Carbon Foot Print Calculator

By

Waddaa Gasim Mohamed Gasim

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Supervisor name:

Dr. Azizul Buang

CERTIFICATION OF APPROVAL

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by

Waddaa Gasim Mohamed

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(Dr. Azizul Buang)

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CERTIFICATION OF ORIGINALITY

This is to certify that I am responsible for the work submitted in this project, that the original work is my own except as specified in the references and acknowledgements, and that the original work contained herein have not been undertaken or done by unspecified sources or persons.

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WADDAA GASIM MOHAMED

Abstract

A carbon footprint is the measure of the environmental impact of a particular individual or organization's lifestyle or operation, measured in units of carbon dioxide. Increased carbon footprint yields global warming which is defined as the rise in the average temperature of Earth's atmosphere and oceans since the late 19th century and its projected continuation.

The objective of this project is to calculate carbon footprint of Universiti Teknologi PETRONAS (UTP). The carbon footprint has been estimated after identifying main contributors to the carbon footprint and selecting criteria of calculating. A special calculator has been developed to estimate contribution of UTP to the carbon footprint. The model was developed using Microsoft Excel for simplicity and the results showed that it is capable of predicting the Co2 emissions. Furthermore, the study examined contribution of different emission sources such as transportation and electricity to UTP carbon footprint.

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ABBREVIATIONS AND NOMENCLATURES

IPCC = Intergovernmental Panel on Climate Change.

Co_2 = Carbon Dioxide.

UTP = Universiti Teknologi PETRONAS.

EMS = Environment Management System.

GHGP = Greenhouse Gas Protocol.

GHG = Greenhouse Gas.

CHAPTER 1:

INTRODUCTION

1.1 Project Background.

A carbon footprint is the measure of the environmental impact of a particular individual or organization's lifestyle or operation, measured in units of carbon dioxide. Carbon footprint is also defined as the amount of greenhouse gases and specifically carbon dioxide emitted by something (as a person's activities or a product's manufacture and transport) during a given period.

Carbon footprint is composed of two parts, a primary and secondary footprint. The primary footprint is the sum of the direct carbon dioxide emissions of burning of fossil fuels, like domestic energy consumption by furnaces and waters heaters, and transportation, like automobiles and airplane travel. The secondary footprint is the sum of indirect emissions associated with the manufacture and breakdown of all products, services and food an individual or business consumes. The best way to calculate the carbon dioxide emissions is based on the fuel consumption.

The current trending towards the need for environment protection is affecting organisations throughout the world. The pressure toward the organisations is increasing to act upon environmental issues. One of the obvious issues is global warming, which is slowly increasing sea level and temperature of the earth.

Global warming is the rise in the average temperature of Earth's atmosphere and oceans since the late 19th century and its projected continuation. Since the early 20th century, Earth's mean surface temperature has increased by about 0.8 °C (1.4 °F), with about two-thirds of the increase occurring since 1980. Warming of the climate system is unequivocal, and scientists are more than 90% certain that it is primarily caused by increasing concentrations of greenhouse gases produced by human activities such as the burning of fossil fuels and deforestation.

As it is known that the infrared radiation from the sun's energy adsorbed from the atmosphere is happening everyday in result of the green house effects. This is essential in keeping the earth warm.

If there was no green house effect, the earth may not be suitable for living because of the low temperatures. The problem is that the concentration of this greenhouse gases is increasing due to human activities.

As well as climate change, the impacts of the imbalance to the natural greenhouse include the rising sea levels, which resulting in floods and droughts, negative influences on the flora and fauna and hence exposing humans to great difficulties.

Due to the pressure to act upon issue of global warming, it has resulted in the uptake of environmental management system by the business organizations. Environment Management System (EMS) is a set of processes that enable an organization to reduce its environmental impacts and increase its operating efficiency.

The EMS helps the organization to manage its environmental impact and sustainability goals in the form of measurement and reporting tools. One tool relevant to this work is the carbon footprint, which reports a business` activities in equivalent emissions of carbon dioxide (CO_2).

Impacts of climate change include rising sea levels, resulting in floods and droughts, as well as influences on the flora and fauna therefore exposing humans to great difficulties. The years that have the highest temperatures ever recorded are all during the 1990s, where the surface temperature rose by 0.6°C and the sea level increased by 10 - 20 cm. Predictions by the Intergovernmental Panel on Climate Change (IPCC), in its Third Assessment Report published in 2001, showed that the temperature will rise by an additional 1.4 to 5.8°C, while the mean sea level will increase by 9 to 88 cm by the end of the 21st century, depending on the actual rate of emissions (DEFRA, 2005).

1.2 Problem Statement:

Carbon foot print has become a widely used term and concept in the global climate damage. It had a significant increase in public appearance over the last few years. Despite its well known, there seems to be some confusion what it actually means and measures and what unit is to be used.

Globally, academic institutions have a substantial contribution to the total carbon footprint in the world. The main problem addressed in this study is that there is no available specialized calculator for calculating carbon footprint contribution by academic institutions in Malaysia. Absence of information about the carbon footprint in academic institutions results in low interest and less attention about their contributions towards the total footprint in Malaysia.

1.3 Objectives & Scope of the Study:

In order to improve the understanding towards the suitability to use carbon footprint tool, this study will review available carbon footprint online calculators to analyze the elements used in the calculations and analyze the calculators in terms of accuracy and easiness to use.

1.3.1 Objectives:

- Identify main contributors to carbon emission in Universiti Teknologi PETRONAS (UTP).
- Determine criteria to be used in evaluating carbon footprint and propose a carbon footprint calculator for UTP.
- Calculate carbon footprint in UTP by using a special designed calculator.

1.3.2 Scope of the Study:

The study scope is divided into three parts. First scope is to identify carbon footprint contributors inside UTP. Second is to analyze available online carbon footprint calculators to identify and understand the contributors to carbon emission calculation and relate them to carbon footprint contributors in UTP.

The third part is to propose and build carbon footprint calculator to calculate carbon footprint in University Teknologi PETRONAS (UTP) according to the main contributors identified.

1.4 Feasibility of the study:

This project requires identifying available carbon footprint calculators which could be executed during the literature review. I n addition to that main carbon footprint contributors in UTP need to be identified, this requires a special searching in side UTP campus. Last but not least is to develop a special carbon footprint calculator to calculate contribution of UTP to the carbon footprint in Malaysia. All required items of this study and the objectives are available and feasible within the proposed time.

CHAPTER 2

LITERATURE REVIEW

2.1 Carbon Footprint:

The carbon footprint is described as: "a representation of the effect you, or your organization, have on the climate in terms of the total amount of green house gases produced (measured in units of carbon dioxide)'', defined by the World Resources Institute (Barrett, 2003).

When the combustion of fuels take place in most of the activities that's causes amount of CO_2 to be emitted into the environment, example of this activates are lighting, hot-water, heating, ventilation, cooking ant I.T. equipment purposes.

Lastly, the confiscation of CO_2 through tree planting is another environmentally attributes to be thinking about. In general carbon footprint is definite as a quantification of the remaining CO_2 which is the metric commonly used to adjust the contribution to global warming and climate change.

2.1.1 Factors affecting the carbon footprint

Energy uses are the most contributors to carbon emissions. Greenhouse gases emissions are also caused by all means of transportation except walking and cycling. The highest emission of gases is caused by planes and cars the worst means of transportation, as the amount of emission is calculated according to the number of passengers related to the mode and the distance travelled.

2.2 Ecological footprints:-

Another reporting tool for performance of organisation toward environmental presentation is ecological footprint.

The ecological footprint is come into view as the world's first measure of humanity's require on nature, there are few critiques of the ecological footprint but two main issues are the methodology used to calculate the ecological footprint varies widely and the unit analysis used ecological footprint quantifies the used land over.

2.2.1 Carbon footprint VS Ecological footprint.

Some common areas are known among the two analyses. Though each one them of focuses on different aspects. That is to say, the carbon footprint is an estimate helping to lead to more improvements, as the ecological footprint focuses on the environments healing form the emissions.

2.3 Environmental accounting:

Burritt et al. presented a comparison between environmental accounting and conventional accounting. There are many similarities between the environmental accounting and conventional accounting. The latter can include physical data and monetary data. Although people usually think of monetary values when thinking of accounting, physical data are also an important part of conventional accounting. In addition, physical data forms the basis for many of the monetary values.

In traditional accounting, a distinction is also made between financial accounting and management accounting. Management accounting help managers to make decisions. While management accounting has an internal focus, financial accounting has an external focus. Financial accounting is used for communication with stakeholders.

Legal requirements are one reason to use financial accounting. Some reports are required by law depending on the company (Burritt et al, 2002). Financial accounting is also used to report to other stakeholders than government, like banks and other investors, customers, media, potential employees and partners, and interest groups like local communities and Non-Governmental Organizations.

A parallel can be made between conventional accounting and environmental accounting, however Burritt et al. (2002) do not entirely approve of the term conventional accounting.

Both monetary data and physical data are areas of interest in environmental accounting.

Moreover, environmental accounting is just like traditional accounting, different stakeholders are interested in different types of information. Within the company, at the production department, there is a need for environmental data related to production to minimize environmental impacts and financial costs that arise from them. This would be a type of environmental management accounting.

Multiple types of environmental accounting can be found. Distinction can be made between internal and external environmental accounting. There is a distinction between physical and monetary environmental accounting. Different parts of the framework can be related to each other.

If a company has to pay taxes when they have a certain amount of CO_2 emissions, then CO_2 emission data could be converted to monetary data. Therefore, the framework of Burritt et al. (2002) provides a distinction between monetary and physical data; however it also provides an overarching structure to relate the different parts of environmental accounting.

2.4 Increasing economic relevance of carbon related information:

According to Burritt et al. (2010), Attention is drawn to the carbon related information for three main reasons: first, carbon emissions are subject to standardized quantitative measurement and are one of the common environmental aspects appearing in corporate external reports, Mechanism and Joint Implementation measures.

Second, the information needed in support of improved carbon management has received increasing attention over the last two decades reinforced by the introduction of emissions trading systems, the Cleaner Development. And third, carbon management has recently been gaining attention in public discourse. As a consequence, information and the management of information about CO2 releases has become an economically relevant topic for corporate management.

At the end of the 1980s managers were pushed to engage with environmental issues by stakeholder (Mitchell et al., 1997). At about the same time criticism of company accounting systems which failed to reflect environmental and social dimensions of corporate activities was raised (Gray et al., 1996). Since then various tools of environmental and sustainability accounting have been developed and applied (Unerman et al., 2007), however, only a limited amount of research has been conducted on the practical implementation and use of sustainability management accounting (Schaltegger et al., 2008) and even less is known about corporate practice on collecting, managing and communicating carbon related information in the company. According to Jeswani et al. (2007), the amount of actual research conducted on information management practices in regard to carbon issues in companies to date remains limited even though attention directed to carbon issues in companies is on the increase.

According to Burritt et al., (2002), a number of main issues remain unexplored, but are of key importance to understanding challenges to managing carbon-related accounting information. On the one hand there has been little evidence obtained about what kind of information is actually collected, how often the information is collected, and why it is collected. Despite these gaps in knowledge, carbon management accounting has been evolving as a tool to support managers in utilising carbon-related. Despite that, companies have struggled with managing carbon related activities, for various interrelated reasons such as:

i. Deciding what information is relevant to decisions.
ii. The need to redesign information management systems to better accommodate current and future short and long term needs.
iii. The actual uses to be made of available information.

Carbon management accounting systems are being introduced to gather information in response to the growing regulatory, market and informational requirements being set down in a growing number of countries around the world as steps are taken to meet Kyoto Protocol requirements (Garnaut, 2008), to design sustainability reports in accordance with the Global Reporting Initiative (GRI) and to excel in sustainability ratings conducted for purposes of financial investment. The question of how such carbon management accounting systems are actually emerging is relevant and for systematic research a suitable framework is needed. Such a framework is considered in the next section.

2.5 Types of emissions and activities that can cause emissions:

Greenhouse gas (GHG) emissions have been classified into different types by ISO 14064 (2006) that are: direct GHG emissions and removals, energy indirect GHG emissions and other indirect GHG emissions. A direct greenhouse gas emission is defined as a “GHG emission from greenhouse gas sources owned or controlled by the company”. An energy indirect greenhouse gas emission is defined as a “GHG emission from the generation of imported electricity, heat or steam consumed by the organization”. Another indirect GHG emission is defined as a “GHG emission, other than energy indirect GHG emissions, which is a consequence of an organization’s activities, but arises from greenhouse gas sources that are owned or controlled by other organizations" (ISO, 2006).

The Greenhouse Gas Protocol (GHGP) presents about the same categories as ISO. Operational boundaries can be defined by companies on what types of emissions to include in the assessment.

Emissions can be categorized into three scopes that are: scope 1 (direct GHG emissions), scope 2 (electricity indirect GHG emissions) and scope 3 (other indirect GHG emissions). Scope 1 and 2 are mandatory for companies to be compliant with the standard (WBCSD & WRI, 2003). Different types of emissions can be attributed to these three different scopes. The following emissions are emissions of scope 1 (WBCSD & WRI, 2003):

- Generation of electricity, heat or steam
- Physical or chemical processing
- Emission resulting from combustion of fuels in company owned/controlled mobile combustion sources that are used for transportation of materials, products, waste and employees.
- Fugitive emissions: These fugitive emissions are the result of certain emission releases of the organization, like air-conditioning or refrigerators

Scope 2 contains purchased electricity, which is used as "shorthand for electricity, steam and heating/cooling". Scope 3 contains the following activities according to the GHGP (WBCSD &WRI, 2003):

- Extraction and production of purchased materials and fuels
- Transport-related activities
- Electricity-related activities not included in scope 2

- Leased assets, franchises and outsourced activities

- Use of sold products and services

- Waste disposal

Scope 3 has similar items that listed as in scope 1. The difference between scope 1 and scope 3 is that scope 1 is about emission sources that are owned by the company, and scope 3 is about emission sources that are not owned by the company. Reporting scope 3 emissions is not mandatory according to the GHG Protocol (WBCSD & WRI, 2003). Furthermore, some emission sources may be present in both scope 1 and scope 3. For example, scope 1 emissions include emissions from combustion of fuels in cars, while scope 3 includes emissions of the production of purchased fuels that may be used for cars (WBCSD & WRI, 2003).

Transport-related activities are a very important source of CO2 emissions for universities. The GHG Protocol (WBCSD & WRI, 2003) provides some more explanation about this category. The following activities in scope 3 are transport-related: transportation of purchased materials or goods, transportation of purchased fuels, employee business travel, employees commuting to and from work, transportation of sold products and transportation of waste. The "waste disposal" category which may also be relevant to universities can include waste of operations, waste of production of purchased goods and waste of disposal of sold products (WBCSD & WRI, 2003).

It is very important to distinguish between direct and indirect emissions. A company may report a certain emission under direct emissions (scope 1), while another company might attribute the same emission to indirect emissions (scope 2 or 3).

2.6 Collecting and processing of information:

In this part three main components are discussed that are: Firstly different ways to collect and process data for assessing carbon footprints, an introduction is given to two of the most important standards for assessing carbon footprints. Second are the actual calculations necessary for calculating a carbon footprint. Third is the information systems that can be present in a company for supporting environmental accounting and, more specifically, calculating carbon footprints.

Ways to collect and process data

According to ISO 14064 (2006), three different methodologies of quantifying greenhouse gases

(GHGs) can be used: measurement, calculation, and a combination of calculation and measurement. Measurement can either be continuous or intermittent. Calculation can be based on the following factors (ISO, 2006):

- GHG activity data multiplied by GHG emission or removal factors

- The use of models

- Facility-specific correlations

- Mass balance approach

According to Schaltegger & Burritt (2000), an environmental information system is very important. A way to do environmental accounting is to do a life-cycle assessment (LCA). LCA calculates the physical impact of a product, service, activity, infrastructure or process on the environment. LCA tries to capture all the environmental interventions or the environmental impact added during the entire life-cycle. Schaltegger & Burritt (2000) also discussed the difference between collecting data from all parts of the value chain and using background inventory data. Using background inventory data means using standard data that relate an amount of a certain product to the impact on the environment.

For example, tables could be available on the emissions of a kilogram of paper. It is usually much cheaper for companies to calculate their emissions based on the inventory data and the amount of paper that they use. However, using inventory data results in an estimation, rather than more detailed, specific information on the life-cycle. For example, information could be gathered on how the paper is made. Emissions of each process that is necessary for creating the paper can be calculated and added up to calculate the total emissions of an amount of papers.

According to Schaltegger & Burritt, (2000), collecting specific data for each stage of the life-cycle can be hard. If one company is doing the life-cycle assessment, then data from other companies is necessary as well. Different companies should cooperate to be able to make a good assessment of the total environmental impact of a product. Suppliers, producers and customers should cooperate in such a situation. In addition, the government has the power to create incentives for companies for doing environmental accounting. This could be used to promote LCAs to assess the environmental impact of a product.

The carbon footprint is here more broadly defined by PAS 2050 (BSI, 2008), -a standard that calculates the carbon footprint of products- as the amount of greenhouse gas emissions, instead of the amount of CO2 emissions. A more general standard for calculating the carbon footprint of an entire organization is The Greenhouse Gas Protocol, often abbreviated as the GHG Protocol, (WBCSD & WRI, 2003). In this case, carbon footprint deals with the emission of the six greenhouse gases that are covered in the Kyoto protocol. Carbon footprint as it is defined by Wiedmann & Minx (2007) as: "a measure of the exclusive total amount of carbon dioxide emissions that is directly and indirectly caused by an activity or is accumulated over the life stages of a product". PAS 2050 and the GHG Protocol could be used together, depending on the level of detail that someone desires. The carbon footprint of an organization should be the sum of the footprints of each of the individual services and products that the company uses, produces or sells.

CHAPTER 3

METHODOLOGY

The main aim of this study is to calculate carbon footprint in Universiti Teknologi PETRONAS (UTP), in Malaysia. Methodology of achieving objectives of this project depends on a broad research on the available carbon footprint calculators to understand how they work and then come up with a special calculator to calculate the carbon footprint of UTP. In order to calculate the contribution of UTP to Malaysia's total carbon footprint, it is necessary to identify the main carbon footprint sources and contributors.

Available calculators and calculation methods are first searched and discussed in the following paragraphs.

There is no much information about the actual carbon footprints calculations in ISO (2006). More details about the calculations of carbon footprint are available in standards like the GHG Protocol (WBCSD & WRI, 2003) and PAS 2050 (BSI, 2008).

To calculate the CO2 emissions of a company or product, two basic types of data are necessary.

First, activity data is necessary which provide more detailed information about the activities that lead to emissions. Examples of activity data can be the amount of gasoline used in a certain time frame, or the amount of paper consumed. To convert activity data to CO2 emissions, emission factors are used. Emissions can be expressed into CO2 emitted per unit of measurement. For example, an emission factor could state the amount of CO2 that is emitted per kilogram of paper. Emission factors are source specific. This means (for example) that emissions of electricity produced by coal will be different from emissions of electricity produced by nuclear power. In general, below is the formula for calculating an emission (WBCSD & WRI, 2003; BSI, 2008; Carbon Trust & Crown, 2008; Putt del Pino & Bhatia, 2002):

CO_2 emission = Activity data (kg / km / litres / etc) * Emission factor (CO_2 per unit).

For both activity data and emission factors, a distinction can be made between primary data and secondary data. Primary data are direct measurements within the life cycle of a specific product. For example, the amount of liters of gasoline used per number of kilometers can be directly measured. Secondary data consists of external, averaged data, which are not specific to the product (Carbon Trust & Crown, 2008).

According to the guide to PAS 2050 (Carbon Trust & Crown, 2008), the first step is to create a process map, when calculating the carbon footprints of products. A process map is a map that contains all of the different processes, activities and materials of the product's life cycle that could possibly result in emissions. The life cycle for business-to-business (B2B) is different than for business-to-consumer (B2C). In B2B, the cradle-to-gate approach is used, meaning that the life cycle stops at the moment where the product or service is delivered to a different organization. For B2C, the life cycle is the entire process from raw materials to disposal and/or recycling. For the life-cycle of services, an activity-based assessment is used; the life-cycle of a service contains any stage and emission source contributing to the delivery or use of the service to the.

The second step is defining the boundaries of the analysis. The system boundary "defines the scope for the product carbon footprint, i.e. which life cycle stages, inputs and outputs should be included in the assessment (Carbon Trust & Crown, 2008). According to PAS 2050, if a Product Category Rule is available, then this rule should be used to define the product's life cycle. PAS 2050 includes several exceptions that state what should not be included in the analysis. For example, employees travelling from and to work should not be included in calculating the carbon footprint of a product (BSI, 2008).

Collecting the data necessary for calculating the carbon footprint is the third step. Data should be relevant, consistent, complete, accurate and. Activity data and emission factors are, as discussed before, the data that is necessary for calculating the carbon footprint.

The fourth step is the actual calculation of the footprint. According to PAS 2050, "the equation for product carbon footprint is the sum of all materials, energy and waste across all activities in a product's life cycle multiplied by their emission factors". So activity data should be multiplied with the emission factors for all activities, and then all of these calculated CO2 emissions should be added up. Schaltegger & Burritt (2000) stated that, total mass of the input of all the materials should equal the total mass of the output. The process map should be used as guidance for the calculation of the footprint of a product, which splits the whole life-cycle of the product into small steps. For each step, the carbon footprint should be calculated, and carbon footprints of each step should be added up to get the total carbon footprint of a product.

Greenhouse Gas Protocol (GHGP) A big difference between the Greenhouse Gas Protocol (WBCSD & WRI, 2003) in relation to PAS 2050 is that the GHGP deals with the carbon footprint of organizations rather than products or services. Just like PAS 2050, the GHGP provides a number of steps to assess the carbon footprint:

- Identify GHG emissions sources

- Select a GHG emissions calculation approach

- Collect activity data and choose emission factors

- Apply calculation tools

- Roll-up GHG emissions data to corporate level

First, emission sources have to be identified, which can be categorized into scope 1, scope 2 and scope 3 emissions. An additional explanation of activities that can be included in the assessment, specifically for office-based organizations like UTP are provided by Putt del Pino & Bhatia (2002). Combustion of fuel in boilers and furnaces can be included in the assessment. In scope 1, business travel and commuting in UTP owned vehicles is included. Scope 3 also includes "incineration of office waste or decomposition in a landfill when the facilities are not owned by the reporting organization" and emissions of outsourced activities. After the identification of emission sources, a calculation method should be chosen. The GHG Protocol is not very specific about which calculation methods organizations can use. Calculation methods can range from using direct monitoring to using generic emission factors. Each organization should choose what is most appropriate for them. Third, activity data has to be collected and emission factors have to be chosen.

Fourth, calculation tools have to be used. Just as with PAS 2050, emissions can be calculated by multiplying activity data with emission factors. A number of calculation tools for specific sectors are obtained from the GHGP's website. One or more calculation tools to will be used to calculate UTP carbon footprint. The last step in calculating the carbon footprint of UTP, when using the GHG protocol, is rolling up the GHG emissions data to the corporate level. Data can come from different sources. Therefore, data from all parts of UTP should be taken together to calculate the total carbon footprint.

3.1 Available calculators:

The procedure of selecting and analyzing available online carbon footprint calculator involves the following tasks:

- ❖ Identify carbon calculator from internet.
- ❖ Understand how the calculator does works.
- ❖ Identify/listed out items considered in calculation.
- ❖ Prior to the analysis, the criteria to evaluate the calculators will be carried out.

The second part will be developed based on the evaluation conducted on the online carbon footprint calculators. The tasks involved are to:

- ❖ Identify which is suitable to be used for development of UTP calculator.
- ❖ Identify data to be collected.
- ❖ Validity.

3.2 Criteria for evaluation:

For this study, the evaluation of the online carbon footprint calculators will be conducted based on:

1. Accuracy
2. Easiness to use and understand.

The accuracy and the easiness to use and understand a calculator can be defined by several factors as shown in the table below;

Table 1: Variables of evaluation criteria.

Criteria	Variables/Parameters
Accuracy	- Type and unit of data - Emission factor
Easiness to use and understand	- Display of results - Usability of results

3.2.1 Accuracy

Accuracy is assessed using the following components:

- Type and unit of data – depends on which data a calculator required. This data can be expenditure-based (money spent on fuel) or quantity-based (fuel consumption or distance travelled). The latter is more accurate since it closely report the consumption of energy and hence the more accurate of carbon emission. In addition, the unit which reported the direct fuel consumption (liter of fuel) is more accurate than the distance travelled (km driven).

Furthermore, if the calculator is requires more elaborative or specific data (e.g. data input for short and long flight distance vs. input for flight distance only), the more accurate the calculator would be.

- Emission factor- the most accurate if the emission factors used in the online calculator follow the governmental guidelines or based on the international standards/recommendation.

3.2.2 Easiness to use and understand

The analysis on this parameter is to check as to how easily the results can be read and understood and used to carry out any action for improvement. The assessment will use the following parameter:

- Display of results- high accuracy is assigned for the calculator which provides clear graphics and images that represent the profile of carbon emission for the organization activities rather than the one that provide only a single figure/value carbon result.
- Usability of results- high accuracy is also assigned for results that provide relevant feedback and guidance on what improvement (if any) is needed to achieve good emission results.

3.3Comparison of carbon footprint models:

There is big number of available online Carbon footprint calculators or models. Kenny and Gray (2009) said that by converting the amount of electricity, oil, gas or coal used per year into CO_2 emissions, the existing models can calculate the primary footprint. Models or calculators also convert the number of kilometers driven in a car, kilometers on various types of public transport and flied kilometers to CO2 emissions. There are no standards or codes of practice associated with these models leading to potentially significant differences and inconsistencies between these calculators. Models or calculators are provided by a range of organizations including government agencies, non-governmental organizations (NGOs) and private companies.

Three models were selected in this comparison on the basis of the abovementioned considerations:

3.3.1 The Carbon Footprint model

The UK's Department for the Environment, Food and Rural Affairs (Defra) metrics is used in the Carbon Footprint model. Examination of the conversion factors showed that Defra (2005) is the source of home heating, transport and fuel conversion factors, which are based on the National Atmospheric Emissions Inventory for 2003 and the UK Greenhouse Gas Inventory for 2003. These conversion factors have been superseded by two Defra reports published in June 2007 (Defra, 2007a,b). The separate flight emissions model states it is based on the Defra (2007b) guidelines but when flights are calculated they do not concur.

3.3.2 Resurgence model

English Magazine is used to cover the subjects such as ecology, sustainability, art and nature for the last 40 years in the Resurgence model. The National Energy Foundation (NEF), Defra, and the National Office of Statistics are the sources of the conversion factors. An average family car returning 29 mpg (6.38 km l−1) has gave the car emissions of 223 g CO_2/passenger km are. In the Defra (2007a) guidelines the average emissions indicated for this engine size exceed for these emissions equate to those of petrol or diesel cars greater than 2 l. For short-haul flights in economy class the flight emissions of 180 g CO_2/passenger km where multiplied by a factor of 3 to take account of the effects of radioactive forcing from condensation trails and nitrogen oxide emissions.

From electricity and natural gas emissions are only agreed by the UK models, Carbon Footprint and Resurgence. According to Defra (2007a) data, both underestimate natural gas emissions; Carbon Footprint over estimates public transport and flight emissions whereas Resurgence underestimates bus emissions and over estimates car and flight emissions.

3.3.3 Carbon Fund

From the US Department of Energy's Energy Information Agency are used the Carbon Fund model, which details American fuel emission coefficients. The lowest flight emission factors are offered. By the World Resource Institute (2007) support the Safe Climate model and is based on information from the GHG Protocol website. The GHG Protocol site states all calculation tools have been peer-reviewed and tested by experts and industry leaders and represent a best practice for emission calculation tools but does not give further information as to the source of the emission factors. The emissions are high in comparison of from oil, flights and electricity to the other sites. It is a US based model with an option to select one's country of residence.

Household	Units	Carbon Footprint con. factor to kg CO_2	Resurgence con. factor to kg CO_2	Carbon Fund con. factor to kg CO_2
Number of occupants		Yes	Yes	Yes
Selection by country		No (UK based)	No (UK based)	No (USA based)
Electricity	kWh	0.430	0.430	0.610
Natural gas	kWh	0.190	0.190	0.200
LPG	l	1.490	1.510	*X*
LPG	kg	*X*	*X*	*X*
Butane	l	*X*	1.510	*X*
Butane	kg	*X*	*X*	*X*
Propane	l	*X*	1.510	*X*
Propane	kg	*X*	*X*	*X*
Oil	l	2.690	2.680	2.680
Kerosene	l	*X*	*X*	*X*
Coal	kg	2.550	2.410	*X*
Turf	kg	*X*	*X*	*X*
Briquettes	bale	*X*	*X*	*X*
Wood	kg	*X*	0.518	*X*
Electricity from renewables	kg	0.000	*X*	*X*

Figure 1: Comparison of existing carbon footprint model conversion.

X denotes not included in model.

3.4 Gantt Chart for FYP I & FYP II:

Item	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Selection of the project topic														
Preliminary research work (Background study of Carbon foot print)														
Preliminary report submission						✸								
Experiment Design& Data collection														
Submission of Interim draft report												✸		
Submission of Interim Report													✸	

Figure 2: Gantt chart for FYP I

Item	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Signal Analysis for Feature Extraction															
Algorithm Test															
Results gathering and Analysis															
Submission progress report								✸							
Pre - EDX											✸				
Submission of draft report												✸			
Submission of dissertation (soft bound)													✸		
Submission of Technical Paper													✸		
Oral presentation														✸	
Submission of project dissertation (hard bound)															✸

Figure 3: Gantt chart for FYP II

CHAPTER 4

RESULT AND DISCUSSION

4.1 Developing UTP footprint calculator:

Greenhouse Gases (GHGs) can be measured by recording emissions at source by continuous emissions monitoring or by estimating the amount emitted by multiplying activity data by relevant emissions conversion factors. What are Greenhouse Gas Conversion Factors? These conversion factors allow activity data to be converted into kilograms of carbon dioxide equivalent (CO_2e). CO_2e is a universal unit of measurement that allows the global warming potential of different GHGs to be compared.

Conversion factors used after comparing available calculator or models and taking available reports of Malaysia's carbon footprint in considerations such as Guidelines to Defra / DECC's GHG Conversion Factors for Company Reporting (2012) are:

Electricity consumption: 0.524 kg CO_2/ KWh

Cars and Busses (petrol): 2.331 kg CO_2/ Liter

Flights:

Domestic: 0.16513 kgCO_2/ Km

Short-haul International: 0.09429 kgCO_2/ Km

Long-haul International: 0.10789 kgCO_2/ Km

4.2 Developed calculator:

This calculator developed to calculate the numbers kilograms of Co_2 per year in UTP considering four elements which they are electricity, cars, motorcycles and flights.

	A	B	C	D	Formula Bar	F	G
1	Source	Input	Unit	Carbon Footprint			
2	Electricity	20000	KWh	3,825,200.00	kg CO2		
3							
4	Cars :						
5	Number of	Consumption					
6	Cars	/Day					
7	1500	2	Litre	2,552,445.00	kg CO2		
8							
9	Motocycles:						
10	Number of	Consumption					
11	Motocycles	/Day					
12	1500	0.5	Litre	638,111.25	kg CO2		
13							
14	Flights:						
15	Type	Distance					
16				Number of Trips			
17	Domestic	700	Km	8000	924,000.00	kg CO2	
18	Short haul		Km	5000		kg CO2	
19	International	2000			9,430,000.00		
20	Long haul		Km	3000		kg CO2	
21	International	5000			1,631,850.00		
22							
23	Total Footprint per year				19,001,606.25	kg CO2	
24							
25							

Figure 4: Developed calculator for UTP

From this calculator the following graph resulted to the relation between Electricity and Total Carbon foot print is Proportional.

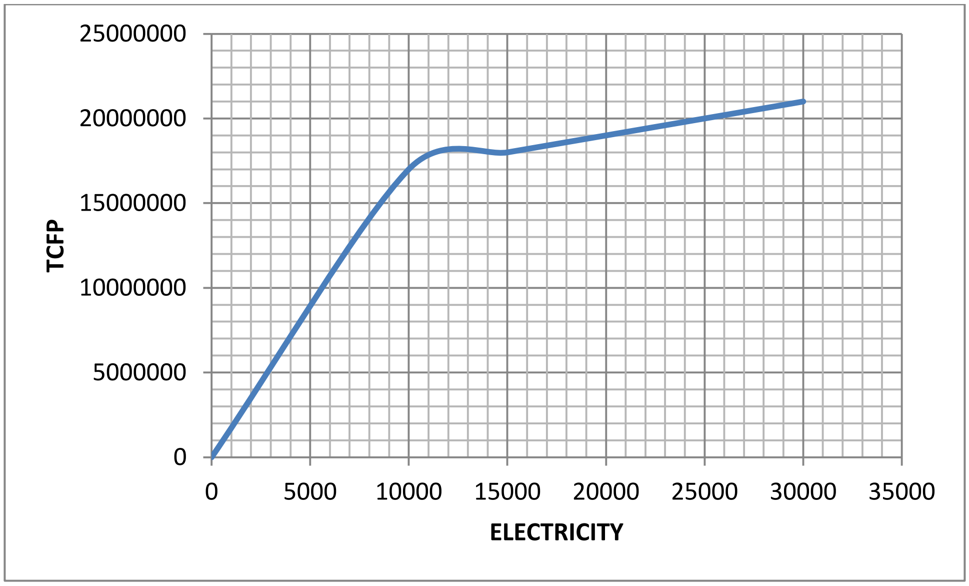

Figure 5: Relation between Electricity and TCFP

Also the relation between Cars and Total carbon footprint is proportional.

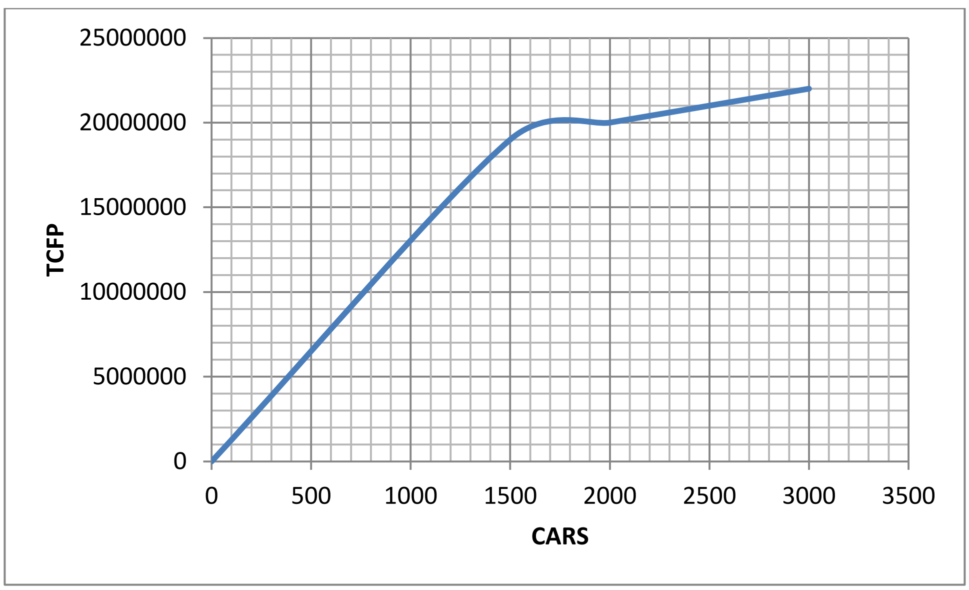

Figure 6: Relation between Cars and TCFP

In the coming graph the increase in domestic flights and the international flights increases the Total Carbon footprint.

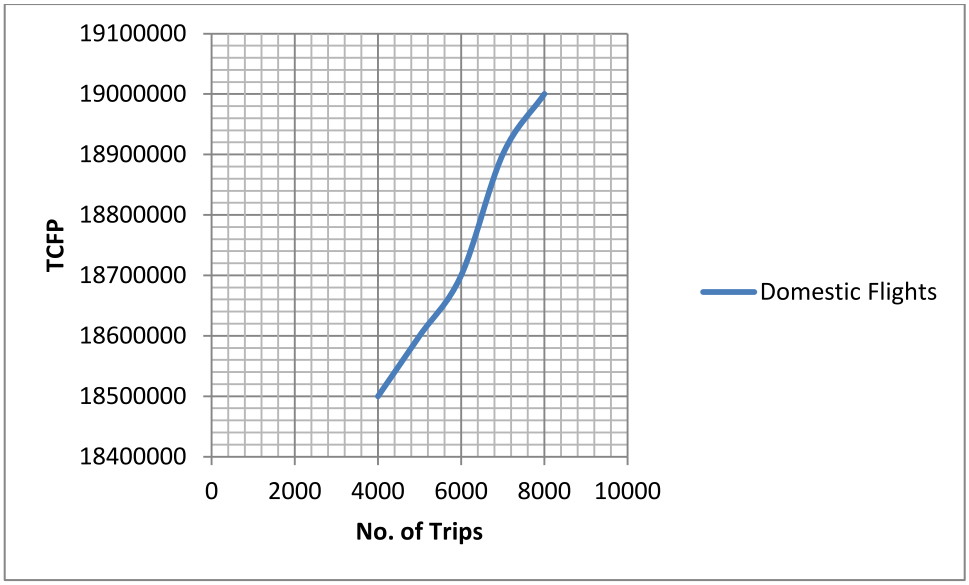

Figure 7: Relation between Domestic Flights and TCFP

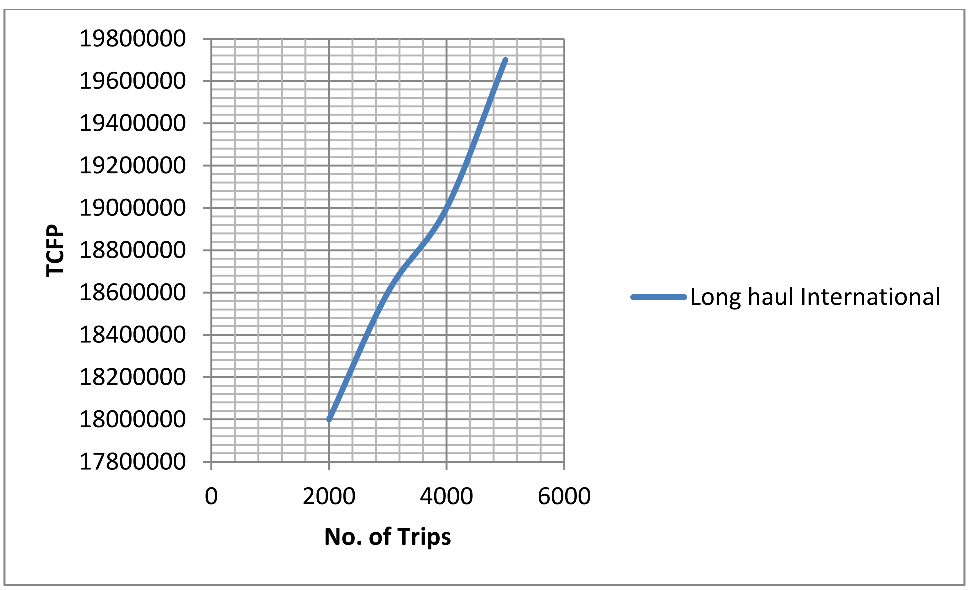

Figure 8: Relation between International Flights and TCFP

CHAPTER 5

CONCLUSION AND RECOMMENDATION

5.1 Conclusion

It could be concluded that calculations of UTP footprint have been done after selecting a specified calculator and identifying the main contributors to this carbon footprint. From the results obtained we can conclude that the calculator to be use in UTP will have these coming elements (no. of Electricity, no. of Cars, no. of Buses) as the conversion factors could be for each one as :-

- Electricity consumption: 0.524 kg CO2/ KWh
- Cars and Busses (petrol): 2.331 kg CO2/ Liter
- Flights:

- Domestic: 0.16513 kgCO2/ Km
- Short-haul International: 0.09429 kgCO2/ Km
- Long-haul International: 0.10789 kgCO2/ Km

5.2 Recommendation

It is recommended that more attention be drawn towards the contribution of academic institutions like UTP to the global footprint; it is also recommended that UTP calculate its contribution to the global footprint and draw clear plans to reduce it.

CHAPTER 6

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