered car by

staff and students was collected from the Auxiliary Police Office. Plus, the information on the usage of buses and vehicles owned by bus and vehicle usage that owned by the campus was also collected from the Transportation and Facilities Department. The carbon footprint for electricity of year 2014 was calculated by multiplying the electric consumption in kilowatt hour (kWh) 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. Next, the carbon footprint for transportation usage is calculated by multiplying the total mileage with the emission factor of the vehicle. The emission factor for the type of vehicle is provided by Department of Food and Rural Affairs 2012 (DEFRA) as shown in Table 1. Equations used are developed by GHG protocol as presented below:

The calculation for staff transportation:

$$\text{Average distance per person} \times \text{the number of type of the staff vehicle in UiTM Seri Iskandar} \times \text{total working days in the year 2014} \times \text{the emission factor} \tag{1}$$

The calculation for student transportation:

$$\text{Average distance per person} \times \text{the number of the type of student's vehicle in UiTM Seri Iskandar} \times \text{total day of classes attend in 2014} \times \text{the emission factor} \tag{2}$$

The calculation for transportation for vehicle owned by University:

$$\text{Total mileage used by vehicle} \times \text{the emission factor} \tag{3}$$

The calculation for electricity purchased:

$$\text{Monthly electric consumption in kilowatt hour} \times \text{the emission factor} \tag{4}$$

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

4.0 Result

The study showed that the carbon footprint for electricity purchased by UiTM Seri Iskandar, Perak for the year 2014 is 10463.77 MT CO₂, and the average usage per month is 871.98 MT CO₂. For electricity purchased, the important factor that affects the carbon footprint emission is caused by the air conditioner usage. Meanwhile, for transportation, the total carbon emission in the year 2014 is 1378.32 MT CO₂ as shown in Table 2. Figure 1 shows the percentage of transportation that contributes to the carbon emission in UiTM Seri Iskandar, Perak the year 2014. The main factor that affects the carbon emission for the transportation aspect is the total mileage. The staff contributes 85 percent of the carbon footprint for transportation. The number of staff who work in UiTM Seri Iskandar, Perak contribute to the highest ranking of carbon emission in transportation. This is due to the fact that 82.5 percent of them own a personal vehicle and they travel alone from home to the 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 also contributes to the main reason of carbon emission even though majority of them are carpooling and live nearby to the University. However, the result for transportation might not be accurate for the students because they might not have classes for one or two days per weeks. Therefore, the total carbon footprint for the UiTM Seri Iskandar, Perak in the year 2014 is 11842.09 MT CO₂ as stated in Table 3. Figure 2 shows the percentage of each sources of carbon emission. It can be concluded that electricity purchased is the major contributor which is 98 percent to the greenhouse gas emission in UiTM Seri Iskandar, Perak in the year 2014 followed by transportation.

Table 2: Total carbon emission for transportation in UiTM Seri Iskandar, Perak for the year 2014

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

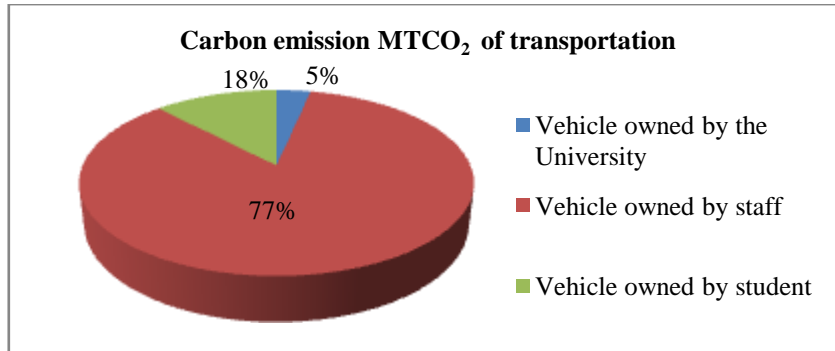


Figure 1: Total carbon emission for transportation in UiTM Seri Iskandar, Perak for the university in the year 2014

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

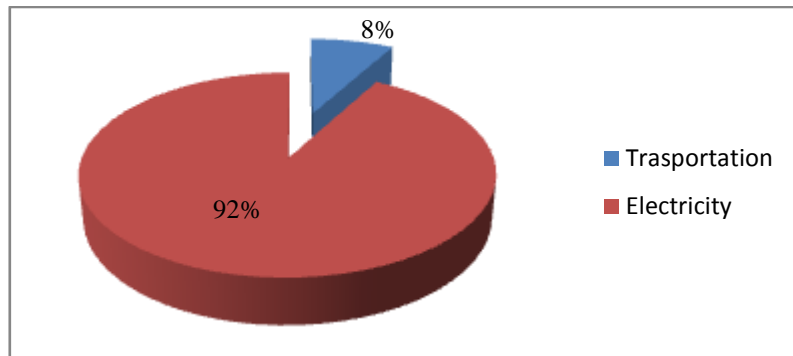


Figure 2 : Percentage of total carbon footprint for the UiTM Seri Iskandar in the year 2014 for each contribution source.

5.0 Conclusion

The larger emissions of GHG lead to the higher gas concentration in the atmosphere. The main source of increasing GHG emission in the atmosphere is coming from human activities. There are a lot of human activities that are responsible to the increasing GHG emission that traps the heat in the atmosphere. For example, the uses of electricity, transportation, industry, commercial and residential, and agriculture. Therefore, the main objective of this study will help in encouraging the campus to be more sustainable as the concerns towards environmental issues rise. As a result, the study found that the total carbon footprint emitted from UiTM Seri Iskandar, Perak is 11842.09 MTCO₂. The contributing aspect of carbon emission comes from the electricity purchased that covers 92% from the total emission. However, 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 institution. Thus, the aspect of solid waste disposal can be recommended for the next study.

As illustrated by the results, the strategies to lessen the carbon footprint have been identified. Generally, the amount of GHG emission in the environment may be reduced if we practice good lifestyles. By reducing the demand of fossil fuel and using the source wisely, global warming will be reduced. The action such as reforestation will improve the soil condition and at the same time removes carbon dioxide from the atmosphere. As we all know, plants will absorb carbon dioxide for the process of photosynthesis. Therefore, by reforestation the amount of carbon dioxide can be reduced while controlling the global warming. The electricity saving is a very good 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 of 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.

Another action that we need to take into consideration in order 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 own 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.

Hence, we need to respond urgently in order to avoid more harmful impact of climate change. We as the caliphs should be responsible in properly managing our environment and play a role in making the world a better place to live in.

6.0 References

- Awang, M., Jaafar, A., Abdullah, A., Ismail, M., Hassan, M., Abdullah, R., Johan, S. Noor, H. (2000). Air Quality in Malaysia: Impacts, Management Issues and Future Challenges. *Journal of Respirology*, Vol 5, 183–196.
- Alshuwaikhat, H.M. and Abubakar, I. (2008). An Integrated Approach to Achieving Campus Sustainability: Assessment of the Current Campus Environmental Management Practices. *Journal of Cleaner Production*, 16, 1777-1785.
- Atmospheric Constituents and in Radiative Forcing. In: *Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change* [Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M. Tignor and H.L. Miller (eds.)]. Cambridge (pp. 130-234)
- EPA (2015). Sources of Greenhouse Gas Emissions. Retrieved 11/8/2015, from <http://www.epa.gov/climatechange/ghgemissions/sources.html>
- Forster, P., Ramaswamy, V., Artaxo, P., Berntsen, T., Betts, R., Fahey, D.W., Haywood, J., Lean, J., Lowe, D.C., Myhre, G., Nganga, J., Prinn, R., Raga, G., Schulz, M. & Van Dorland, R. (2007). Changes in
- M.Hitchcock, D.Hitchcock (2008). *Cool Trends. 10 things cities are doing now to reduce greenhouse gases.* International Society of Sustainability Professionals.
- Norelyza Hussein. (2011). *Contribution of Energy Consumption, Transportation and Solid Waste Carbon Footprint of UTM, Malaysia.*
- R. Heijungs, S. Suh. (2002). *The Computational Structure of Life Cycle Assessment.* Dordrecht, The Netherlands: Kluwer Academic Publishers.
- S. Suh, G. Huppes. (2005). Methods for life cycle inventory of a product. *Journal of Cleaner Production*, 13 (7), 687–697
- Tao Gao, Qing Liu and Jianping Wang. (2013). *A comparative study of carbon footprint and assessment standards.* *International Journal of Low-Carbon Technologies Advance*
- Wiedmann, T., and Minx, J. (2008). *A Definition of 'Carbon Footprint'.* In: C. C. Pertsova, *Ecological Economics Research Trends.* (Chapter 1, 1-11). Hauppauge NY, USA.: Nova Science Publishers.
- Y. Zeynab, A. Gelareh, Talkhestan, and K.M. Zaki (2013) Assessment of Carbon Footprint at University Technology Malaysia (UTM). *Applied Mechanics and Materials* Vol 295-298 (2013), 872-875.