

Refrigerants: Real GWP and PFAS

			IPCC AR4 (2007)		IPCC AR6 (2021)		PFAS
Refrigerants / Brand Name	Type	Composition	GWP 100 years	Real GWP 20 years	GWP 100 years	Real GWP 20 years	Yes/No
R143a	HFC	100% R143a	4470	5890	5810	7840	Yes
R125	HFC	100% R125	3500	6350	3740	6740	Yes
R134a	HFC	100% R134a	1430	3830	1530	4140	Yes
R32	HFC	100% R32	650	2330	771	2690	No
R404A Freon 404A	HFC	44% R125 / 4% R134a / 52% R143a	3922	6010	4728	7208	Yes
R407A Freon 407A	HFC	20% R32, 40% R125, 40% R134a	2102	4538	2262	4890	Yes
R410A Freon 410A	HFC	50% R125 / 50% R32	2075	4340	2255	4715	Yes
R407C Freon 407C	HFC	23% R32 / 25% R125 / 52% R134a	1768	4115	1908	4457	Yes
R452A Opteon XP44	HFC/ HFO	11% R32 / 59% R125 / 30% R1234yf	2137	4003	2292	4273	Yes
R449A Opteon XP40	HFC/ HFO	24.3% R32 / 24.7% R125 / 25.7% R134a / 25.3% R1234yf	1390	3119	1504	3383	Yes
R448A Solstice N40	HFC/ HFO	26% R32 / 26% R125 / 21% R134a / 7% R1234ze / 20% R1234yf	1379	3062	1494	3321	Yes
R449C Opteon XP20	HFC/ HFO	20% R32 / 20% R125 / 29% R134a / 31% R1234yf	1245	2847	1346	3087	Yes
R452B Opteon XL55	HFC/ HFO	67% R32 / 7% R125 / 26% R1234yf	681	2006	779	2275	Yes
R454B Opteon XL41	HFC/ HFO	68.9% R32 / 31.1% R1234yf	448	1606	531	1854	Yes
R513A Opteon XP10	HFC/ HFO	44% R134a / 56% R1234yf	629	1686	673	1823	Yes
R450A Solstice N13	HFC/ HFO	42% R134a / 58% R1234ze	601	1611	643	1742	Yes
R454C Opteon XL20	HFC/ HFO	78.5% R1234yf / 21.5% R32	140	502	166	580	Yes
R455A Solstice L40X	HFC/ HFO	75.5% R1234yf / 21.5% R32 / 3% R744	140	502	166	580	Yes
R744	Natural	CO ₂	1	1	1	1	No
R600a	Natural	Isobutane	<1	<1	<1	<1	No
R290	Natural	Propane	<1	<1	<1	<1	No
R1270	Natural	Propylene	<1	<1	<1	<1	No
R717	Natural	NH ₃	0	0	0	0	No
R718	Natural	H ₂ O	0	0	0	0	No
R729	Natural	Air	0	0	0	0	No



ATMOsphere calls for the adoption of the 20-year GWP and the avoidance of PFAS refrigerants

The effects of global warming are already visible across the whole globe, with estimated global economic costs reaching up to US\$178 trillion by 2070.¹ Scientists have slowly yet steadily advanced their understanding of fluorinated greenhouse gases' behavior in the atmosphere, refining their tools to understand their heat trapping potential.

It is alarming to see that Assessment Report after Assessment Report, these human-made substances have overwhelmingly increased global warming potential, not only on a 100-year perspective, but on a 20-year too. Comparisons between both 20-year and 100-year values, as well as between Assessment Reports, show a story of neglected urgency. Policymakers are still relying on outdated values from the Fourth Assessment Report written in 2007 to comply with international legal obligations. ATMOsphere urges policymakers worldwide to reflect scientific advancements across legislation governing the use of these gases and to adopt the latest values.

Climate action based on these values has the potential to yield much needed short-term climate benefits. In addition, carbon dioxide GWP value on a 20-year perspective is unaltered, so efforts taken on these short-lived fluorinated greenhouse gases would not hamper or neglect action on other long-lived heat trapping molecules. ATMOsphere believes there is no margin left to consider the climate impact of these gases on a 100-year perspective. The science is clear: we have already increased global temperature by 1.2°C² and are set to overshoot the 1.5°C threshold even before 2027.³

In addition, we should not solve the climate problem by worsening another one. Per- and polyfluoroalkyl substances (PFAS) are "forever chemicals," meaning they stay with us and in the environment for a long time. Different PFAS have been related to multiple health hazards,⁴ and there is widespread evidence of PFAS contamination.⁵ Most of the commonly used fluorinated refrigerants are considered PFAS according to the definition of these chemicals proposed by the OECD⁶ and are investigated under the legislation governing chemicals' use in Europe.

Natural heat-carrying fluids are a technologically available reality in HVAC&R systems across the globe for all applications; these working fluids have simpler chemical structures that can be found in nature, do not deplete the ozone layer and do not disproportionately alter climate systems.

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Notes to the table:

- Values listed under the IPCC AR4 column are sourced from: https://archive.ipcc.ch/publications_and_data/ar4/wg1/en/ch2s2-10-2.html
- Values listed under the IPCC AR6 column are sourced from: https://www.ipcc.ch/report/ar6/wg1/downloads/report/IPCC_AR6_WGI_Chapter07_SM.pdf
- PFAS refrigerants are those meeting the working scope of the European PFAS Restriction Intention. Available for reference here: <https://echa.europa.eu/registry-of-restriction-intentions/-/dislist/details/0b0236e18663449b>
- Values of blends are reported as of the weighted sum of the single components, in accordance with the formula listed in Annex IV of the EU F-gas Regulation. For values under IPCC AR4 of blends containing refrigerants not yet invented at the time, the values listed under the IPCC AR6 are taken into account. Weighted sum are linear calculations and do not consider higher or lower percentages of single components that might compose the blend.
- Beside carbon dioxide, natural refrigerant values are not listed in either Assessment reports, hence are reported directly from the previous ATMOsphere factsheet available here: <https://atmosphere.cool/fact-sheets/impact-of-refrigerants-fact-sheet-1-v-1-1/>
- Propane, R290, is listed in the IPCC Sixth Assessment Report with the values of 0.02 and 0.072 for GWP 100 years and GWP 20 years, respectively.

Notes to the text

1. Deloitte, 2022. Deloitte research reveals inaction on climate change could cost the world's economy US\$178 trillion by 2070. Sourced from: <https://www.deloitte.com/an/en/about/press-room/deloitte-research-reveals-inaction-on-climate-change-could-cost-the-world-economy-us-dollar-178-trillion-by-2070.html>
2. European Commission. Copernicus. Global indicator. Climate - Temperatures. Available online at: <https://climate.copernicus.eu/esotc/2022/temperature#:~:text=The%20annual%20average%20temperature%20shows,the%20warmest%20year%20on%20record>
3. World Meteorological Organisation. Global Annual to Decadal Climate Update. Target years: 2023 and 2023-2027. Available online at: <https://lib.icimod.org/record/36305#:~:text=AddThis%20Sharing%20Buttons-WMO%20Global%20Annual%20to%20Decadal%20Climate,Target%20years%3A%202023%202027>
4. European Chemical Agency. Per- and polyfluoroalkyl substances (PFAS). Available online at: <https://echa.europa.eu/hot-topics/perfluoroalkyl-chemicals-pfas>
5. See for instance the work conducted by the Forever Pollution Project in Europe, available online at: <https://foreverpollution.eu/>, and the PFAS Project Lab in the US, available online at: <https://pfasproject.com/>
6. OECD. Reconciling Terminology of the Universe of Per- and Polyfluoroalkyl Substances: Recommendations and Practical Guidance. Available online at: <https://www.oecd.org/chemicalsafety/portal-perfluorinated-chemicals/terminology-per-and-polyfluoroalkyl-substances.pdf>