

GREENPEACE

F-gases and Radiative Forcing

Greenhouse gases have different strengths – some warm the globe more than others. To measure their net impact on the climate system, we use radiative forcing. The International Panel on Climate Change (IPCC) regularly measures the total net human contribution to radiative forcing. Their findings show two things:

1. A significant proportion of the global warming already happening is due to F-gases, including banned ozone-depleting substances, already in the atmosphere.
2. The effect of the legal gas HFC will grow massively if allowed to be produced in “business as usual” amounts.

Types of gases

Ozone depleting substances: now banned under the Montreal Protocol of 1992

Chlorofluorocarbons (CFCs), Hydro-chlorofluorocarbons (HCFCs), Carbon Tetrachloride (CCL₄)

Kyoto F-gases: counted in Kyoto Protocol measurements for human-induced warming

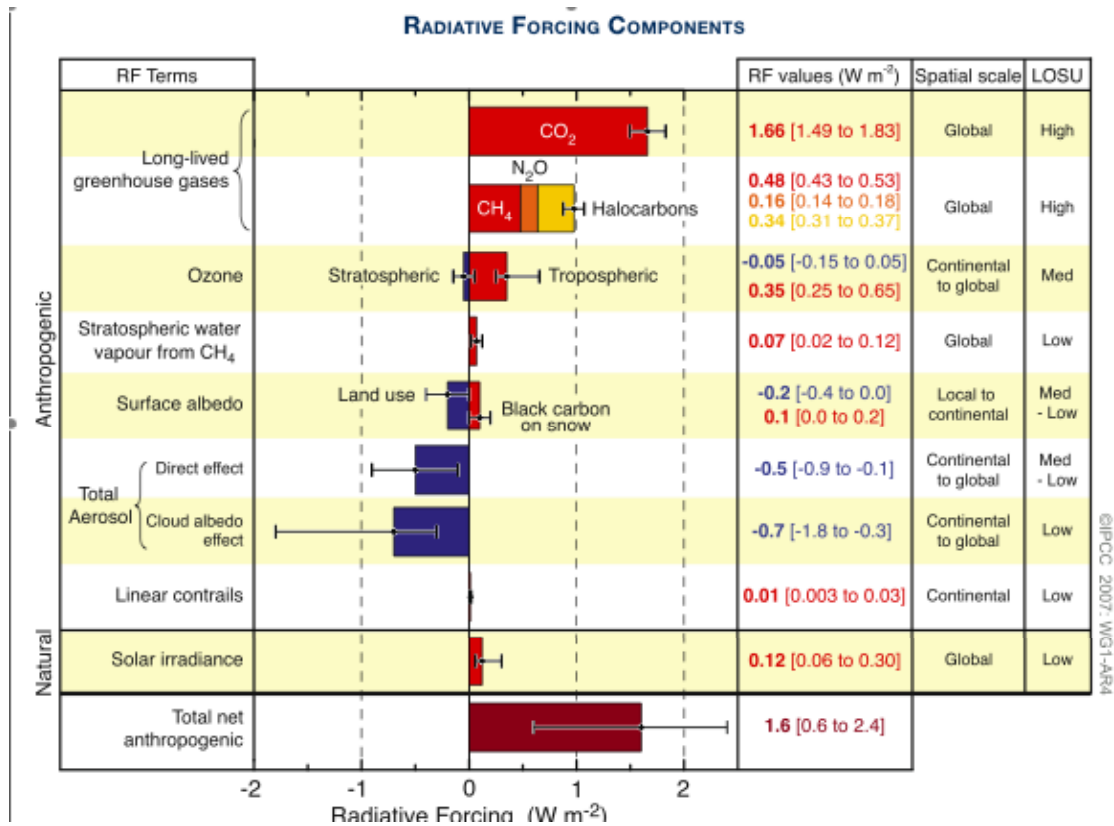
Hydro-fluorocarbons (HFCs), Perfluorocarbons (PFCs), and Sulphur Hexafluoride (SF₆)

Radiative forcing is measured at the top of the troposphere; approximately 10km above the Earth's surface. The units are Watts per square metre (W/m²), describing how much power or heat is applied per square metre. It is important to note that the radiative forcing of a substance is not the same as its emissions.

Radiative forcing is linked to emissions of a substance, but it does not follow that because something contributed 10% to global carbon emissions in a certain year, its radiative forcing will be 10% of the total that year. For example, CFCs, HCFCs and Cl₄ only accounted for a small percentage of carbon emissions in 2005, but their built up presence in the atmosphere made them responsible for 17% of the total net human-caused radiative forcing that year.

The table below is from the 2007 IPCC report, and shows radiative forcing values for 2005.¹ In this table, “anthropogenic”, means the global warming created by people. The total net amount is 1.6 watts per metre (W/m²). The contributions of all the different sources of warming are shown to the right of zero as red and orange bars.

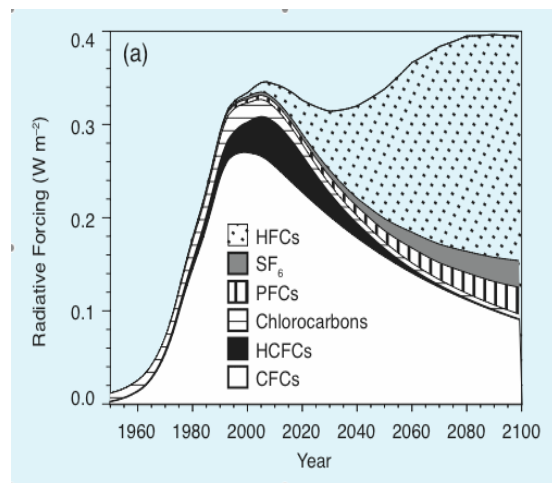
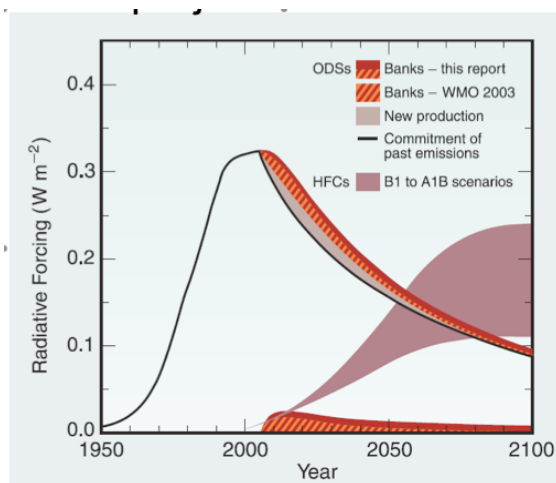
- According to the IPCC data, all halocarbons and F-gases were responsible for **18% of total net anthropogenic radiative forcing in 2005.**²
- Of all the halocarbons and F-gases combined, **the ozone-depleting gases already in the atmosphere contributed the most, 16.8%** of total positive forcing.^{3,4}
- In 2005, **HFCs alone contributed only 0.6% to total warming caused by humans**, while all the Kyoto F-gases combined contributed 1%^{5,6}.



So right now, the majority of warming from halocarbons and F-gases comes from ozone depleting substances phased out under the Montreal Protocol. Because of the ban, the contribution of ozone-depleting substances should go down steadily over the next 100 years, as shown in graphs below⁷. However, the potential climate benefits of the ban could be more than cancelled out by the current uptake of HFCs.

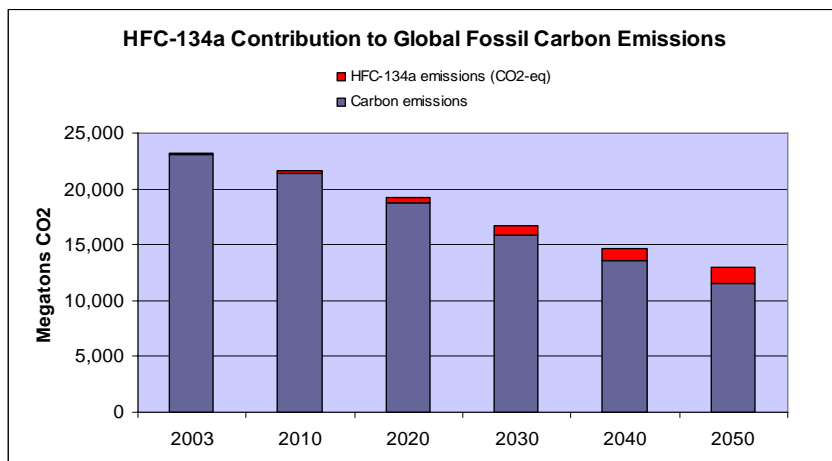
HFC Emissions

The graph to the right shows that under a business-as-usual scenario, **HFCs will overtake ozone-depleting substances in their contribution to total global warming** caused by humans by the 2050s⁸. The term “banks” refers to that amount of gas that had already been manufactured and is currently inside appliances, cars, etc.



In combating global warming, we urgently need to slash the world's total carbon dioxide emissions (CO₂). Greenpeace released the *Energy [R]evolution* scenario to show how we can make a 50% reduction of fossil CO₂ emissions by 2050 from 2000 levels. If we do not do this, we face runaway climate change.

As carbon emissions are reduced in the future the relative levels of HFCs could increase, making a bigger and bigger contribution to warming in the next 40 years. The chart below illustrates the drop in fossil carbon emissions under the *Energy [R]evolution* scenario and in red, shows how much the level of HFC-134a emissions currently predicted by the IPCC^{9,10} would contribute relative to the total. According to this scenario, **HFC-134a emissions could equal 11.5% of global fossil carbon emissions by 2050.**



New research is now emerging that predicts even larger growth in HFC emissions than the IPCC estimated, and thus a much higher contribution than these scenarios anticipate.

F-gases counted under in the Kyoto Protocol (HFCs, PCFs, and SF₆) accounted for 1.5% of total greenhouse gas emissions in 2003. A paper by Oko Recherche found that the percentage would significantly increase as HFCs replace ODSs¹¹.

Recherche re-calculated historic CFC and HCFC emissions as future HFC emissions that would likely succeed them. The finding was that Kyoto F-gas emissions would represent 4.1% or 5.2% of global greenhouse gas emissions in 2003. (rated with 100 year and 20 year global warming potentials respectively).

NOTES

¹ IPCC Fourth Assessment Report Working Group I – Summary for Policymakers. Page 4. Accessible at: <http://www.ipcc.ch/pdf/assessment-report/ar4/wg1/ar4-wg1-spm.pdf>

² Calculation: 0.34 W/m² positive forcing minus 0.05 W/m² negative forcing from stratospheric ozone equals 0.29 W/m², given as a percentage of the total.

³ Calculation: CFCs, HCFCs, and CCL₄ make up 0.32 of 0.34 W/m², minus negative forcing of stratospheric ozone equals 0.27W/m², given as a percentage of the total.

⁴ IPCC Special Report on Ozone and Climate. Chapter 2. Accessible at: <http://www.ipcc.ch/ipccreports/sroc.htm>

⁵ Calculation: 0.01 W/m² for HFCs, and 0.017 W/m² for all Kyoto F-gases

⁶ IPCC Special Report on Ozone and Climate. Chapter 2. Accessible at: <http://www.ipcc.ch/ipccreports/sroc.htm>

⁷ IPCC Special Report on Ozone and Climate. Chapter 1. Page 122. Report accessible at: <http://www.ipcc.ch/ipccreports/sroc.htm>

⁸ IPCC Special Report on Ozone and Climate. Chapter 1. Page 123. Report accessible at:
<http://www.ipcc.ch/ipccreports/sroc.htm>

⁹ HFC-134a emissions data is taken from the IPCC's Special Report on Emissions Scenarios. The A1 scenario for HFC-134a was used. This represents 930 kts of HFC-134a emissions in 2050, whereas the other scenarios presented are about half this, in the range of 506-561 kt/yr (or 6.2% of 2050 *energy [r]evolution* CO2 emissions). Report accessed at: <http://www.ipcc.ch/ipccreports/sres/emission/index.htm>

¹⁰ Greenpeace and European Renewable Energy Council *energy [r]evolution*. Global CO2 emissions in the alternative scenario. Page 95. Accessible at: <http://www.greenpeace.org/usa/campaigns/global-warming-and-energy>

¹¹ Öko-Recherche. The rise and rise of fluorinated greenhouse gases as a share of global warming emissions. June 2004. Accessible at: <http://www.oekorecherche.de/english/berichte/volltext/F-gas-share.pdf>