NF_3

NITROGEN TRIFLUORIDE

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WHAT IS THIS GAS?

Origins	NF_3 is another example of an anthropogenic gas. It is a newly discovered resource in the electronics industry used for computer chips, LCD flat-screens, and solar photovoltaics. NF_3 was introduced as a potential replacement for SF6, CFCs, and HCFCs, but has since shown negative effects on climate change.
What is the current PPM of this gas? And the atmospheric trend since 1700 and since 1960?	The current (2020) atmospheric content of NF_3 is approximately 1.7×10^{-6} PPM. NF_3 measurements began in the mid-late 90s, so there is no measurement for the year 1986. Preindustrial levels of NF_3 are assumably no greater than 0.008 PPT (8e-9 PPM), which is virtually zero.
Why is this gas important to climate change? How long does it remain in the atmosphere?	NF_3 is a new concern regarding climate change. It has a long atmospheric lifetime ranging 500+ years. NF_3 has a GWP of 16,000-17,000 over a span of 100 years in terms of heat trapping abilities (Infrared heat gets trapped as it is absorbed, thus contributing to global warming). NF_3 is also a harmful substance to human health. Prolonged exposure can result in liver and kidney damage as well as headaches. Because NF_3 is used and produced in the electronics industry, it is a growing concern for individuals working closely to it.
What is an appropriate PPM goal to meet 1.5 degree threshold?	NF_3 is a relatively recent concern compared to other greenhouse gases such as carbon dioxide and methane. The dangers of NF_3 have been acknowledged, but there is no (PPM) number associated with meeting or working towards the 1.5-degree threshold.

REDUCTION POTENTIAL

Can emissions be reduced?	The reduction of NF_3 emissions is not widely practiced. NF_3 has been acknowledged as a harmful contributor to climate change. It is not included in the Kyoto Protocol, which has been revised many times and pushes for globally reduced GHG emissions. NF_3 is recognized as a greenhouse gas yet demand for it is increasing. In 2022, the market for NF_3 in the United States alone is estimated to be worth $1700 M. By 2029, if there are no implemented regulations, it could be worth up to $3400 B.
Can emissions be captured at source?	NF_3 was only recently acknowledged as a greenhouse gas. Its use was actually encouraged during the 1990s to reduce the use of other greenhouse gases. There is very little information pertaining to any reduction efforts or capture technologies. NF_3 accounts for a small amount of the breakdown of greenhouse gases, however, its potency is what causes the recent concern.
Can this gas be removed from the atmosphere or ocean?	Because NF_3 has only been recently considered a contributor to climate change, removal from the atmosphere and the oceans is widely unknown. There seems to be hypothesized methods and potential technologies / strategies, however nothing is certain.

TECHNOLOGY REMAINS IN DEVELOPMENTAL STAGES

What are current and potential removal technologies?	There are no current technologies being used to remove NF_3. Any and all technologies described are in the experimental stages, therefore, not used on a large scale if used at all. One of these experimental technologies explains using kinetic energy alongside the exposure to ozone over a long period of time to potentially remove NF_3. Another result from experimental data explained the process of UV photolysis (the decomposition of molecules in light). These removal findings are experimental. While potential removal strategies have been discovered, there is not large-scale technology to continuously expose NF_3 to ozone or allow NF_3 to decompose within the stratosphere.
Which of these technologies are potentially scalable?	NF_3 removal has been studied on a molecular level. Research for the science behind different removal strategies on a molecular level is recently emerging, so there is no technology that has yet to implement these findings. With that being said, removal technologies are essentially non-existent, so there is no scalable technology aside from experiments and studies looking into the science of removal.

FOR EACH TECHNOLOGY:

What are the uses of the removed gas?	It has only recently been discovered that the most important portion of removal (NF_3) has to do with decomposition when it is exposed to UV light. Because there are no existing removal technologies, there is no known use for removed NF_3. The science of removal is still being investigated.
If the use is sequestration, what is the sequestration time frame?	Because removal research is preliminary, the uses for removed NF_3 is not understood as the potential removal sciences are still being studied.
What is the net energy requirement to process removal?	The net energy requirement has not been determined. The science of removing NF_3 from certain layers of the atmosphere is still being investigated, but research is beginning to emerge. NF_3 only became a widely used gas in the 1990s to lessen other greenhouse gas emissions. It has been acknowledged as a contributor to climate change, however, it is not recognized in the Kyoto Protocol. Its recent use and barely emerging studies make it difficult to quantify net energy requirements. This quantity is likely in the process of configuration along with potential removal sciences.

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