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Climate change, global warming & HFCs

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Massive growth in HFCs is not considered likely in the IPCC Scenarios

As part of the Fifth Assessment Report [1] of Working Group I of the Intergovernmental Panel on Climate Change, the climate change impact from the anticipated release of greenhouse gases was evaluated. Consequently, the assessment addresses explicitly the climate change impact expected from fluorocarbons and sulphur hexafluoride in both absolute terms and relative to other well mixed greenhouse gases. It concluded that, over the coming century, the combined impact from ozone depleting fluorocarbons and F-gas greenhouse gases will remain constant, at worst, or reduce slowly after 2040, at best.

Thus the replacement of CFCs and HCFCs, which are both ozone depleters and greenhouse gases (and regulated under the Montreal Protocol), with HFCs (emissions of which are regulated under the Kyoto Protocol) is not expected to produce the runaway greenhouse effect speculated in some publications [2, 3, 4].

For all greenhouse gases, the IPCC authors used **Representative Concentration Pathways (RCPs)**. These are composite scenarios selected from the published literature documenting the results of Integrated Assessment Models of different social and economic futures that might bring about specified increases in global radiative forcing (the driver for global climate change). Thus:

- RCP8.5 One high pathway for which radiative forcing reaches $>8.5 \text{ W m}^{-2}$ by 2100 and continues to rise for some amount of time;
- RCP6.0 and RCP4.5 Two intermediate stabilization pathways in which radiative forcing is stabilized at approximately 6 W m^{-2} and 4.5 W m^{-2} after 2100;
- RCP2.6 One pathway where radiative forcing peaks at approximately 3 W m^{-2} before 2100 and then declines.

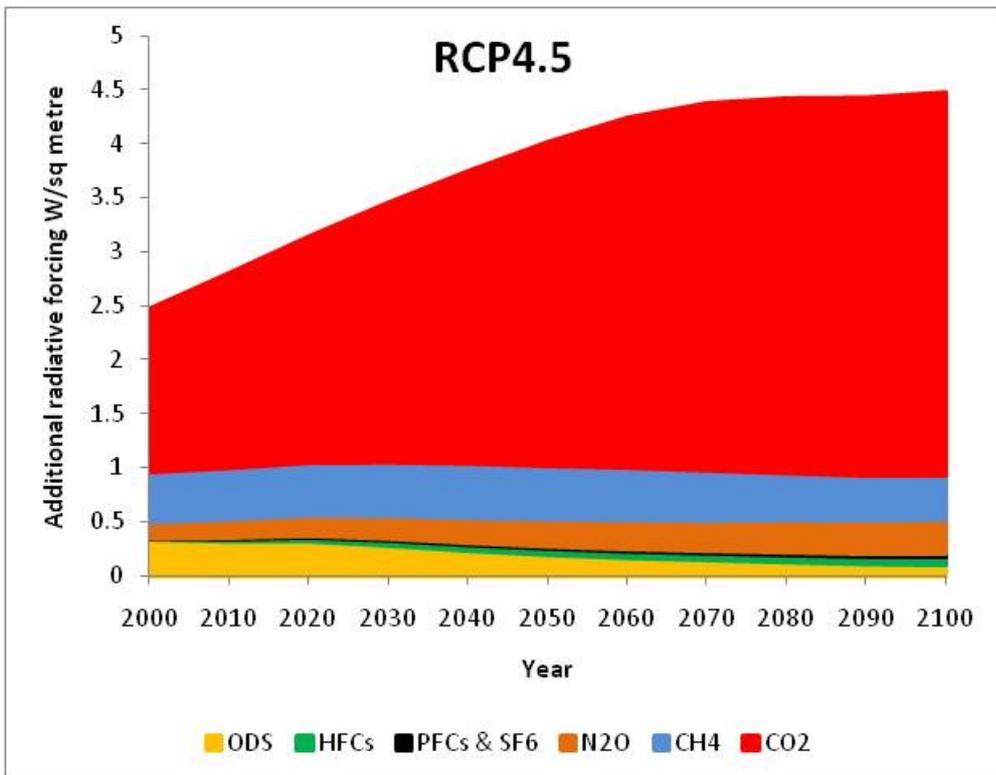
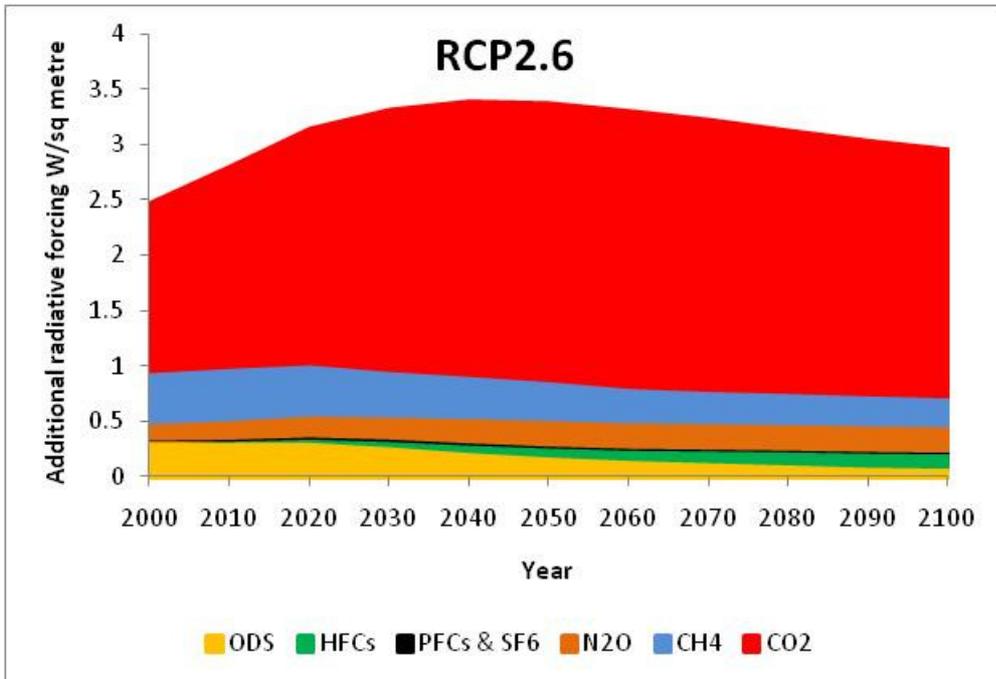
The scenarios underlying the pathways include time series of emissions and concentrations of the full suite of greenhouse gases and aerosols and chemically active gases, as well as land use/land cover. For the purposes of comparison here, only the contribution from well mixed greenhouse gases is shown in the graphs below.

These depict the total anticipated radiative forcing and the contributions of each class of compounds to this. Ozone depleting substances (ODS) are shown in yellow at the bottom and are expected to exert less and less influence as their atmospheric concentrations decline due to the controls of the Montreal Protocol. Next up is the expected contribution from all HFC emissions, in green, and then those from PFCs and SF₆, in black; these three classes of chemicals constituting the F-gases included in European Union legislation [5]. It is clear that, far from having a runaway climate impact, the effect of the F-gases will remain constant or will decline over the coming century, both in absolute terms and relative to the other greenhouse gases. This directly contradicts misguided assertions that a ban on HFCs would "save 0.5 °C warming"; the fact is that, even in a scenario that is expected to produce only 2 °C warming (RCP2.6), HFC emissions would be responsible for 0.04 °C (2% of the total). The other, less optimistic, RCPs contain similar absolute contributions from HFCs but higher contributions from other well mixed greenhouse gases.

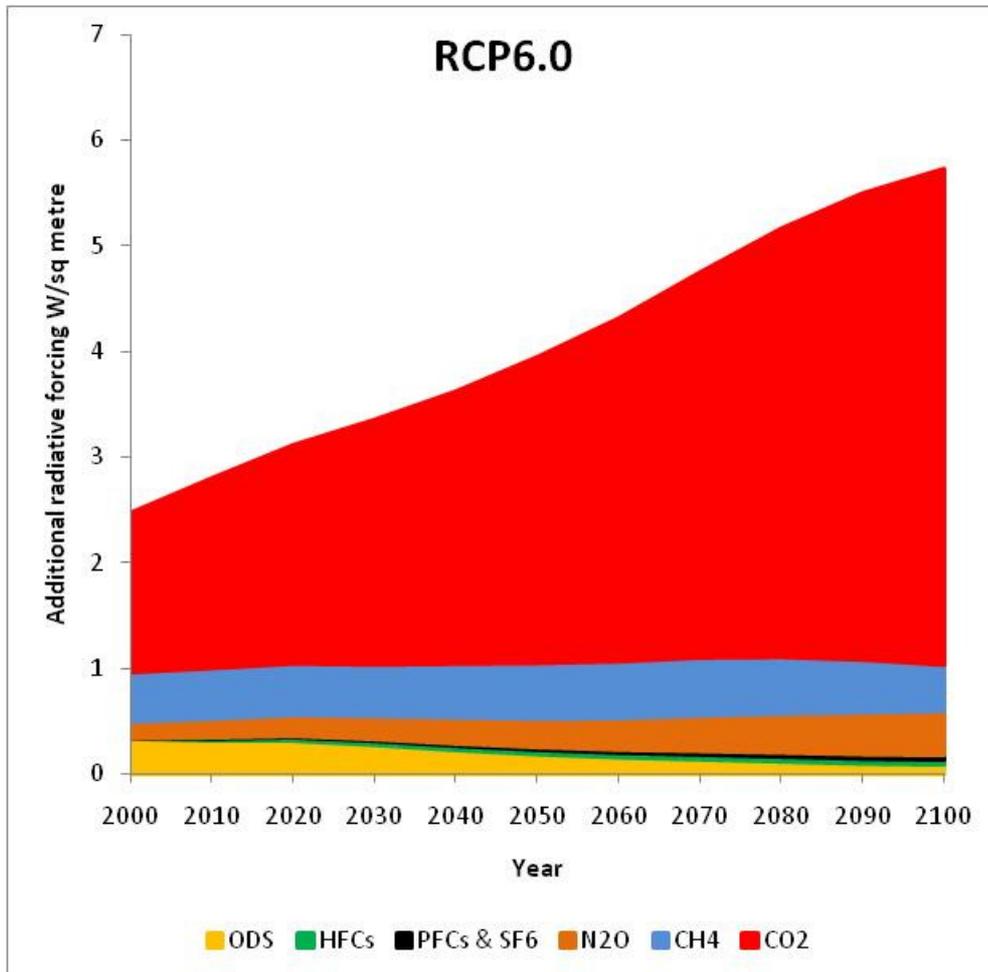
Future climate change impact will be dominated by the non-fluorinated greenhouse gases, particularly carbon dioxide (CO₂).[6]

Sources

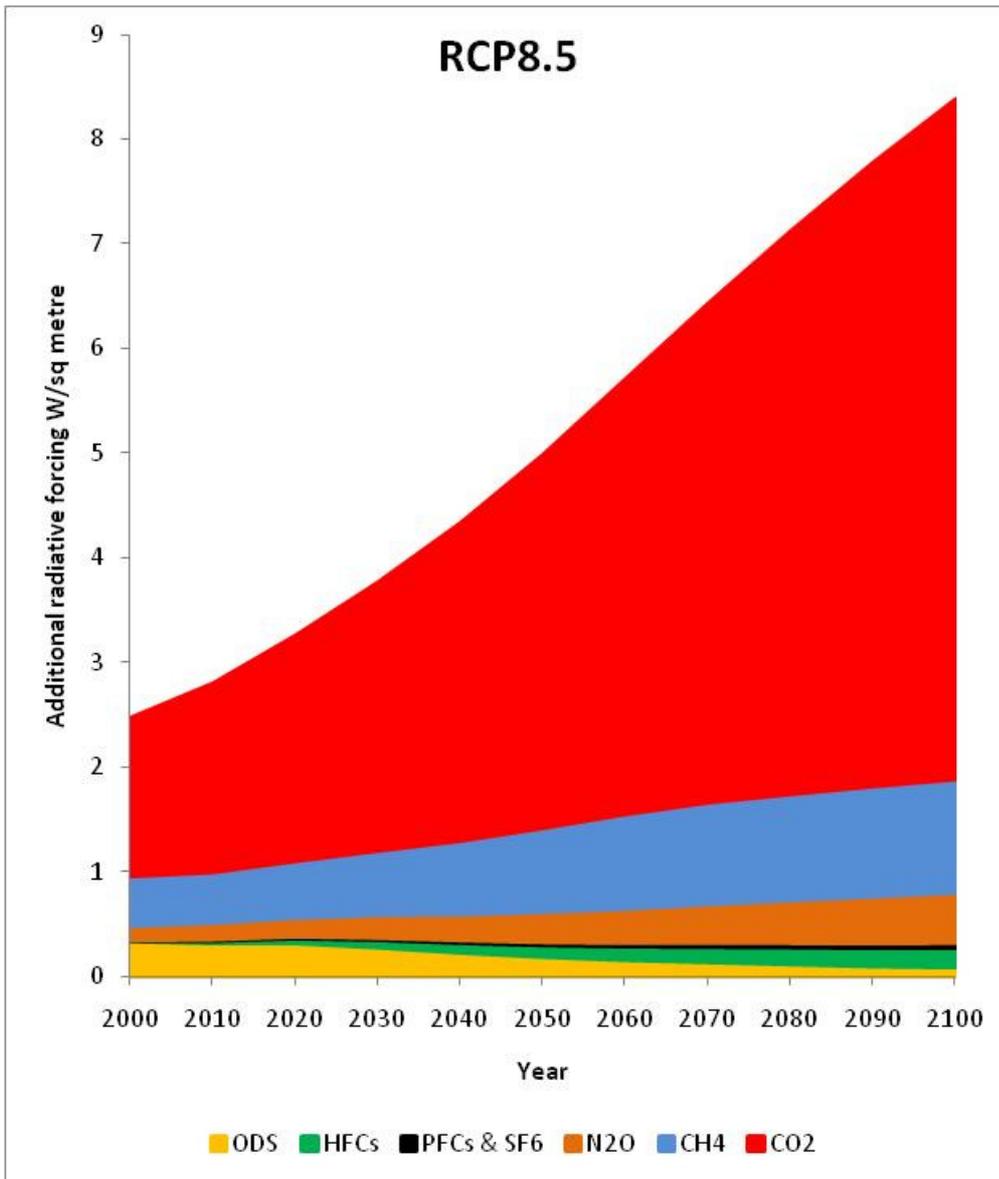
1. IPCC, 2013: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 1535 pp.
2. Velders, G. J. M., D. W. Fahey, J. S. Daniel, M. McFarland, and S. O. Andersen, The large contribution of projected HFC emissions to future climate forcing. Proceedings of the National Academy of Sciences of the United States of America, 106, 10949-10954 (2009).
3. Xu Y., Zaelke D., Velders G.J.M., Ramanathan V., The role of HFCs in mitigating 21st century climate change, Atmospheric Chemistry and Physics 13:6083-9 (2013).
4. Ozonews, Vol XIII, 30 October 2013.
5. Directive 2006/40/EC of the European Parliament and of the Council of 17 May 2006 relating to emissions from air-conditioning systems in motor vehicles and amending Council Directive 70/156/EEC and Regulation (EC) No 842/2006 of the European Parliament and of the Council of 17 May 2006 on certain fluorinated greenhouse gases.
6. Because fossil fuel combustion is the principal source of CO₂ emissions, energy efficiency is paramount, and F-gases have a role in reducing CO₂ emissions.



Radiative Forcing from emissions of well mixed greenhouse gases in the scenarios underlying the Representative Concentration Pathways RCP2.6 and RCP4.5. Calculated from the data in Tables AII.6 of the Fifth Assessment Report of IPCC, Working Group I.



Radiative Forcing from emissions of well mixed greenhouse gases in the scenarios underlying the Representative Concentration Pathway RCP6.0. Calculated from the data in Tables AII.6 of the Fifth Assessment Report of IPCC, Working Group I.



Radiative Forcing from emissions of well mixed greenhouse gases in the scenarios underlying the Representative Concentration Pathway RCP8.5. Calculated from the data in Tables AII.6 of the Fifth Assessment Report of IPCC, Working Group I.