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# World Greenhouse Gas Emission Profile: A Review

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**Abstract:** Environment and related issues are in the essence of discussion in the world as of serious environmental pollution. That has been recorded over the large 100 years. The need of industrial revolution is unavoidable as of growing demand for all resources that are consumed by growing human population. Many activities undertaken by human are not compatible with environment and such activities do disturb natural environmental balance which then lead to natural disasters. Greenhouse effects and global warming are closely correlated and being discussed seriously by many countries to develop practically possible protocols in order to minimize such effects to level that does not create harmful effect to environment and its balance. Greenhouse gases are generated by many activities especially anthropogenic emissions pay a key role in the total amount of greenhouse gases emitted. Hence, this review basically summarizes fundamentals of greenhouse effects, factors that affect greenhouse effect, greenhouse gases and their sources, trends of greenhouse gas emission in the world over the time, environmental check and of greenhouse effect and possible ways for mitigating such effects. This review article is very useful for researchers, industrialists and other organizations related to environment and policy makers to propose solutions in order to keep environment dynamic and fresh for better survival.

**Key words:** Emission · Gas · Greenhouse · World

## INTRODUCTION

Over the last century, the atmospheric community has changed with the increasing concentration of trace gases known as greenhouse gases which warm the earth significantly and have the potential to cause global warming. Greenhouse gas emissions have increased worldwide after the beginning of industrial revolution [1]. Presence of the atmosphere keeps the planet warmer than it would be without an atmosphere. About 70% of the solar radiation is absorbed and reemitted by the surface. The long wave radiation is partially absorbed by the clouds and greenhouse gases when reemitted and scattered in all direction. So that the long term scattering of rays to surface cause significant increase in the temperature of the planet earth surface. This phenomenon is known as greenhouse effect and global warming. Key greenhouse gases are carbon dioxide ($CO_2$), Methane ($CH_4$), Nitrous Oxide ($N_2O$) and Fluorinated gases, but Ozone and water vapor provide minor contribute to greenhouse effects. Radiative forcing of these gases is important for their ability to cause global warming. Radiative forcing is the phenomenon which gives the relationship between incoming and outgoing radiation. Positive radiative forcing tends to warmer the surface by reducing the emission than absorption that causes greenhouse effects and negative radiative forcing tend to cool the earth. Radiative forcing of $CH_4$ and $N_2O$ is 25 and 300 times higher than $CO_2$ respectively [1].

$CO_2$ is the primary greenhouse gas contributing nearly 76% to the global warming. Potential sources are fossil fuel combustion, deforestation and land use, agriculture, transportation and industrial processes [2]. $CH_4$ is the second most abundant greenhouse gas emission covers nearly 16% of total emission. $N_2O$ is nearly 6% of total emission and sources are agriculture and natural nitrogen cycle. Remaining percentages are covered by F-gases, which include hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulfur hexafluoride ($SF_6$). Black carbon is a solid particle or aerosol, not a gas, but it also contributes to warming of the atmosphere. Cryosphere melting, rising of sea level, flooding, increased wild fire activity, hurricane and destruction of biosphere are some effects of greenhouse gas emissions

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[2]. This paper will therefore discuss about major greenhouse gases and their emission trends over the year, sources and sectors, global profile of greenhouse gas emission and ways to mitigate greenhouse gas emission.

**Greenhouse gas emission**

**$CO_2$ Emission**

**Global $CO_2$ Emission Trends:** World $CO_2$ emission reaches 35.3 billion tones (Gt) in 2013, comparatively 2% higher than the previous year. From 1995 to 2002 the average annual increase of $CO_2$ emission was about 1.2% but the last decade from 2003 to 2013 the annual increase was about 3.8%. But, recently the increase in the emission is significantly reduced than expected due to use of renewable energy. $CO_2$ emission in 2012, 2013, 2014 and 2015 is 35.3 billion tons Gt, 35.9 Gt and 35.7 Gt respectively [3].

*$CO_2$ emission by countries*


Fig. 1: Global $CO_2$ emission trend-2015 [5].

The six largest emitting countries which together account 70% of total $CO_2$ emissions are china (29%), United States (15%), European Union (11%), India (6%), Russian Federation (5%) and Japan (4%). In all these major countries increase in $CO_2$ emissions has been reduced in the recent year. China reduces their emission by reducing the demand for coal consumption. United States reduces it by increasing the natural gas usage and reducing fossil fuel consumption. European Union does it by reducing the consumption of oil, gas and coal and moving towards to renewable energy sources [2].

China is the largest emitter of global $CO_2$ which emits twice as higher than that of United States. But Based on the per capita emission United state emits twice as higher than of both China and European union due to low population with high emission potential.

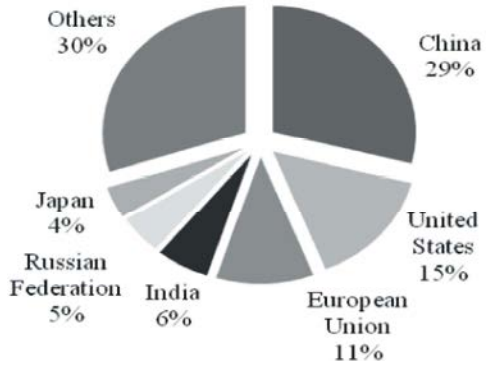


Fig. 2: Global $CO_2$ Emission by countries in 2015 [2]

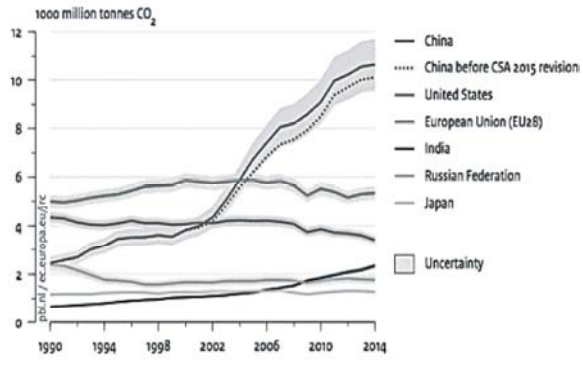


Fig. 3: Top seven $CO_2$ emitters in world [3].

**$CO_2$ Emission by Sources and Sectors**

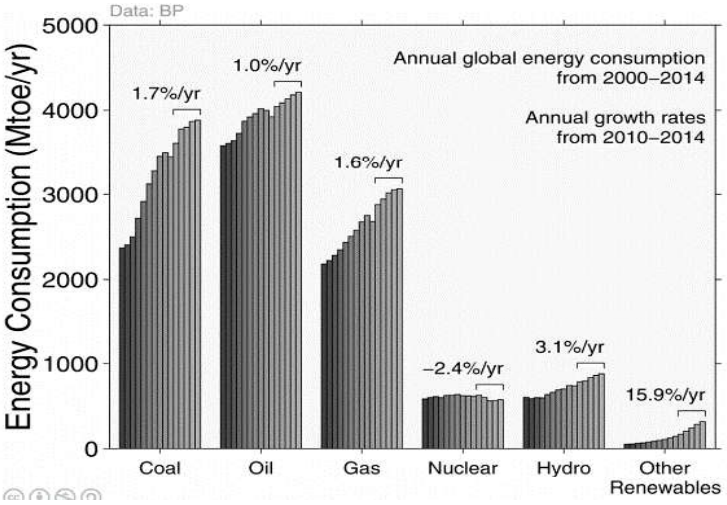


Fig. 4: Global $CO_2$ emission Sources– 2014 [4].

Fossil fuel and coal consumption is the key sources for $CO_2$ emission.It accounts for about 90% of total global $CO_2$ emission.Usage of natural gases obtain considerable amount of contribution to global. Nuclear, solar power and other renewable sources are the emerging ways to reduced or low carbon emission to world [3].

For the energy generation coal, oil and gases are the major sources. Totally about 25% of $CO_2$ is released by heat and electricity production of energy sector [5]. Agriculture and other land use management sectors contribute nearly equal percentage of energy sector. They both together contributes half of the Global $CO_2$ emission by economic sectors.Industrial processes dontribute 21% of global $CO_2$ emission [2].

**Methane Emission**

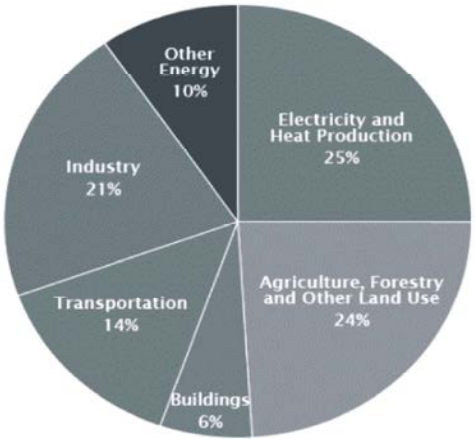


Fig. 5: Global $CO_2$ emission Sectors – 2015 [5].

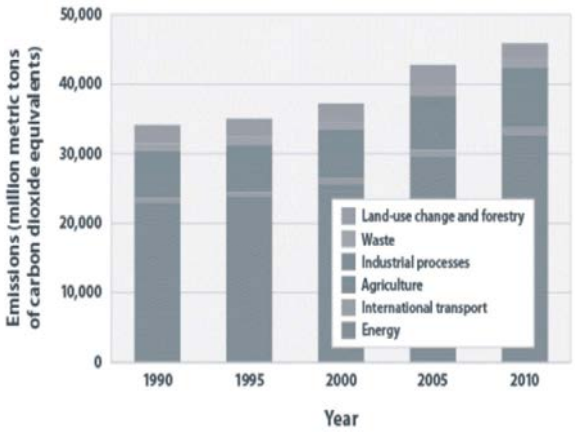


Fig. 6: Global $CO_2$ emission Sectors: 1990-2010 [2].

**Global $CH_4$ Emission Trends:** Global methane ($CH_4$) emissions show an increase in its trends over the year. It shows a moderate increase up to 2002. Then average stable emission during 1993-2000 periods and a strong emission have been reduced in 10 years [6].

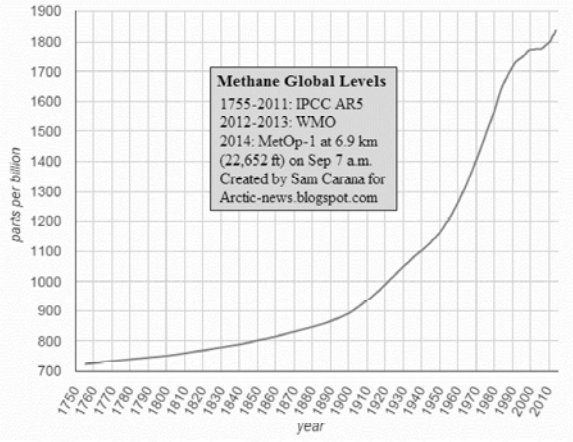


Fig. 7: Global $CH_4$ emission trends-2014 [7].

**$CO_2$ Emission by Sources and Sectors:** Methane is emitted predominantly from agriculture, fuel production and waste generation. Approximately 50% of the Global $CH_4$ emission is covered by major five sources such as agriculture, coal mining, landfill, oil and natural gas system and wastewater. In agriculture rice cultivation (10%) in water logging condition and livestock enteric fermentation (29%) play a key role in Global $CH_4$ emission. Coal mining level remains constant over the year. In waste generation anaerobic landfill condition and wastewater emit 20% of total Global $CH_4$ emission [6].

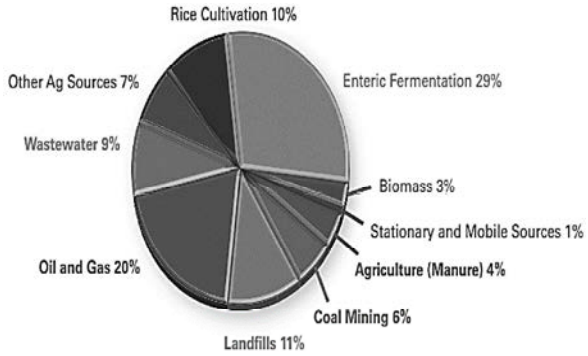


Fig. 8: Global $CH_4$ emission sectors -2015 [2].

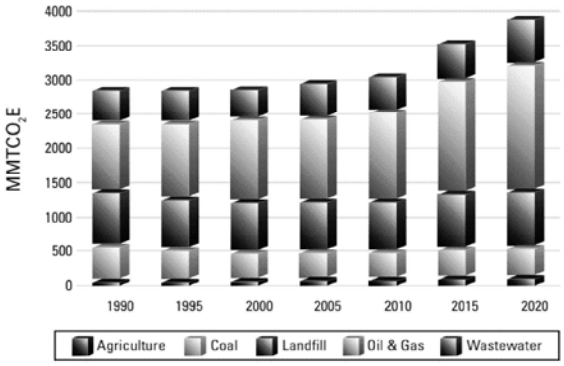


Fig. 9: Global $CH_4$ emission sectors -1990-2020 [2]

**Nitrous Oxide Emission**

**Global $N_2O$ Emission Trends:** Global nitrous oxide ($N_2O$) emissions show an increase in trends over year. Industrialized countries show a small increase of emission in the period 1970-1980 followed by a decline of $N_2O$ emissions to below 1970 levels in the recent years [8]. Developing countries show a continuous increase over the years [8].

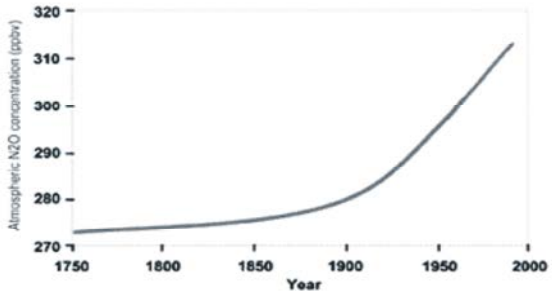


Fig. 10: Global $N_2O$ emission trends: 1750- 2000 [8].

**$N_2O$ Emission by Sources and Sectors:** Nitrous oxide emissions are mainly by agriculture activities, industrial processes and large scale biomass burning. Nitrification and denitrification process add $N_2O$ naturally to the atmosphere. Aaout 75% of the $N_2O$ emission comes from agriculture sources due to the usage of synthetic and organic nitrogen fertilizers, livestock manure and nitrogen fixing crops etc. Agricultural $N_2O$ emission shows an increasing trend due to strong usage of fertilizers. But industrial processes show a downward emission of $N_2O$ due to development in Industrial growth. Biofuel production and municipal waste emit significant amount of $N_2O$ globally, which saws an increasing trend.

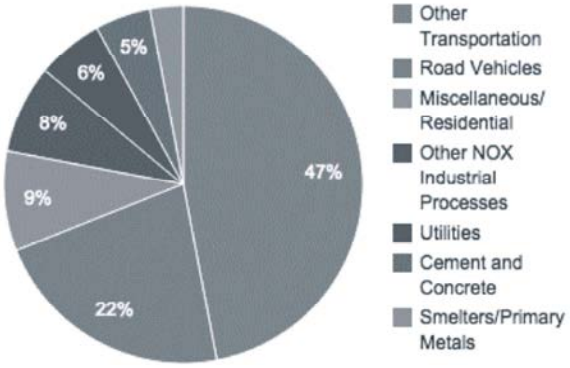


Fig. 11: Global $N_2O$ emission sectors -2015 [9].

**Greenhouse Gas Mitigation Scenarios:** UNFCC was established to negotiate net greenhouse gas emission reduction. Kyoto Protocol, in 1992, the UNFCCC was established with the ultimate objective to achieve stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system.

According to the Kyoto Protocol, Agriculture acts as a emitter and sink for greenhouse gases. Agriculture main emission sources from enteric fermentation, manure management, rice cultivation, soil management, field burning and deforestation. Agriculturally related sinks are aforestation and reforestation.

Carbon sequestration is the long term storage of $CO_2$ and other forms of carbon for the mitigation of global warming. $CO_2$ is normally captured from atmosphere through biological, physical and chemical processes. The change of land use pattern from agriculture to tree plantation, conversion of land to native vegetation, residue management, minimum disruptive tillage systems, increased use of perennials and winter cover crops, altered forest harvest practices, land use conversion to forest or pasture, restoration of soils are the soil carbon sequestration methods. These practices can increase the carbon retention [10].

Fossil fuel is the main source in the carbon emission. As a substitute biomass such as agricultural products can be used as feedstock for power plants. That will reduce the net $CO_2$ concentration into atmosphere. Because $CO_2$ use for biomass growth by photosynthesis, that remove about 95% of $CO_2$ emitted, when burning the biomass causing a recycling of the emission. Use liquid fuel such as ethanol as a substitute for the petroleum, by conversion of maize and other cellulose products into ethanol [10]. This may recycle the greenhouse gas emission from fuel use. Concrete block and steel production industries uses the fossil fuel as the energy source, so by increase the use of wood in construction also reduces the net emission [10].

Reduced nitrogen fertilizer application, use of nitrification inhibitors, improved nitrogen nutrient management, reduced nitrogen content of animal feed are strategies for nitrous oxide emission reduction. Draining of water during rice cultivation and allowing the soil to become aerobic condition will lows oxidation of $CH_4$ and reduces the $CH_4$ emission [10].

## CONCLUSION

A review of Global greenhouse emission profile, highlight the major greenhouse gas emission trend which is increasing over year but recent years show a reduction trends by implementation of mitigation protocols. This presentation will be useful for academics, researchers regarding global greenhouse emission and will be useful for future researches. Since it provide baseline information on a summary to formulate hypothesis for future researches.

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