Umwelt Bundesamt

Treibhauspotentiale (Global Warming Potential, GWP) ausgewählter Verbindungen und deren Gemische gemäß Viertem (AR4) und Fünftem (AR5) IPCC Sachstandsbericht sowie Verordnung (EU) 2024/573 (F-Gas-VO) bezogen auf einen Zeitraum von 100 Jahren

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Tabelle 1: Treibhauspotentiale (GWP_{100}) teil(chlor)fluorierter und perfluorierter Kohlenwasserstoffe (HFKW, HFCKW und FKW) sowie anderer perfluorierter Verbindungen

Industrielle Bezeichnung	Chemische Bezeichnung	Chemische Formel / Zusammensetzung	GWP AR4 [1]	GWP AR5 [3]	GWP F-Gas-VO [5]
Teil(chlor) fluorierte Kohlenwasserstoffe (HFKW und HFCKW)					
HFKW-23	Trifluormethan	CHF_3	14 800	12 400	14 800
HFKW-32	Difluormethan	CH_2F_2	675	677	675
HFKW-41	Fluormethan	CH_3F	92	116	92
HFKW-125	1,1,1,2,2-Pentafluorethan	CF_3-CHF_2	3 500	3 170	3 500
HFKW-134	1,1,2,2-Tetrafluorethan	CHF_2-CHF_2	1 100	1 120	1 100
HFKW-134a	1,1,1,2-Tetrafluorethan	CF_3-CH_2F	1 430	1 300	1 430
HFKW-143	1,1,2-Trifluorethan	CHF_2-CH_2F	353	328	353
HFKW-143a	1,1,1-Trifluorethan	CF_3-CH_3	4 470	4 800	4 470
HFKW-152	1,2-Difluorethan	CH_2F-CH_2F	53	16	53
HFKW-152a	1,1-Difluorethan	CHF_2-CH_3	124	138	124
HFKW-161	Fluorethan	CH_2F-CH_3	12	4	12
HFKW-227ea	1,1,1,2,3,3,3-Heptafluorpropan	CF_3-CHF-CF_3	3 220	3 350	3 220
HFKW-236cb	1,1,1,2,2,3-Hexafluorpropan	CF_3-CF_2-CH_2F	1 340	1 210	1 340
HFKW-236ea	1,1,1,2,3,3-Hexafluorpropan	CF_3-CHF-CHF_2	1 370	1 330	1 370
HFKW-236fa	1,1,1,3,3,3-Hexafluorpropan	CF_3-CH_2-CF_3	9 810	8 060	9 810
HFKW-245ca	1,1,2,2,3-Pentafluorpropan	CHF_2-CF_2-CH_2F	693	716	693

Industrielle Bezeichnung	Chemische Bezeichnung	Chemische Formel / Zusammensetzung	GWP AR4 [1]	GWP AR5 [3]	GWP F-Gas-VO [5]
HFKW-245fa	1,1,1,3,3-Pentafluorpropan	CF_3-CH_2-CHF_2	1 030	858	1 030
HFKW-365mfc	1,1,1,3,3-Pentafluorbutan	CF_3-CH_2-CF_2-CH_3	794	804	794
HFKW-43-10mee	1,1,1,2,2,3,4,5,5,5-Decafluorpentan	CF_3-CF_2-CHF-CHF-CF_3	1 640	1 650	1 640
HCKW-1130 (E)	trans-1,2-Dichlorethen	CHCl=CHCl		1	
HFKW-1132 (E)	trans-1,2-Difluorethen	CHF=CHF		1	>1
HFKW-1132a	1,1-Difluorethen	CH_2=CF_2		1	0,052
HFCKW-1224yd (Z)	cis-1-Chlor-2,3,3,3-Tetrafluorprop-1-en	CHCl=CF-CF_3 (Z)		1	0,06
HFCKW-1233xf	2-Chlor-3,3,3-Trifluorprop-1-en	CH_2=CCl-CF_3			1
HFCKW-1233zd (E)	trans-1-Chlor-3,3,3-Trifluorprop-1-en	CHCl=CH-CF_3 (E)	4,5 [2]	1	3,88
HFKW-1234yf	2,3,3,3-Tetrafluorprop-1-en	CH_2=CF-CF_3	4 [2]	1	0,501
HFKW-1234ze (E)	trans-1,3,3,3-Tetrafluorprop-1-en	CHF=CH-CF_3 (E)	7 [2]	1	1,37
HFKW-1336mzz (E)	trans-1,1,1,4,4,4-Hexafluorbut-2-en	CF_3-CH=CH-CF_3 (E)			17,9
HFKW-1336mzz (Z)	cis-1,1,1,4,4,4-Hexafluorbut-2-en	CF_3-CH=CH-CF_3 (Z)	9 [2]	2	2,08
	1,1,1,2,3,4,5,5,5-Nonafluor-4-trifluormethyl-pent-2-en	CF_3-CF=CF-CF(CF_3)$_2$			1
Perfluorierte Kohlenwasserstoffe (FKW)					
FKW-14	Tetrafluormethan (Perfluormethan)	CF_4	7 390	6 630	7 380
FKW-116	Hexafluorethan (Perfluorethan)	C_2F_6	12 200	11 100	12 400
FKW-c-216	Hexaafluorcyclopropan (Perfluorcyclopropan)	c-C_3F_6	17 340	9 200	9 200
FKW-218	Oktafluorpropan (Perfluorpropan)	C_3F_8	8 830	8 900	9 290
FKW-c-318	Octafluorcyclobutan (Perfluorcyclobutan)	c-C_4F_8	10 300	9 540	10 200
FKW-3-1-10	Decafluorbutan (Perfluorbutan)	C_4F_{10}	8 860	9 200	10 000
FKW-4-1-12	Dodecafluorpentan (Perfluorpentan)	C_5F_{12}	9 160	8 550	9 220
FKW-4-1-14	Perfluor-2-methylpentan	CF_3-CF(CF_3)-CF_2-CF_2-CF_3 (i-C_6F_{14})			7 370

Industrielle Bezeichnung	Chemische Bezeichnung	Chemische Formel / Zusammensetzung	GWP AR4 [1]	GWP AR5 [3]	GWP F-Gas-VO [5]
FKW-5-1-14	Tetradecafluorhexan (Perfluorhexan)	C_6F_{14}	9 300	7 910	8 620
FKW-9-1-18	Octadecafluordecalin (Perfluordecalin)	$C_{10}F_{18}$	7 500	7 190	7 480
Andere perfluorierte Verbindungen					
	Schwefelhexafluorid	SF_6	22 800	23 500	24 300
	Stickstofftrifluorid	NF_3	17 200	16 100	17 400
	Trifluormethylschwefel-pentafluorid	SF_5CF_3	17 700	17 400	18 500
	Sulfuryldifluorid	SO_2F_2		4 090	4 630
R-13I1	Trifluoriodmethan	CF_3I	0,4		
	Heptafluorisobutyronitril	$(CF_3)_2CF\text{-}CN$ (i-C_3F_7CN)			2 750
	Perfluor-N-methylmorpholin	$C_5F_{11}NO$			8 800
	Perfluortripropylamin	$C_9F_{21}N$			9 030
	Perfluortributylamin (PFTBA)	$C_{12}F_{27}N$			8 490

Tabelle 2: Treibhauspotentiale (GWP_{100}) (chlor)fluorierter Ether (HFE, HCFE), fluorierter Alkohole und Ketone und Perfluorpolyether (PFPE)

Industrielle Bezeichnung	Chemische Bezeichnung	Chemische Formel / Zusammensetzung	GWP AR4 [1]	GWP AR5 [3]	GWP F-Gas-VO [5]
(Chlor)Fluorierte Ether (HFE und HCFE)					
HFE-125		CHF_2-O-CF_3	14 900	12 400	14 300
HFE-134 (HG-00)		CHF_2-O-CHF_2	6 320	5 560	6 630
HFE-143a		CH_3-O-CF_3	756	523	616
HFE-227ea		CF_3-CHF-O-CF_3	1 540	6 450	7 520
HCFE-235ca2 (Enfluran)		CHF_2-O-CF_2-CHFCl		583	654
HCFE-235da2 (Isofluran)		CHF_2-O-CHCl-CF_3	350	491	539
HFE-236ca12 (HG-10)		CHF_2-O-CF_2-O-CHF_2	2 800	5 350	6 060
HFE-236ea2 (Desfluran)		CHF_2-O-CHF-CF_3	989	1 790	2 590
HFE-236fa		CF_3-CH_2-O-CF_3	487	979	1 100
HFE-245cb2		CF_3-CF_2-O-CH_3	708	654	747
HFE-245fa1		CHF_2-CH_2-O-CF_3	286	828	934
HFE-245fa2		CHF_2-O-CH_2-CF_3	659	812	878
HFE-254cb1		CH_3-O-CF_2-CHF_2	359	301	328
HFE-263mf		CF_3-CH_2-O-CH_3	11	1	2,06
HFE-329mcc2		CF_3-CF_2-O-CF_2-CHF_2	919	3 070	3 770
HFE-338mcf2		CF_3-CH_2-O-CF_2-CF_3	552	929	1 040
HFE-338mmz1		$(CF_3)_2$CH-O-CHF_2	380	2 620	3 040
HFE-338pcc13 (HG-01)		CHF_2-O-CF_2-CF_2-O-CHF_2	1 500	2 910	3 320
HFE-347mcc3 (HFE-7000)		CH_3-O-CF_2-CF_2-CF_3	575	530	576
HFE-347mcf2		CHF_2-CH_2-O-CF_2-CF_3	374	854	963
HFE-347mmy1		$(CF_3)_2$CF-O-CH_3	343	363	392
HFE-347mmz1 (Sevofluran)		CH_2F-O-$CH(CF_3)_2$		216	195
HFE-347pcf2		CHF_2-CF_2-O-CH_2-CF_3	580	889	980
HFE-356mec3		CH_3-O-CF_2-CHF-CF_3	101	387	264
HFE-356mm1		$(CF_3)_2$CH-O-CH_3	27	14	8,13

Industrielle Bezeichnung	Chemische Bezeichnung	Chemische Formel / Zusammensetzung	GWP AR4 [1]	GWP AR5 [3]	GWP F-Gas-VO [5]
HFE-356pcc3		CH_3-O-CF_2-CF_2-CHF_2	110	413	277
HFE-356pcf2		CHF_2-CH_2-O-CF_2-CHF_2	265	719	831
HFE-356pcf3		CHF_2-O-CH_2-CF_2-CHF_2	502	446	484
HFE-365mcf3		CF_3-CF_2-CH_2-O-CH_3	11	1	1,6
HFE-374pc2		CHF_2-CF_2-O-CH_2-CH_3	557	627	12,5
HFE-449s1 (HFE-7100)		C_4F_9-O-CH_3	297	421	460
HFE-569sf2 (HFE-7200)		C_4F_9-O-C_2H_5	59	57	60,7
HFE-43-10pccc124 (H-Galden 1040x)		CHF_2-O-CF_2-O-C_2F_4-O-CHF_2	1 870	2 820	3 220
n-HFE-7100		CF_3-CF_2-CF_2-CF_2-O-CH_3			544
i-HFE-7100		$(CF_3)_2$CF-CF_2-O-CH_3			437
i-HFE-7200		$(CF_3)_2$CF-CF_2-O-CH_2-CH_3			34,3
HFE-7300		n-$(CF_3)_2$CF-CF(O-CH_3)-C_2F_5			405
Fluorierte Alkohole und Ketone					
	2,2,3,3,3-Pentafluorpropan-1-ol	CF_3-CF_2-CH_2-OH	42	19	34,3
	Bis(trifluormethyl) methanol	$(CF_3)_2$CH-OH	195	182	206
	Octafluortetramethylen-hydroxymethyl-Gruppe	-$(CF_2)_4$CH(OH)-	73	13	13,6
	1,1,1,3,4,4,4-Heptafluor-3-(trifluormethyl)butan-2-on	CF_3-C(O)-$CF(CF_3)_2$			0,29
	Perfluor(2-methyl-3-pentanon)	CF_3-CF_2-C(O)-$CF(CF_3)_2$			0,114
Perfluorpolyether (PFPE)					
PFPMIE	Perfluorpolymethyl isopropylether	CF_3(O-$CF(CF_3)CF_2)_n$-(O-$CF_2)_m$-O-CF_3 (n,m=1)	10 300	9 710	10 300

Tabelle 3: Treibhauspotentiale (GWP_{100}) halogenfreier Stoffe

Industrielle Bezeichnung	Chemische Bezeichnung	Chemische Formel / Zusammensetzung	GWP AR4 [1]	GWP F-Gas-VO [5]
	Methan	CH_4	25	27,9
R-170	Ethan	CH_3-CH_3	5,5	0,437
R-290	Propan	CH_3-CH_2-CH_3	3,3	0,02
R-600	n-Butan	CH_3-CH_2-CH_2-CH_3	4	0,006
R-600a	i-Butan (Isobutan)	$(CH_3)_2CH$-CH_3	3	0
R-601	n-Pentan	CH_3-CH_2-CH_2-CH_2-CH_3	5 [4]	0
R-601a	i-Pentan (Isopentan)	$(CH_3)_2CH$-CH_2-CH_3	5 [4]	0
	Cyclopentan	C_5H_{10}		0
R-E170	Dimethylether (DME)	CH_3-O-CH_3	1	1
R-610	Diethylether	CH_3-CH_2-O-CH_2-CH_3	4	4
R-611	Methylformiat	$HCOOCH_3$	25	11
R-702	Wasserstoff	H_2	6	6
R-717	Ammoniak	NH_3	0	0
R-718	Wasser	H_2O	0	0
R-723	Dimethylether-Ammoniak-Gemisch	R-717 (NH_3): 60% R-E170 (CH_3-O-CH_3): 40%	1	1
R-744	Kohlendioxid	CO_2	1	1
R-1150	Ethen (Ethylen)	CH_2=CH_2	3,7	4
R-1270	Propen (Propylen)	CH_2=CH-CH_3	1,8	0

Tabelle 4: Treibhauspotentiale (GWP_{100}) von HFKW-Gemischen / Kältemittelblends

Industrielle Bezeichnung	Chemische Formel / Zusammensetzung	GWP AR4 [1]	GWP AR5 [3]	GWP F-Gas-VO [5]
R-404A	HFKW-125 (CHF_2-CF_3): 44% HFKW-134a (CH_2F-CF_3): 4% HFKW-143a (CH_3-CF_3): 52%	3 922	3 943	3 922
R-407A	HFKW-32 (CH_2F_2): 20% HFKW-125 (CHF_2-CF_3): 40% HFKW-134a (CF_3-CH_2F):40%	2 107	1 923	2 107
R-407B	HFKW-32 (CH_2F_2): 10% HFKW-125 (CHF_2-CF_3): 70% HFKW-134a (CF_3-CH_2F): 20%	2 804	2 547	2 804
R-407C	HFKW-32 (CH_2F_2): 23% HFKW-125 (CHF_2-CF_3): 25% HFKW-134a (CH_2F-CF_3): 52%	1 774	1 624	1 774
R-407D	HFKW-32 (CH_2F_2): 15% HFKW-125 (CHF_2-CF_3): 15% HFKW-134a (CF_3-CH_2F): 70%	1 627	1 487	1 627
R-407E	HFKW-32 (CH_2F_2): 25% HFKW-125 (CHF_2-CF_3): 15% HFKW-134a (CF_3-CH_2F): 60%	1 552	1 425	1 552
R-407F	HFKW-32 (CH_2F_2): 30% HFKW-125 (CHF_2-CF_3): 30% HFKW-134a (CF_3-CH_2F): 40%	1 825	1 674	1 825
R-407G	HFKW-32 (CH_2F_2): 2,5% HFKW-125 (CHF_2-CF_3): 2,5% HFKW-134a (CF_3-CH_2F): 95%	1 463	1 331	1 463
R-407H	HFKW-32 (CH_2F_2): 32,5% HFKW-125 (CHF_2-CF_3): 15% HFKW-134a (CF_3-CH_2F): 52,5%	1 495	1 378	1 495
R-407I	HFKW-32 (CH_2F_2): 19,5% HFKW-125 (CHF_2-CF_3): 8,5% HFKW-134a (CF_3-CH_2F): 72%	1 459	1 337	1 459
R-410A	HFKW-32 (CH_2F_2): 50% HFKW-125 (CHF_2-CF_3): 50%	2 088	1 924	2 088
R-410B	HFKW-32 (CH_2F_2): 45% HFKW-125 (CHF_2-CF_3): 55%	2 229	2 048	2 229
R-413A	HFKW-134a (CH_2F-CF_3): 88% FKW-218 (CF_3-CF_2-CF_3): 9% R-600a ($(CH_3)_2CH$-CH_3) [1]: 3%	2 053	1 945 [1]	2 095
R-417A	HFKW-125 (CHF_2-CF_3): 46,6% HFKW-134a (CH_2F-CF_3): 50% R-600 (CH_3-CH_2-CH_2-CH_3) [1]: 3,4%	2 346	2 127 [1]	2 346

Industrielle Bezeichnung	Chemische Formel / Zusammensetzung	GWP AR4 [1]	GWP AR5 [3]	GWP F-Gas-VO [5]
R-417B	HFKW-125 (CHF_2-CF_3): 79% HFKW-134a (CH_2F-CF_3): 18,3% R--600 (CH_3-CH_2-CH_2-CH_3) [1]: 2,7%	3 027	2 742 [1]	3 027
R-417C	HFKW-125 (CHF_2-CF_3): 19,5% HFKW-134a (CH_2F-CF_3): 78,8% R-600 (CH_3-CH_2-CH_2-CH_3) [1]: 1,7%	1 809	1 643 [1]	1 809
R-419A	HFKW-125 (CHF_2-CF_3): 77% HFKW-134a (CF_3-CH_2F): 19% R-E170 (CH_3-O-CH_3) [1]: 4%	2 967	2 688 [1]	2 967
R-419B	HFKW-125 (CHF_2-CF_3): 48,5% HFKW-134a (CF_3-CH_2F): 48% R-E170 (CH_3-O-CH_3) [1]: 3,5%	2 384	2 161 [1]	2 384
R-421A	HFKW-125 (CHF_2-CF_3): 58% HFKW-134a (CF_3-CH_2F): 42%	2 631	2 385	2 631
R-421B	HFKW-125 (CHF_2-CF_3): 85% HFKW-134a (CF_3-CH_2F): 15%	3 190	2 890	3 190
R-422A	HFKW-125 (CHF_2-CF_3): 85,1% HFKW-134a (CF_3-CH_2F): 11,5% R-600a ($(CH_3)_2CH$-CH_3) [1]: 3,4%	3 143	2 847 [1]	3 143
R-422B	HFKW-125 (CHF_2-CF_3): 55% HFKW-134a (CF_3-CH_2F): 42% R-600a ($(CH_3)_2CH$-CH_3) [1]: 3%	2 526	2 290 [1]	2 526
R-422C	HFKW-125 (CHF_2-CF_3): 82% HFKW-134a (CF_3-CH_2F): 15% R-600a ($(CH_3)_2CH$-CH_3) [1]: 3%	3 085	2 794 [1]	3 085
R-422D	HFKW-125 (CHF_2CF_3): 65,1% HFKW-134a (CF_3-CH_2F): 31,5% R-600a ($(CH_3)_2CH$-CH_3) [1]: 3,4%	2 729	2 473 [1]	2 729
R-422E	HFKW-125 (CHF_2CF_3): 58% HFKW-134a (CF_3-CH_2F): 39,3% R-600a ($(CH_3)_2CH$-CH_3) [1]: 2,7%	2 592	2 350 [1]	2 592
R-423A	HFKW-134a (CF_3-CH_2F): 52,5% HFKW-227ea (CF_3-CHF-CF_3): 47,5%	2 280	2 274	2 280
R-424A	HFKW-125 (CHF_2-CF_3): 50,5% HFKW-134a (CF_3-CH_2F): 47% R-600 (CH_3-CH_2-CH_2-CH_3) [1]: 1% R-600a ($(CH_3)_2CH$-CH_3) [1]: 0,9% R-601a ($(CH_3)_2CH$-CH_2-CH_3) [4]: 0,6%	2 440 [4]	2 212 [1,4]	2 440
R-425A	HFKW-32 (CH_2F_2): 18,5% HFKW-134a (CF_3-CH_2F): 69,5% HFKW-227ea (CF_3-CHF-CF_3): 12%	1 505	1 431	1 505

Industrielle Bezeichnung	Chemische Formel / Zusammensetzung	GWP AR4 [1]	GWP AR5 [3]	GWP F-Gas-VO [5]
R-426A	HFKW-125 (CHF_2-CF_3): 5,1% HFKW-134a (CF_3-CH_2F): 93% R-600 (CH_3-CH_2-CH_2-CH_3) [1]: 1,3% R-601a ((CH_3)$_2$CH-CH_2-CH_3) [4]: 0,6%	1 508 [4]	1 371 [1,4]	1 508
R-427A	HFKW-32 (CH_2F_2): 15% HFKW-125 (CHF_2-CF_3): 25% HFKW-134a (CF_3-CH_2F): 50% HFKW-143a (CH_3-CF_3): 10%	2 138	2 024	2 138
R-427B	HFKW-32 (CH_2F_2): 20,6% HFKW-125 (CHF_2-CF_3): 25,6% HFKW-134a (CF_3-CH_2F): 34,8% HFKW-143a (CH_3-CF_3): 19%	2 382	2 315	2 382
R-427C	HFKW-32 (CH_2F_2): 25% HFKW-125 (CHF_2-CF_3): 25% HFKW-134a (CF_3-CH_2F): 40% HFKW-143a (CH_3-CF_3): 10%	2 063	1 962	2 063
R-428A	HFKW-125 (CHF_2-CF_3): 77,5% HFKW-143a (CH_3-CF_3): 20% R-290 (CH_3-CH_2-CH_3) [1]: 0,6% R-600a ((CH_3)$_2$CH-CH_3) [1]: 1,9%	3 607	3 417 [1]	3 607
R-429A	HFKW-152a (CHF_2-CH_3): 10% R-E170 (CH_3-O-CH_3) [1]: 60% R-600a ((CH_3)$_2$CH-CH_3) [1]: 30%	14	15 [1]	13
R-430A	HFKW-152a (CHF_2-CH_3): 76% R-600a ((CH_3)$_2$CH-CH_3) [1]: 24%	95	106 [1]	94
R-431A	HFKW-152a (CHF_2-CH_3): 29% R-290 (CH_3-CH_2-CH_3) [1]: 71%	38	42 [1]	36
R-434A	HFKW-125 (CHF_2-CF_3): 63,2% HFKW-134a (CF_3-CH_2F): 16% HFKW-143a (CH_3-CF_3): 18% R-600a ((CH_3)$_2$CH-CH_3) [1]: 2,8%	3 245	3 076 [1]	3 245
R-435A	HFKW-152a (CHF_2-CH_3): 20% R-E170 (CH_3-O-CH_3) [1]: 80%	26	28 [1]	26
R-437A	HFKW-125 (CHF_2-CF_3): 19,5% HFKW-134a (CF_3-CH_2F): 78,5% R-600 (CH_3-CH_2-CH_2-CH_3) [1]: 1,4% R-601 (CH_3-CH_2-CH_2-CH_2-CH_3) [4]: 0,6%	1 805 [4]	1 639 [1,4]	1 805
R-438A	HFKW-32 (CH_2F_2): 8,5% HFKW-125 (CHF_2-CF_3): 45% HFKW-134a (CF_3-CH_2F): 44,2% R-600 (CH_3-CH_2-CH_2-CH_3) [1]: 1,7% R-601a ((CH_3)$_2$CH-CH_2-CH_3) [4]: 0,6%	2 265 [4]	2 059 [1,4]	2 264

Industrielle Bezeichnung	Chemische Formel / Zusammensetzung	GWP AR4 [1]	GWP AR5 [3]	GWP F-Gas-VO [5]
R-439A	HFKW-32 (CH_2F_2): 50% HFKW-125 (CHF_2-CF_3): 47% R-600a ($(CH_3)_2CH$-CH_3) [1]: 3%	1 983	1 828 [1]	1 983
R-440A	HFKW-134a (CF_3-CH_2F): 1,6% HFKW-152a (CHF_2-CH_3): 97,8% R-290 (CH_3-CH_2-CH_3) [1]: 0,6%	144	156 [1]	144
R-442A	HFKW-32 (CH_2F_2): 31% HFKW-125 (CHF_2-CF_3): 31% HFKW-134a (CF_3-CH_2F): 30% HFKW-152a (CHF_2-CH_3): 3% HFKW-227ea (CF_3-CHF-CF_3): 5%	1 888	1 754	1 888
R-444A	HFKW-32 (CH_2F_2): 12% HFKW-152a (CHF_2-CH_3): 5% HFKW-1234ze (E) (CHF=CH-CF_3) [2]: 83%	93 [2]	89	88
R-444B	HFKW-32 (CH_2F_2): 41,5% HFKW-152a (CHF_2-CH_3): 10% HFKW-1234ze (E) (CHF=CH-CF_3) [2]: 48,5%	296 [2]	295	293
R-445A	HFKW-134a (CF_3-CH_2F): 9% HFKW-1234ze (E) (CHF=CH-CF_3) [2]: 85% R-744 (CO_2): 6%	135 [2]	118	130
R-446A	HFKW-32 (CH_2F_2): 68% HFKW-1234ze (E) (CHF=CH-CF_3) [2]: 29% R-600 (CH_3-CH_2-CH_2-CH_3) [1]: 3%	461 [2]	461 [1]	459
R-447A	HFKW-32 (CH_2F_2): 68% HFKW-125 (CHF_2-CF_3): 3,5% HFKW-1234ze (E) (CHF=CH-CF_3) [2]: 28,5%	583 [2]	572	582
R-447B	HFKW-32 (CH_2F_2): 68% HFKW-125 (CHF_2-CF_3): 8% HFKW-1234ze (E) (CHF=CH-CF_3) [2]: 24%	741 [2]	714	739
R-448A	HFKW-32 (CH_2F_2): 26% HFKW-125 (CHF_2-CF_3): 26% HFKW-134a (CF_3-CH_2F): 21% HFKW-1234yf (CH_2=CF-CF_3) [2]: 20% HFKW-1234ze (E) (CHF=CH-CF_3) [2]: 7%	1 387 [2]	1 273	1 386
R-448B	HFKW-32 (CH_2F_2): 21% HFKW-125 (CHF_2-CF_3): 21% HFKW-134a (CF_3-CH_2F): 31% HFKW-1234yf (CH_2=CF-CF_3) [2]: 20% HFKW-1234ze (E) (CHF=CH-CF_3) [2]: 7%	1 321 [2]	1 211	1 320
R-449A	HFKW-32 (CH_2F_2): 24,3% HFKW-125 (CHF_2-CF_3): 24,7% HFKW-134a (CF_3-CH_2F): 25,7% HFKW-1234yf (CH_2=CF-CF_3) [2]: 25,3%	1 397 [2]	1 282	1 396

Industrielle Bezeichnung	Chemische Formel / Zusammensetzung	GWP AR4 [1]	GWP AR5 [3]	GWP F-Gas-VO [5]
R-449B	HFKW-32 (CH_2F_2): 25,2% HFKW-125 (CHF_2-CF_3): 24,3% HFKW-134a (CF_3-CH_2F): 27,3% HFKW-1234yf (CH_2=CF-CF_3) [2]: 23,2%	1 412 [2]	1 296	1 411
R-449C	HFKW-32 (CH_2F_2): 20% HFKW-125 (CHF_2-CF_3): 20% HFKW-134a (CF_3-CH_2F): 29% HFKW-1234yf (CH_2=CF-CF_3) [2]: 31%	1 251 [2]	1 147	1 250
R-450A	HFKW-134a (CF_3-CH_2F): 42% HFKW-1234ze (E) (CHF=CH-CF_3) [2]: 58%	605 [2]	547	601
R-451A	HFKW-134a (CF_3-CH_2F): 10,2% HFKW-1234yf (CH_2=CF-CF_3) [2]: 89,8%	149 [2]	133	146
R-451B	HFKW-134a (CF_3-CH_2F): 11,2% HFKW-1234yf (CH_2=CF-CF_3) [2]: 88,8%	164 [2]	146	161
R-452A	HFKW-32 (CH_2F_2): 11% HFKW-125 (CHF_2-CF_3): 59% HFKW-1234yf (CH_2=CF-CF_3) [2]: 30%	2 140 [2]	1 945	2 139
R-452B	HFKW-32 (CH_2F_2): 67% HFKW-125 (CHF_2-CF_3): 7% HFKW-1234yf (CH_2=CF-CF_3) [2]: 26%	698 [2]	676	697
R-452C	HFKW-32 (CH_2F_2): 12,5% HFKW-125 (CHF_2-CF_3): 61% HFKW-1234yf (CH_2=CF-CF_3) [2]: 26,5%	2 220 [2]	2 019	2 220
R-453A	HFKW-32 (CH_2F_2): 20% HFKW-125 (CHF_2-CF_3): 20% HFKW-134a (CF_3-CH_2F): 53,8% HFKW-227ea (CF_3-CHF-CF_3): 5% R-600 (CH_3-CH_2-CH_2-CH_3) [1]: 0,6% R-601a ($(CH_3)_2$CH-CH_2-CH_3) [4]: 0,6%	1 765 [4]	1 636 [1,4]	1 765
R-454A	HFKW-32 (CH_2F_2): 35% HFKW-1234yf (CH_2=CF-CF_3) [2]: 65%	239 [2]	238	237
R-454B	HFKW-32 (CH_2F_2): 68,9% HFKW-1234yf (CH_2=CF-CF_3) [2]: 31,1%	466 [2]	467	465
R-454C	HFKW-32 (CH_2F_2): 21,5% HFKW-1234yf (CH_2=CF-CF_3) [2]: 78,5%	148 [2]	146	146
R-454D	HFKW-32 (CH_2F_2): 43% HFKW-1234yf (CH_2=CF-CF_3) [2]: 57%	293 [2]	292	291
R-455A	HFKW-32 (CH_2F_2): 21,5% HFKW-1234yf (CH_2=CF-CF_3) [2]: 75,5% R-744 (CO_2): 3%	148 [2]	146	146
R-455B	HFKW-32 (CH_2F_2): 42% HFKW-1234yf (CH_2=CF-CF_3) [2]: 52% R-744 (CO_2): 6%	286 [2]	285	284

Industrielle Bezeichnung	Chemische Formel / Zusammensetzung	GWP AR4 [1]	GWP AR5 [3]	GWP F-Gas-VO [5]
R-455C	HFKW-32 (CH_2F_2): 43% HFKW-1234yf (CH_2=CF-CF_3) [2]: 54% R-744 (CO_2): 3%	292 [2]	292	291
R-456A	HFKW-32 (CH_2F_2): 6% HFKW-134a (CF_3-CH_2F): 45% HFKW-1234ze (E) (CHF=CH-CF_3) [2]: 49%	687 [2]	626	685
R-457A	HFKW-32 (CH_2F_2): 18% HFKW-152a (CHF_2-CH_3): 12% HFKW-1234yf (CH_2=CF-CF_3) [2]: 70%	139 [2]	139	137
R-457B	HFKW-32 (CH_2F_2): 35% HFKW-152a (CHF_2-CH_3): 10% HFKW-1234yf (CH_2=CF-CF_3) [2]: 55%	251 [2]	251	249
R-457C	HFKW-32 (CH_2F_2): 7,5% HFKW-152a (CHF_2-CH_3): 14,5% HFKW-1234yf (CH_2=CF-CF_3) [2]: 78%	72 [2]	72	69
R-457D	HFKW-32 (CH_2F_2): 4% HFKW-152a (CHF_2-CH_3): 14% HFKW-1234yf (CH_2=CF-CF_3) [2]: 82%	48 [2]	47	45
R-458A	HFKW-32 (CH_2F_2): 20,5% HFKW-125 (CHF_2-CF_3): 4% HFKW-134a (CF_3-CH_2F): 61,4% HFKW-227ea (CF_3-CHF-CF_3): 13,5% HFKW-236fa (CF_3-CH_2-CF_3): 0,6%	1 650	1 564	1 650
R-459A	HFKW-32 (CH_2F_2): 68% HFKW-1234yf (CH_2=CF-CF_3) [2]: 26% HFKW-1234ze (E) (CF_3-CH=CHF) [2]: 6%	460 [2]	461	459
R-459B	HFKW-32 (CH_2F_2): 21% HFKW-1234yf (CH_2=CF-CF_3) [2]: 69% HFKW-1234ze (E) (CF_3-CH=CHF) [2]: 10%	145 [2]	143	142
R-460A	HFKW-32 (CH_2F_2): 12% HFKW-125 (CHF_2-CF_3): 52% HFKW-134a (CF_3-CH_2F): 14% HFKW-1234ze (E) (CHF=CH-CF_3) [2]: 22%	2 103 [2]	1 912	2 102
R-460B	HFKW-32 (CH_2F_2): 28% HFKW-125 (CHF_2-CF_3): 25% HFKW-134a (CF_3-CH_2F): 20% HFKW-1234ze (E) (CHF=CH-CF_3) [2]: 27%	1 352 [2]	1 242	1 350
R-460C	HFKW-32 (CH_2F_2): 2,5% HFKW-125 (CHF_2-CF_3): 2,5% HFKW-134a (CF_3-CH_2F): 46% HFKW-1234ze (E) (CHF=CH-CF_3) [2]: 49%	766 [2]	695	763

Industrielle Bezeichnung	Chemische Formel / Zusammensetzung	GWP AR4 [1]	GWP AR5 [3]	GWP F-Gas-VO [5]
R-461A	HFKW-125 (CHF_2-CF_3): 55% HFKW-134a (CH_2F-CF_3): 32% HFKW-143a (CH_3-CF_3): 5% HFKW-227ea (CF_3-CHF-CF_3): 5% R-600a ($(CH_3)_2CH$-CH_3) [1]: 3%	2 767	2 567 [1]	2 767
R-462A	HFKW-32 (CH_2F_2): 9% HFKW-125 (CHF_2-CF_3): 42% HFKW-134a (CH_2F-CF_3): 44% HFKW-143a (CH_3-CF_3): 2% R-600 (CH_3-CH_2-CH_2-CH_3) [1]: 3%	2 249	2 060 [1]	2 249
R-463A	HFKW-32 (CH_2F_2): 36% HFKW-125 (CHF_2-CF_3): 30% HFKW-134a (CH_2F-CF_3): 14% HFKW-1234yf (CH_2=CF-CF_3) [2]: 14% R-744 (CO_2): 6%	1 494 [2]	1 377	1 493
R-464A	HFKW-32 (CH_2F_2): 27% HFKW-125 (CHF_2-CF_3): 27% HFKW-227ea (CF_3-CHF-CF_3): 6% HFKW-1234ze (E) (CHF=CH-CF_3) [2]: 40%	1 323 [2]	1 240	1 321
R-465A	HFKW-32 (CH_2F_2): 21% HFKW-1234yf (CH_2=CF-CF_3) [2]: 71,1% R-290 (CH_3-CH_2-CH_3) [1]: 7,9%	145 [2]	143 [1]	142
R-466A	HFKW-32 (CH_2F_2): 49% HFKW-125 (CHF_2-CF_3): 11,5% R-13I1 (CF_3I) [1]: 39,5%	733	696 [1]	733 [1]
R-467A	HFKW-32 (CH_2F_2): 22% HFKW-125 (CHF_2-CF_3): 5% HFKW-134a (CF_3-CH_2F): 72,4% R-600a ($(CH_3)_2CH$-CH_3) [1]: 0,6%	1 359	1 249 [1]	1 359
R-468A	HFKW-32 (CH_2F_2): 21,5% HFKW-1234yf (CH_2=CF-CF_3) [2]: 75% HFKW-1132a (CH_2=CF_2) [3]: 3,5%	148 [2,3]	146	146
R-468B	HFKW-32 (CH_2F_2): 13% HFKW-1234yf (CH_2=CF-CF_3) [2]: 81% HFKW-1132a (CH_2=CF_2) [3]: 6%	91 [2,3]	89	88
R-468C	HFKW-32 (CH_2F_2): 42% HFKW-1234yf (CH_2=CF-CF_3) [2]: 52% HFKW-1132a (CH_2=CF_2) [3]: 6%	286 [2,3]	285	284
R-469A	HFKW-32 (CH_2F_2): 32,5% HFKW-125 (CHF_2-CF_3): 32,5% R-744 (CO_2): 35%	1 357	1 251	1 357

Industrielle Bezeichnung	Chemische Formel / Zusammensetzung	GWP AR4 [1]	GWP AR5 [3]	GWP F-Gas-VO [5]
R-470A	HFKW-32 (CH_2F_2): 17% HFKW-125 (CHF_2-CF_3): 19% HFKW-134a (CF_3-CH_2F): 7% HFKW-227ea (CF_3-CHF-CF_3): 3% HFKW-1234ze (E) (CHF=CH-CF_3) [2]: 44% R-744 (CO_2): 10%	980 [2]	909	977
R-470B	HFKW-32 (CH_2F_2): 11,5% HFKW-125 (CHF_2-CF_3): 11,5% HFKW-134a (CF_3-CH_2F): 3% HFKW-227ea (CF_3-CHF-CF_3): 7% HFKW-1234ze (E) (CHF=CH-CF_3) [2]: 57% R-744 (CO_2): 10%	753 [2]	717	749
R-471A	HFKW-227ea (CF_3-CHF-CF_3): 4,3% HFKW-1234ze (E) (CHF=CH-CF_3) [2]: 78,7% HFKW-1336mzz (E) (CHF_2-CF_3) [5]: 17,0%	147 [2,5]	148 [5]	143
R-472A	HFKW-32 (CH_2F_2): 12% HFKW-134a (CF_3-CH_2F): 19% R-744 (CO_2): 69%	353	329	353
R-472B	HFKW-32 (CH_2F_2): 10% HFKW-134a (CF_3-CH_2F): 32% R-744 (CO_2): 58%	526	484	526
R-473A	HFKW-23 (CHF_3): 10% HFKW-125 (CHF_2-CF_3): 10% HFKW-1132a (CH_2=CF_2) [3]: 20% R-744 (CO_2): 60%	1 831 [3]	1 558	1 831
R-474A	HFKW-1132 (E) (CHF=CHF) [3]: 23% HFKW-1234yf (CH_2=CF-CF_3) [2]: 77%	3 [2,3]	1	1
R-474B	HFKW-1132 (E) (CHF=CHF) [3]: 31,5% HFKW-1234yf (CH_2=CF-CF_3) [2]: 68,5%	3 [2,3]	1	1
R-475A	HFKW-134a (CF_3-CH_2F): 43% HFKW-1234yf (CH_2=CF-CF_3) [2]: 45% HFKW-1234ze (E) (CF_3-CH=CHF) [2]: 12%	618 [2]	560	615
R-475B	HFKW-134a (CF_3-CH_2F): 10,1% HFKW-1234yf (CH_2=CF-CF_3) [2]: 35,4% HFKW-1234ze (E) (CF_3-CH=CHF) [2]: 54,5%	150 [2]	132	145
R-476A	HFKW-134a (CF_3-CH_2F): 10% HFKW-1234ze (E) (CF_3-CH=CHF) [2]: 78% HFKW-1336mzz (E) (CF_3-CH=CH-CF_3) [5]: 12%	151 [2,5]	133 [5]	146

Industrielle Bezeichnung	Chemische Formel / Zusammensetzung	GWP AR4 [1]	GWP AR5 [3]	GWP F-Gas-VO [5]
R-478A	HFKW-32 (CH_2F_2): 26% HFKW-125 (CHF_2-CF_3): 15% HFKW-134a (CF_3-CH_2F): 15% HFKW-152a (CHF_2-CH_3): 3% HFKW-227ea (CF_3-CHF-CF_3): 4% HFKW-1234ze (E) (CF_3-CH=CHF) [2]: 30% R-744 (CO_2): 7%	1 050 [2]	985	1 048
R-479A	HFKW-32 (CH_2F_2): 21,5% HFKW-1132 (E) (CHF=CHF) [3]: 28% HFKW-1234yf (CH_2=CF-CF_3) [2]: 50,5%	147 [2,3]	146	146
R-479B	HFKW-32 (CH_2F_2): 44% HFKW-1132 (E) (CHF=CHF) [3]: 23% HFKW-1234yf (CH_2=CF-CF_3) [2]: 33%	299 [2,3]	298	297
R-480A	HFKW-227ea (CF_3-CHF-CF_3): 9% HFKW-1234ze (E) (CF_3-CH=CHF) [2]: 86% R-744 (CO_2): 5%	296 [2]	302	291
R-481A	HFKW-32 (CH_2F_2): 16,9% HFKW-125 (CHF_2-CF_3): 6,3% HFKW-134a (CF_3-CH_2F): 74,4% HFCKW-1233zd (E) (CHCl=CH-CF_3) [2]: 1,8% R-601a ($(CH_3)_2$CH-CH_2-CH_3) [4]: 0,6%	1 399 [2,4]	1 281 [4]	1 399
R-482A	HFKW-134a (CF_3-CH_2F): 10% HFCKW-1224yd (Z) (CHCl=CF-CF_3) [3]: 6,5% HFKW-1234ze (E) (CF_3-CH=CHF) [2]: 83,5%	143 [2,3]	130	143
R-485A	HFKW-32 (CH_2F_2): 21% HFKW-1132a (CH_2=CF_2) [3]: 10% R-744 (CO_2): 69%	143 [3]	143	142
R-486A	HFKW-134a (CF_3-CH_2F): 6,3% HFKW-1234yf (CH_2=CF-CF_3) [2]: 21,9% HFKW-1234ze (E) (CF_3-CH=CHF) [2]: 33,8% R-13I1 (CF_3I) [1]: 38%	93 [2]	83 [1]	91 [1]
R-488A	HFKW-32 (CH_2F_2): 6% HFKW-152a (CHF_2-CH_3): 3% HFKW-1234yf (CH_2=CF-CF_3) [2]: 50% HFKW-1234ze (E) (CF_3-CH=CHF) [2]: 41%	49 [2]	46	45
R-491A	HFKW-152a (CH_3-CHF_2): 65% HFKW-1132 (E) (CHF=CHF) [2]: 35%	81 [2]	90	81
R-492A	HFKW-32 (CH_2F_2): 18% HFKW-152a (CH_3-CHF_2): 14% HFKW-1132a (CH_2=CF_2) [3]: 12% HFKW-1234ze (CHF=CH-CF_3) [2]: 56%	143 [3]	142	140
R-494A	HFKW-152a (CH_3-CHF_2): 60% R-13I1 (CF_3I) [1]: 36% R-744 (CO_2): 4%	75	83 [1]	75 [1]

Industrielle Bezeichnung	Chemische Formel / Zusammensetzung	GWP AR4 [1]	GWP AR5 [3]	GWP F-Gas-VO [5]
R-494B	HFKW-152a (CH_3-CHF_2): 38% R-13I1 (CF_3I) [1]: 58% R-744 (CO_2): 4%	47	53 [1]	47 [1]
R-495A	HFKW-32 (CH_2F_2): 4,5% HFKW-134a (CF_3-CH_2F): 9% HFKW-1234yf (CH_2=CF-CF_3) [2]: 76% HFKW-1234ze (E) (CF_3-CH=CHF) [2]: 10,5%	163 [2]	148	160
R-496A	FKW-14 (CF_4): 18% HFKW-23 (CHF_3): 37,8% FKW-116 (C_2F_6): 44,2%	12 317	10 787	12 404
R-497A	R-1270 (CH_2=CH-CH_3): 15% R-13I1 (CF_3I) [1]: 85%	0,6	0,6 [1]	0,3 [1]
R-498A	R-170 (CH_3-CH_3): 7% R-290 (CH_3-CH_2-CH_3) [1]: 8% R-13I1 (CF_3I) [1]: 85%	1	1 [1]	0,4 [1]
R-4101A	HFKW-32 (CH_2F_2): 11% HFKW-152a (CH_3-CHF_2): 30,5% R-13I1 (CF_3I) [1]: 58,5%	112	117 [1]	112 [1]
R-4102A	HFKW-134a (CF_3-CH_2F): 10% HFKW-1234ze (E) (CF_3-CH=CHF) [2]: 60% HFCKW-1233zd (E) (CHCl=CH-CF_3) [2]: 30%	149 [2]	131	145
R-4103A	HFKW-32 (CH_2F_2): 10% HFKW-152a (CH_3-CHF_2): 22% HFKW-1234ze (E) (CF_3-CH=CHF) [2]: 51% R-13I1 (CF_3I) [1]: 17%	98 [2]	99 [1]	96 [1]
R-4104A	HFKW-1132a (CH_2=CF_2) [3]: 5,4% R-13I1 (CF_3I) [1]: 94,6%	1 [3]	1 [1]	0,1 [1]
R-4105A	HFKW-32 (CH_2F_2): 15% HFKW-1234yf (CH_2=CF-CF_3) [2]: 70% HFKW-1234ze (E) (CF_3-CH=CHF) [2]: 12,2% R-600a ((CH_3)$_2$CH-CH_3) [1]: 3% R-744 (CO_2): 0,8%	105 [2]	102 [1]	102 [1]
R-4106A	HFKW-32 (CH_2F_2): 72,8% HFKW-125 (CHF_2-CF_3): 5,2% HFKW-1234ze (E) (CF_3-CH=CHF) [2]: 20% R-744 (CO_2): 2,0%	675 [2]	658	674
R-507A	HFKW-125 (CHF_2-CF_3): 50% HFKW-143a (CH_3-CF_3): 50%	3 985	3 985	3 985
R-508A	HFKW-23 (CHF_3): 39% FKW-116 (C_2F_6): 61%	13 214	11 607	13 336
R-508B	HFKW-23 (CHF_3): 46% FKW-116 (C_2F_6): 54%	13 396	11 698	13 504
R-511A	R-E170 (CH_3-O-CH_3) [1]: 5% R-290 (CH_3-CH_2-CH_3) [1]: 95%	3	3 [1]	0,07

Industrielle Bezeichnung	Chemische Formel / Zusammensetzung	GWP AR4 [1]	GWP AR5 [3]	GWP F-Gas-VO [5]
R-512A	HFKW-134a (CF_3-CH_2F): 5% HFKW-152a (CHF_2-CH_3): 95%	189	196	189
R-513A	HFKW-134a (CF_3-CH_2F): 44% HFKW-1234yf (CH_2=CF-CF_3) [2]: 56%	631 [2]	573	629
R-513B	HFKW-134a (CF_3-CH_2F): 41,5% HFKW-1234yf (CH_2=CF-CF_3) [2]: 58,5%	596 [2]	540	594
R-514A	HFKW-1336mzz (Z) (CF_3-CH=CH-CF_3) [2]: 74,7% HCKW-1130 (E) (CHCl=CHCl) [3]: 25,3%	7 [2,3]	2	2 [3]
R-515A	HFKW-227ea (CF_3-CHF-CF_3): 12% HFKW-1234ze (E) (CHF=CH-CF_3) [2]: 88%	393 [2]	403	388
R-515B	HFKW-227ea (CF_3-CHF-CF_3): 8,9% HFKW-1234ze (E) (CHF=CH-CF_3) [2]: 91,1%	293 [2]	299	288
R-516A	HFKW-134a (CF_3-CH_2F): 8,5% HFKW-152a (CHF_2-CH_3): 14% HFKW-1234yf (CH_2=CF-CF_3) [2]: 77,5%	142 [2]	131	139
Isceon® MO89	HFKW-125 (CF_3-CHF_2): 86% FKW-218 (CF_3-CF_2-CF_3): 9% R-290 (CH_3-CH_2-CH_3) [1]: 5%	3 805	3 527 [1]	3 846

[1] GWP_{100} aus: Climate Change 2007: *The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 996 pp.

[2] GWP_{100} aus: WMO (World Meteorological Organization), Scientific Assessment of Ozone Depletion: 2010, Global Ozone Research and Monitoring Project–Report No. 52, Geneva, Switzerland, 2010.

[3] GWP_{100} aus: Climate Change 2013: *The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 1535 pp.

[4] Standardwert aufgrund des GWP_{100} anderer Kohlenwasserstoffe.

[5] GWP_{100} aus: Verordnung (EU) 2024/573 des Europäischen Parlaments und des Rates vom 7. Februar 2024 über fluorierte Treibhausgase, zur Änderung der Richtlinie (EU) 2019/1937 und zur Aufhebung der Verordnung (EU) Nr. 517/2014. https://eur-lex.europa.eu/legal-content/DE/TXT/?uri=CELEX:32024R0573 (07.03.2024).

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