SAP 2026 update on emissions of HFC-23

Scientific Assessment Panel Response to Decision XXXVII/2: ***Emissions of HFC-23***

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With thanks to:
TEAP, TEAP's MCTOC, the Multilateral Fund, and the Ozone Secretariat

Other contributors:
AGAGE scientists and data providers, L. Western

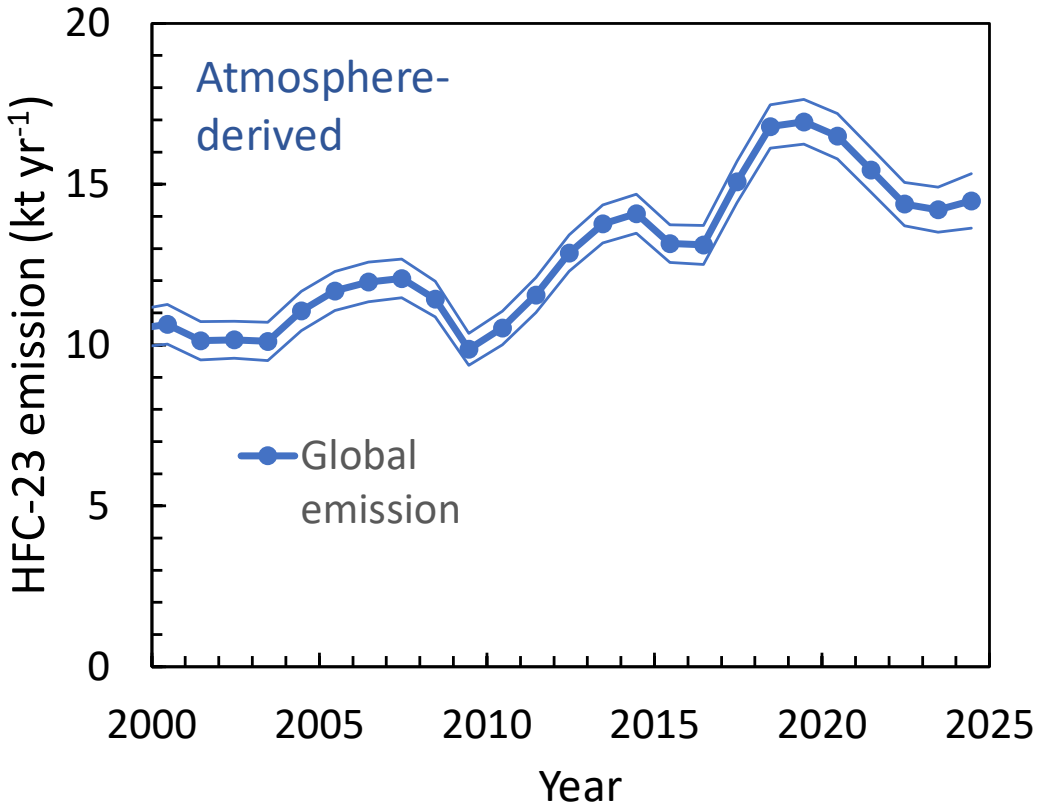
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SAP 2026 update on emissions of HFC-23

- **Decision XXXVII/2 requests an update by SAP and TEAP on emissions of HFC-23, specifically on the discrepancy between reported emissions and those derived from atmospheric measurements.**
- **This update follows SAP special reports on HFC-23 emissions in 2024 and 2025, and it is based on information emerging since those reports, including:**
  - The 2026 Scientific Assessment of Ozone Depletion Quadrennial Report
    - *which includes updated global atmospheric measurements (through 2024)*
  - TEAP reports on HFC-23 in 2024, 2025, and 2026
  - Updated reporting to the Ozone Secretariat of production, generation, and emissions of halocarbons including HFC-23

Global HFC-23 emissions derived from atmospheric measurements

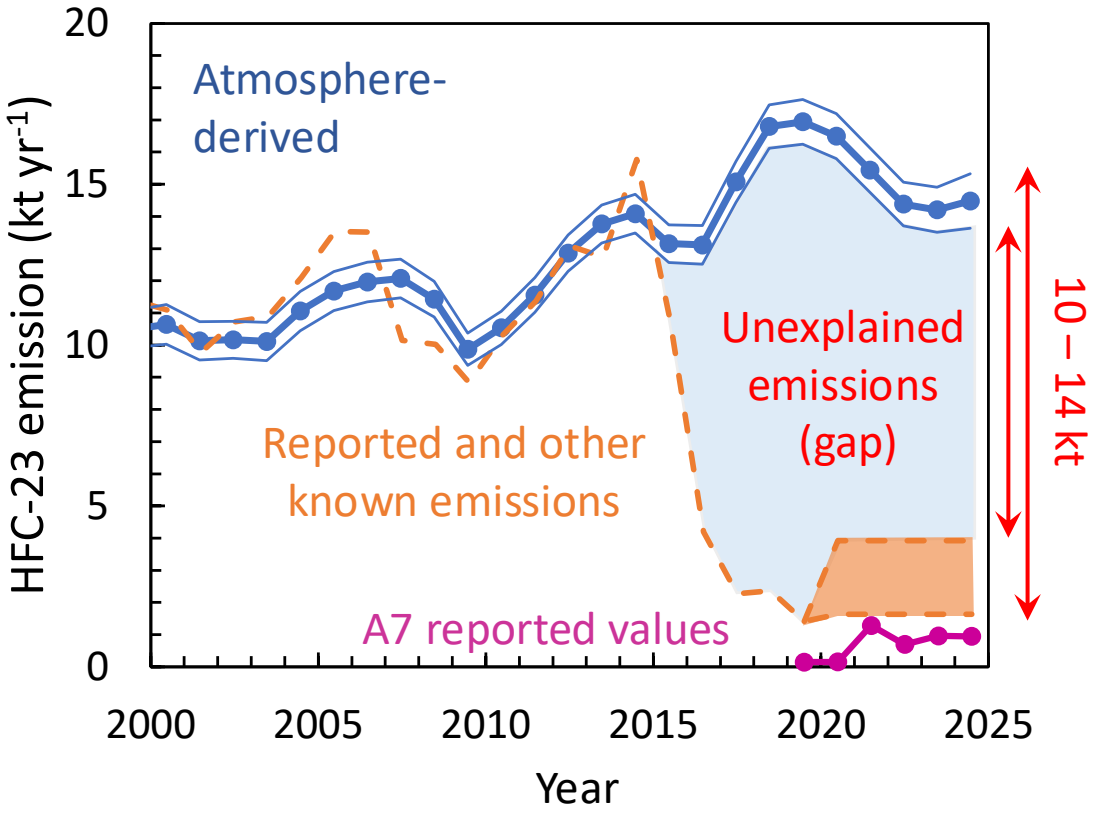
- **Global HFC-23 emissions in 2024 derived from measured atmospheric abundances totaled 14 ± 1 kt yr^{-1} and were 16 ± 7% lower than peak emissions derived for 2018-2019 of 17 ± 1 kt yr^{-1}.**
- **Emissions did not change appreciably from 2022 through 2024 (14 ± 1 kt yr^{-1}).**
- **Emissions have declined from their peak despite a 20% increase over that same period in HCFC-22 production, the process thought to be primarily responsible for HFC-23 generation.**



Global emissions: Comparing *atmosphere-derived* to *reporting-based* totals

- **More than three quarters of HFC-23 emissions in 2024 derived from atmospheric measurements cannot be explained by reported emissions and other known sources.**
- **The unexplained emissions emerged around 2015 and coincide with an increase in reported abatement of HFC-23.**
- **In 2024, the difference (or gap) between atmosphere-derived and reporting-based global total emissions was 10-14 kt yr^{-1}.** This gap has decreased from its high of 15 kt yr^{-1} in 2019.

A7 reported emissions are shown for reference



Adapted from Figure ES-4 from the Executive Summary of the 2026 Ozone Assessment using TEAP & Secretariat data

Estimating the HFC-23 source from *atmospheric photochemistry*

- **The breakdown of some HFCs, HFOs, and HCFOs in the atmosphere forms HFC-23.**
- **This source is less than 2% of current global HFC-23 emissions and is projected to remain under 20% throughout the 21st century relative to current emissions of HFC-23.**
- *An explicit modeling analysis* since SAP 2026 Assessment Report suggests the current contribution is about an order of magnitude smaller than 2%.*

Contributing gases that have been measured in the atmosphere:

HFC-143a	HFO-1234ze(E)
HFC-245fa	HFO-1336mzz(E)
HFC-365mfc	HCFO-1233zd(E)
HFC-236fa	

HCFC-133a

→ *Contributing gases have the chemical structure:*

CF_3CH_2 - R or
CF_3CH = R

** Adam et al., https://doi.org/10.5194/acp-26-10979-2026*

Regional emissions of HFC-23 through 2023

Unchanged from the 2025 SAP Report on HFC-23 emissions

- **Our understanding of regional contributions to global HFC-23 emissions remains incomplete.**
- **The sum of all available observationally-derived regional emission estimates accounted for only 43 ± 10 % of global emissions in 2023 (6.1 ± 0.7 kt yr^{-1}).**
- **Regional emission of HFC-23:**

5.6 ± 0.7 kt	eastern China
0.23 ± 0.02 kt	Republic of Korea
0.15 ± 0.04 kt	north-western EU (Belgium, France, Germany, Luxembourg, Netherlands, UK)
0.10 ± 0.07 kt	western Japan
0.025 kt	Australia
0.01 ± 0.01 kt	Democratic People's Republic of Korea

- **These countries accounted for the majority (~93%) of reported HFC-23 generation in 2023;**
  - China accounted for 79% of total reported HFC-23 generation in 2023

Take-home messages from the 2026 update from SAP

- **Global emissions of HFC-23 have dropped 16% from their peak in 2018-2019, and have remained unchanged from 2022 to 2024 at 14 ± 1 kt yr^{-1}.** Global HCFC-22 production in 2024 was 20% larger than in 2018-2019.
- **The difference (or gap) between atmosphere-derived and estimates of emissions from all known sources remains substantial. This gap was 10-14 kt yr^{-1} of HFC-23 in 2024.**
- **Regional emissions of HFC-23 estimated from atmospheric measurements account for 43% of global total emissions. Regional emission estimates are available for the majority of regions that produce HCFC-22.**

THANK YOU FOR YOUR ATTENTION,

MURAKOZE!