

# Recent increases in global HFC-23 emissions

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 Published in *Geophysical Research Letters*, 29 January 2010  
 (Volume 37, L02808, doi:10.1029/2009GL041195, 2010)

**Global atmospheric concentrations and emissions of HFC-23 have continued to increase despite efforts in both developed and developing countries to reduce emissions of this potent greenhouse gas during the past decade.**

**• Observations:** Recent HFC-23 emissions were derived from gas measurements made in ambient air and in the Antarctic snowpack (firn) three times between 2001 and 2009.

**Background: HFC-23**  
 Hydrofluorocarbon-23 (HFC-23) emissions arise primarily from over-fluorination of chloroform during HCFC-22 production.

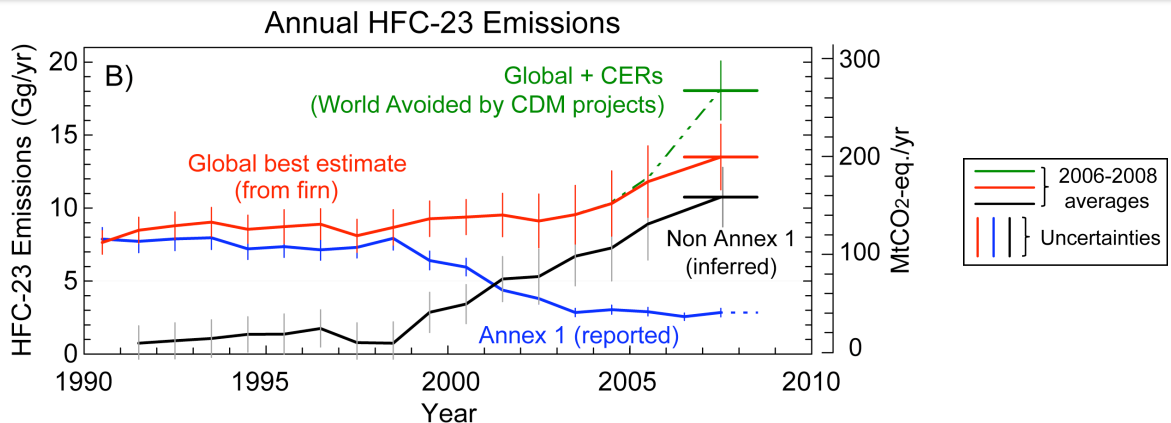


Figure lines

— Global annual HFC-23 emissions derived from atmospheric and firn air observations.

Global HFC-23 emissions have **increased** by 55% :  
 • 2006-2008 average: 13.5 ± 2 Gg/yr or 200 ± 30 Mt CO<sub>2</sub>-eq.  
 • 1990-2000 average: 8.7 ± 1 Gg/yr or 129 ± 15 Mt CO<sub>2</sub>-eq.

— Developed country (Annex 1) annual HFC-23 emissions reported to UNFCCC.  
 • HFC-23 emissions have **decreased** in developed countries from 6 - 8 Gg/yr in the late 1990s to 2.8 Gg/yr in 2007.

— Developing country (non-Annex 1) annual HFC-23 emissions. They are inferred here as the difference between derived global emissions and reported Annex-1 emissions. Non-Annex-1 HFC-23 emissions are generally not reported to the UNFCCC.

• HFC-23 emissions have **increased** steadily in developing countries from 1 - 3 Gg/yr in the 1990s to 11 ± 2 Gg/yr in 2006-2008 as a result of rapidly increasing HCFC-22 production.

— World Avoided by CDM projects: Global annual HFC-23 emissions from atmospheric observations + HFC-23 amounts destroyed by **Certified Emission Reductions (CERs)** under the UNFCCC Clean Development Mechanism (CDM).

• Without CERs, HFC-23 global emissions would have **doubled** from approximately 9 to 18 Gg/yr between 2000-2002 and 2006-2008.

• Substantial amounts of HCFC-22 were produced but **not covered** by existing CDM projects (~57%) in 2007 and the HFC-23 associated with this production appears to be emitted to the atmosphere.

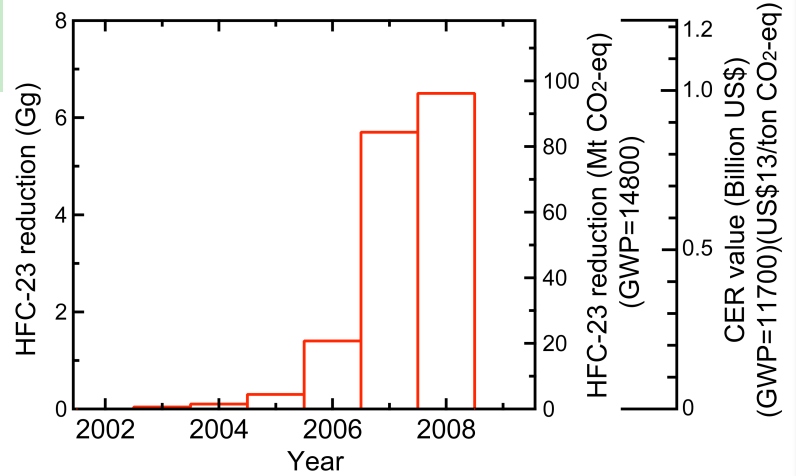
**Background:**  
 HFC-23 has a 100-yr global warming potential (GWP) of 14,800 (or 11,700 for UNFCCC CDM purposes).  
 1Gg HFC-23 = 14.8 Mt CO<sub>2</sub>-eq  
 1Gg HCFC-22 = 1.8 Mt CO<sub>2</sub>-eq

- HFC-23 CERs through 2008 total 14 Gg which corresponds to **208 Mt CO<sub>2</sub>-eq.** of emission reduction.

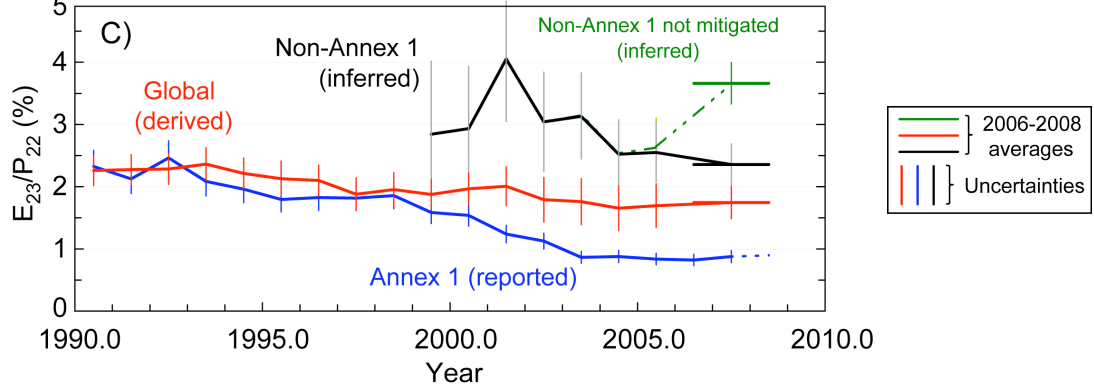
- HFC-23 CO<sub>2</sub>-eq. emissions in recent years have been about **1/3 as large** as HCFC-22 CO<sub>2</sub>-eq. emissions because of the large GWP of HFC-23 and despite the low yield in HCFC-22 production.

- The total value of CERs between 2003 and 2008 is **2.1 Billion US\$** assuming a HFC-23 GWP of 11700 and a US\$13/ton CO<sub>2</sub>-eq market value. (Wara, 2007)

HFC-23 Certified Emission Reductions (CERs)



HFC-23 emission to HCFC-22 production ratio ( $E_{23}/P_{22}$ )



**Annual ratio of global HFC-23 emissions to global HCFC-22 production ( $E_{23}/P_{22}$ )**

- Global HFC-23 emissions as a percentage of total HCFC production have **decreased** since the mid 1990's to an average value of 1.7% in 2006-2008.

**Developed country (Annex 1) annual  $E_{23}/P_{22}$  ratios from values reported to UNFCCC and UNEP.**

- $E_{23}/P_{22}$  values have steadily **decreased** in developed countries from approximately 2% in the 1990s to 0.9% during 2003-2007.

**Developing country (non-Annex 1) annual  $E_{23}/P_{22}$  ratios from inferred HFC-23 emissions and reported HCFC-22 production.**

- $E_{23}/P_{22}$  values have **decreased** in developing countries since the early 2000's to reach  $2.4 \pm 0.3\%$  for 2006-2008.

**Developing country (non-Annex 1) annual  $E_{23}/P_{22}$  ratios from inferred HFC-23 emissions and HCFC-22 production not associated with CDM projects.**

- $E_{23}/P_{22}$  values in HCFC-22 production not associated with CDM projects are **high** ( $3.7 \pm 0.3\%$ ) compared to values in the past obtained in either non-Annex-1 or Annex-1 countries.

**Background:**

Under the Montreal Protocol HCFC-22 production and consumption for non-feedstock uses will end in developed/developing countries in 2020/2030. The Montreal Protocol does not restrict feedstock production of HCFC-22.

Figure lines

