EFCTC
EUROPEAN FLUOROCARBONS TECHNICAL COMMITTEE

cefic sector group

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Radiative Forcing of Well Mixed Greenhouse Gases

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

The Fifth Assessment Report[1] of Working Group I of the Intergovernmental Panel on Climate Change is available on the internet at *http://www.ipcc.ch/report/ar5/wg1/*. Parts of this wide ranging study cover the climate change impacts from historical and anticipated releases of greenhouse gases.

In a more recent paper, the actual historical radiative forcing of carbon dioxide has been measured[2]. At 0.2 Wm^{-2} between 2000 and 2010, the measurement over just ten years is ten times the total impact of all HFCs ever produced, as recorded in the Assessment Report. Thus the transition from CFCs and HCFCs that has been accomplished in developed countries has resulted in a relatively small impact from HFCs.

As for the future, 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[3,4,5].

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).

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1 The final draft Report, dated 7 June 2013, of the Working Group I contribution to the IPCC 5th Assessment Report "Climate Change 2013: The Physical Science Basis" was accepted but not approved in detail by the 12th Session of Working Group I and the 36th Session of the IPCC on 26 September 2013 in Stockholm, Sweden. It consists of the full scientific and technical assessment undertaken by Working Group I.

2 D.R. Feldman, W.D. Collins, P.J. Gero, M.S. Torn, E.J. Mlawer & T.R. Shippert, Observational determination of surface radiative forcing by CO2 from 2000 to 2010, Nature, doi:10.1038/nature14240 (2015)

3 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).

4 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).

5 Ozonews, Vol XIII, 30 October 2013.

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Thus:

- RCP8.5: One high pathway for which radiative forcing reaches >8.5 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 that from PFCs and SF_6, in black. These three classes of chemicals constitute the fluorine containing gases. It is clear that, far from having a runaway climate impact, the effect of the fluorine containing 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 ^{o}C warming"; the fact is that, even in a scenario that is expected to produce only 2 ^{o}C warming (RCP2.6), HFC emissions would be responsible for 0.04 ^{o}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 (CO_2).

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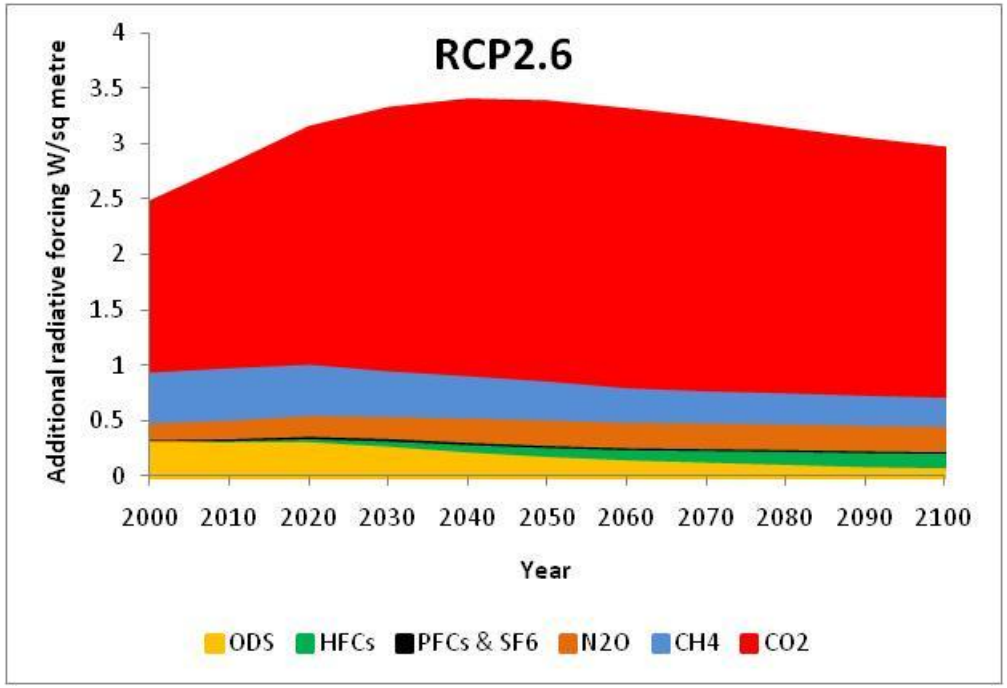
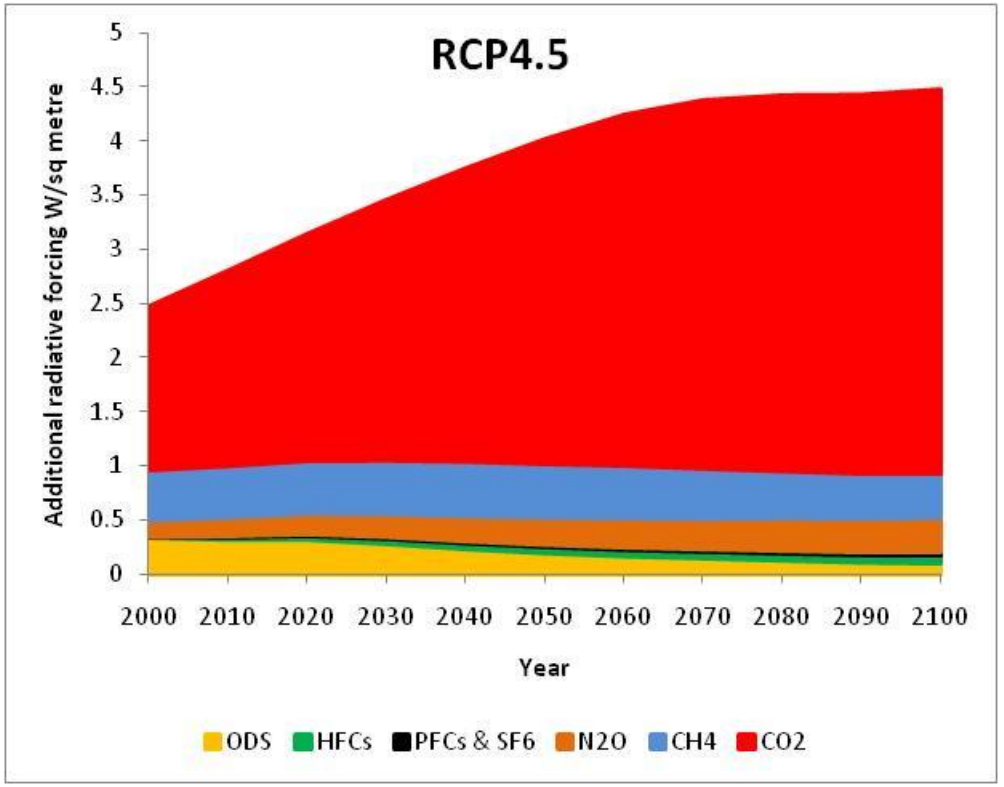
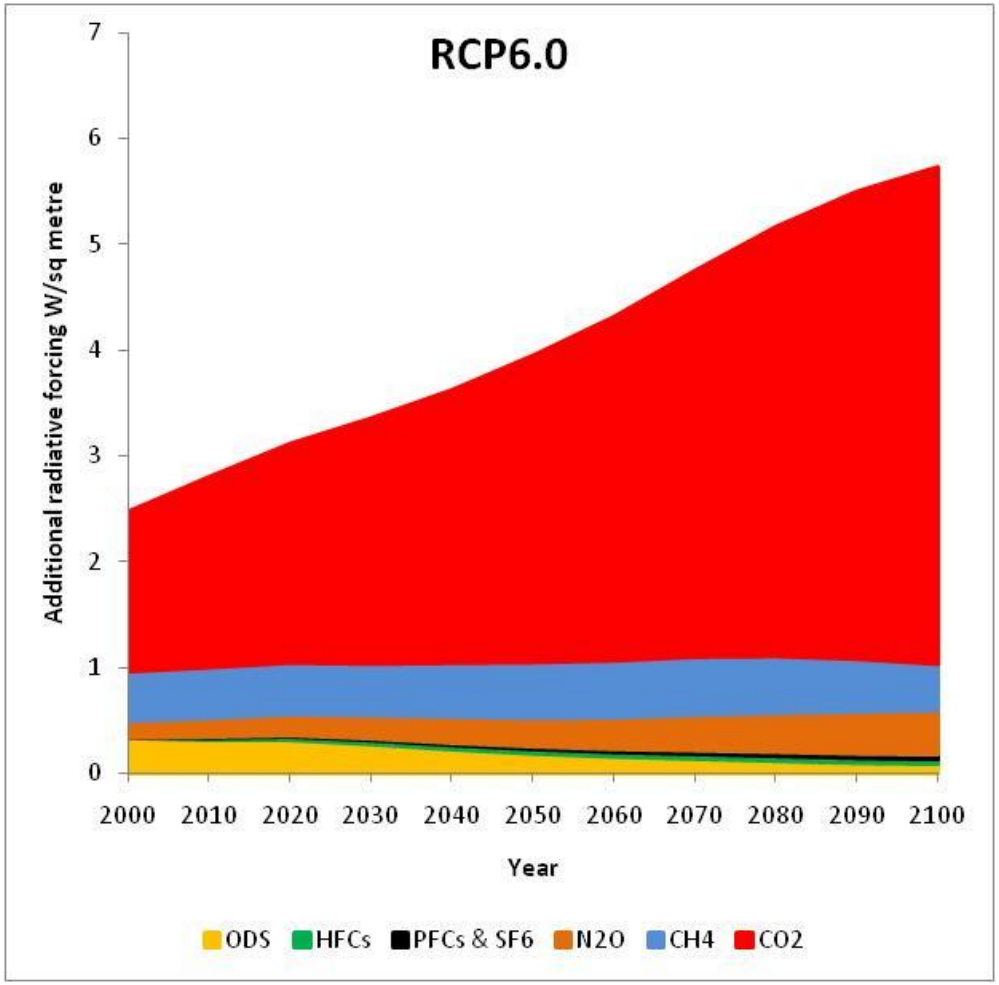
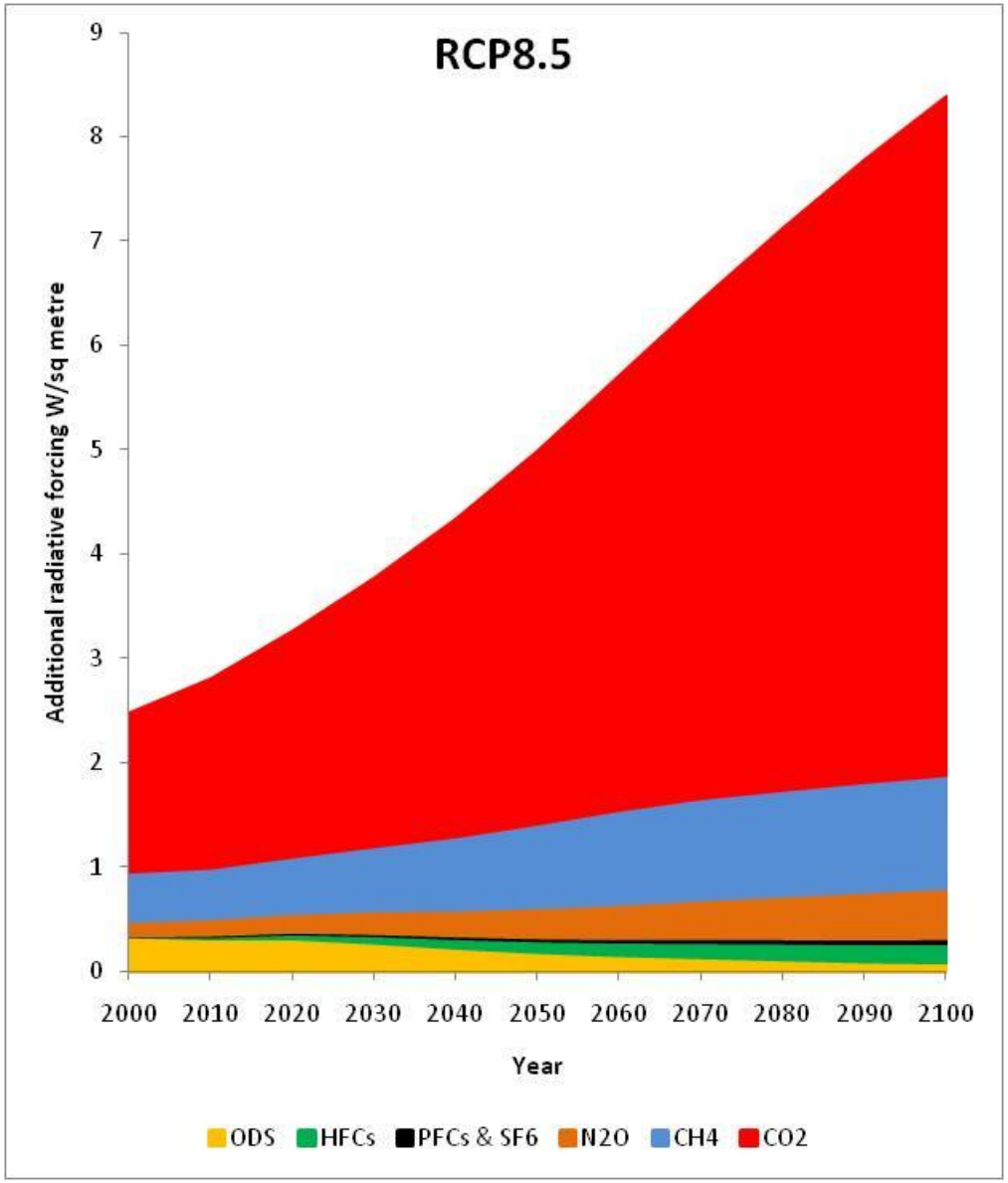




Radiative Forcing from emissions of well mixed greenhouse gases in the scenarios underlying the Representative Concentration Pathways RCP2.6 to RCP8.5. Calculated from the data in Tables AII.6 of the Fifth Assessment Report of IPCC, Working Group I.


RCP6.0
Additional radiative forcing W/sq metre
0
1
2
3
4
5
6
7
2000
2010
2020
2030
2040
2050
2060
2070
2080
2090
2100
Year
ODS
HFCs
PFCs & SF6
N2O
CH4
CO2


RCP8.5
Additional radiative forcing W/sq metre
0
1
2
3
4
5
6
7
8
9
2000
2010
2020
2030
2040
2050
2060
2070
2080
2090
2100
Year
ODS
HFCs
PFCs & SF6
N2O
CH4
CO2