
O. Anomohanran
Department of Physics, Delta State University, Abraka, Delta State, Nigeria

Abstract: The fact that the concentration of greenhouse gases in the atmosphere are increasing and contributing to the degradation of the environment has elicited global concern. One greenhouse gas which plays prominent role in this regard is carbon dioxide (CO₂). Hence, this study investigated the amount of CO₂ emissions obtained from petroleum products consumed in Nigeria from 1990 to 2009. Data were obtained from record of all petroleum products distributed and consumed in Nigeria within this period. These were subjected to the Tier 1 method of greenhouse gas determination using the Reference Approach. Result showed that 518.84 million metric tons (mmt) of CO₂ was released into the atmosphere between 1990 and 2009. This value represents 0.26% when compared with the global value of 202,640 mmt. Result also showed that there was a remarkable decrease in the total CO₂ emission in the first ten years from a peak value of 30.76 mmt in 1992 to a low value of 17.26 mmt in 1999. Between 2000 and 2009, greenhouse gas emission increased systematically reaching a peak of 32.56 mmt. Result also suggests that the consumption of Premium Motor Spirit, Automotive Gas Oil and House Hold Kerosene constituted 85% of the total emission in the past twenty years. Furthermore, the study showed that the average yearly increase in CO₂ emission in the past ten years was 4.7% as against global average rate of 1.9%. It is recommended that good and efficient energy utilization process be put in place in Nigeria.

Key words: Greenhouse gas, carbon dioxide (CO₂), emission, reference approach, pollution

INTRODUCTION

The challenges connected with the emission of greenhouse gases and the worsening quality of the environment have become of great concern to environmentalists and policy makers alike Lotfalipour and Falahi (2010) and Kamalan et al. (2011). Ghorbani et al. (2008) reason that this concern is based on the fact that the increase associated with greenhouse gas have negative impact both on the climate and the environment. This was what led many countries of the world to enter into many international agreements including the Kyoto protocol. The greenhouse gases which constitute important environmental issue are atmospheric gases that are transparent to radiation at one wavelength and absorb at another, usually at a longer wavelength. The Intergovernmental Panel on Climate Change (IPCC, 2007) stated that the important anthropogenic greenhouse gases which can be traced to human activities include carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), chlorofluorocarbons (CFCs), perfluorocarbons (PFCs), and hydrofluorocarbons (HFCs).

Carbon dioxide emissions are produced in our daily lives through burning fossil fuels to meet essential needs such as electricity, heating and transportation and have been identified to be a major component of greenhouse gas emission (Nkongolo et al., 2008). Various researchers have stated that CO₂ emission is known to contribute significantly to global warming which account for rising global temperatures and eventually cause sea level to rise (Guy and Levine, 2001; Joseph et al., 2011; Shu et al., 2010). As mentioned by Azam and Farooq (2005), the increase of CO₂ in the atmosphere also threaten to alter global as well as local climate condition, affect forests, crop yields and water supplies. This fact was also collaborated by Blasing et al. (2004) when they emphasized that anthropogenic emissions of carbon dioxide when compared with global warming potentials constitute by far, the largest part of the emission of greenhouse gases.

According to Wijnsma (2009), the Swedish scientist Svante Arrhenius was the first to speculate that the increase in CO₂ levels has the potential of changing the earth's surface temperature. He noted that cutting CO₂ levels by half would lower the earth's temperature by 4.5°C.

It is a common fact that CO₂ emissions produced from fuel combustion make up the great majority of the total greenhouse gas concentration and that almost all may be directly estimated from the combustion activities
The main fossil fuels burned by humans are petroleum (oil), natural gas and coal. Good estimates of CO₂ emissions are essential for the construction of inventories, monitoring of emission control obligations and are utilized for potential control measures. The estimates are invaluable for the preparation and analysis of emission abatement policies.

Hingane and Murty (1984) have shown that CO₂ emission from the combustion of fossil fuels in India from 1950 to 1982 has increased ten-fold due to petroleum products. This is on the high side when compared with two fold due to firewood and four fold due to coal. Boden et al. (2010) remarked that the extensive use of nuclear power has clearly curtailed fossil fuel related greenhouse gas emissions from France. They stated that the per capital emissions have declined steadily since the 1970s to present level which is 1600 kg per French person.

The Intergovernmental Panel on Climate Change (IPCC) noted in their publication that the estimation of CO₂ emission from fuels can be classified under two broad terms which are short term and long term (IPCC, 1996). Short-term emissions of CO₂ are those emissions occurring within twenty years of the fuel use. Long-term CO₂ emissions result from the final oxidation of long-life materials manufactured from fuel carbon and are usually emissions from waste destruction. However, Friedlingstein et al. (2010) stated that CO₂ emissions are computed from statistics on energy consumption and converted to CO₂ emission by fuel type.

Shu et al. (2010) identified two methods of estimating the quantity of CO₂ emission from fuel. They are the Tier 1 method and the ‘bottom-up’ method. The Tier 1 methods comprise the Reference Approach (RA) and the Sectoral Approach (SA) and both estimate the carbon emissions from the supply of fuels to the economy rather than from the actual emissions at combustion plant. On the other hand, a more detailed method known as ‘bottom up’ method uses records of fuel consumed at various combustion plants together with details of fuel supplied to other sources of emission.

According to the Environmental Protection Agency (EPA, 2006), where a country has detailed information on the consumption of fuels in the main consuming activities or sectors then detailed ‘bottom-up’ calculation can be made. Whichever method is used in CO₂ determination, the equation by the EPA is applicable and has been used in this study.

This study which is aimed at determining CO₂ emission derived from petroleum products consumed in Nigeria was carried out as a result of the growing concern that the concentration of greenhouse gases in the atmosphere are increasing and contributing to the rising average global surface temperature, sea level rise, flooding and other environmental crises. This study will therefore evaluate the quantity of CO₂ emission from this source to the atmosphere and provide information which will be the bases for the monitoring and control of CO₂ emission in Nigeria.

MATERIALS AND METHODS

The study area is Nigeria situated along West African Coast and covering a land area of 910,770 km². It is bordered on the north with Niger, to the east with Cameroon, to the west with Republic of Benin and to the south with the Atlantic Ocean (Fig. 1). It has a population of 140 million people (FGN, 2009) with the economy depending mainly on petroleum.

The method adopted for this study because of its suitability is the Reference Approach (RA) which provides estimates of CO₂ emission from all fuel supplied to the various consuming activities and also offers a breakdown of emissions by main fuel type. The quantity of petroleum products supplied to the various consuming activities across the country from 1990 to 2009 was calculated in this study by using the IPCC guideline for estimating the apparent fuel consumption by a country (IPCC, 1996). The guideline takes into account the quantity of petroleum products produced locally, the quantity imported, the quantity exported, the quantity used for international transport also known as bunkers and the net increases and decreases in stocks of the products.

The estimation of the carbon dioxide emitted from the petroleum products supplied across the country was carried out using the procedure as defined by the IPCC and the EPA (IPCC, 1996; EPA, 2006). The process involves six main steps which are as follows:

- Estimating the apparent fuel consumption in original units
- Converting to a common energy unit
- Multiplying the values obtained by emission factors to compute the carbon content for each product
- Computing the carbon stored
- Correction for carbon unoxidised
- Converting carbon oxidised to CO₂ emission

These steps were carried out for all the petroleum products on a year by year base for the twenty years and the results analysed. The average yearly increase in CO₂ emission in the past 10 years was calculated and compared with the global average rate. The study also determined the average CO₂ emission per person in Nigeria from this source.
RESULTS AND DISCUSSION

The data collected for this study was subjected to the various calculations as specified by EPA and IPCC and the quantity of CO$_2$ emitted on a year by year basis from 1990 to 2009 determined.

The quantity of CO$_2$ emission on a yearly base was plotted as shown in Fig. 2. Figure 2 shows that 518.84 million metric tons (mmt) of CO$_2$ was realised to the atmosphere from the use of petroleum products from 1990 to 2009. This value represents 0.26% of the global CO$_2$ emission from petroleum products within the same
period which stood at 202, 640 mmt of CO₂ (EIA, 2010). Figure 2 also shows that there was a modest increase in CO₂ emission from 25.59 (mmt) to 30.76 million metric tons between 1990 and 1992. From 1993 to 1999, there was a remarkable reduction of CO₂ emission. The value reduced from 30.61 mmt in 1993 and attaining its lowest value of 17.26 mmt of CO₂ emission in 1999. Meanwhile, from the year 2000, the total CO₂ emission started rising again until it attains a value of 32.56 mmt in 2009. This continuous increase between 2000 and 2009 tend to buttress the fear raised by Nwaichi and Uzozobora (2011), that CO₂ associated air pollution gave significant and worrisome concentration as a result of gas flaring. It again conform the point by Azam and Farooq (2005), that there is the likelihood that CO₂ concentration in the atmosphere will continue to rise as a result of growth in population. It is pertinent to observe that the reduction of CO₂ emission between 1992 and 1999 was not as a result of any government policy geared towards reducing CO₂ emission, rather, it was due to the various austerity measures introduced by the then Military Government of Nigeria. This was what gave rise to the low demand for petroleum products and it is in agreement with the work of Wijnsma (2009) which claimed that there was fall in the rising rate of CO₂ between 1998 and 1999 and that this period coincides with global economic recessions. However, with the successful transition to civilian regime in 1999, the economy bounced back to life hence the demand for petroleum products increased tremendously. Also, the use of electricity generating sets became rampant during the last 10 years of 2000 to 2009 thereby increasing the quantity of petroleum products consumed and by implication increase the quantity of CO₂ emitted. This is in agreement with the fact that economic growth is related to CO₂ emissions (Friedlingstein et al., 2010). This fact was also confirmed by Igwenagu (2011), when he observed that in Nigeria there was strong positive correlation between CO₂ emission and gross domestic product.

Analysis of the data as shown in Fig. 2 shows that the yearly average increases of CO₂ emission in the past 10 years which is from 2000 to 2009 is 4.7%. This is 2.8% higher than the global average rate of 1.9% (EIA, 2010).

Analysis of the data also shows that the average CO₂ emitted per person in Nigeria through the consumption of petroleum products in 2009 is 229 kg. This value is comforting when compared with the France value of 1,600 kg of CO₂ per French person.

Figure 3 shows the total CO₂ emission of each of the petroleum products over the period of twenty years. The figure reveals that the use of Premium Motor Spirit (PMS) introduced 262.31 mmt of CO₂ into the atmosphere in the past twenty years. This is followed closely by Automotive Gas Oil (AGO) with a value of 111.80 mmt and House Hold Kerosene (HHK) with a value of 71.20 mmt. These three products were responsible for the release of 455.31 mmt of CO₂ to the environment between 1990 and 2009. This amounts to 86% of the total CO₂ emitted into the atmosphere from consumed petroleum products in
Nigeria within the period of study. This value corresponds to 0.23% of the total global release for the period. This is the more reason while measures which will reduce the consumption of these products and by implication reduced the quantity of CO₂ released into the atmosphere should be encouraged by all to ensure the future of our environment (Jegannathan et al., 2011; Shamma et al., 2011; Ab-Rahman et al., 2009; Azmi et al., 2011; Fakoya et al., 2011).

CONCLUSION

This study has shown that greenhouse gas emission resulting from the consumption of petroleum products in Nigeria has increased in the past ten years. It is recommended that good and efficient energy utilization process that will check waste and reduce the quantity of petroleum products consumed in Nigeria should be put in place. It is also recommended that the policy of one man to plant one tree be encouraged and pursued with vigour in Nigeria as these trees have the potential of utilizing a good size of the greenhouse gas emitted.

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REFERENCES


3213


