

HFOs and TFA

KNOW THE FACTS

Trifluoroacetic acid, or TFA, is a naturally occurring organic acid with a similar structure to acetic acid (e.g., vinegar).

95%
NATURALLY
OCCURRING



From volcanic activity, emitted by deep-sea vents
>200 million tons found in the world's oceans^{1,2,3}

5% MANMADE

Manufacturing: Used as an intermediate in many chemical processes, including pharmaceutical production⁴

Agriculture: From breakdown of specific fertilizers and herbicides⁵

Sewage treatment: Formed during the breakdown and ozonation of some effluents⁶

Refrigerants: From atmospheric decomposition of certain refrigerants, including HFC-134a and HFO-1234yf⁷

Proper handling of refrigerants, e.g., responsible recovery, recycling, and reclamation, as well as routine system inspection, reduces the likelihood and potential magnitude of leakage and emissions.

Does manmade TFA harm the environment or human health?

Numerous independent studies conducted over the past two decades have concluded that TFA from manmade sources **DOES NOT** pose a risk to the environment or human health.^{8,9,10}



Mammals, including humans, are **UNAFFECTED** by TFA at levels many hundreds to thousands of times higher than are expected to occur in the environment.¹¹



Will future HFO refrigerant use significantly increase the amount of TFA in the environment?

If all the AC units in all the world's cars were equipped with **HFO-1234YF**, it would only increase the amount of TFA in the world's oceans by **0.04%**¹²



"There is still **NO** indication that exposure to current and projected concentrations of salts of TFA in surface waters present a risk to the health of humans and the environment."

- 2018 Assessment Report, United Nations Environment Programme

The Environmental Benefits of HFO-1234yf



HFO-1234YF REFRIGERANT is a high-performing, non-ozone depleting alternative to legacy refrigerants, with a

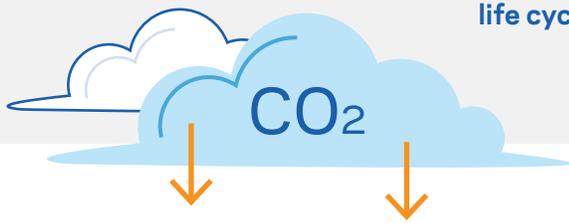
99% REDUCTION in global warming potential (GWP).



When HFO-1234yf is combined with other components, the resulting lower-GWP blends are suitable for a range of cooling and refrigeration applications, and enable excellent system energy performance—**maximizing the benefit to the environment while minimizing life cycle cost.**

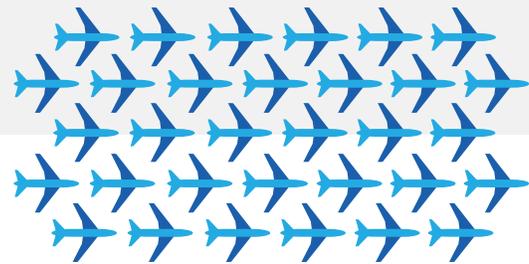


Opteon™ XL refrigerants for commercial applications, which include HFO-1234yf, deliver a **significantly lower climate-change impact** than other alternative technologies, including CO₂ and hydrocarbons.¹³



By 2025, the global use of Opteon™ refrigerants is expected to have eliminated an estimated

325 MILLION TONS OF CO₂ EQUIVALENT



That's equal to the greenhouse gas emissions produced by

193 MILLION transatlantic flights¹⁴

Our Commitment

Chemours stands behind the safety and sustainability of our products, and we have confidence in the long-term viability of our Opteon™ HFO refrigerants product portfolio. Reducing greenhouse gas (GHG) emissions is a key component of our Corporate Responsibility Commitment. We've set a goal of becoming carbon positive by 2050, in part by offsetting our direct and indirect GHG emissions with the emissions avoided by using our products, including Opteon™ refrigerants.

For more information, visit opteon.com.



¹ Scott B.F., et al., "Haloacetic Acids in the Freshwater and Marine Environment," First International Symposium on Atmospheric Reactive Substances, 14-16 April 1999, Bayreuth, Germany.

² Von Sydow L., et al., "Natural background levels of trifluoroacetate in rain and snow," Environmental Science & Technology, 34, 3115-3118, 2000.

³ Frank H., et al., "Trifluoroacetate in Ocean Waters," Environmental Science & Technology, 36, 12-15, 2002.

^{4,5,6} Bavarian State Office for the Environment, "F-Gases and Water Protection: Trifluoroacetic Acid (TFA)," presentation from conference, "The Way to Natural Refrigerant Technologies," WWA Nuremberg, 2019.

⁷ "EFCTC Special Review: Understanding TFA," European Fluorocarbons Technical Committee, 2016.

⁸ Boutonnet J.C., et al., "Environmental Risk Assessment of Trifluoroacetic Acid," Human and Ecological Risk Assessment, 5(1), 59-124, 1999.

⁹ Solomon K.R., et al., "Sources, fates, toxicity, and risks of trifluoroacetic acid and its salts: Relevance to substances regulated under the Montreal and Kyoto Protocols," Journal of Toxicology and Environmental Health, 19, 289-304, 2016.

¹⁰ Bais AF, et al., "Environmental effects of ozone depletion, UV radiation and interactions with climate change: UNEP Environmental Effects Assessment Panel, update 2017," Photochemical and Photobiological Sciences, 2018 Feb 14; 17(2): 127-179.

¹¹ "EFCTC Special Review: Understanding TFA," European Fluorocarbons Technical Committee, 2016.

¹² Henne S., Shallcross D.E., Reimann S., Xiao P., Brunner D., O'Doherty S., Buchmann B., "Future Emissions and Atmospheric Fate of HFC-1234yf from Mobile Air Conditioners in Europe," Environmental Science & Technology 46 (3):1650-8 (2012).

¹³ "The Path to Reducing Climate Change Emissions from Commercial Refrigeration Application," Chemours white paper, featuring results of a third-party study conducted by WAVE Refrigeration.

¹⁴ CO₂ Calculator, German Environment Agency (Umweltbundesamt), www.umweltbundesamt.de (Figure based on one-way flight between London Heathrow and New York JFK.)

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