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# Greenhouse Gas Emissions

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Portage Northern High School

Portage, MI

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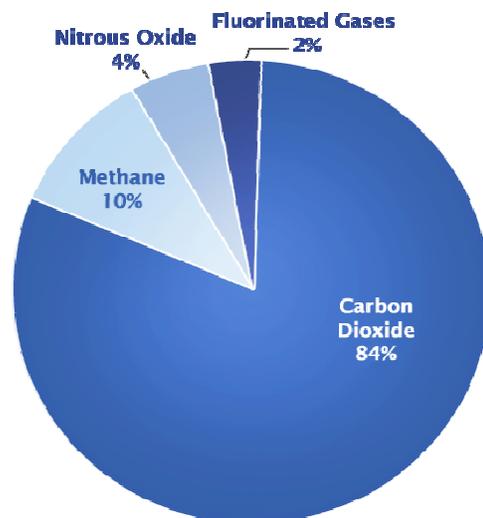
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## Greenhouse Gas Emissions

Sunlight enters the Earth's atmosphere freely, but when it reaches the surface, some of the sunlight is reflected back into space in the form of infrared radiation. Greenhouse gases absorb the infrared radiation, and trap it in the atmosphere as heat. The amount of energy coming from the sun and the amount being reflected from the Earth's surface, over time, should balance out, keeping the temperature of the Earth's surface constant<sup>6</sup>. However, natural and human causes lead to fluctuation in the Earth's temperature. Over the past 150 years, greenhouse gases have increased by 25% due to industrialization<sup>6</sup>. The major greenhouse gases (GHG) are carbon dioxide, methane, nitrous oxide, and fluorinated gases. Figure 1 (below) shows the percentages of the four major greenhouse gas emissions in the U.S. in 2010. These greenhouse gases stay in the atmosphere for varying amounts of time, fluctuating between a few years to thousands of years. In the period that the gases are in the atmosphere they mix well, so the amount of GHG is about the same all around the globe regardless of the source. Greenhouse gases contribute to making the planet warmer, but their effects vary<sup>3</sup>.

Figure 1 U.S. Greenhouse Gas Emissions in 2010<sup>3</sup>



Carbon dioxide is the primary greenhouse gas that is emitted through human activities. In 2010, 84% of greenhouse gas emissions in the United States alone are from carbon dioxide, due to human activities. Carbon dioxide is constantly being exchanged between the atmosphere, ocean, and land, where it is produced and absorbed by plants and animals. The production and absorption of carbon dioxide by natural causes tends to balance out. But, since the Industrial Revolution, more and more human activities have been disturbing the carbon cycle, causing many climate changes. Human activities alter the carbon cycle by adding more carbon dioxide into the atmosphere and by affecting the ability of natural processes to remove it from the atmosphere. Carbon dioxide can stay in the atmosphere from 50 to 200 years. Combustion of fossil fuels, such as coal, natural gas, and oil, is the major human activity that emits carbon dioxide into the atmosphere. Fossil fuels are combusted for energy (electricity) and transportation. Combusting fossil fuels to generate electricity is the largest source of carbon dioxide emissions in the U.S. Burning fossil fuels for transportation, such as gasoline or diesel, is the second largest source of carbon dioxide emissions. Most industrial processes also emit carbon dioxide through fossil fuel combustion or chemical reactions. Reducing fossil fuel consumption would make a big difference in how much carbon dioxide is emitted into the atmosphere'.

Methane is the second most emitted greenhouse gas from human activities in the United States. Methane lives in the atmosphere for a shorter time period than carbon dioxide, about 12 years, but it traps more radiation. Because of this, methane has a 20 times greater impact on climate change than carbon dioxide. Human activities contribute to 60% of methane emissions, through industry, agriculture, and waste management activities. Natural gas and petroleum industries emit methane. Methane is the basic component of natural gas and petroleum.

Production, refinement, and transportation of natural gas and petroleum makeup 37% of overall methane emissions. Livestock in agricultural fields produce large quantities of methane through their digestive processes. Methane is also released when animal manure is stored. Though this seems like a natural source, it is considered human-related because humans raise the animals for food. Waste management activities, such as landfills, produce methane as waste decomposes and through the process of wastewater treatment. Methane is also emitted by natural sources, such as wetlands, termites, sediments, oceans, volcanoes, and wildfires. Methane emissions can be reduced by upgrading the technology used to produce, store, and transport natural gas and petroleum. It can also be reduced by changing how we manage manure in agricultural areas<sup>4</sup>.

Nitrous oxide is the cause of 40% of greenhouse gas emissions as a result of human activities. Nitrous oxide stays in the atmosphere for about 120 years, but it has a 300 times more impact on warming the atmosphere than carbon dioxide. Though nitrous oxide naturally exists in the atmosphere because of the nitrogen cycle, human activities, such as agriculture, transportation, and industrial activities, increase the amount. In the U.S., the largest source of nitrous oxide emissions is through agricultural soil management, like using fertilizers. Natural nitrous oxide emissions occur in the nitrogen cycle, a natural exchange of nitrogen between the atmosphere, plants, animals, and microorganisms. Nitrous oxide is mainly emitted when bacteria break down nitrogen in soil and the oceans. Nitrous oxide emissions can be decreased by using fertilizers more efficiently, by reducing fuel consumption in motor vehicles, and by upgrading technologies and using different fuels in industries<sup>5</sup>.

In 2010, fluorinated gases made up 2% of greenhouse gas emissions. Though this number is low these gases have a large effect on global temperatures. Fluorinated gases have no natural sources, and are only generated by human activities. Fluorinated gases stay in the atmosphere for

long periods of time, sometimes thousands of years. The only way fluorinated gases can be removed from the atmosphere is by being destroyed by sunlight. The largest source of fluorinated gases is from substitutes for ozone-depleting substances. Refrigerants, such as air conditioning in buildings and cars, are the major emission source in this category. Refrigerants and other such hydrofluorocarbons (HFCs) were developed to replace chlorofluorocarbons (CFCs) because HFCs do not weaken the ozone layer. CFCs are banned to be used in products under the Montreal Protocol, so HFCs are used instead. However, hydrofluorocarbons stay in the atmosphere for long periods of time and have a great effect on global temperature.

Perfluorocarbons (PFCs), another category of fluorocarbons, are a by-product of many industrial processes, such as aluminum production. PFCs also stay in the atmosphere for long periods of time and have a large effect on global temperature. Sulfur hexafluoride is the third category of fluorocarbons that is used in electrical transmission equipment, such as circuit breakers. Sulfur hexafluoride has a 23,900 times more effect on warming the earth than carbon dioxide does, making it “the most potent greenhouse gas that the Intergovernmental Panel on Climate Change has evaluated. Fluorinated gas emissions can be reduced by using lower global warming potentials as substitutes. We can also reduce emissions by creating process that recycle and destroy fluorinated gas<sup>2</sup>.

Greenhouse gases are necessary for the survival of the life on the Earth because without them, heat wouldn't be trapped in the atmosphere, so the Earth would freeze. However, in the last few decades, greenhouse gas emissions have increased greatly, mainly because of the Industrial Revolution. Carbon dioxide emissions have increased by 12% since 1990, although levels decreased slightly during the economic recession in 2009. By 2020, carbon dioxide emissions are estimated to increase by about 1.5%<sup>1</sup>. Methane, however, has decreased by less

than 1% since 1990. It is estimated to be an 8% increase in methane emissions by 2020 due to an increase in the use of natural gas. Nitrous oxide has also decreased, by about 3%, since 1990. This decrease is occurring because of advances in vehicle emissions and installation of pollution controls. In the future, however, nitrous oxide emissions are predicted to increase by about 5%, mostly from agricultural activities<sup>5</sup>. Fluorinated gases have increased the most out of the four other greenhouse gases. These gases have increased by 58% since 1990. This drastic increase is mostly because of the 233% increase in hydrofluorocarbon emissions, which have been in great usage since 1990 as a replacement for ozone-depleting substances. By 2020, hydrofluorocarbons are estimated to grow by about 140% for the same reason as it has been increasing for the past decade<sup>2</sup>. These estimated increases show that we are not making a large enough effort to try and prevent these greenhouse gases from increasing. The reason for this might be that people may not know what greenhouse gases are and what they do to our planet. In order to see what people know about greenhouse gases, I took a survey of 30 high school students that go to Portage Northern High School. Out of the 30 people, 23 are aware of greenhouse gases. The majority of the students think that greenhouse gases are bad for the environment and believe that the levels of these gases have increased since 2000. Most of the students also say that greenhouse gases are causing global warming. More than half the students care about greenhouse gases, but do not plan on taking the initiative to do something about the problem. The survey also shows that the students surveyed learned about greenhouse gases from various sources, such as school, media, and parents. However, there are a few students who have never heard of greenhouse gases. This survey shows that even though people are aware of greenhouse gases and know that they are a cause for global warming, no one is taking action to prevent excess amounts of these gases from being emitted into the atmosphere. There are many easy and effective ways in reducing

greenhouse gas emissions, such as using less energy by turning lights off when not in use, by using more efficient cars like hybrids, or by recycling to keep landfills from filling. There are many ways in reducing GHG emissions and save the planet for future generations. It could start with you.