OPPORTUNITIES FOR 1.5˚C CONSISTENT HFC MITIGATION

Key Messages

- Full compliance with the Kigali Amendment HFC phase-down schedule is expected to achieve a 56% reduction in HFC emissions by 2050, compared to 2010 levels. This will not surpass the 70-80% threshold set by 1.5°C consistent scenarios.
- Increasing ambition by applying maximum technically feasible reductions could achieve over 99% reduction in HFC emissions by 2050, compared to 2010 levels. However, it could achieve this mitigation one-decade sooner than Kigali phase-down schedule, resulting in a cumulative reduction of 18 Gt CO_2e HFC emissions.
- Applying available energy efficiency technologies in parallel with the Kigali phase-down can also result in electricity savings exceeding a fifth of future global electricity consumption. By 2050 this could reduce energy-related emissions of CO_2 by 1.4 Gt and methane by 9 Mt annually. Similarly, global SO_2 emissions could be reduced by 9%, NOx by 16%, and $PM_{2.5}$ by 8% by 2050.

HFC Emissions Trends

- HFCs were first introduced at replacements to Ozone Depleting Substances managed by the Montreal Protocol in the mid 1990's and quickly became the fastest growing specific of climate forcing emissions in the world.
- HFC emissions reached 1,111 Mt CO_2e in 2015 and without any controls, emissions were expected to more than double by 2030 and nearly quadruple by 2050.
- The growth of HFC emissions has been driven by a strong increase in demand for refrigeration and air conditioning, as well as increases in per capita wealth in developing countries and a warming climate. These trends are expected to continue into the foreseeable future.
- Today, global consumption and production of HFCs are managed by the Montreal Protocol through its 2016 Kigali Amendment.
- With full compliance with the Kigali Amendment, global HFC emissions are expected to decrease to 1283 Mt CO_2e by 2030 and drop to 321 Mt CO_2e by 2050.
- However, if Maximum Technically Feasible Reductions (MTFR) are pursued, HFC emissions are expected to decrease to 598 Mt CO_2e by 2030 and 3 Mt CO_2e by 2050. This indicates that MTFR can achieve near-full mitigation approximately 10 years earlier than the current Kigali phase-down schedule.

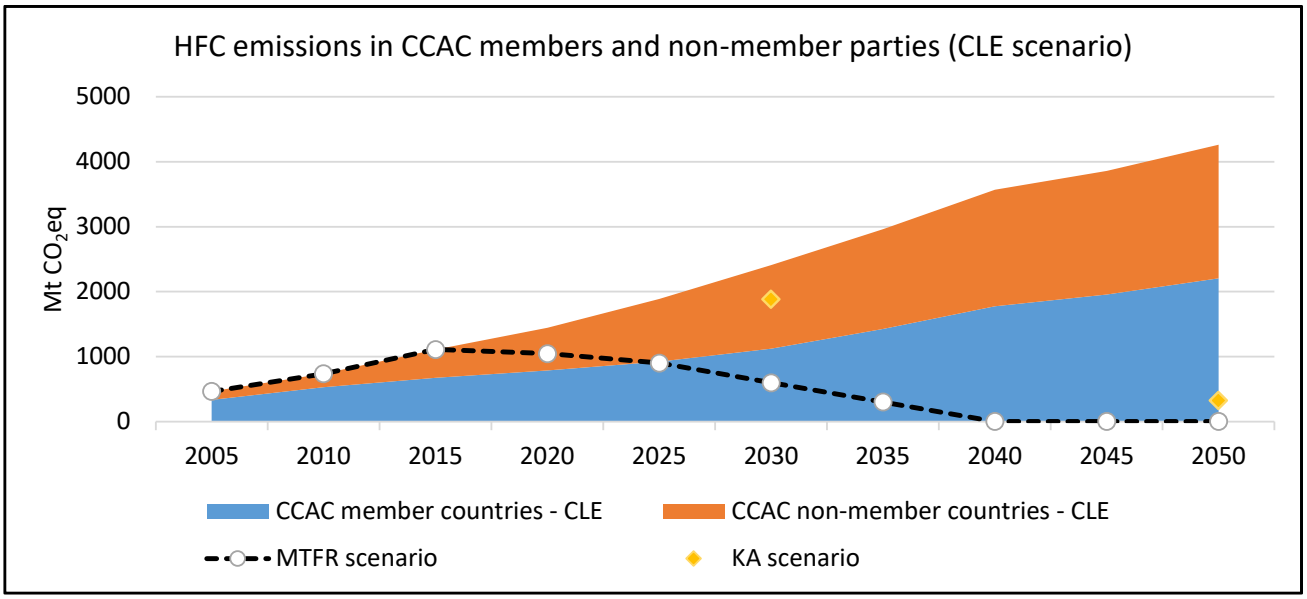

Figure 1 – Global HFC emissions growth without the Kigali Amendment, with full compliance with the Kigali Amendment phase-down schedule, and with maximum technically feasible reductions. Total emissions are also broken down into total contributions from CCAC and non-CCAC partner countries (scenarios provided by IIASA GAINS)

HFC Mitigation Consistent with 1.5˚C

- To be consistent with 1.5˚C scenarios, by 2050 HFCs should be reduced by **70% - 80%** compared to 2010 levels.
- The Kigali Amendment and Maximum Technically Feasible Reduction scenarios could achieve 56% and over 99% reductions in 2050 compared to 2010 levels, respectively. This means that MTFR scenarios surpass the 1.5˚C threshold. Attaining 1.5ºC threshold under the Kigali Amendment scenario calls for enhancing the ambition of mitigation efforts by all Parties.
- However, moving to a Maximum Technically Feasible Reduction scenario could achieve near-complete mitigation of emissions 10 years earlier than the current Kigali phase-down schedule.
- Moving from the Kigali phase-down schedule to the MTFR could result in a cumulative reduction of approximately 6 Gt CO_2e by 2030 and 18 Gt CO_2e by 2050.

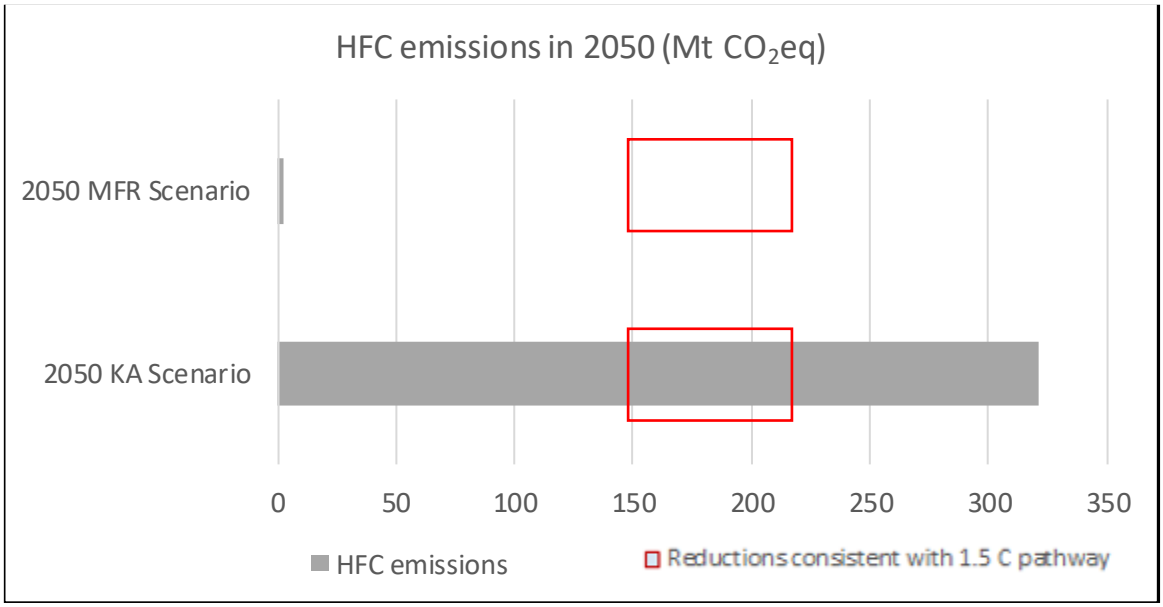

Figure 2: The upper bar shows the projected 2050 HFC emissions (Mt CO_2e) if maximum technically feasibly actions are implemented globally. The lower bar shows the projected HFC emissions (Mt CO_2e) if countries meet full compliance with the current Kigali Amendment phase down schedule. The two red-outlined boxes show the range of emissions reductions in 1.5°C consistent scenarios reported in the IPCC 1.5°C Special Report (2018). (scenarios provided by IIASA GAINS)

Additional Climate and Air Pollutant Mitigation from Energy Efficiency

- In 2018 the global stock of equipment for air conditioning, refrigeration, and mobile cooling consumed 3.4% of the world's total final energy demand. Energy demand for space cooling accounts for the largest share of cooling energy consumption at about 2000 billion kilowatt hours (kWh) and is projected to triple by 2050.[1]
- Previous phaseouts of Ozone Depleting Substances under the Montreal Protocol have catalysed substantial simultaneous improvements in the efficiency of cooling and refrigeration equipment. In recognition of this, the Kigali Amendment is the first time that maintaining and/or enhancing the energy efficiency of equipment is explicitly included as a goal. Best available technologies can double and even triple the average energy efficiency of many current cooling applications.
- According to recent analysis by IIASA and LBNL,[2] applying maximum technically available energy efficiency technologies in parallel with the Kigali Amendment phase-down could reduce electricity consumption equivalent to approximately **26%** of the expected global electricity consumption in 2050.
- This would result in reduced climate and air pollutant emissions reductions associated with energy productions. By 2050, annual emissions of CO_2 would be reduced by an estimated 1.4 Gt, and methane by 9 Mt. Similarly, global SO_2 emissions could be reduced by 9%, NOx by 16%, and $PM_{2.5}$ by 8% by 2050.

[1] United Nations Environment Programme and International Energy Agency (2020). Cooling Emissions and Policy Synthesis Report. UNEP, Nairobi and IEA, Paris. https://ccacoalition.org/en/resources/cooling-emissions-and-policy-synthesis-report-benefits-cooling-efficiency-and-kigali.

[2] Purohit, P. et al. (2020) Electricity savings and greenhouse gas emission reductions from global phase-down of hydrofluorocarbons, Atmospheric Chemistry and Physics, https://doi.org/10.5194/acp-2020-193

Avoiding Banks of Refrigerants

- Refrigerant Banks are stockpiles of refrigerants trapped in millions of refrigerators, air conditioners, and other cooling equipment as well as in chemical stockpiles and foams. If not destroyed, gases trapped in these banks are released into the atmosphere over a period of few years to a decade. Refrigerant banks are not currently managed by the Montreal Protocol.
- A 2014 study concluded that phasing out of HFCs sooner, would substantially reduce the build-up of HFC banks. If HFC production stopped completely in 2020, instead of being phased down gradually, this could provide additional mitigation of 53 $GtCO_2e$ from 2020 to 2060.[3]

Non-Mechanical opportunities for HFC emission reductions

There are many not-in-kind and strategies available today that can significantly reduce climate emissions from the cooling sector while meeting growing cooling needs. These include improved building design, maintenance, and operation to reduce the need for cooling in the first instance. Measures to reduce urban heat islands, such as tree planting and cool roofs and pavement, can further reduce cooling needs, while also addressing equity, as lower income neighbourhoods tend to disproportionately experience elevated heat exposure. While these options could substantially reduce HFC and electricity consumption in residential and commercial buildings, their benefits are not assessed in this briefing note.

[3] Velders G. J. M., et al. (2013) Growth of climate change commitments from HFC banks and emissions, ATMOS. CHEM. PHYS. DISCUSS. 13:32989–33012, 33000. https://acp.copernicus.org/preprints/13/32989/2013/acpd-13-32989-2013.pdf