Available online at www.sciencedirect.com
SciVerse ScienceDirect
APCBEE Procedia 5 (2013) 175 – 180
Procedia APCBEE
www.elsevier.com/locate/procedia

ICESD 2013: January 19-20, Dubai, UAE

Carbon Footprint of Faculty of Environment and Resource Studies, Mahidol University, Salaya Campus, Thailand

Sayam Aroonsrimorakot[a*], Chumporn Yuwaree[b], Chumlong Arunlertaree[b], Rungjarus Hutajareorn[b] and Tarinee Buadit[b]

[a,b]*Faculty of Environment and Resource Studies, Mahidol University,Salaya campus, Nakhonpathom 73170 Thailand*

Abstract

Greenhouse gas emission, a significant amount of which comes from corporate organizations, is the cause of global warming, and is a threat to humanity at this time. As a result, the concept of measuring greenhouse gases by the management of organizations was established to help reduce the amount of greenhouse gases. This study focuses on the importance of measuring the amount of greenhouse gases or Carbon Footprint by calculating greenhouse gas emissions in units of carbon dioxide equivalent (CO_2e) from the activities of the Faculty of Environment and Resource Studies, Mahidol University with data collection of greenhouse gases sources such as electricity and water supply consumption, quantity of wastewater and garbage, and amount of fuels used etc. Then, multiply these data by the emission factors that are recognized internationally. The results showed that a GHGs emission from Faculty of Environment and Resource Studies is equal to 1,091.85 tonCO_2e. Sources that emit the most greenhouse gases are the use of electric energy, followed by produced solid waste. Thus, power consumption and the amount of waste created should be reduced with the use of current energy-saving technologies or energy saving campaigns to reduce the power consumption of students and staff including waste classification to facilitate recycling and so on.

Key words : Carbon Footprint ; greenhouse gases ; Facu lty of Environment and Resource Studies, Mahidol University

* Corresponding author. Tel.: +66-2441-5000 Ext.2304; fax: +66 2441 9509-10.
E-mail address: sayam.aro@mahidol.ac.

doi:10.1016/j.apcbee.2013.05.031

1. Introduction

The first carbon footprint challenge for companies is to assess the greenhouse gas emissions resulting from their activities, both directly and indirectly, such as the burning of fuel, electricity consumption, and waste management and transport, by showing the amount of greenhouse gas emissions in units of carbon dioxide equivalent (CO_2e). Six species of greenhouse gas are used to assess the carbon footprint under the Kyoto Protocol; carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorideperfluoro carbons (HFCs), perfluoro carbons (PFCs) and sulfur hexafluoride (SF_6).

Carbon footprint can be calculated by using the life cycle assessment (LCA), which is the international standard ISO 14040, 14044, used for the assessment of environmental impact throughout the life cycle. It can be calculated from the formula: CO_2 equivalent of each process = Amount of activity x CO_2 emission intensity. Total amount of every type of greenhouse gas from all activities, which were converted into units of carbon dioxide equivalents by multiply total emissions of each type of greenhouse gas with its global warming potential (GWP) , is the Carbon Footprint of the organization.

2. Methodology

2.1. Setting Organization Boundaries

The Faculty of Environment and Resource Studies, Mahidol University, Salaya campus, consists of four buildings as follows: Buildings 1-2, Environmental information building, and Singwaedlom Phattanadon building.

2.2. Setting Operational Boundaries

Identify all sources of greenhouse gas emissions both direct and indirect sources, which can be divided into the 3 scopes as follows:

Scope 1: Travels in terms of fuel consumption and amount of greenhouse gases generated by sewage treatment processes.

Scope 2: Emissions which arise from energy imports and the purchase of electricity and water supply.

Scope 3: Indirect greenhouse gases emissions, such as the use of paper, waste generated, amount of chemicals used in the laboratory, and the use of laboratory supplies.

2.3. Data Inventory

The data collected in this study were the collected relevant documents of both primary data (solid waste occurred) and secondary data (electricity and water supply, quantity and quality of the wastewater, fuel consumption, paper consumption, and the use of chemicals).

2.4. Calculation of GHG Emission

GHGs can be calculated by multiplying with the emission factor, which is commonly used internationally, and in accordance with the guidelines of the Intergovernmental Panel on Climate Change (IPCC) or from a national database of each country, and so on. The example of emission factors that are used in the study are shown in Table 1.

3. Results

Resource consumption and waste generated by the Faculty of Environment and Resource Studies in the year 2010 and the emission factors used to calculate the amount of each greenhouse gas sources are presented in Table 2.

Table 1. The example of emission factor used in the study [1]

GHGs Sources	Unit	Emission Factor *($kgCO_2e$)*	References
Water Supply	m^3	0.0264	Metropolitan Waterworks Authority (Thailand)
Electricity	kWh	0.5610	TC Common data
Paper	kg	0.7350	SimaPro
Diesel	kg	0.5200	BUWAL250 (D=0.839 kg/l)
Gasohol	L	2.93	TGO CFP Guideline

Table 2. Consumption of resources and the amount of waste generated by Faculty of Environment and Resource Studies the in the year 2010

GHGs Sources	Resource consumption/ Waste generated	Emission factor	Unit
Scope 1			
Diesel consumption	8,146.40 kg	0.5200	kg
Gasohol consumption	1,135.66 L	2.93	L
Quantity of wastewater	15,418,400 L	CH_4 Emission factor = 0.3 [2] N_2O Emission factor = 0.005 [2]	$kgCH_4$ kgN_2O-N
Scope 2			
Tap water used	19,273 m^3	0.0264	m^3
Electricity consumption	1,550,126 kWh	0.5160	kWh
Scope 3			
Amount of paper used	4,815.42 kg	0.7350	kg
Amount of chemicals used.	269,392 kg	Emission factor of each chemical	kg
The use of laboratory supplies.	49.4 kg	Emission factor of each materials	kg
Solid waste generated	50059.45 kg	Emission factor of each type of waste	kg

The total greenhouse gas emissions that resulted from the activities of the Faculty of Environment and Resource Studies in the year 2010 are equal to 1,091.85 tonCO_2e as shown in Figure 1, and the ratio of the amount of greenhouse gases generated of each activity is seen in Figure 2.

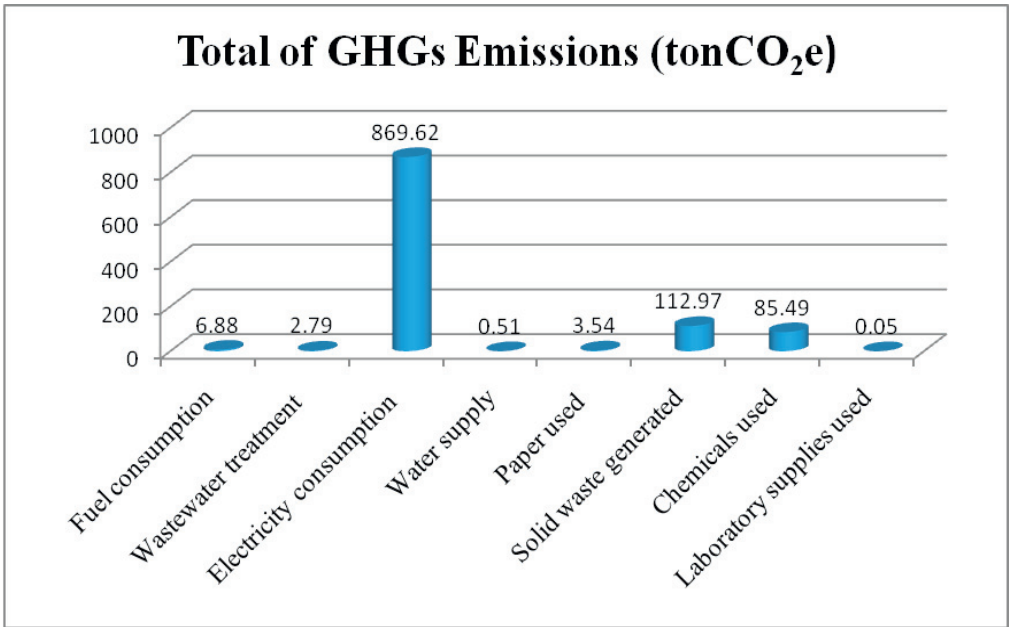

Fig. 1. The amount of greenhouse gases resulting from the activities of Faculty of Environment and Resource Studies in the year 2010

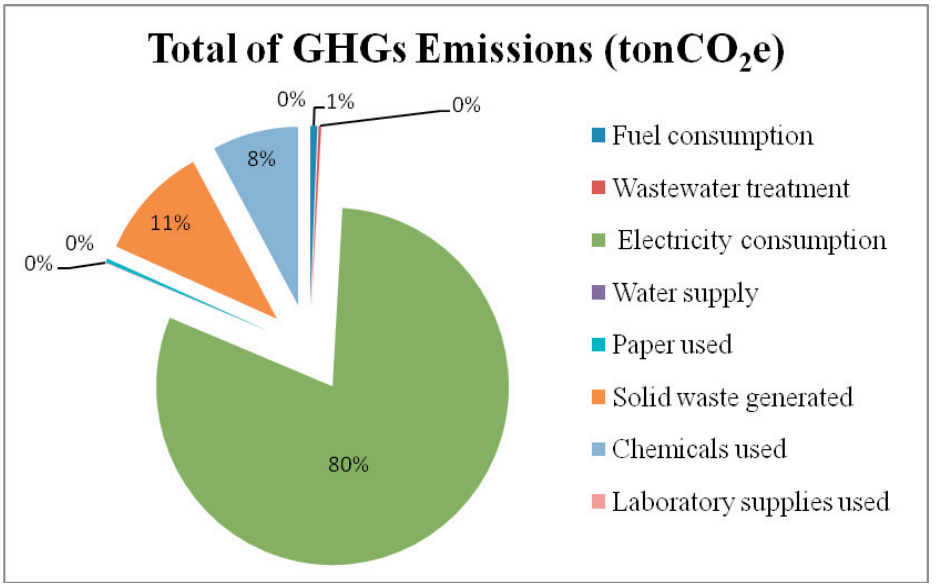

Fig. 2. Percentage of greenhouse gases emissions of each activity.

In summary, in 2010, the Faculty of Environment and Resource Studies releases greenhouse gas emissions from activities in the amount of 1,091.85 tonCO_2e. The emission of greenhouse gases by the Faculty of Environment and Resource Studies in each scope is demonstrated in Table 3.

Table 3. The amount of greenhouse gases that result from the activities of Faculty of Environment and Resource Studies.

Greenhouse Gases Source	Total of GHGs Emissions *(tonCO_2e)*
Scope 1: Direct greenhouse gas emissions	
• Travel (Fuel consumption)	6.88
• Greenhouse gases generated by the wastewater treatment	2.79
Scope 2: GHGs emissions arising from the importation of energy	
• Electricity consumption	869.62
• Water supply	0.51
Scope 3: Indirect greenhouse gas emissions	
• Paper used within the faculty	3.54
• Solid waste generated	112.97
• Chemicals used	85.49
• Laboratory supplies used	0.05

4. Conclusion and Discussion

The total of the greenhouse gas emissions by the Faculty of Environment and Resource Studies is 1,091.85 tonCO_2e. The source of greenhouse gases that has the highest emissions is electricity consumption, followed by the solid waste generated. The source with the minimal release is the use of laboratory supplies, such as rubber gloves, etc.

The Faculty of Environment and Resource Studies is an educational organization that has consumption of electricity, water supply, and waste from teachers, staff, and students, which have activities related to teaching and learning in the area of the faculty. Moreover, the amount of waste will increase every Friday of each week due to the arrival of a market under the building of the faculty that causes the amount of greenhouse gases from waste to increase as well.

The amount of greenhouse gas emissions is not only determined by the amount of resources used or the amount of waste that occurs. It also depends on the Emission Factor as well. Although the source amount may be less, if the source has a higher Emission Factor used to calculate the amount of greenhouse gas emissions, the results obtained may be much higher than a greater source with a lower Emission Factor. The time of the academic calendar is another factor that affects the amount of greenhouse gases. This is due to the fact that the in-class semester period and the vacation period have different levels and types of student and staff activity.

Alternatives to compensate for the greenhouse gas emissions of the organization

- Planting trees to absorb carbon dioxide

Teak plantations can produce carbon sequestration in the approximate amount of 4.61 tons/rai/year (1 rai = 1,600 SqMts). For Northern Black Wattle, the amount of carbon sequestration is about 9.08 tons/ha/year. As such, if the Faculty of Environment and Resource Studies is to reduce the amount of carbon dioxide, it should plant 236.84 rai of teak or plant 120.25 rai of Northern black wattle.

- Carbon Credit (CERs)

It can be observed that through the three cooperative mechanisms of the Kyoto Protocol, carbon credits become more like commodities, and they are tradable or exchangeable in a market known as the "carbon market." If the Faculty of Environment and Resource Studies wants to reduce the amount of GHGs 1,091.85 tonCO_2e per year by purchasing CERs at the price of the ECX Dec '11 market, the faculty will have to pay the total cost of 604,172.90 Baht or will pay a total cost of 605,594.48 Baht for the BlueNext Spot market. (Carbon credit trading market at 21-25 March 2011 from Thailand Greenhouse Gas Management Organization; TGO [3])

References

[1] Thailand Greenhouse Gas Management Organization. 2011. **Emission Factor** [Online]. Available at: http://thaicarbonlabel.tgo.or.th/download/Emission_Factor.pdf. April 20, 2011.

[2] Intergovernmental Panel on Climate Change. 2007. **2006 IPCC Guidelines for National Greenhouse Gas Inventories: Volume 5 Waste, Chapter 6: Wastewater Treatment and Discharge**. Available source: http://www.ipcc-nggip.iges.or.jp/public/2006gl/vol5.html. June 13, 2011.

[3] Thailand Greenhouse Gas Management Organization. 2011. **Carbon Market** [Online]. Available at: http://www.tgo.or.th/index.php?option=com_content&task=section&id=9&Itemid=50. May 10, 2011.

[4] Thailand Greenhouse Gas Management Organization. 2011. **GHG & Climate Change** [Online]. Available at: http://www.tgo.or.th/index.php?option=com_content&task=section&id=5&Itemid =28. Jauary 20, 2011.

[5] United Nations Framework Convention on Climate Change. 2011 . **United Nations Framework Convention on Climate Change** [Online]. Available at: http://unfccc.int/2860.php. January 20, 2011.