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Effects of the Kigali Amendment to the Montreal Protocol on the Climate Impact of HFCs

Created: January 2017

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Summary

The Kigali Amendment was agreed to on October 15, 2016 at the 28th Meeting of the Parties to the Montreal Protocol. The amendment sets out an HFC consumption phasedown of 85% in developed countries (known in the treaty as Article 2 parties) between 2019 and 2036. For developing countries (known in the treaty as Article 5 parties) HFC phasedown reduces consumption by 85% between 2024 and 2047, with some delayed implementation for a number of A5 parties.

The potential effect of the Kigali Amendment on reducing Climate Impact depends critically on the forecast growth in HFC emissions in the absence of the global HFC phase-down.

There are two highly relevant sources for scenarios used to produce HFC forecasts that can be referenced when evaluating the impact of the Kigali Amendment:

- The Intergovernmental Panel on Climate Change (IPCC)
- G.J.M. Velders et al

The IPCC estimates of future climate impact cover all greenhouse gases when determining future global temperature rise. In one of these scenarios (Representative Concentration Pathways RCP4.5) that shows a pathway which could almost accomplish limiting global temperature rise to 2°C, the contribution of future HFC emissions in the absence of the Kigali Amendment is about 0.04 °C (the scenario predates the 2016 agreement in Kigali). The Kigali Amendment, therefore, does not reduce the need to control and constrain emissions of all other greenhouse gases. The reductions foreseen in the Paris Agreement are still required in full.

In contrast to the IPCC RCP4.5, one of the Velders scenarios envisages a ten-fold increase in HFC emissions between now and 2050, mainly in developing countries. The global temperature increase as a result of the high future consumption and emissions of HFCs in this scenario could have been 0.5°C. This temperature increase has been used by some to explain the impact of the Kigali Amendment, but this should not be confused with the emission reduction requirements envisaged by the Paris Agreement.

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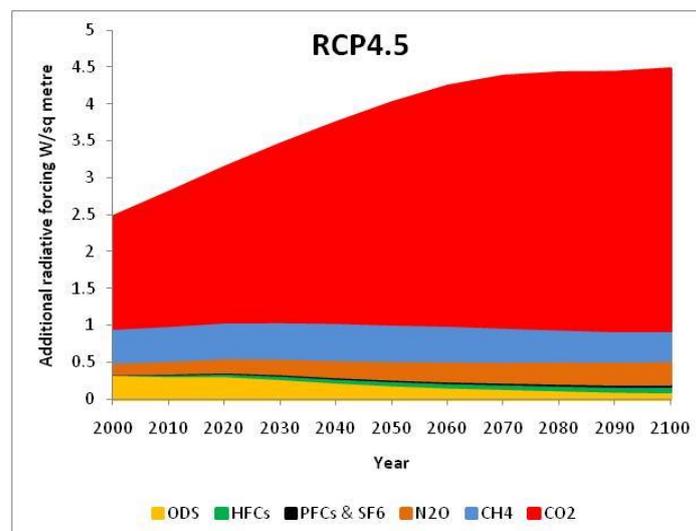
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Irrespective of the HFC forecasts, the Kigali Amendment is an extremely important step in reducing future HFC emissions and should be fully supported and implemented.

Detail

- The metric for *Climate Impact* used by IPCC is *additional radiative forcing*, estimated in Watts per square meter. Very roughly, the global temperature could increase by 1°C for every 2 W/m² additional radiative forcing.
- To estimate future climate impact IPCC uses scenarios known as Representative Concentration Pathways (RCP)¹. These cover emissions of all greenhouse gases, including the emissions of HFCs, calculated individually, from the banks in systems such as refrigeration and air conditioning that use them.
- This scientific input provided the background to the Paris Agreement in which countries committed to attempt to limit global temperature rise to 2°C. One scenario



¹ U. Cubasch et al., Chapter 1 of Climate Change 2013: The Physical Science Basis. Fifth Assessment Report of IPCC. Cambridge University Press, 1535 pp.

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that could almost accomplish this is RCP4.5, with the contributions from anticipated future emissions of greenhouse gases shown in the graph below.

- The contribution from the significant growth in all HFC emissions envisaged in this scenario is 1.5% in 2050 and 1.8% in 2100, or about 0.04°C in an overall temperature rise of 2°C.
- The alternative scenarios for HFCs, proposed by Velders and colleagues did not underlie the IPCC's Scientific Assessment and so did not form a scientific basis for the Paris Agreement.
- Velders' scenarios have changed since the first was published in 2009² and the current version envisages a ten-fold increase in HFC emissions between now and 2050, mainly in developing countries³. The global temperature increase as a result of the high future consumption and emissions of HFCs in the original scenario could have been 0.5°C.
- The extremely high growth in HFCs forecast by Velders and colleagues in a business as usual scenario, results in a climate impact that would have been additional to the IPCC scenarios used as a basis for the Paris Agreement. Consequently, the Kigali Amendment to the Montreal Protocol obviates future *additional* impact but does not reduce the need to control and constrain emissions of all other greenhouse gases. The reductions foreseen in the Paris Agreement are still required in full.

² G.J.M. Velders et al., The large contribution of projected HFC emissions to future climate forcing, *Proc. Nat. Acad. Sci.* DOI:10.1073/pnas.0902817106

³ G.J.M. Velders, et al., Future atmospheric abundances and climate forcings from scenarios of global and regional hydrofluorocarbon (HFCs) emissions, *Atmos. Environ.*, in press, DOI: 10.1016/j.atmosenv.2015.10.071