

ANNEX I

Fluorinated greenhouse gases referred to in Article 2(1)¹ – *hydrofluorocarbons, perfluorocarbons and other fluorinated compounds*

Substance			GWP ⁽²⁾	20 years-GWP ⁽³⁾ for information purposes only
Industrial designation	Chemical name (Common name)	Chemical formula		
<i>Section 1: Hydrofluorocarbons (HFCs)</i>				
HFC-23	trifluoromethane (fluoroform)	CHF ₃	14 800	12 400
HFC-32	difluoromethane	CH ₂ F ₂	675	2 690
HFC-41	Fluoromethane (methyl fluoride)	CH ₃ F	92	485
HFC-125	pentafluoroethane	CHF ₂ CF ₃	3 500	6 740
HFC-134	1,1,2,2-tetrafluoroethane	CHF ₂ CHF ₂	1 100	3 900
HFC-134a	1,1,1,2-tetrafluoroethane	CH ₂ FCF ₃	1 430	4 140
HFC-143	1,1,2-trifluoroethane	CH ₂ FCHF ₂	353	1 300
HFC-143a	1,1,1 –trifluoroethane	CH ₃ CF ₃	4 470	7 840
HFC-152	1,2-difluoroethane	CH ₂ FCH ₂ F	53	77,6
HFC-152a	1,1 –difluoroethane	CH ₃ CHF ₂	124	591
HFC-161	Fluoroethane (ethyl fluoride)	CH ₃ CH ₂ F	12	17,4

¹ **Mixtures containing the substances listed in this Annex are considered as fluorinated greenhouse gases covered by the rules of this Regulation (Article 2(1)).**

² Based on the Fourth Assessment Report adopted by the Intergovernmental Panel on Climate Change, unless otherwise indicated.

³ Based on the Sixth Assessment Report adopted by the Intergovernmental Panel on Climate Change, unless otherwise indicated.

HFC-227ea	1,1,1,2,3,3,3-heptafluoropropane	CF ₃ CHF ₂ CF ₃	3 220	5 850
HFC-236cb	1,1,1,2,2,3-hexafluoropropane	CH ₂ FCF ₂ CF ₃	1 340	3 750
HFC-236ea	1,1,1,2,3,3-hexafluoropropane	CHF ₂ CHF ₂ CF ₃	1 370	4 420
HFC-236fa	1,1,1,3,3,3-hexafluoropropane	CF ₃ CH ₂ CF ₃	9 810	7 450
HFC-245ca	1,1,2,2,3-pentafluoropropane	CH ₂ FCF ₂ CHF ₂	693	2 680
HFC-245fa	1,1,1,3,3-pentafluoropropane	CHF ₂ CH ₂ CF ₃	1 030	3 170
HFC-365mfc	1,1,1,3,3-pentafluorobutane	CF ₃ CH ₂ CF ₂ CH ₃	794	2 920
HFC-43-10mee	1,1,1,2,2,3,4,5,5,5-decafluoropentane	CF ₃ CHFCH ₂ CF ₂ CF ₃	1 640	3 960

Substance			GWP 100	GWP 20
Industrial designation	Chemical name (Common name)	Chemical formula		
<i>Section 2: Perfluorocarbons (PFCs)</i>				
PFC-14	tetrafluoromethane (perfluoromethane, carbon tetrafluoride)	CF ₄	7 380	5 300
PFC-116	Hexafluoroethane (perfluoroethane)	C ₂ F ₆	12 400	8 940
PFC-218	octafluoropropane (perfluoropropane)	C ₃ F ₈	9 290	6 770
PFC-3-1-10 (R-31-10)	decafluorobutane (perfluorobutane)	C ₄ F ₁₀	10 000	7 300
PFC-4-1-12 (R-41-12)	dodecafluoropentane (perfluoropentane)	C ₅ F ₁₂	9 220	6 680
PFC-5-1-14 (R-51-14)	tetradecafluorohexane (perfluorohexane)	CF ₃ CF ₂ CF ₂ CF ₂ CF ₂ CF ₃	8 620	6 260
PFC-c-318	octafluorocyclobutane	C-C ₄ F ₈	10 200	7 400

	(perfluoro cyclobutane)			
PFC-9-1-18 (R-91-18)	Perfluorodecalin	C ₁₀ F ₁₈	7 480	5 480
PFC-4-1-14 (R-41-14)	perfluoro-2-methylpentane	CF ₃ CF ₂ CF ₃ CF ₂ CF ₂ CF ₃ (I-C ₆ F ₁₄)	7 370 ⁽⁴⁾	(*)
<i>Section 3: Other (per)fluorinated compounds and fluorinated nitriles</i>				
	sulphur hexafluoride	SF ₆	25 300	18 300
	Heptafluoroisobutyronitrile (2,3,3,3-tetrafluoro-2-(trifluoromethyl)-propanenitrile)	Iso-C₃F₇CN	2 750	4 580

⁴ Droste et al. (2019). Trends and Emissions of Six Perfluorocarbons in the Northern and Southern Hemisphere. Atmospheric Chemistry and Physics.
<https://acp.copernicus.org/preprints/acp-2019-873/acp-2019-873.pdf>

* Global warming potential not yet available.

ANNEX II

Other fluorinated greenhouse gases referred to in Article 2(1) ⁽⁵⁾ – **unsaturated hydro(chloro)fluorocarbons, fluorinated substances used as inhalation anaesthetics and other fluorinated substances**

Substance		GWP ⁽⁶⁾	20 years-GWP
Common name/industrial designation	Chemical formula		
<i>Section 1: Unsaturated hydro(chloro)fluorocarbons</i>			
HCFC-1224yd	CF ₃ CF=CHCl	0,06 ⁽⁷⁾	(*)
Cis/Trans-1,2-difluoroethylene (HFC-1132)	CHF=CF ₂	0,005	0,017
1,1-difluoroethylene (HFC-1132a)	CH ₂ =CF ₂	0,052	0,189
1,1,1,2,3,4,5,5,5(or1,1,1,3,4,4,5,5,5)-nonafluoro-4(or2)-(trifluoromethyl)pent-2-ene	CF ₃ CF=CFCFCF ₃ CF ₃ or CF ₃ CF ₃ C=CFCF ₂ CF ₃	1 ^{Fn} ⁽⁸⁾	
HFC-1234yf	CF ₃ CF = CH ₂	0,501	1,81

HFC-1234ze	trans — CHF = CHCF ₃	1,37	4,94
HFC-1336mzz(E)	(E)-CF ₃ CH = CHCF ₃	17,9	64,3
HFC-1336mzz(Z)	(Z)-CF₃CH = CHCF₃	2,08	7,48

⁵ Mixtures containing the substances listed in this Annex are considered as fluorinated greenhouse gases covered by the rules of this Regulation (Article 2(1)).

⁶ Based on the Sixth Assessment Report adopted by the Intergovernmental Panel on Climate Change, unless otherwise indicated.

⁷ Tokuhashi, K., T. Uchimaru, K. Takizawa, & S. Kondo (2018): Rate Constants for the Reactions of OH Radical with the (E)/(Z) Isomers of CF₃CF=CHCl and CHF₂CF=CHCl. The Journal of Physical Chemistry A 122:3120–3127.

* Global warming potential not yet available.

⁸ Default value, global warming potential not yet available.

HCFC-1233zd	CF ₃ CH = CHCl	3,88	14
HCFC-1233xf	CF ₃ CCl = CH ₂	1	
<i>Section 2: fluorinated substances used as inhalation anaesthetics</i>			
HFE-347mmz1 (sevoflurane) and isomers	(CF ₃) ₂ CHOCH ₂ F	195	702
HCFE-235ca2 (enflurane) and isomers	CHF ₂ OCF ₂ CHFCl	654	2 320
HCFE-235da2 (isoflurane) and isomers	CHF ₂ OCHClCF ₃	539	1 930
HFE-236ea2 (desflurane) and isomers	CHF ₂ OCHF ₂ CF ₃	2 590	7 020
<i>Section 3: other fluorinated substances</i>			
nitrogen trifluoride	NF ₃	17 400	13 400
sulfuryl fluoride	SO ₂ F ₂	4 630	7 510

Fluorinated greenhouse gases referred to in Article 2(1)⁹ – *fluorinated ethers, ketones and alcohols and other fluorinated compounds*

Substance		GWP ⁽¹⁰⁾	20 years–GWP ⁽²⁾ for information purposes only
Common name/industrial designation	Chemical formula		
<i>Section 1: Fluorinated ethers, ketones and alcohols</i>			
HFE-125	CHF ₂ OCF ₃	14 300	13 500
HFE-134 (HG-00)	CHF ₂ OCHF ₂	6 630	12 700
HFE-143a	CH ₃ OCF ₃	2 170	616
HFE-245cb2	CH ₃ OCF ₂ CF ₃	747	2 630
HFE-245fa2	CHF ₂ OCH ₂ CF ₃	3 060	878
HFE-254cb2	CH ₃ OCF ₂ CHF ₂	328	1 180
HFE-347 mcc3 (HFE-7000)	CH ₃ OCF ₂ CF ₂ CF ₃	576	2 020
HFE-347pcf2	CHF ₂ CF ₂ OCH ₂ CF ₃	980	3 370
HFE-356pcc3	CH ₃ OCF ₂ CF ₂ CHF ₂	277	995
HFE-449s1 (HFE-7100)	C ₄ F ₉ OCH ₃	460	1 620
HFE-569sf2 (HFE-7200)	C ₄ F ₉ OC ₂ H ₅	60,7	219
HFE-7300	(CF ₃) ₂ CF ₂ CF ₂ OC ₂ H ₅ CF ₂ CF ₂ CF ₃	405	1 420

⁹ *Mixtures containing the substances listed in this Annex are considered as fluorinated greenhouse gases covered by the rules of this Regulation (Article 2(1)).*

¹⁰ Based on the Sixth Assessment Report adopted by the Intergovernmental Panel on Climate Change, unless otherwise indicated.

n-HFE-7100	$\text{CF}_3\text{CF}_2\text{CF}_2\text{CF}_2\text{OCH}_3$	544	1 920
i-HFE-7100	$(\text{CF}_3)_2\text{CFCF}_2\text{OCH}_3$	437	1 540
i-HFE-7200	$(\text{CF}_3)_2\text{CFCF}_2\text{OCH}_2\text{CH}_3$	34,3	124
HFE-43-10pcccl24 (H-Galden 1040x) HG-11	$\text{CHF}_2\text{OCF}_2\text{OC}_2\text{F}_4\text{OCHF}_2$	3 220	8 720
HFE-236cal2 (HG-10)	$\text{CHF}_2\text{OCF}_2\text{OCHF}_2$	6 060	11 700
HFE-338pcccl3 (HG-01)	$\text{CHF}_2\text{OCF}_2\text{CF}_2\text{OCHF}_2$	3 320	9 180
HFE-347mmyl	$(\text{CF}_3)_2\text{CFOCH}_3$	392	1 400
2,2,3,3,3-pentafluoropropan-1-ol	$\text{CF}_3\text{CF}_2\text{CH}_2\text{OH}$	34,3	123
1,1,1,3,3,3-Hexafluoropropan-2-ol	$(\text{CF}_3)_2\text{CHOH}$	206	742
HFE-227ea	$\text{CF}_3\text{CHFOCF}_3$	7 520	9 800
HFE-236fa	$\text{CF}_3\text{CH}_2\text{OCF}_3$	1 100	3 670
HFE-245fal	$\text{CHF}_2\text{CH}_2\text{OCF}_3$	934	3 170
HFE 263fb2	$\text{CF}_3\text{CH}_2\text{OCH}_3$	2,06	7,43
HFE-329 mcc2	$\text{CHF}_2\text{CF}_2\text{OCF}_2\text{CF}_3$	3 770	7 550
HFE-338 mcf2	$\text{CF}_3\text{CH}_2\text{OCF}_2\text{CF}_3$	1 040	3 460
HFE-338mmzl	$(\text{CF}_3)_2\text{CHOCHF}_2$	3 040	6 500
HFE-347 mcf2	$\text{CHF}_2\text{CH}_2\text{OCF}_2\text{CF}_3$	963	3 270
HFE-356 mec3	$\text{CH}_3\text{OCF}_2\text{CHFCF}_3$	264	949
HFE-356mm1	$(\text{CF}_3)_2\text{CHOCH}_3$	8,13	29,3
HFE-356pcf2	$\text{CHF}_2\text{CH}_2\text{OCF}_2\text{CHF}_2$	831	2 870
HFE-356pcf3	$\text{CHF}_2\text{OCH}_2\text{CF}_2\text{CHF}_2$	484	1 730
HFE 365 mcf3	$\text{CF}_3\text{CF}_2\text{CH}_2\text{OCH}_3$	1,6	5,77
HFE-374pc2	$\text{CHF}_2\text{CF}_2\text{OCH}_2\text{CH}_3$	12,5	45

2,2,3,3,4,4,5,5- octafluorocyclopentan-1-ol	(CF ₂) ₄ CH (OH)-	13,6	49,1
1,1,1,3,4,4,4-Heptafluoro-3-(trifluoromethyl)butan-2-one	CF ₃ C(O)CF(CF ₃) ₂	0,29 ⁽¹¹⁾	(*)
<i>perfluoropolymethylisopropyl-ether (PFPMIE)</i>	<i>CF₃OCF(CF₃)CF₂OCF₂OCF₃</i>	<i>10 300</i>	<i>7 750</i>
<i>Perfluoro(2-methyl-3-pentanone)</i>	<i>CF₃CF₂C(O)CF(CF₃)₂*</i>	<i>0.114</i>	<i>0.441</i>
<i>Section 2: Other fluorinated compounds</i>			
trifluoromethylsulphurpentafluoride	SF ₅ CF ₃	18 500	13 900
Perfluorocyclopropane	c-C ₃ F ₆	9 200 ⁽¹²⁾	6 850
Heptafluoroisobutyronitrile (2,3,3,3-tetrafluoro-2-(trifluoromethyl)-propanenitrile)	Iso-C ₃ F ₇ CN	2 750	4 580
perfluorotributylamine (PFTBA, FC43)	C ₁₂ F ₂₇ N	8 490	6 340
perfluoro-N-methylmorpholine	C ₅ F ₁₁ NO	8 380 ^{*(13)}	(*)

¹¹ Ren et al. (2019). Atmospheric Fate and Impact of Perfluorinated Butanone and Pentanone. *Environ. Sci. Technol.* 2019, 53, 15, 8862–8871

¹² WMO et al. (2018). Scientific Assessment of Ozone Depletion.

¹³ REACH registration dossier. <https://echa.europa.eu/registration-dossier/-/registered-dossier/10075/5/1>

Not yet available. Perfluorotripropylamine	C ₉ F ₂₁ N	9 030	6 750
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