

Which of the following gases has the longest atmospheric lifetime?

- A. CH<sub>2</sub>F<sub>2</sub>    B. CFCl<sub>3</sub>    C. CH<sub>4</sub>    D. N<sub>2</sub>O

Answer quoted from <http://whatsyourimpact.org/greenhouse-gases> (accessed October 13, 2016)

Greenhouse gases are a group of compounds that are able to trap heat (longwave radiation) in the atmosphere, keeping the Earth's surface warmer than it would be if they were not present.<sup>1</sup> These gases are the fundamental cause of the greenhouse effect.<sup>2</sup> Increases in the amount of greenhouse gases in the atmosphere enhances the greenhouse effect which is creating global warming and consequently climate change.

Greenhouse gases take many years to leave the atmosphere. CO<sub>2</sub>, CH<sub>4</sub>, N<sub>2</sub>O and the fluorinated gases are all well-mixed gases in the atmosphere<sup>3</sup> and they do not react to changes in either temperature or air pressure and thus do not get removed easily like water that condenses to become rain or snow. Their long atmospheric lifetimes allows them to have a lasting effect on global warming and climate change.

Nitrous oxide emissions gets produced by both natural and human sources. Important natural sources include soils under natural vegetation and the oceans. Natural sources create 62% of total emissions. Human-related sources are responsible for 38% of total emissions. Important human sources come from agriculture, fossil fuel combustion and industrial processes.

Since the Industrial Revolution, human sources of nitrous oxide emissions have been growing. Activities such as agriculture, fossil fuel combustion and industrial processes are the primary cause of the increased nitrous oxide concentrations in the atmosphere. Together these sources are responsible for 77% of all human nitrous oxide emissions. Other sources include biomass burning (10%), atmospheric deposition (9%) and human sewage (3%).<sup>4</sup>

Industrial processes also causes nitrous oxide emissions. The two main industrial sources are the production of nitric and adipic acid. Nitric acid is an important ingredient for synthetic fertilizers, while adipic acid is primarily used for making synthetic fibers.<sup>5</sup> For both of these acids, oxidization of nitrogen compounds during the production process creates nitrous oxide.

Chemical reactions in the atmosphere produce a significant amount of nitrous oxide emissions. The atmosphere acts as a source for nitrous oxide through the oxidation of ammonia which creates 5% of emissions.<sup>4</sup>

Ammonia is a natural occurring gas in the atmosphere. The oceans, manure from wild animals as well as aging and rotting plants form the most important natural sources of ammonia in the air. The oxidization of ammonia from natural sources creates 600,000 tonnes of nitrous oxide per year.<sup>4</sup>

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