Preserving Montreal Protocol climate benefits by limiting HFCs

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Short version of the paper

The Montreal Protocol is not only protecting the ozone layer, it is also providing some climate protection. However, this climate benefit may be reduced or lost completely if the use of hydrofluorocarbons (HFCs) as substitutes for ozone depleting substances, continues to increase. The climate benefits of the Montreal Protocol can be preserved by choosing appropriate alternatives to fulfill the growing global demand for HFCs for refrigeration, air-conditioning and foam production applications. This is the conclusion of a study published in the scientific journal Science.

The Montreal Protocol is responsible for a global phase-out of the consumption and production of most ozone-depleting substances (ODSs). Hydrofluorocarbons (HFCs), which do not destroy stratospheric ozone, were considered long-term substitutes for ODSs and are not controlled by the Montreal Protocol. Because most HFCs are potent greenhouse gases, they are included in the Kyoto Protocol. HFCs are being used increasingly in applications that traditionally used ODSs, e.g., refrigeration and air-conditioning equipment, blowing agents for foams, aerosol sprays, fire protection systems, and solvents. Rising use of HFCs is directly attributable to intent and actions of the Montreal Protocol, hence, the HFC contribution to climate change can be viewed as an unintended negative side effect of these actions. In an upper-range scenario, global radiative forcing from HFCs increases from about 0.012 W/m^2 in 2010 to 0.25 to 0.40 W/m^2 in 2050. This corresponds to 14 to 27% of the increase in CO_2 forcing under the range of IPCC business-as-usual scenarios from 2010 to 2050.

Most fluorocarbons (e.g., CFCs, HCFCs, and HFCs) have a similar ability (within about a factor of three) to trap infrared radiation, on a per-molecule basis, in Earth's atmosphere. Therefore, differences in the future relative impact of HFCs on climate arise primarily from differences in atmospheric lifetimes. The longer the lifetime of a molecule, the larger its potential contribution to climate forcing. If the current mix of HFCs with an average lifetime of 15 years (average GWP of 1600) were replaced by HFCs with lifetimes less than 1 month (GWP less than ~20), the total HFC radiative-forcing contribution in 2050, even under the high-emission scenario, would be less than the current forcing from HFCs. Such choices are currently available.

A large number of countries have formally stated their intention to preserve the climate benefits of the Montreal Protocol. A challenge for policy-makers is to identify how this might be accomplished. Given that climate impacts of HFC use can be viewed as unintended side effects of the Montreal Protocol, an option is to expand provisions of this protocol while drawing from parties' experience in formulating successful ODS controls that took scientific, economic, and technical aspects into account. The Montreal Protocol has the relevant infrastructure for accomplishing this. This infrastructure and experience suggest that such an approach could effectively and quickly limit continued growth of high-GWP HFCs and preserve the substantial climate benefits that were gained by the Montreal Protocol in phasing out ODSs.