National Institute for Public Health
and the Environment
Ministry of Health, Welfare and Sport

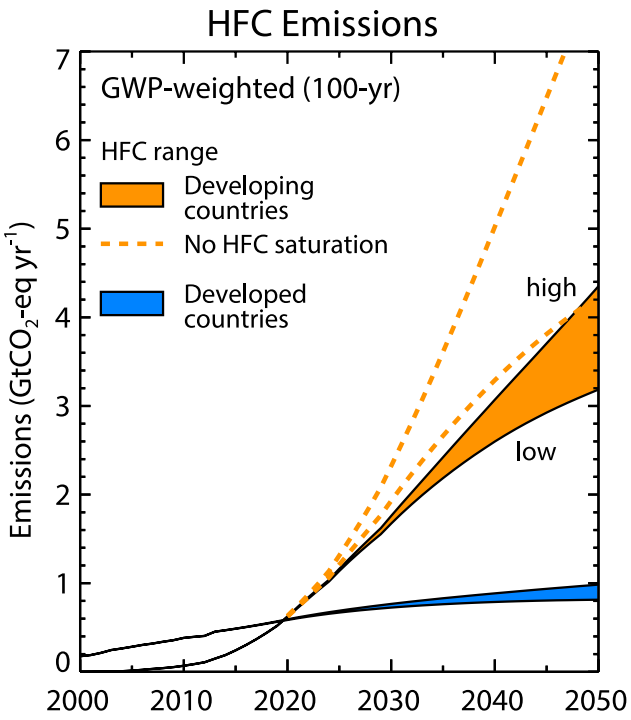
Future atmospheric abundances and *climate forcings* from HFC scenarios

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 $GtCO_2$-eq yr^{-1} in the absence of regulations.

This is equivalent to 5–11% of projected global CO_2 emissions in business-as-usual scenarios or 9–29% of the increase in annual CO_2 emissions from 2015 to 2050. HFCs are weak ozone depleting substances, but, along with CFCs and HCFCs, potent greenhouse gases which contribute to the radiative forcing of climate.

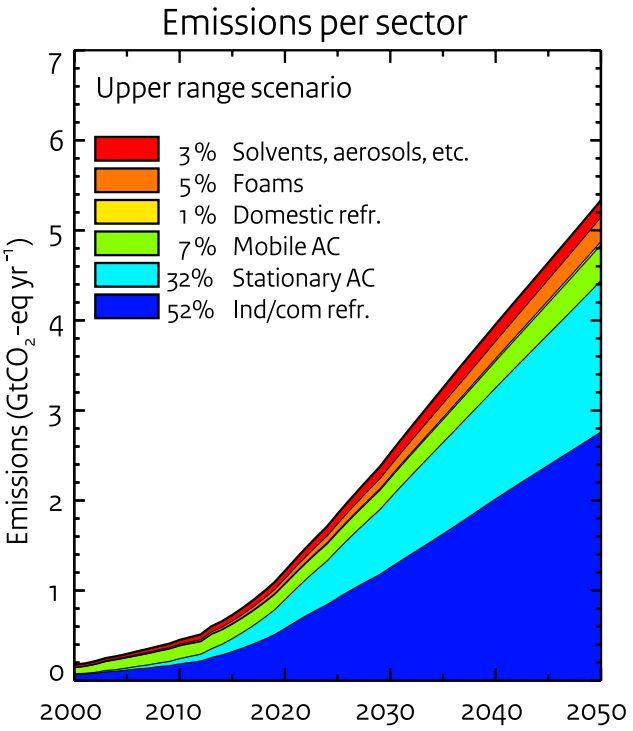


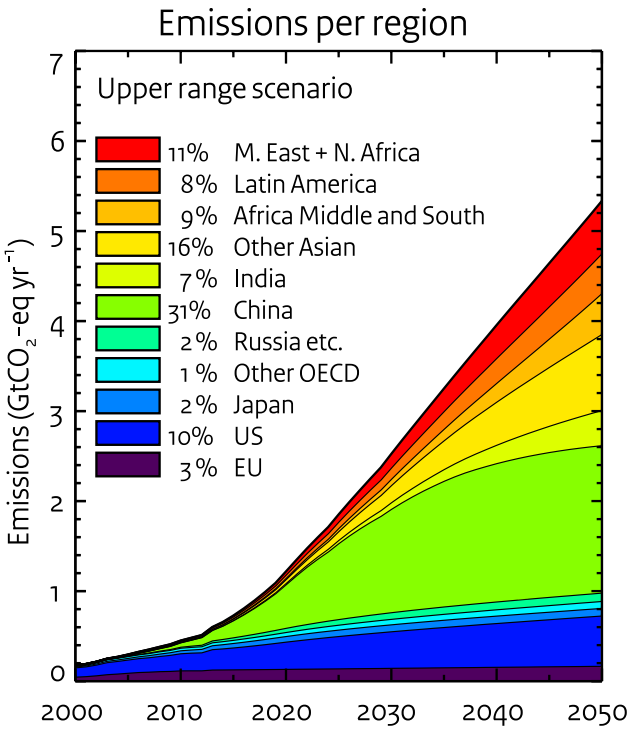
Background on the Montreal Protocol

- The Montreal Protocol of 1987 is a global treaty for the protection of the ozone layer. All countries of the United Nations have signed the protocol. It has been very successful in reducing the global consumption of chlorofluorocarbons (CFCs); by more than 95% from its peak value. CFCs are the principal ozone-depleting substances.
- As a result of the Montreal Protocol, the consumption of HCFCs (hydrochlorofluorocarbons) as substitute compounds has increased. With the 2007 accelerated HCFC phaseout under the protocol, the consumption of HCFCs should be virtually zero in developed countries by 2020 and in developing countries by 2030.
- Therefore, as a direct result of the Montreal Protocol, the consumption of HFCs, as substitute compounds, has increased in recent years and is projected to continue to increase globally in business-as-usual scenarios.

3. Baseline scenario details.

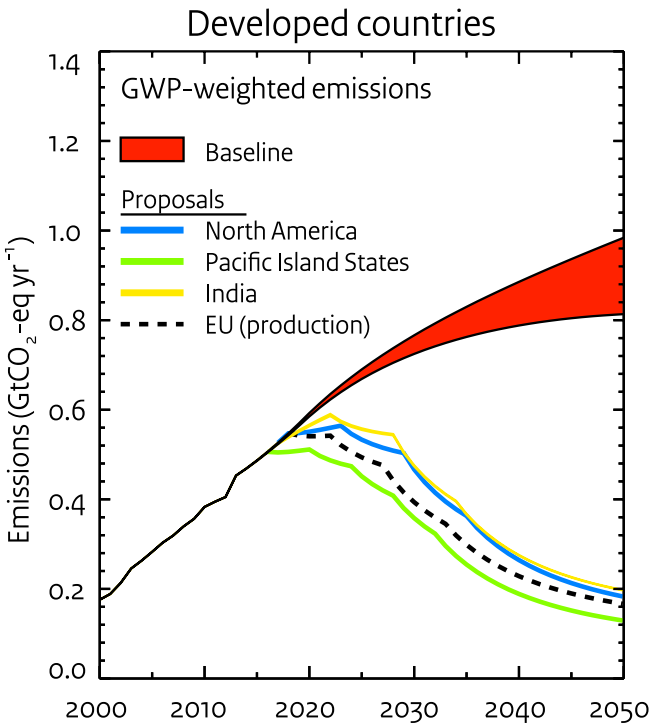
New emission scenarios are derived from gross domestic product (GDP) and population growth from the new Shared Socioeconomic Pathways (SSPs) and include:
- 10 HFC compounds (excl. HFC-23),
- 11 global regions,
- 13 application sectors,
- atmospheric observations of HFCs through 2013,
- patterns of replacement of HCFCs by HFCs and alternatives,
- saturation of HFC consumption in developing countries at levels found in developed countries.

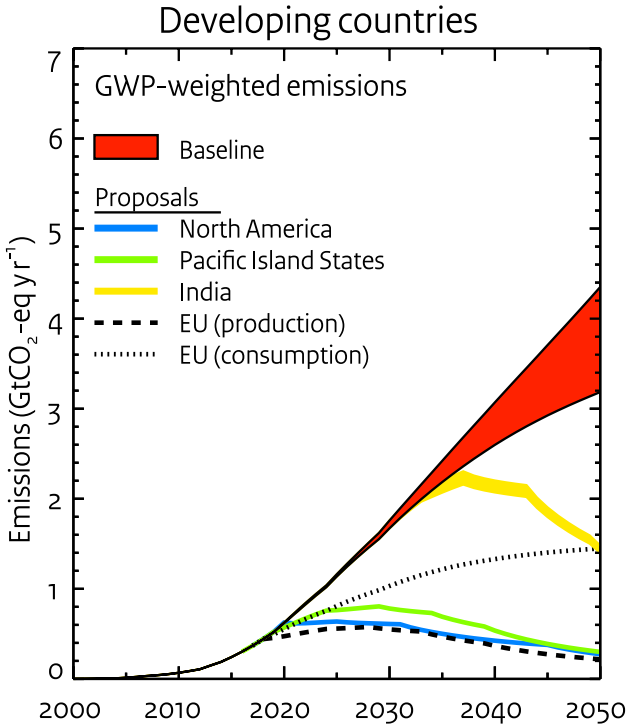




4. Montreal Protocol amendment proposals are estimated to reduce HFC emissions significantly.

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.



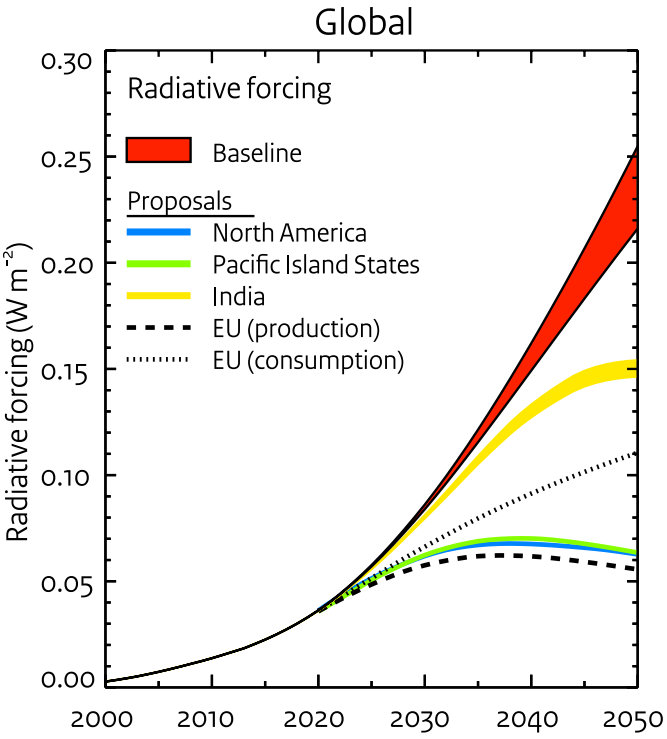


5. In the baseline scenario, global HFC radiative forcing in 2050 is projected to be 0.22-0.25 W m^{-2}.

This is equivalent to 6–9% of global CO_2 emissions in business-as-usual scenarios or 12–24% of the increase in CO_2 radiative forcing from 2015 to 2050.

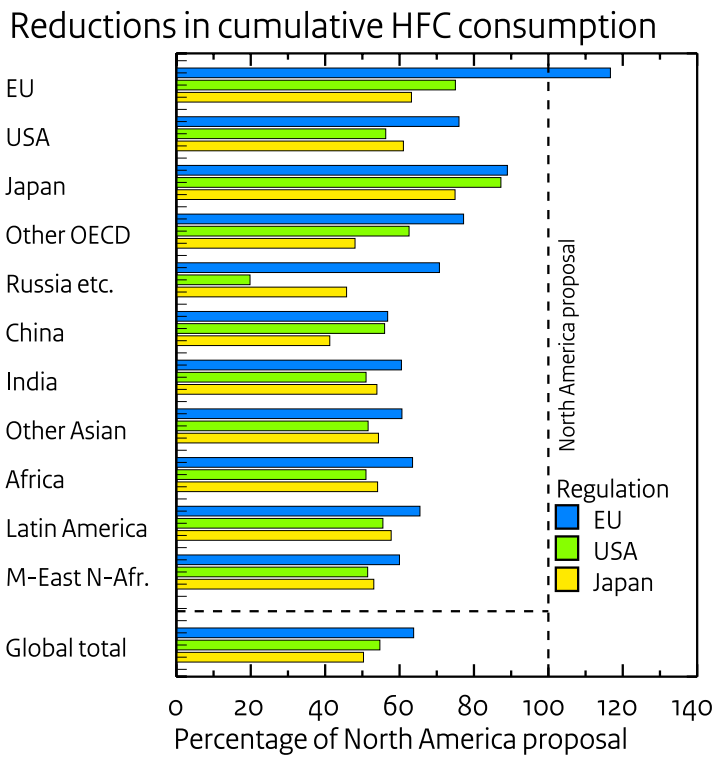
6. Global HFC radiative forcing is projected to decrease after 2035 in most proposals.

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.



7. Global adoption of technologies required to meet national regulations in EU, USA, and Japan reduce 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.



Contact information: Guus Velders (RIVM, Netherlands, guus.velders@rivm.nl), David W. Fahey and John S. Daniel (NOAA/ESRL, USA), Stephen O. Andersen (IGSD, USA), Mack McFarland (USA).

Article in press in Atmospheric Environment (2015), http://www.journals.elsevier.com/atmospheric-environment

Published by

National Insitute for Public Health and the Enviroment
P.O. Box 1 | 3720 BA Bilthoven
www.rivm.nl/en

november 2015

More information can be found in the following article: G.J.M. Velders, D.W. Fahey, J.S. Daniel, S.O. Andersen, M. McFarland, Atmospheric Environment, 2015 (in press), doi:10.1016/j.atmosenv.2015.10.071

008554