

Carbon Footprints

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INTRODUCTION

It will be of academic interest to know how this terminology gained entry into the complex world of confusing terminology jargons. Sometimes I wonder whether these words were coined for the specific purpose of confusing the public rather than to disseminate knowledge. The aim should be to educate the public on the harmful effect of some gases that find their way to the atmosphere through human (in-human?) activities. I purposely did not use the term 'greenhouse' gas here as even the word 'greenhouse' gas is not a commonly used word by the general public although they might have read about it in newspapers without really understanding its multi facet components.

Let us look at how the name 'greenhouse' gas came into existence. The glass panes of a 'greenhouse' are known to transmit radiation. Similarly, the atmosphere also transmits radiation from the sun,

which has a temperature of over 6000°C and most of them are short waves lying in the visible portion of the spectrum. As a result, only very little portion of this radiation is absorbed by the atmosphere or reflected back into space, leaving the majority to be absorbed by the earth's surface. This causes the warming up of the earth's surface but eventually the heat will be radiated back as long infra red waves to the atmosphere by the three modes of heat transfer: conduction, convection or radiation. Carbon dioxide (CO₂) does not possess emission and absorption bands in the short and visible wave lengths of the spectrum but like the water vapour have several infra red bands between the wave lengths 2.36 to 16.5 μm.

The large portion of the infra red radiations from the surface of the earth to the atmosphere is mostly absorbed and partially reflected back to earth by the CO₂ and water vapour present in the atmosphere. As the atmosphere is not fully reflective, it absorbs most of the heat waves falling on it just like the panes of the 'greenhouse'.

The word 'greenhouse' gas (GHG) was coined by Joseph Fourier in 1827 and quantified by a Swedish Nobel price win-

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ner Svante Arrhenius. The naturally occurring GHG are as follows:

Water vapour: 95%, carbon dioxide: 3.62%, methane: 0.32%, nitrous oxide: 0.95% and other gases: 0.7%.

It can be defined as a gas that absorbs the radiated infra red heat waves from the atmosphere, causing a temperature rise within the space occupied by the gas layer and the surface of earth.

How do we name such a gas, planet's heat regulating gases (HRG)? Methane is 24 times as harmful as CO₂ and most of the palm oil mills using anaerobic digestion ponds are guilty of generating it but only a few mills have provision to trap it and produce electricity. The CO₂ is bad enough but methane is more potent than CO₂. At the same time, the contribution of the water vapour, that includes the clouds, is so high that it is arguable whether the CO₂ could be held responsible for any climate change on earth as the variation in the cloud formation itself could balance the CO₂ production rate! The quantity of cloud in the atmosphere need not remain constant at 95%. It may rise to 98% or reduce to 92% and in case of the latter event the impact of CO₂ will be almost completely nullified. This raises the question on whether we are over-reacting towards CO₂.

We are also confronted by another term 'Carbon Footprints' which is fast catching up to occupy the world of confusing terms. There is a rumour that Al Gore coined this phrase in the 1980s. But British Petroleum is widely known to be responsible for popularising it in the United Kingdom. This term does not by itself give any clue on what it really means to an ordinary person.

Let us look at its established definition: it is the measure of the impact our activities have on the environment and in particular climate change. It relates to the amount

of GHG produced in our day to day lives through burning fossil fuels for electricity, heating, transportation, etc.

This definition seems to be skewed too much towards CO₂ and much less on gases like methane or nitrous oxide, which are more powerful GHG than CO₂.

Another definition goes as follows: the total set of GHG emissions caused directly and indirectly by an individual, organisation, event or product and it is measured by undertaking a GHG emissions assessment. The carbon footprint is a measurement of all GHG we individually produce and has units of tonnes of CO₂ equivalent. It is made up of two parts:

- the primary footprint is a measure of our direct emissions of CO₂ from the burning of fossil fuels including domestic energy consumption and transportation. We have direct control of these.
- the secondary footprint is a measure of the indirect CO₂ emissions from the whole life cycle of products we use and those associated with their manufacture and eventual breakdown. In simple terms, the more products we buy the more emissions will be caused.

This definition appears to be better than the previous one. It looks as though any one can define it as they please. One fact remains certain, that is; no one has to step on powdered carbon to produce footprints or step on frozen CO₂ that will not even leave CO₂ footprints. So why use this strange term that does not convey any real meaning to an ordinary man? Why not use the term gases responsible for climate change (GRCC) and the footprints can be replaced with the word index so that we can refer to it as GRCC Index, unless it is *ultra vires* for developing nations to use such a term. Nevertheless, let us fall back to carbon footprints, the accepted terminology to please a number of experts who are now familiar with the term.

Now that we know what carbon footprints are all about, let us see how it can be applied to all of us as individuals and the organisations we are working for. After reading all the discussions in this Bulletin, please do not decide to quit working. Let us take the case of an engineer working in a palm oil mill and analyse his seemingly innocent actions during the processing operation but which leaves behind a blazing trail of carbon footprints. This analysis takes into consideration every action by individuals as well as the milling operation that can directly and indirectly result in the creation of carbon footprints that we are not ordinarily aware of. An example is given under the Titbits section.

THE IMPACT OF CARBON DIOXIDE ON TEMPERATURE RISE

During the past 650 000 years, it is claimed that the CO₂ concentration in the atmosphere has remained relatively steady within the range 180 to 300 ppm. This was done by carefully analysing the air trapped within ice blocks, when water froze hundreds of thousands years ago. The concentration started to change after 1950 when it rose above 300 ppm and in 2005 reached 370 ppm. From 1960 onwards, the temperature rise measured directly is confirmed as true. The latest assessment by the Intergovernmental Panel on Climate Change (IPCC), which was set up in 1988 by the World Meteorological Organisation and the United Nations Environmental Programme, which made its report on 2 February 2007, concluded that the global warming is unequivocal and gave the strongest warning yet that it is very likely caused by human activities.

Climate change is a global problem with global consequences. In 2006, warmer-than-average temperatures were recorded across the world for the 30th consecutive year. Increasing average temperatures are melting glaciers polar ice caps and raising sea levels, putting coastal areas at greater risk of flooding. Mounting evidence indicates that these changes are not the result of the

natural variability of climate. The theory of human-induced climate change is supported by a number of recognised scientific bodies, including the British Royal Society, the American National Academies and the IPCC.

The IPCC established in 1988 is the world's most powerful body on climate change, and its role is to assess on a comprehensive, objective, open and transparent basis the scientific, technical and socio-economic information relevant to understanding the scientific basis of risk of human-induced climate change, its potential impacts and options for adaptation and mitigation. It reported in 2007 that human activity since 1750 has caused a significant increase in CO₂ production. This can trigger climate change as it can cause a frequent change in weather events and other disasters frequently overlooked.

Evidence of Climate Change

- Sea temperature have risen by an average 0.5°C over the last 40 years (Tim Barnett, Scripps Institution of Oceanography in La Jolla, California).
- The 20 000 km² of freshwater ice melted in the Arctic between 1965 and 1995 (Ruth Curry, Woods Hole Oceanographic Institution in Connecticut).
- Global surface temperature have risen about 0.7°C in the past 100 years (Met Office).
- Eleven of the last 12 years rank amongst the 12 warmest year on record for global temperatures since 1850 (IPCC, 2007).
- Since 1975, the increase of the five-year mean temperature is about 0.5°C, a rate that is faster than for any previous period of equal length (NASA, 1999).
- The average annual temperature in the Arctic has increased by about 1°C over the last century - a rate that is approximately double that of global average temperatures (IPCC, 1998).
- There is widespread evidence that glaciers are retreating in many mountain areas of the world. For example, since the 1850, the glaciers of the European Alps



TABLE 1. A ROUGH GUIDE TO HOUSEHOLD ENERGY CONSUMPTION – APPLICABLE TO MALAYSIA

Appliance	Frequency of usage	Consumption per use	kWhr per year	kg CO ₂ per year
Microwave oven (5 units per day)	200 times/year	5 units/day x 200	1 000	1 000
Washing (machine 2 units per load)	5/week x 52 260 washes/year	2 units/load x 260	520	520
Drying machine (150 kW)	260 cycles/year 2 hour/cycle	1 unit x 260	260	260
Electric kettle (2 kW)	10 min x 200	2(10/60) x 300	100	100
Fridge (200 W)	365 x 20 hr	0.2 x 365 x 20	1 460	1 460
Lighting (200 W)	365 x 6	0.2 x 365 x 6	438	438
Hair dryer (30 W)	300 x 20 min	0.03 x 300 x 20/60	3	3
Electric iron (2000 W)	120 x 2 hr	2 x 120 x 2	480	480
Television (250 W)	365 x 4 hr	0.25 x 365 x 4	365	365
Computer (20 W)	150 x 4 hr	0.02 x 150 x 4	120	120
Battery charge- mobile phones, computer <i>etc.</i>	365 x 2 hr x 2	0.001 x 365 x 2 x 2	11.5	11.5
To produce 1 kWhr of electricity will generate approximately 1 kg CO ₂		Total	4 807.5	4.8 t

have lost about 30% to 40% of their surface and about half of their volume (Haerberli and Beniston, 1998).

Action Plan

If possible, use right now only renewable energy for all electrical energy requirements. This can be from biomass, biogas, land fill gas, biofuel, wind power, small hydro power generators, solar energy or nuclear energy. If there is no facility, we have to start working on the development of one of the method of power generation as soon as possible as fossil fuels are certain to make its exit.

Development of solar energy for domestic water heating system is simple and cost-effective. One simple practical method is to make it mandatory to install solar heat-

ers for new housing projects. If every house were to cut down electricity consumption by a moderate 2 units per day (four-member house), then the electricity saved for a community of 1 million people would amount to 60 million units per month. This is an attractive proposal with guaranteed results.

As water production involves significant electricity consumption, we have to try to conserve as much water as possible for our use like gardening, car wash, water closet flushing, *etc.* If every household make an effort along this lines not only we will not have to face the ordeal of water rationing, we will be developing a culture of not wasting our resources. Probably the government can offer a subsidy for the first one million houses who are willing to implement it then gradually the others will follow suit.