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Evalution of Carbon Footprint

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Abstract*: Due to manufactured technology enchantment the living being has much convenience and luxury. Though, at the same time, our current existence is doing damage to the environment. Like water pollution, air pollution and Carbon dioxide (CO_2) emissions on so forth. But CO_2 emissions are the one of the major reason polluting the environment. Furthermost of what we utilise in our daily life lead to emitting CO_2 into the environment. Due to this it leads to global warming and climate change problems. Therefore, carbon auditing (Carbon Footprint Analysis) is the first essential step to review the use of energy, to improve energy conservation and to allow building to go green. For this reason we need carbon audit to reduce usage raw materials, waste generation so on so forth to minimise GHG emissions ."CARBON AUDIT" is conducted within the building's boundary which includes the following stages:- People Survey to gather employee-level data, Building Survey to gather building-operation data, Carbon Footprint Analysis to evaluate the greenhouse gas (GHG) emission and Final Carbon Audit Report to provide tailored recommendations for going green along with action plan to get started.

Keywords: Electricity, Greenhouse gas, Carbon auditing, Climatic change and emissions

I. INTRODUCTION

Due to rapid industrialisation there is rapid growth in different sectors that causing emission of Carbon dioxide is a greenhouse gas (GHG) into the environment. Carbon footprint is measure of amount of greenhouse gases that released different activities is expressed as in terms of the equivalent amount of CO_2 emission (Elmuali and Kwawu, 2012, World Bank 2015). Besides CO_2, there are other GHG chemicals and sources, e.g. refrigerant and unburned fuel gas. Due this the CO_2 concentration in the environment is accumulating at very fast rate. There is a pressing need to diminish GHG emissions on a global scale. Currently, many nations are aiming to decrease GHG emissions and therefore carbon audit as it required in the management of carbon footprints.

II. METHODOLOGY

In directive to ensure to control and decrease CO_2 emissions for an establishment, one must clearly comprehend the source of each emission and the equivalent amount of CO_2 (Clément et al,). Hence, carbon audit is the first and foremost vital step. In a carbon audit, the carbon auditor should review all the company activities, raw materials used, waste generated, products, and services among others that may cause direct and indirect GHG emissions (Finkbeiner, 2009;Wang et al, .2010).

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"CARBON AUDIT" is conducted within the building's boundary which includes following stages(WWF Hong Kong, 2009)**:**

- People Survey (Data Collection From people)
- Building Survey
- Carbon Footprint Calculation and Analysis
- Final Carbon Audit Report and Action Plan

People survey was conducted in two stages. In the first stage the data was collected from staff, both teaching and non-teaching staffs and in the second stage it was collected from all the students.

Data collection hand outs (Questionnaire type) were prepared. This hand out includes questions regarding mobile combustion sources and few feedback questions regarding going green. The data was collected from all the staff members around 34 as well as from the students around 545 and it was collected via hand outs.

Data and Calculations

Direct emission data Calculation:

<u>People survey</u>

The data is collected per day & converted to per year basis

For Staff:

Mobile Combustion Sources

Average working day for staff in a year = 250 days.

Motor Cycle:

Quantity of petrol required for all staffs commuting through motor cycle per day= 4.588 L/day.

Quantity of petrol required for all staffs commuting through motor cycle per year (4.588 X 250) = 1147 L/year.

Car:

Quantity of petrol required for all staffs commuting through car per day =7.57 L/day.

Quantity of petrol required for all staffs commuting through car per year (7.57 X250) = 1892 L/year.

Bus:

Quantity of diesel required for all staffs commuting through bus per day =1.92 L/day.

Quantity of diesel required for all staffs commuting through bus per year (1.92 X 250) = 480L/year.

Van:

Quantity of gas required for all staffs commuting through van per day = 5.38 L/day.

Quantity of diesel required for all staffs commuting through bus per year (5.38 X 250) = 1345 L/year.

For Student:

Mobile Combustion Sources

Average working day for student in a year = 200 days

Motor Cycle:

Quantity of petrol required for all students commuting through motor cycle per day= 12.558 L/day.

Quantity of petrol required for all student commuting through motor cycle per year (12.558 X 200) = 2511.6 L/year.

Bus:

Quantity of diesel required for all student commuting through bus per day43.1331= L/day.
Quantity of diesel required for all student commuting through bus per year (43.1331 X 200) = 8626.2L/year.
Stationary Combustion Sources:
The only stationary combustion source is the generator which is used to generate electricity at the time of power cut.
One Litre of diesel generates about 3.5 kWh of power. Power required per day is 229.16 kWh. There is a power cut of two hours per day. So, around 51 kWh of power has to be generated with the help of generator. Hence, the amount of diesel required to generate power per day is 14.55 L. The amount of diesel required to generate power per year is 2910 L, considering 200 days.
Indirect Emission Data Calculation:
Electricity
Electricity required per month = 5500 kWh.
Total quantity of electricity required per year, considering 11 months = 60500 kWh.
Other Indirect Emission Data Calculation:
Paper
Average weight of one meter square exam paper = 70 gsm.
Total quantity of paper required for 3 internal exams = 3087.31 m2.
Total quantity of paper required for 1 semester exam = 2058.21 m2.
Overall quantity of paper per year = 10291.05 m2.
Overall quantity of paper per year (10291.05 X0.07) = 720.3735 kg.
70% of paper is recycled (0.70 X 720.37) = 504.26 kg.
Raw materials
Wood:
Total quantity wood present in one main door (MD) = 0.45 m^3
Total quantity wood present in 87 doors (D) = 9.50 m^3
Total quantity wood present in 44 doors (D1) = 3.31 m^3
Total quantity wood present in 356 Window (W) = 37.11 m^3
Total quantity wood present in 53 Ventilators (V) = 1.25 m^3
Total = 51.62 m^3
Average density of wood = 600 kg/m³.
Total quantity of wood (51.62 x 600) = 30972 kg.
Total quantity of wood in 120 benches in class rooms = 6000 kg.
Total quantity of wood in 60 tables in smart class rooms = 1200 kg.
Total quantity of wood in 11 staff benches in class rooms = 220 kg.
Total quantity of wood in 205 stools in laboratories = 1640 kg.
Total quantity of wood in 15 benches in laboratories = 2250 kg.
Total quantity of wood in 115 tables in auto-cad labs = 805 kg.
Total quantity of wood work in staff cabin = 1751.6 kg.
Overall quantity of wood required = 44838 kg.
Steel:
Total quantity of steel (grills) in 356 windows = 8.544 t.
Total quantity of steel (rods) in 53 ventilator = 0.212 t.
Total quantity of steel in verandah grills = 2.4 t.
Total quantity of steel used as reinforcement for construction = 388.822 t.
Total quantity of steel in laboratory machinery and all steel chairs =10.955t.
Overall quantity of steel = 410.933 t.
Cement:
Density of cement is taken as 1440 kg/m³.
Total quantity of cement used in basement = 317.35 m^3
Total quantity of cement used in ground floor =184.98 m^3
Total quantity of cement used in first floor = 171.17 m^3
Total quantity of cement used in second floor =184.99 m^3
Total = 858.49 m^3
Overall quantity of concrete = 1236124.8 kg.
Stone:
Density of aggregate is taken as 1500 kg/m³.
Density of brick is taken as 1765 kg/m³.
Total quantity of aggregate used in basement = 1327.42 m^3
Total quantity of aggregate used in ground floor = 827.92 m^3
Total quantity of aggregate used in first floor = 767.95 m^3
Total quantity of aggregate used in second floor = 829.94 m^3
Total = 3753.23 m^3
Overall quantity of aggregate (3753.23 x 1500) = 5629845 kg.
Overall quantity of brick (1111.91 x 1765) = 1962521.15 kg.
Glass:
Average of density of glass = 2600 kg/m³.
Overall quantity of glass = 1.8884 m³.
Overall quantity of glass (1.8884 x 2600) = 4910 kg.
Cement (Lab waste):
Density of cement is taken as 1440 kg/m³.
Total quantity of cement waste in laboratory per year = 10.90 m^3.
Overall quantity of concrete (10.9 x 1440) = 15710.40 kg.
Stone (Lab waste):
Density of aggregate is taken as 1500 kg/m³.
Total quantity of aggregate waste in laboratory per year = 49.10 m^3.
Overall quantity of aggregate (49.10 x 1500) = 73636.36 kg.
Fresh water:
Average quantity of fresh water consumed per person per day = 3 L.
Total quantity of fresh water consumed per year for all people, considering 200 working days = 360 m^3.
Solid waste:
Average quantity of Solid waste per day = 3 kg.
Total quantity of Solid waste per year considering 200 working days = 1800 kg.
Liquid waste:
Average quantity of water used per person per day = 35 L.
Total quantity of water disposed as liquid waste is 70% of consumption which is equal to 3360 m3.

Carbon Footprint Calculation and Analysis

Carbon Footprint Calculation

Data from people survey and building survey are used to calculate annual carbon footprint. For calculating carbon footprint, we used SME Carbon Audit Toolkit Software, which grants the guidelines particularly intended for small and medium initiatives (SMEs) to measure their carbon footprints due to goods manufactured and services provided. The evidence and endorsements provided can ease actual management of carbon footprints by enhancing energy efficiency, energy conservation, water conservation, paper recycling, GHG offset plantation, green manufacturing, green management and so on.

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As a result, SMEs can progress their ecological performance to meet the market demands for green products and services. SMEs can also diminish charges through effective use of resources and energy. The guidelines are suitable for a extensive range of users, including SME managers, environmental consultants, engineers, carbon auditors, and academics. By using SME Toolkit Carbon Calculator, equivalent CO_2 emission is calculated in kg by using Carbon Footprint Report generated from SME Toolkit represents the equivalent CO_2 emission as shown in figure 1 and 2.

4/8/2016 SME carbon audit

Section No.	Description	Equivalent CO_2 Emissions (kg CO_2-eq) Actual	Percentage (%)
Scope 1 Direct Emission			
	Mobile Combustion Sources		
1	(a) Fuel Consumption Approach	40,222	50.25
	(b) Mileage Approach	0	0.00
2	Stationary Combustion Sources	7,615	9.51
3	Refrigerant	33,103	41.36
4	Tree Planting	-897	1.12
	Total in Scope 1	80,043	
Scope 2 Energy Indirect Emissions			
1	Electricity	50,820	100.00
2	Towngas	0	0.00
	Total in Scope 2	50,820	

Fig 1. Carbon footprint Report (Scope 1 and Scope 2)

Scope 3 Other Indirect Emissions			
1	Paper	2,154	0.14
2	Raw Materials for Manufacturing of Products	1,555,894	99.64
3	Food	0	0.00
4	Plastic Bags	0	0.00
5	Fresh Water	153	0.01
	Waste		
	(a) Solid Waste	2,700	0.17
6	(b) Liquid Waste (Sewage)	578	0.04
	(c) Chemical Waste (Other than mineral oil)	0	0.00
	Staff Travel:		
7	(a) Distance Approach	0	0.00
	(b) Expense Approach	0	0.00
	Total in Scope 3	1,561,478	

Fig 2. Carbon footprint Report (Scope 3)

From the above results, equivalent CO_2 for each scope is calculated and carbon footprint summary is made. We can benchmark the performance against the peers and categories.

Some of action plans to diminish their carbon footprint is listed below:

Air-conditioning

- By using water-cooled air-conditioning system as a substitute of air-cooled system can bar electricity 30% and reduce carbon footprint.
- Regular cleaning of Air Conditioning Filters can to save energy and money on cooling costs. Save 350 lbs. of CO_2 per year.
- Use energy efficient lamps and also turned off electronic devices can save energy. Save over 1,000 lbs. of CO_2 per year.
- Use paper on both sides for printing and copying.
- Print draft document in multiple frames per page to save paper.
- Switch off standby power for office equipment after office hours, e.g. computers, printers, copiers etc.
- Use occupancy sensors to switch off lighting and air-conditioning in conference rooms and restrooms when they are not occupied.

Transportation

- Avoid driving at exceedingly high speed, rapid acceleration and brake to save 5% carbon emission.
- Reduce air travel whenever possible; overseas meeting can be conducted by video-conferencing.
- Combine your trip with another. This will reduces individuals travel costs such as fuel costs, tolls, and the stress of driving. This is more environmentally friendly and viable way to travel as distribution rides reduces carbon emissions, traffic congestion on the roads, and the need for parking spaces.

Others

- Installing three colours coded bins and encourages waste reusing and recycling.
- Displaying energy saving stickers and also using stair case rather than using lifts.
- Can be increasing the life span of the equipments by utilising electronic frequency inverters and soft starters.
- See the utilisation of the goods before purchasing or reusing of the goods that will help to conserve the resources and indirectly 60% of reduction in the carbon foot print.

III. CONCLUSION

Due to complexity of our activities the changes in the climate system also becomes complex. Then it is very difficult to predict or to understand the effect of the GHG in the atmosphere. If we emit the GHG at current rate the scientists predicted that the earth temperature will be warm by around 2°C to 4°C (3.6°F to 7.2°F) by end of this century. The important issue in the risk is uncertainty that has to be addressed to reduce emissions that will assure in contradiction of the possibility of catastrophic warming. The goal of this carbon auditing has been to help in mass recognize, analyse and reduce their carbon footprint.

If mass make a thoughtful determination to reduce their own carbon footprint they will be antagonised with a number of tasks. Meeting their basic needs and service footprint on a severe carbon budget is not easy. But this task or the accomplishment said above
is exactly what we must do both individually and collectively in order to limit the risks of climate change.

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