Overview of Greenhouse Gases and Emissions Sources

The principal GHG s of concern are carbon dioxide (CO_2), methane (CH_4), Nitrous Oxide (N_2O), hydrofluorocarbons (HFCs), Perfluorocarbons (PFCs) and Sulfur hexafluoride (SF6). Global emissions of these six GHGs have grown since pre-industrial times and have increased by 70% between 1970 and 2004. In 2000, U.S. GHG emissions accounted for approximately 21% of the global total.[i] There are other GHGs and aerosols that have climatic warming effects: water vapor, chlorofluorocarbons (CFCs), hydrochlorofluorocarbons (HCFCs), halons, stratospheric and tropospheric ozone (O_3), and black carbon.[ii]

Pursuant to the United Nations Framework Convention on Climate Change (UNFCCC) that the United States ratified in 1992, EPA prepares an annual complete inventory of GHG emissions from human activities as well as natural processes that absorb or remove GHGs from the atmosphere (e.g., CO_2 uptake by plants through photosynthesis).

The primary GHG emitted as a result of human activities in the United States is CO_2, representing approximately 85% of total GHG emissions. CO_2 results primarily from fossil fuel combustion to generate electricity, power vehicles and factories, heat buildings, etc. Methane emissions comprise approximately 8% of total U.S. GHG emissions. However, methane has 20 times the trapping heat ability than CO_2.. The largest sources of methane emissions are enteric fermentation (22.7%), landfills (22.6%), natural gas systems (18.4%), coal mining (10.5%), and manure management (7.5%). Smaller sources such as rice cultivation and incomplete fossil fuel combustion account for the remainder.

Nitrous Oxide emissions are just over 5% of total U.S. GHG emissions. However, N_2O is approximately 300 times more powerful than CO_2, The main anthropogenic activities producing N_2O in the United States are agricultural soil management (72%), and fuel combustion in motor vehicles (9%). A variety of chemical production processes and liquid waste management sources also emit N_2O.

The three other GHGs (HFCs, PFCs, and SF_6) are often grouped together because they contain fluorine. This combined emissions from , these GHGs made up 2.1% of total U.S. GHG emissions in 2006. However, Intergovernmental Panel on Climate Change has found that SF6 is the most potent greenhouse gas that it has evaluated, with a global warming potential of 22,200 times that of CO_2. HFCs and some PFCs are increasingly being used as substitutes for the ozone depleting substances controlled under the Montreal Protocol and Title VI of the CAA. The largest source is the use of HFCs in air conditioning and refrigeration systems. Other sources include HFC-23 mitted during the production of HCFC-22, electrical transmission and distribution systems (SF_6), and PFC emissions from semiconductor manufacturing and primary aluminum production.

Another way to examine GHG emissions is by economic sector. The electricity generation sector which accounts for 33.7% of all U.S. emissions in 2006 includes all facilities that generate electricity primarily for sale rather than for use on site (e.g., most large-scale 100 power plants). The type of fuel combusted by electricity generators has a significant effect on their missions. For example, some electricity is generated with low or no CO_2 emitting energy technologies, particularly non-fossil options such as nuclear, hydroelectric, or geothermal energy. However, over half of the electricity in the U.S. is generated by burning coal, accounting for 94% of all coal consumed for energy in the U.S. in 2006.

Transportation activities accounted for approximately 28% of all GHG emissions in 2006, primarily through the combustion of fossil fuels. Over 60% of the CO_2 emissions resulted from gasoline consumption for personal vehicle use.

The industrial sector contributes 19.4% of total U.S. GHG emissions. The largest share of emissions from industrial facilities comes from the combustion of fossil fuels. The largest emitting industries tend to be the most energy intensive: iron and steel, refining, cement, lime, chemical manufacturing, etc.

Agricultural emission sources resulting from a variety of processes, including: enteric fermentation in domestic livestock, livestock manure management, rice cultivation, agricultural soil management, and field burning of agricultural residues. were responsible for 6.4% of total U.S. GHG emissions GHG emissions Methane and N_2O are the primary GHGs emitted by agricultural
activities.

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[i] The data provided here come from "Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC)

[ii] The production and consumption of these substances are being controlled and phased out under the Montreal Protocol on Substances that Deplete the Ozone Layer, and under Title VI of the CAA because they deplete stratospheric O3, which protects against harmful ultraviolet B (UVB) radiation. Therefore, the climate change research and policy community typically does not focus on these substances .

Black carbon causes a warming effect by absorbing incoming sunlight in the atmosphere (whereas GHGs cause warming by trapping outgoing, infrared heat), and by darkening bright surfaces such as snow and ice, which reduces reflectivity and increases absorption of sunlight at the surface. Some recent research published after the IPCC Fourth Assessment Report, has suggested that black carbon may play a larger role in warming that previously thought. Like other aerosols, black carbon can also alter the reflectivity
and lifetime of clouds, which in turn can have an additional climate effect. How black carbon and other aerosols alter cloud properties is a key source of uncertainty in climate change science. Given these reasons, there is considerably more uncertainty associated with black carbon's warming effect compared to the estimated warming effect of the six long-lived GHGs. Black carbon is also co-emitted with organic carbon, which tends to have a cooling effect on climate because it reflects and scatters incoming sunlight. The ratio of black carbon to organic carbon varies by fuel type and by combustion efficiency. Black carbon is a subcomponent of particulate matter (PM), which is regulated as a NAAQS pollutant under the CAA Diesel vehicles are estimated to be the largest source of black carbon in the U.S., but these emissions are expected to decline substantially over the coming decades due to recently promulgated EPA regulations
targeting PM2.5 emissions from on-road and off-road diesel vehicles (the Highway Diesel Rule and the Clean Air Nonroad Diesel Rule, the Locomotive and Marine Compression Ignition Rule).