Recent increases in global HFC-23 emissions

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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 (firm) 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.

Global annual HFC-23 emissions have increased by 55%:
• 2006-2008 average: 13.5 ± 2 Gg/yr or 200 ± 30 Mt CO₂-eq.
• 1990-2000 average: 8.7 ± 1 Gg/yr or 129 ± 15 Mt CO₂-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 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: Global annual HFC-23 emissions from atmospheric observations + 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.
• HFC-23 CERs through 2008 total 14 Gg which corresponds to 208 Mt CO₂-eq. of climate protection.

• HFC-23 CO₂-eq. emissions in recent years have been about 1/3 as large as HCFC-22 CO₂-eq. emissions despite only a 1.5 - 2.5% yield of HFC-23 during 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 CO₂-eq market value.

• 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.

• E₂₃/P₂₂ values have steadily decreased in developed countries from approximately 2% in the 1990s to 0.9% during 2003-2007.

• E₂₃/P₂₂ values have decreased in developing countries since the early 2000’s to reach 2.4 ± 0.3% for 2006-2008.

• E₂₃/P₂₂ values in HCFC-22 production not associated with CDM projects are high (3.7 ± 0.3%) compared to values in the past obtained in either non-Annex-1 or Annex-1 countries.

Background:
Developing country (Annex 1) annual HCFC-22 production as reported to UNEP.

- Developed country annual HCFC-22 production has decreased in the last decade.

Developing country (non-Annex 1) annual HCFC-22 production as reported to UNEP.

- Developing country annual HCFC-22 production has increased with a substantial growth rate in the last decade.

Developing country (non-Annex 1) annual HCFC-22 production not associated with CDM projects.

- A large fraction (57%) of developing country HCFC-22 production was not included in CDM projects in 2007 and hence is associated with unmitigated HFC-23 production.

** Data reported to the United Nations Environment Programme (UNEP). Data for years before 1996 are incomplete for feedstock and non-feedstock uses.

Total HCFC-22 production = feedstock (fluoropolymers, e.g., Teflon, etc.) + non-feedstock (emissive uses, e.g., air conditioning and refrigeration).

Annual HCFC-22 Feedstock and Non-feedstock Production **

- The Montreal Protocol does not control HCFC-22 feedstock production so when the HCFC-22 phaseout is complete in 2020/2030, HFC-23 will potentially still be emitted from continuing HCFC-22 feedstock production.

- Feedstock use of HCFC-22 since the mid 1990s has increased in both Annex-1 and non-Annex-1 countries and currently has a large growth rate in non-Annex-1 countries.

- Non-feedstock use has fallen steadily in developed countries in the last decade while it has increased strongly (25%/yr) in developing countries since 2002.

- Production of HCFC-22 for feedstock use worldwide accounted for 37% (over a third) of total HCFC-22 production in 2007 and has been increasing at ~5% per year in recent years.

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