



Choosing a Future-Proof Refrigerant for Your Ice Arena

How do ice rink refrigerants impact the environment?

How will they be regulated in the future?

Which refrigerant is the best investment for your rink?

Ice rink owners have used R22 and HFC refrigerants to make ice, but these are environmentally damaging gases that are being phased out or down in countries around the world.

That leaves rink owners with two options: another fluorinated gas like R513A (an HFO blend) – or a natural refrigerant like ammonia (NH₃/R717) or carbon dioxide (CO₂/R744) that does no harm to the environment and is future-proof.

Do You Know What is Really in R513A?

It turns out that R513A consists of 44% R134a, one of the powerful climate-warming HFCs that are being phased down globally.¹ The remaining 56% is HFO-1234yf, which changes in the atmosphere into an acid (TFA) that is potentially harmful to human health and the environment.

An EIA exposé found that if all of North America's community ice rinks install R513A instead of ammonia, it would lead to additional CO₂e emissions over the lifetime of those systems that are equivalent to emissions of 15 coal-fired power plants or 13 million cars.²



The Real Numbers Behind Your Refrigerant Options:

	Ammonia (R717)	CO ₂ (R744)	F-Gas (R513A)
Composition	100% ammonia	100% CO ₂	44% HFC-134a 56% HFO-1234yf
100-Year Global Warming Potential (GWP) ³	0	1	600
20-year GWP ³	0	1	1,700
Emissions Related to Production (CO ₂ e lbs/lbs produced) ⁴	2.1	0.8	3.6 (R134a) 10.9 (R1234yf)
Undergoing Phase Down	No	No	Yes (for R134a)
Negative Ecological Impact	No	No	Yes

Why Should You Be Concerned About TFA?

In the atmosphere, HFO-1234yf rapidly breaks down into trifluoroacetic acid (TFA) in only 10-12 days.⁵ TFA is brought to Earth in rainfall. More and more credible studies are surfacing showing the increased levels of TFA in fresh water supplies around the world.

R1234yf and TFA are not being regulated ... yet. However, TFA belongs to the category of highly durable "forever chemicals" known as PFAS (per- and polyfluoroalkyl substances).⁶ You might have noticed the increasing media coverage on PFAS and how they are bad for the human health and the environment, with multiple governments considering restrictions.

TFA has already been found to be unhealthy for freshwater green alga⁷, and high levels of TFA have been found to harm the livers of rats.⁵

TFA is extremely difficult to remove from drinking water, and experts are sounding the alarm about its potential health and environmental effects if it is used in large volumes.⁸

Rising Threat: TFA Warnings Around the World



TFA levels in the Arctic ice are 10 times higher than before 1987.⁹



TFA in rainwater in Germany has increased by three-to-five times in the last 25 years.¹⁰



TFA deposition is projected to be 10,000 metric tons per year by 2040 over European land, rising from about 2,000 metric tons in 2020.¹⁰



The concentration of TFA in urban landscape waters in Beijing, China, increased 17-fold between 2002 and 2012.¹¹



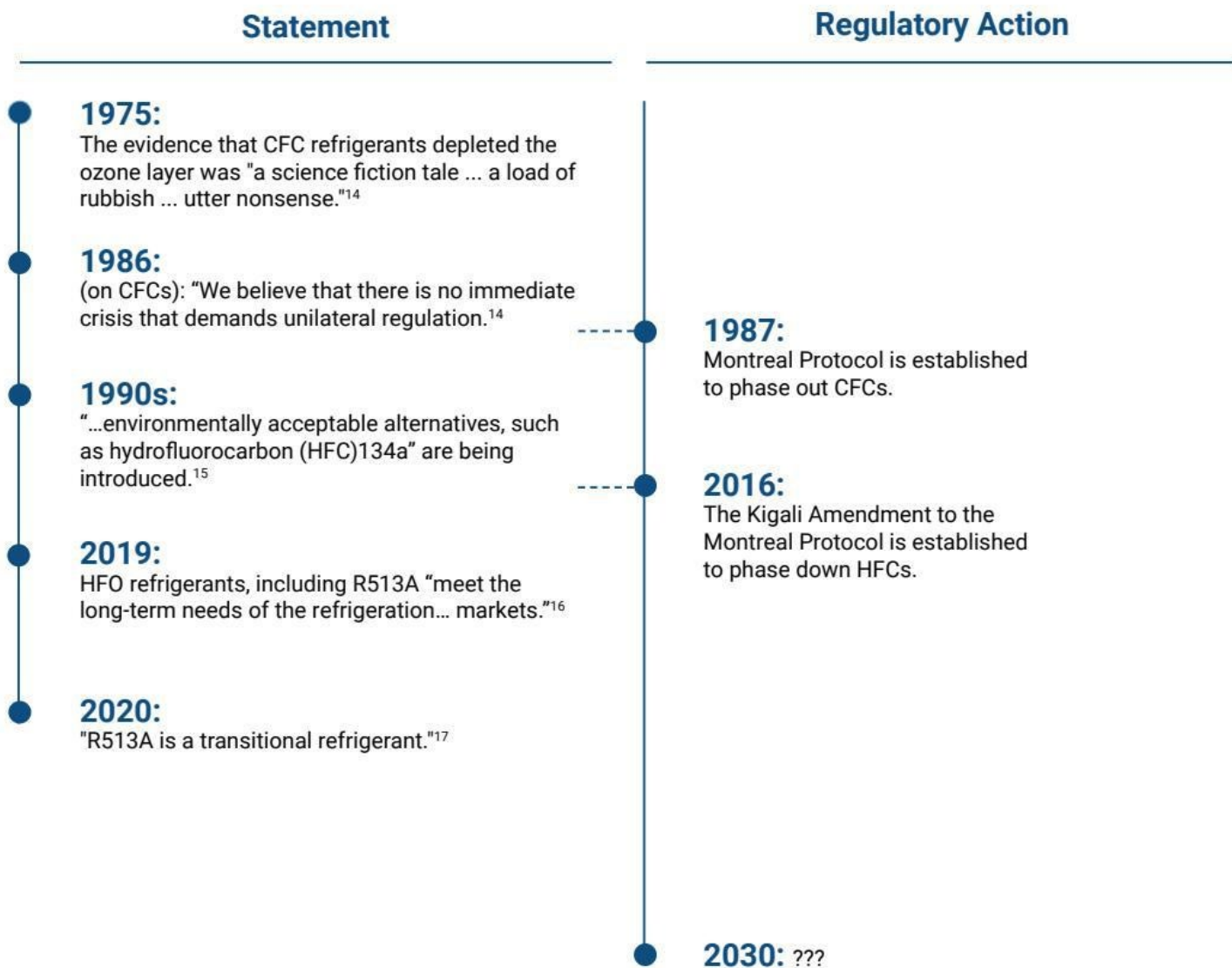
High levels of TFA were found in the blood plasma of Chinese adults.¹²



TFA has been found in beer samples from 23 countries.¹³

Should the Chemical Companies Be Believed?

A Timeline of Chemical Industry F-Gas Comments



CFC -> HCFC -> HFC -> HFO

References

- ¹ (n.a.). (n.d.). 'Product Information: Refrigerant Gases – Lower GWP Alternatives'. NationalRef.com. Available online at: <https://bit.ly/3GGaXR3>
- ² (n.a.). (2021). 'On Thin Ice: How the NHL is Cheating the Climate'. Environmental Investigation Agency, November 17. Available online at: <https://bit.ly/3nBiUz9>
- ³ (n.a.). (2021). 'Real GWP: 20 years vs 100 years: Impact of Refrigerants Fact Sheet #1 (V.1.1.)'. ATMOsphere. Available online at: <https://bit.ly/3HJOYJe>
- ⁴ Kauffeld, M. (2021). 'Impact of refrigerants on our health, safety, and the greater environment' [PowerPoint Presentation]. ATMO Europe Summit 2021. Available online at: <https://bit.ly/3jJNV1L>
- ⁵ Frank, T. (2021). 'Health Impacts of fluorinated refrigerants' [PowerPoint presentation]. ATMO Europe Summit 2021. Available online at: <https://bit.ly/3jJNV1L>
- ⁶ Garry, M. (2021). 'Certain HFCs and HFOs Are in PFAS Group that Five EU Countries Intend to Restrict'. R744.com, July 23. Available online at: <https://bit.ly/3BmY4am>
- ⁷ Fleet, D et al. (2017). 'Study on environmental and health effects of HFO refrigerants'. Norwegian Environmental Agency, December 22. Available online at: <https://bit.ly/3pM8K05>
- ⁸ Garry, M. (2021). 'Experts Sound the Alarm about Rising TFA Levels'. R744.com, October 20. Available online at: <https://bit.ly/3vPXIOh>
- ⁹ Garry, M. (2020). 'Canadian Researchers Find Elevated Levels of HFO-1234yf Byproduct in Arctic Ice'. Hydrocarbons21.com, May 15. Available online at: <https://bit.ly/3CtsB86>
- ¹⁰ Behringer, D. (2021). 'Persistent degradation products of halogenated refrigerants and blowing agents in the environment' [PowerPoint Presentation]. ATMO Europe Summit 2021. Available online at: <https://bit.ly/3jJNV1L>
- ¹¹ Zhai, Z et al. (2015). 'A 17-fold increase of trifluoroacetic acid in landscape waters of Beijing, China during the last decade', Chemosphere, vol. 129, pp. 110-117. Available online at: <https://bit.ly/3pRrICu>
- ¹² Duan, Y et al. (2020). 'Distribution of novel and legacy per-/polyfluoroalkyl substances in serum and its associations with two glycemic biomarkers among Chinese adult men and women with normal blood glucose levels', Environment International, vol. 134, no. 105295. Available online at: <https://bit.ly/3BFRhbY>
- ¹³ Scheurer, M & Nödler, K. (2021). 'Ultrashort-chain perfluoroalkyl substance trifluoroacetate (TFA) in beer and tea – An unintended aqueous extraction', Food Chemistry, vol. 351, no 129304. Available online at: <https://bit.ly/3CDuqza>
- ¹⁴ (n.a.). (n.d.). 'DuPont: A Case Study in the 3D Corporate Strategy'. Greenpeace. Available online at: <https://bit.ly/3pNziOD>
- ¹⁵ (n.a.). (n.d.). 'DuPont HFC-134a Properties, Uses, Storage, and Handling'. DuPont Suva. Available online at: <https://bit.ly/3pFLvFb>
- ¹⁶ (n.a.). (2019). 'Opteon™ XL41 (R-454B) and Opteon™ XP10 (R-513A) Refrigerants selected by Mitsubishi Electric Hydronics and IT Cooling Systems SpA (MEHITS) Applications'. Chemours, May 27. Available online at: <https://bit.ly/3jJtT7j>
- ¹⁷ Allgood, C., (2020). Video: 'E16: Getting to Know Opteon™ XP10 (R-513A)', 5-minute mark, Chemours, September 22. Available online at: <https://bit.ly/3xgRRfR>

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