

## Major HFC, HFO and HCFOs; HCFC molecules used as feedstocks. Environmental properties and main applications

### Major HFC molecules

Designation	Complete Name	Formula	CAS number	GWP (1)			Atmospheric lifetime AR6 (4)	Main Applications
				F-Gas Regulation 2024/573 AR4 (2)	AR5 (3)	AR6 (4)		
HFC-23	trifluoromethane	CHF <sub>3</sub>	75-46-7	14800	12400	14600	228 years	<ul style="list-style-type: none"> <li>• Very low temperature specialty refrigerant and etchant for semi-conductor manufacturing</li> <li>• By product in production of HCFC-22 and aluminium smelting</li> <li>• Used as a feedstock</li> </ul>
HFC-32	difluoromethane	CH <sub>2</sub> F <sub>2</sub>	75-10-5	675	677	771	5.4 years	<ul style="list-style-type: none"> <li>• Refrigerant for <a href="#">air-conditioning</a></li> <li>• Component of refrigerants for air-conditioning, <a href="#">commercial refrigeration</a> and heat pumps</li> </ul>
HFC-125	pentafluoroethane	CHF <sub>2</sub> CF <sub>3</sub>	354-33-6	3500	3170	3740	30 years	<ul style="list-style-type: none"> <li>• Blend component for <a href="#">stationary air-conditioning</a>, <a href="#">commercial refrigeration</a> and heat pumps</li> </ul>
HFC-134a	1,1,1,2-tetrafluoroethane	CH <sub>2</sub> FCF <sub>3</sub>	811-97-2	1430	1300	1530	14 years	<ul style="list-style-type: none"> <li>• Refrigerant for <a href="#">mobile air-conditioning</a> applications (servicing only for cars) and transport refrigeration (reefers)</li> <li>• Blend component for <a href="#">stationary-air conditioning</a> and <a href="#">commercial refrigeration</a></li> </ul>

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								<ul style="list-style-type: none"> <li>• Propellant for pharmaceutical aerosols (<a href="#">MDIs</a>); and for technical aerosols, to meet national safety standards from 2018</li> <li>• <a href="#">Blowing agent</a> component for extruded polystyrene foams (XPS)</li> </ul>
HFC-143a	1,1,1-trifluoroethane	CH <sub>3</sub> CF <sub>3</sub>	420-46-2	4470	4800	5810	51 years	<ul style="list-style-type: none"> <li>• Historically, blend component for <a href="#">commercial refrigeration</a>, blends with GWP &gt;2500 restricted to servicing (recycled and reclaimed only)</li> </ul>
HFC-152a	1,1-difluoroethane	CH <sub>3</sub> CHF <sub>2</sub>	75-37-6	124	138	164	1.6 years	<ul style="list-style-type: none"> <li>• Propellant for consumer and specialized industrial aerosols</li> <li>• <a href="#">Blowing agent</a> component for extruded polystyrene foams (XPS)</li> <li>• Propellant for pharmaceutical aerosols (<a href="#">MDIs</a>) (under development)</li> </ul>
HFC-227ea	1,1,1,2,3,3,3-heptafluoropropane	CF <sub>3</sub> CHFCF <sub>3</sub>	431-89-0	3220	3350	3600	36 years	<ul style="list-style-type: none"> <li>• Propellant for Pharmaceutical Aerosols (<a href="#">MDIs</a>)</li> <li>• Refrigerant for high-temperature environments</li> <li>• Blend component for refrigerants</li> </ul>
HFC-236fa	1,1,1,3,3,3-hexafluoropropane	CF <sub>3</sub> CH <sub>2</sub> CF <sub>3</sub>	690-39-1	9810	8060	8690	213 years	<ul style="list-style-type: none"> <li>• Refrigerant for high-temperature environments</li> </ul>
HFC-245fa	1,1,1,3,3-pentafluoropropane	CHF <sub>2</sub> CH <sub>2</sub> CF <sub>3</sub>	460-73-1	1030	858	962	7.9 years	<ul style="list-style-type: none"> <li>• <a href="#">Foam Blowing</a> agent for Polyurethane (PUR) foams</li> <li>• Working fluid for <a href="#">organic rankine cycles (ORC)</a></li> </ul>
HFC-365mfc	1,1,1,3,3-pentafluorobutane	CF <sub>3</sub> CH <sub>2</sub> CF <sub>2</sub> CH <sub>3</sub>	406-58-6	794	804	914	8.9 years	<ul style="list-style-type: none"> <li>• <a href="#">Foam Blowing</a> agent for Polyurethane (PUR) and phenolic foams</li> <li>• Blend component for <a href="#">Solvents</a></li> <li>• Working fluid for <a href="#">organic rankine cycle (ORC)</a></li> </ul>

## Major HFO and HCFO molecules

Designation	Complete Name	Formula	CAS number	GWP (1)			Atmospheric lifetime AR6 (4)	Ozone Depleting Substance (ODS)	Main Applications
				AR4 (2) unless stated	AR5 (3) unless stated	<u>F-Gas Regulation 2024/573</u> AR6 (4)			
HFO-1234yf	2,3,3,3-tetrafluoroprop-1-ene	CF <sub>3</sub> CF=CH <sub>2</sub>	754-12-1	4 (5)	<1	0.501	12 days (0.033 years)	No	<ul style="list-style-type: none"> <li>Refrigerant for <a href="#">mobile air-conditioning</a>, stationary air conditioning and refrigeration</li> <li>Blend component for HFC-HFO blends</li> </ul>
HFO-1234ze(E)	Trans-1,1,3,3,3-tetrafluoroprop-1-ene	Trans-CF <sub>3</sub> CH=CFH	29118-24-9	7 (5)	<1	1.37	19 days (0.052 years)	No	<ul style="list-style-type: none"> <li>Refrigerant for <a href="#">chillers</a>, refrigeration</li> <li>Blend component for HFC-HFO blends</li> <li>Technical aerosol propellant</li> <li>Propellant for pharmaceutical aerosols (<a href="#">MDIs</a>) (under development)</li> <li><a href="#">Blowing agent</a> for insulation foams</li> </ul>
HFO-1336mzz(Z)	Cis-1,1,1,4,4,4-hexafluorobut-2-ene	Cis-CF <sub>3</sub> CH=CHCF <sub>3</sub>	692-49-9	9	2 (6 & 3)	2.08	27 days (0.074 years)	No	<ul style="list-style-type: none"> <li>Refrigerant for low pressure <a href="#">chillers</a>, residential and high temperature <a href="#">heat pumps</a>, refrigeration and air-conditioning</li> <li>Working fluid for <a href="#">organic rankine cycle (ORC)</a></li> <li><a href="#">Blowing agent</a> for insulation foams</li> </ul>



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HCFC-22	chlorodifluoromethane	CHClF <sub>2</sub>	75-45-6	1810	1760	1960	11.9 years	0.055	<ul style="list-style-type: none"> <li>Used as feedstock for the production of PTFE and other fluorocarbons polymers</li> </ul>
HCFC-142b	1-chloro-1,1-difluoro-ethane	CH <sub>3</sub> CClF <sub>2</sub>	75-68-3	2310	1980	2300	18 years	0.065	<ul style="list-style-type: none"> <li>Used as feedstock for the production of vinylidene difluoride for fluoropolymers</li> </ul>

## NOTES

- 1) See [Selecting and Using GWP Values](#). The F-gas Regulation 2024/573 uses AR4 GWP values for HFCs (Annex I) and where available AR6 GWP values for HFOs and HCFOs (Annex II). AR4 GWP values are used for HFCs under the Montreal Protocol (Kigali Amendment), but the Kigali Amendment does not cover HFOs and HCFOs.
- 2) [IPCC Fourth Assessment Report GWP values](#)
- 3) IPCC Working Group I – [The Physical Science Basis](#) – Chap.8 Annex 8.A.1, 5<sup>th</sup> Assessment Report
- 4) IPCC Working Group I- [Climate Change 2021, The Physical Science Basis](#)- 7.SM Chapter 7: The Earth's 2 energy budget, climate feedbacks and climate sensitivity - Supplementary Material
- 5) GWP according to the Report of the 2010 Assessment of the Scientific Assessment Panel (SAP) of the Montreal Protocol, Tables 1-11, citing two peer-reviewed scientific references.
- 6) Atmospheric chemistry of Z- and E-CF<sub>3</sub>CH=CHCF<sub>3</sub>, Freja F. Østerstrøm, Simone Thirstrup Andersen, Theis I. Sølling, Ole John Nielsena and Mads P. Sulbaek Andersen, Phys. Chem. Chem. Phys., 2017, 19, 735—750, <https://pubs.rsc.org/en/content/articlehtml/2017/cp/c6cp07234h>
- 7) Very short-lived substances (VSLs) have chemical lifetimes comparable with tropospheric transport time scales, with the result that the amount of the substance in the atmosphere depends on where and when (time of year) it is released. In practice, this happens for species with atmospheric lifetimes of a few months or less. From a regulatory point of view this means that VSLs cannot be included in the normal categories of the Montreal Protocol; not only is their contribution to ozone depletion very low but it is highly variable between countries and regions. For more detail see [HCFOs, CF3I Stratospheric Ozone and Climate Change](#)
- 8) The World Meteorological Organization (WMO). Scientific Assessment of Ozone Depletion: 2022, GAW Report No. 278, reports the ODP as <0.0004 (Annex: Table A-5. Atmospheric abundances; lifetimes; radiative efficiencies (REs); direct effect Global Warming Potentials (GWPs) for 20-, 100-, and 500-year time horizons; and Global Temperature Change Potentials (GTPs) for 50- and 100-year time horizons
- 9) Tokuhashi K., Uchimarui T., Takizawa K., Kondo S. (2019). Rate Constants for the Reactions of OH Radicals with the (E)/(Z) Isomers of CFCI=CFCl and (E)-CHF=CHF, J. Phys. Chem. A, 123(23), <https://pubs.acs.org/doi/10.1021/acs.jpca.9b02454>. This paper reports a GWP of 0.0056 for HFO-1132(E)

