

# Cutting HFCs to cool the Earth

March 10 2022

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To have a better chance of holding global warming to 1.5 degrees Celsius, we need to accelerate the phase-down of HFC refrigerants under the Montreal Protocol. This could also reduce pollution and improve energy access.

An [air conditioner](#) may freshen the atmosphere in your home, but in doing so, it is probably degrading the atmosphere of Earth. Along with other cooling technologies such as refrigerators and [heat pumps](#), today's

aircon commonly relies on chemicals called HFCs (hydrofluorocarbons), which are very powerful greenhouse gasses. HFCs have been used to replace ozone-depleting substances, and their emissions have increased rapidly in the past two decades.

To meet the Paris climate goals, the world now needs to wean itself off HFCs quickly, according to a new study led by IIASA researchers published in the journal *Nature Climate Change*. As a bonus, this process could reduce global power consumption substantially, bringing many benefits such as lower pollution.

HFCs can be replaced with various gasses that have a far lower climate impact per kilogram, including ammonia, CO<sub>2</sub>, and hydrocarbons such as propane. Indeed, a phase-down of HFCs is already required by international law. In 2016, these chemicals were brought into the Montreal Protocol, a treaty originally set up to curb ozone-depleting substances. The protocol's 2016 Kigali Amendment lays out HFC cuts for four groups of countries up to 2047, requiring consumption to fall by 80 to 85% relative to their respective baselines. The problem is that HFC emissions lag years behind consumption. They can leak out of cooling devices during manufacture and use, and when equipment is scrapped.

The new study considers this lag and examines how various HFC consumption scenarios would affect future emissions, using the IIASA Greenhouse Gas and Air Pollution Interactions and Synergies (GAINS) model. The study projects that, if left uncontrolled, HFC emissions from 2019 to 2050 would have amounted to more than 92 billion tons CO<sub>2</sub> equivalent. (Note that cumulative emissions until 2050 determines the effectiveness of HFC reduction for climate mitigation). Controlled by the Kigali Amendment, the total should be about 32 billion tons. That is however still far above the roughly 16 billion tons in SSP1-1.9 consistent climate scenarios, in which [global warming](#) is limited to around 1.5 degrees Celsius above pre-industrial temperatures.

"Current ambitions for HFC emissions reductions are not sufficient to meet the Paris Agreement's 1.5 degrees Celsius goal. A more ambitious target under the Kigali Amendment could still help achieve the Paris goal if countries act early," says Pallav Purohit, lead author on the study and a senior researcher in the Pollution Management Research Group of the IIASA Energy, Climate, and Environment Program.

The Montreal protocol has a history of ratcheting up ambition, so the authors looked at various options for stronger HFC cuts. For example, in the existing Kigali Amendment, one group of developing nations is allowed to delay cuts by a few years because they have especially high ambient temperatures—so what if they were required to keep the same pace as other developing nations?

This turns out to make little difference to total emissions. Or, what if all nations had to reach 95% emissions cuts by 2050, instead of 80 to 85% in 2047? Again, this barely reduces cumulative emissions to 2050, but it leaves emissions at a lower level for the rest of the century, which is more in line with 1.5 degrees Celsius scenarios.

The most effective option involves all countries not only hitting 95% by 2050, but making accelerated deep cuts before that (for example, developed countries reaching 55% cuts in 2025, instead of the 35 to 40% required in the Kigali Amendment, and developing countries reaching 35% cuts in 2030, compared with 0 to 10% in the Amendment). This leads to 2050 cumulative emissions of less than 24 billion tons CO<sub>2</sub> equivalent—much closer to the 1.5 degrees Celsius climate scenario.

Better still, this early move would be an opportunity to replace old cooling equipment with more efficient hardware. This could save up to 20% of expected future global electricity consumption, which would double the [climate](#) benefits of the HFC phase-down, reduce air pollution, improve energy access and cut consumer energy bills.

"Drawing on the Montreal Protocol's start-and-strengthen approach, accelerated HFC phase-down would increase the chances of staying below 1.5 degrees Celsius," Purohit concludes.

**More information:** Pallav Purohit, Achieving Paris climate goals calls for increasing ambition of the Kigali Amendment, *Nature Climate Change* (2022). [DOI: 10.1038/s41558-022-01310-y](https://doi.org/10.1038/s41558-022-01310-y)

Provided by International Institute for Applied Systems Analysis

Citation: Cutting HFCs to cool the Earth (2022, March 10) retrieved 23 June 2024 from <https://phys.org/news/2022-03-hfcs-cool-earth.html>

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