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ESTIMATION OF CARBON FOOTPRINT FROM FUELS (GASOLINE AND DIESEL) AS AN INSTRUMENT OF ATTENUATING CLIMATE CHANGE – A CASE STUDY OF ABIA STATE POLYTECHNIC, ABA, ABIA STATE, NIGERIA.

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Abstract - *This paper is focused on the estimation of carbon footprint from fuels (gasoline and diesel) of Abia State polytechnic, Aba (ASPA) for the period of March to November in 2016 which is about 189 days. This work was aimed to determine the carbon emissions from tailpipes of engines using fuels on the campus in, set a standards or conditions and to improve the attenuation of climate change which may pose a threat to the polytechnic in the future measurement. The polytechnic total carbon emissions for March – November 2016 was estimated to be 773.9 tones of CO_2. The carbon emissions were estimated to be mostly from diesel engines than gasoline engines. Emission from generators, vehicles and other automobile engines commuting within institution depicts that the institution is approaching the high emission rate of carbon which may cause the health problems to the individuals. Owing to the analysis of the result, mitigation factor such as investing on renewable energy project and probably introducing a green campus initiatives as in ideas which involves planting of trees is suggested.*

Keywords: Carbon footprint, Carbon emissions, CO_2, Attenuation, ASPA

1. Introduction

A carbon footprint is historically the total set of greenhouse emissions caused by an individual event organization or product. It is expressed as CO_2e (Carbon dioxide equivalent) which can broadly be defined as a measure of the greenhouse gas emission that are directly and indirectly caused by an activity or are accumulated over the life stages of a product or service [9]. Intergovernmental Panel on Climate (IPCC) reviewed 18 greenhouse gases with different global warming potential. According to United Nation Framework Convention on carbon dioxide (UNFCCC) and its Kyoto protocol, only Carbon dioxide (CO_2), Methane (CH_4), Nitrous oxide (N_2O), Hydrofluorocarbons (HFCs), Perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6) are considered for the purpose of carbon accounting, with others being regulated elsewhere [3].

The main elements that generates large amounts of carbon dioxide are fossil fuels (especially oil and coal), through burning them for obtaining energy. Of all greenhouse gases, CO_2 has the largest share. Thus, emissions of other greenhouse gases as stated earlier are converted into units of CO_2 equivalents (CO_2e) using the warming potential related to each gas. The calculation of carbon footprint in Abia state polytechnic, Aba (ASPA) was carried out to set a standard on environmental policies and practices, operational platform to achieving a friendly accommodating and sustainable environment in the future [6].

This paper shows results of Abia state polytechnic, Aba on analysis of carbon footprint from fuels as energy sources of engines available on the campus. Carbon footprint is measured in tones of carbon dioxide (CO_2). In other words, when you drive a car the engine burns fuel which emits a certain amount of CO_2, depending on its fuel consumption and the driving distance.

Carbon footprint has been deemed partly responsible for climate change in recent times. The global community now recognizes human induced climate change as the greatest environmental threat of the 21st century. The scientific consensus on climate change is that the climate is changing and that these changes are in large part caused by human activities [1]. These changes in climatic and ozone layer depletion by the activities of humans have been predicted to be at exponentials rate as a result of CO_2 emission. However, the concept name of the carbon footprint originates from ecological footprint.

However, calculation of the exact carbon footprint is impossible because there are no definite rules to calculate a carbon footprint and how the emission of an organization can be allocated to certain division of the organization. These are all relevant issues which arise in institutions that want to report about carbon footprint GHG emission that have been allegedly responsible for climatic change such as global warming, decreasing water availability for humanity, pollution of air, water and soil, melting ice caps and increasing ocean level, degradation of ozone layer, extreme weather events, and changes of the seasons, reducing biodiversity and desertification.
At CO_2 level greater than 0.5%, adverse health effects are present in human's animals and plants. Plant utilize CO_2 as a primarily ingredient in photosynthesis. However under concentrated conditions plants root can actually be suffocated, which inhibits the uptake of nutrients and subsequently kills the plants [2].

1 Materials and Methods

A defined boundary was set which enabled development of comprehensive features of all the activities on the polytechnic campus that had contributed to its carbon footprint. The activities were grouped into sectors of fuels (gasoline and diesel) usage for easy analysis and determination of on campus carbon footprint.

Some tools were deeply employed in estimation and evaluation of the carbon footprint of the polytechnic. These tools involved include Campus carbon calculator, Inventory calculators, Inventory management plan and proposal template [8][4].

1.1 Emission Factors

This research was carried out with relevant standards and procedures such as the Greenhouse gas (GHG) emission factors for estimating combustion of common fossil fuels [7]. Table 1 shows the Carbon Footprint Analytical Framework of ASPA.

Table 1: Carbon footprint analytical framework of ASPA

Emissions Type	Class 1	Class 2
Transportation Emission	Private transportation	Commercial transportation
Campus Energy Emissions	Gasoline generators	Diesel generators

1.2 Private Small Business Operators' Generators

These generators are owned by individuals that run businesses within the campus environs which basically use gasoline. Survey on the quantity of fuel consumed was conducted and the result was tremendously used with appropriate emissions factor to obtain the CO_2 emissions.

1.3 Cooperate Business Operators' Generators

This includes generators owned by cooperate businesses operating in the institution. Such a business operational on the campus is a commercial bank which operates daily by running diesel generator set.

1.4 Institution Energy Emissions

This is the emissions emitted from fuel consumption by the institution for energy acquisition. The Works and Services Department provided grand volumes of fuel consumed in liters. Then using Greenhouse Gas emission factor the quantity of CO_2 emitted would be meaningful to be calculated.

1.5 Transport Emissions

This encompasses the emissions from all kinds of vehicles (tricycles; bikes; cars of all duties) owned by the institution, staff, students, visitors and for commercials. The fuel consumption and distances covered within the institution were considered and included to determine quantity of CO_2 emitted. The results were collected by the aid of questionnaire on fuel consumption and distances.

1.6 Carbon Footprint Formulae

The CO_2 emissions were calculated after the acquisitions of substantial data. There are various formulas for calculating GHG but in this research a formulae that relates amount of carbon contained in fuel to amount of carbon content was used in calculating quantity of CO_2 emissions [5].

Quantity of CO_2 emissions per liter = $OF \times m.w\ of\ \frac{CO2}{C} \times CC\ of\ fuel \times 3.785$

Where,

OF = Oxidation factor of fuel

M.w = Molecular weight

CC = Carbon content of fuel

C = Carbon

CO_2 = Carbon dioxide

2 Results and Discussion

2.1 Private Small Business Operators' Generators

The survey for the total number of privately owned generators used for businesses in the campus showed that 39 generators were being used. It was confirmed that the average liters of fuel (gasoline) used per day for generating power normally is 5 liters within the approximate eight (8) hours they operate officially on the campus (8am – 6pm). This shows that 189 days were spent by private small in ten months of the research. Therefore the CO_2 emissions contributed to the institution environment by individual business is 197.52 tons which amounts 29.69% of the total carbon emissions

2.2 Cooperate Business Operators' Generators

There is only one bank in the school premises, which is Skye Bank. The bank owns an S.P 30KVA generator for its alternative power supply. The generator uses diesel for operation and generating of electricity. The generator consumes average of 100 liters of diesel per week and they operate from Monday – Friday weekly with the exception of public holidays. The cooperate business emitted 135.14 tons of CO_2 in the period of research. This amount of carbon emissions is 20.31% of the total emissions.

2.3 Institution (Campus) Energy Emissions

The institution has eight generators of different powers amongst which only two were regularly used to provide power on the campus during the period of research. The total CO_2 emissions by the institution generators were recorded to be about 332.63 tons which is 49.99% of the total quantity of carbon emissions. One of the 500KVA generators has highest emission of CO_2 which is about 221.02 tons.

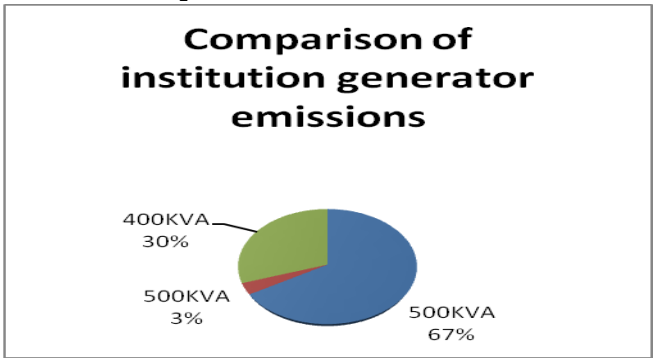

Chart 1: Comparison of CO_2 emissions from ASPA owned generators

2.4 Carbon Energy Emissions Distribution of All Sectors in ASPA

Among the sectors of ASPA that contributed to the emissions of CO_2, it is observed that ASPA generators emitted highest emissions of about 332.63 tons followed by private small business operator' generator which emitted 197.52 tons of CO_2 and the least contributing sector being the cooperate business operator (bank) of about 135.14 tons.

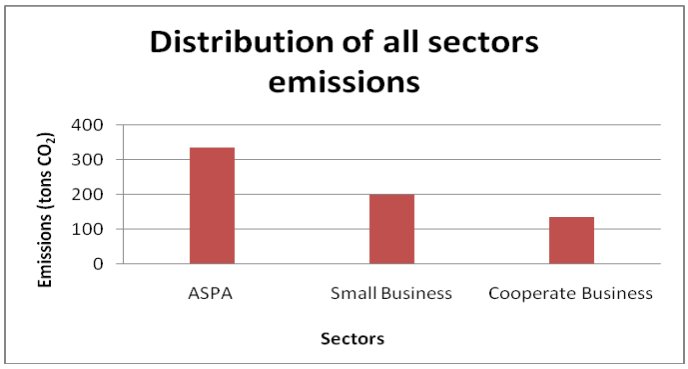

Chart 2: Distribution of all sectors emissions in ASPA

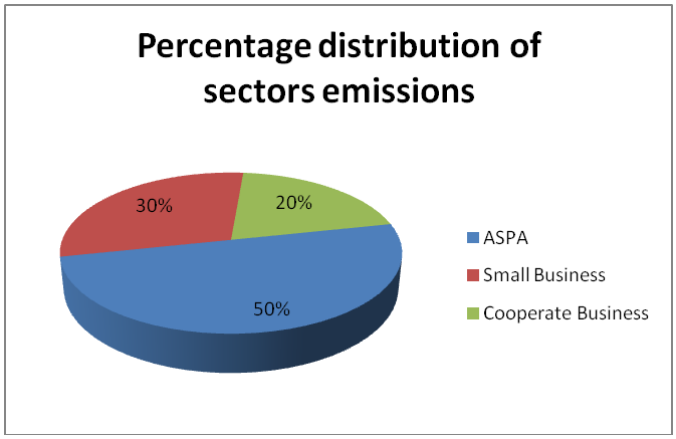

Chart 3: Percentage distribution of all sectors emissions in ASPA

The percentage distribution carbon emissions of the three sectors in ASPA shows that ASPA owned generator contributed 50% of the total carbon emissions which is the highest occurring distribution. Private small business contributed 30% of the total carbon emissions higher than least contributor that is the cooperate business which contributed 20% of emissions.

2.4.1 Transport Emissions

The vehicles that commuted within the institution environment were classified into two which include vehicles of gasoline and diesel engines. The gasoline

engines vehicle consumed about 10161.3 liters of fuel which emitted 98.49 tons of CO_2 and diesel engine vehicle consumed about 642 liters of fuel which emitted about 10.12 tons of CO_2. Both the gasoline and diesel engines comprise of the private and commercial transportation.

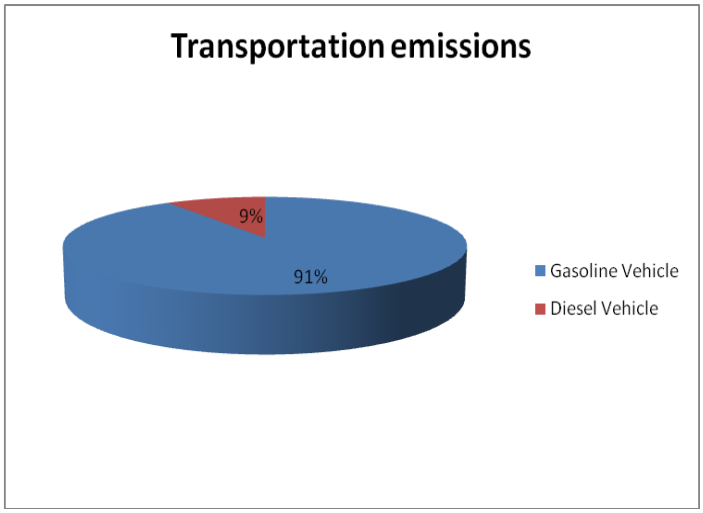

Chart 4: Transportation emissions of vehicles in ASPA

2.5 Average Monthly Emissions

This research was conducted through the months of March to November, 2016. The average emissions of the months were recorded. Each emissions in the months comprises of transportation and campus energy emissions.

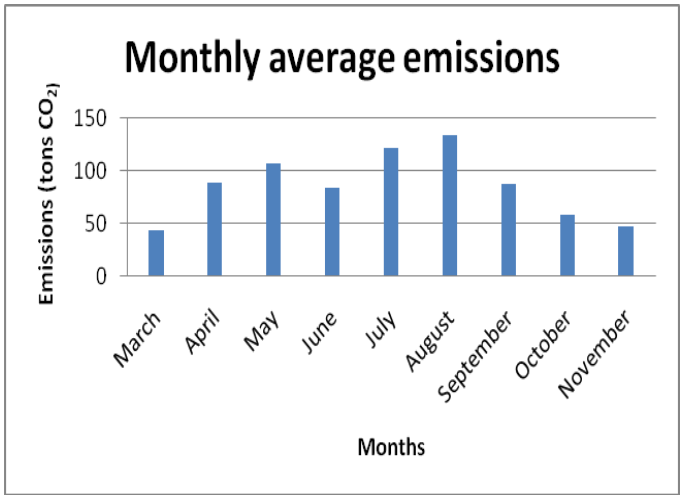

Chart 5: Monthly average emissions in ASPA

The highest emissions occurred in the month of August which has the highest bar of value 134.01 tons and the least emissions occurred in March which is 43.73 tons. This signifies that fuel consumption was highest in August and least in March.

3 Conclusion

The total carbon emissions of Abia State Polytechnic, Aba from March to November in 2015/2016 academic session are estimated to emit about 773.9 tons of CO_2. Though this result may not have captured all data of fuel consumption yet it has provided a baseline for academic carbon emissions of ASPA. Regardless of other sources carbon emissions it can be inferred that fuel consumption of all activities in ASPA is above half a metric ton. However, the carbon emissions are mostly arising from ASPA energy emissions and diesel engines.

3.1 Attenuations

The institution should adopt green plant policies in which the ideal of planting green plants are used in minimizing carbon emissions. This is possible because green plants make use of CO2 as a source of foot during photosynthesis.

Renewable energy should be considered as alternative energy source in ASPA which emit no carbon emissions. The campaign for renewable energy has gone far to reveal environmental friendly nature of the alternative energy.

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