

# Future atmospheric abundances and climate forcings from scenarios of global and regional HFCs emissions

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**1. New business-as-usual scenarios show large growth in demand for hydrofluorocarbons (HFCs).** The global phaseout of CFCs, HCFCs, and halons will leave much of the application demand for refrigeration, air conditioning, heating, and thermal-insulating foam production to be met by HFCs. The demand for HFCs is therefore expected to increase globally, but especially in the developing world (Asia, Latin America, Middle East, Africa), in the absence of regulations. The major use sectors are industrial and commercial refrigeration and stationary air conditioning.

**2. Total global HFC emissions from developed and developing countries in 2050 are projected to be 4.0 – 5.3 GtCO<sub>2</sub>-eq yr<sup>-1</sup> in the absence of regulations.** This is equivalent to 5 – 11% of projected global CO<sub>2</sub> emissions in business-as-usual scenarios or 9 – 29% of the increase in annual CO<sub>2</sub> emissions from 2015 to 2050. Estimates incorporate 100-yr GWP values to weigh individual HFCs in formulating the total emission values.

**3. Baseline scenario details.** New emission scenarios are derived from gross domestic product (GDP) and population growth from the new Shared Socioeconomic Pathways (SSPs) and include:

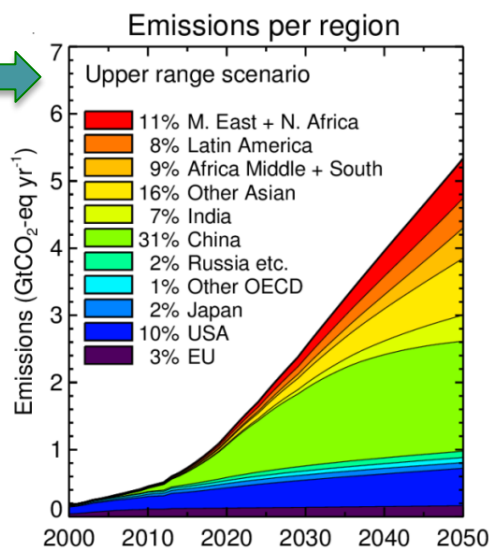
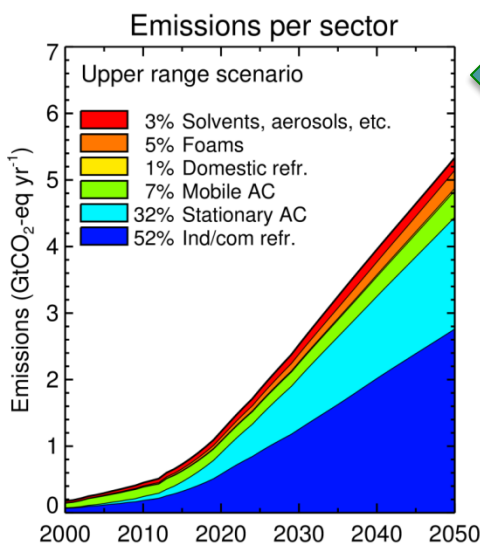
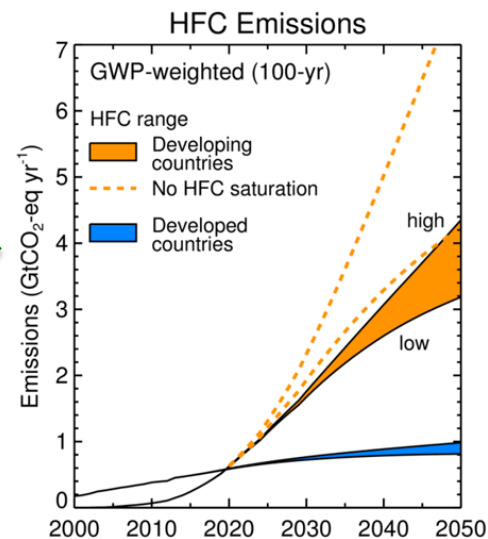
- 10 HFC compounds (excl. HFC-23),
- 11 global regions,
- 13 application sectors,
- atmospheric observations of HFCs through 2013,
- patterns of replacement of HCFCs by HFCs and alternatives,
- saturation of HFC consumption in developing countries at levels found in developed countries.

## Background: HFCs

HFCs are weak ozone depleting substances, but, along with CFCs and HCFCs, potent greenhouse gases which contribute to the radiative forcing of climate.

The GWPs (100-yr) of principal HFCs are:

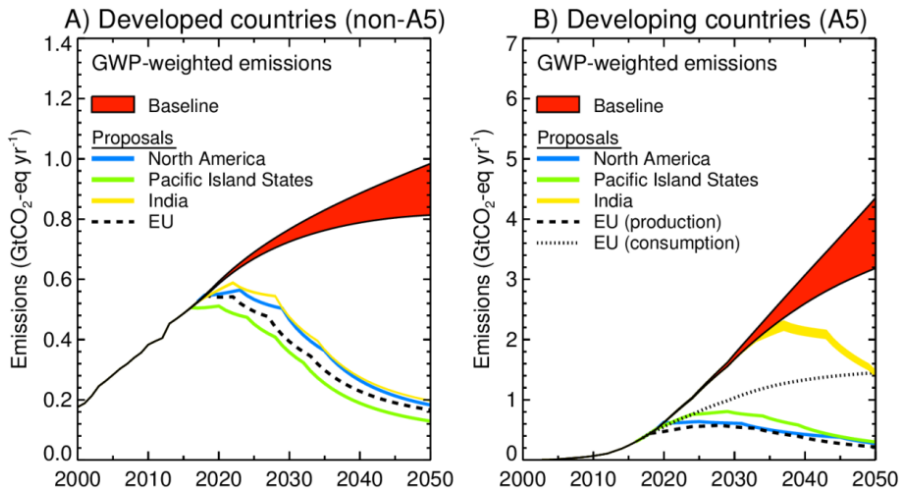
HFC-32	=	704
HFC-125	=	3,450
HFC-134a	=	1,360
HFC-143a	=	5,080



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<sup>\*</sup> Public access: <http://www.journals.elsevier.com/atmospheric-environment/>

# Effects of Montreal Protocol amendment proposals

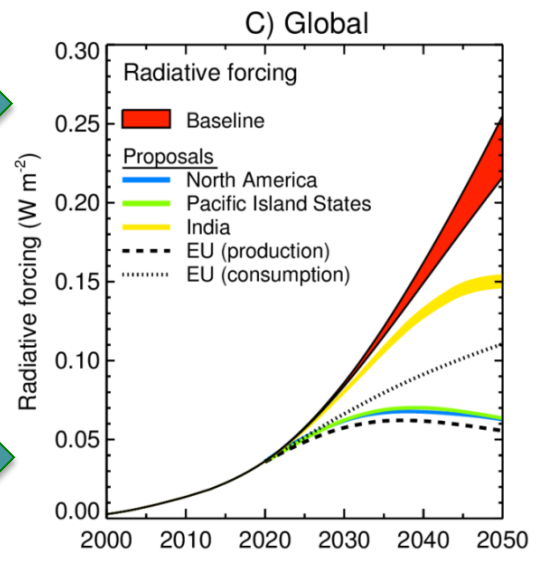


**4. Montreal Protocol amendment proposals are estimated to reduce HFC emissions significantly.** Proposals have been submitted in 2015 by North American countries, the EU, India, and 8 Pacific Island states. All give reductions for developed countries of 80% or more compared to baseline emissions in 2050. The estimated reductions for developing countries show a range depending on the different base levels and reduction schedules in the proposals.

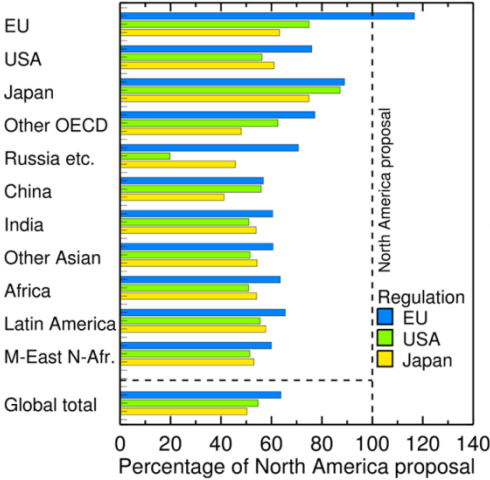
**5. In the baseline scenario, global HFC radiative forcing in 2050 is projected to be 0.22 - 0.25 W m<sup>-2</sup>.** This is equivalent to 6 – 9% of global CO<sub>2</sub> emissions in business-as-usual scenarios or 12 – 24% of the increase in CO<sub>2</sub> radiative forcing from 2015 to 2050.



**6. Global HFC radiative forcing is projected to decrease after 2035 in most proposals.** Differences in emission reductions translate into differences in the estimated reductions in radiative forcing. Radiative forcing is what is ultimately responsible for changes in climate. All the new national regulations (see 7) reduce HFC emissions in 2050, and most amendment proposals are projected to reduce radiative forcing as well.



Reductions in cumulative HFC consumption



**7. Global adoption of technologies required to meet national regulations in EU, USA, and Japan reduce cumulative (2015-2050) consumption and emissions by 50% or more compared to the North American proposal.** Regulations have been adopted in the EU, USA and Japan in 2014/2015 that are projected to reduce the HFC emissions in these regions. It is likely that this will drive global technological developments and thereby also reduce emissions in other regions.