The Risks of Other Greenhouse Gases

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As the stability of the world's climate is increasingly at risk and governments grapple with the monumental task of cutting emissions, there is a group of little known but powerful greenhouse gases that, left unchecked, could ultimately undermine the best efforts to tackle the climate crisis. Fluorocarbons, or F-gases, are the quintessential greenhouse gases, since chemical engineers designed them to trap heat and to be stable and durable.

The Intergovernmental Panel on Climate Change calculated that the cumulative buildup of these gases in the atmosphere was responsible for at least 17 percent of global warming due to human activities in 2005. And the use of these chemicals worldwide is on the rise, with increased consumption in developing countries like China and India.[1]

Several chemical cousins make up the F-gas family: chlorofluorocarbons (CFCs), hydrochlorofluorocarbons (HCFCs), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6). The major applications of these chemicals today are in refrigeration and air-conditioning (including in cars), which account for 80 percent of F-gas use. The chemicals are also used as solvents, as blowing agents in foams, as aerosols or propellants, and in fire extinguishers. The most commonly used F-gases at the moment are the HFCs, a class of powerful greenhouse gases whose consumption is rising exponentially. HFCs were developed by the chemical industry in response to the discovery of damage to Earth's ozone layer due to CFC use. But this development ignored the known global warming effects of the newer chemicals.[2]

F-gases have incredibly strong global warming potential (GWP) relative to carbon dioxide (CO_2) pound per pound, or gram for gram, because they were built to trap heat very effectively. GWP is calculated relative to carbon dioxide, which is assigned a GWP of 1. Global warming potential depends on the ability of a molecule to trap heat and its "atmospheric lifetime"—how long the chemical stays in the atmosphere before it is broken down or is absorbed or settles out into the ocean, soil, or biosphere, for instance.[3]

GWPs are generally averaged over 100 years, as a baseline for comparison to carbon dioxide. The most popular HFC in use today has an atmospheric lifetime of about 14 years and a 100-year GWP of 1,400, but a 20-year GWP of 3,830. This means that one pound of this HFC is the same as 3,830 pounds of CO_2 in terms of global warming impact for 20 years after it is released into the atmosphere. Of course, there is one benefit to this high short-term GWP: phasing

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out HFCs has an immediate global warming benefit. Cutting HFC use slows global warming right now, when that is most needed.[4]

The chemical industry argues that HFCs can be safely contained and prevented from leaking into the atmosphere, but so far containment has been an unqualified failure—more than 50 percent of all HFCs produced to date have already found their way into the atmosphere.[5]

Greenpeace estimates that HFCs will become an ever-increasing portion of the global warming pollution load exactly when scientists say greenhouse gases need to be reduced rapidly. The popular HFC-134a alone, which currently accounts for about 1 percent of greenhouse gases, is expected to account for 10 percent of emissions by 2050—and releases will still be on the rise. Growing HFC emissions could significantly hamper efforts to keep global temperatures from exceeding crucial tipping points in climate change that have been identified by scientists.[6]

Fortunately, there are environmentally safe, efficient, technologically proven, and commercially available alternatives to F-gases in almost all domestic and commercial applications. These use natural substances, such as simple hydrocarbons, carbon dioxide, ammonia, or even straight water. Typically, systems using natural refrigerants are at least as energy-efficient as those using HFCs or even more efficient. So they are less expensive to operate and create fewer greenhouse gases through reduced electricity use, and thus less load on dirty power plants.

In addition, there are novel technological solutions for air conditioning and refrigeration such as solar adsorption, which uses solar heat as the engine for compression of a liquid refrigerant, most commonly water and ammonia or water and lithium bromide salt. There are also refrigerators that operate with sound waves, and in certain climates simple evaporation devices provide air-conditioning.

The chemical industry does not profit from any of these alternatives. Getting rid of HFCs would put an end to the industry's global, long-term hold on the multibillion-dollar monopoly it has enjoyed with CFCs and other F-gases. The industry is therefore fighting any replacements, especially natural refrigerants, using its global lobbying efforts to soften—or stop—strong legislation and regulations.

There are many examples in all sectors of using natural refrigerants instead of HFCs. One outstanding example is the hydrocarbon domestic Greenfreeze refrigerator (safe for both the ozone layer and the climate) developed in 1993 by Greenpeace and a tiny East German company. Greenfreeze refrigerators are typically more efficient than their HFC counterparts. There are an estimated 300 million Greenfreeze-type refrigerators in the world today, built by leading manufacturers and accounting for approximately 40 percent of the 80 million refrigerators produced annually. This technology dominates the domestic refrigeration markets of Europe and is prominent in Japan and China, but it is conspicuously unavailable in North America due to obsolete regulatory obstacles.[7]

The search for HFC alternatives has been taken up by many large multinational corporations that use refrigeration and cooling technology. A technology-sharing coalition called Refrigerants Naturally was founded in 2004, set up by Greenpeace and the United Nations Environment Programme with the goal of replacing HFCs with natural refrigerants in vending machines, freezers, and fridges. The current partners include Unilever, Coca-Cola, PepsiCo, McDonald's, IKEA, and Carlsberg.[8]

The success of Refrigerants Naturally has been broad. By 2008 Unilever had placed up to 275,000 climate-friendly retail ice-cream freezers in the field. And in late 2008 Ben & Jerry's ice cream, a Unilever brand, started using non-HFC freezers in the United States.

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One of Ben & Jerry's non-HFC freezers freshly installed

The new units save at least 10 percent of the energy used by identical HFC freezers. Coca-Cola has developed a new, high-efficiency compressed carbon dioxide technology for its vending machines and planned to have up to 30,000 CO_2 vending machines in the field by 2008, which will increase to 100,000 by 2010. All Coca-Cola vending machines at the 2008 Beijing Olympics were HFC-free.[9]

Supermarkets and other retail stores are also making the switch from HFCs and F-gas technology. In March 2006, several major U.K. supermarket chains—including ASDA, Marks & Spencer, Sainsbury's, Somerfield, Tesco, and Waitrose—announced their decision to phase out their use of HFCs in cooling equipment and to convert to natural refrigerants such as carbon dioxide.[10]

In another crucial development, progress is being made in phasing out potent F-gases from automobile air-conditioning. The European Union (EU) moved to phase out HFC-134a in mobile air-conditioning by 2011. In response, the German car industry decided in August 2007 to deploy compressed carbon dioxide as the replacement refrigerant.[11]

HFCs and other non-ozone depleting F-gases are currently included in the Kyoto Protocol's "basket" of greenhouse gases, but the parties to the treaty have yet to address HFCs specifically and proactively. (CFCs and HCFCs were not included in the Kyoto Protocol because they were already being banned and phased out under the earlier Montreal Protocol on the ozone layer.) In the meantime, a few jurisdictions around the world are already taking action in a variety of ways.

Individual countries and jurisdictions—including Denmark, Switzerland, Austria, the EU Commission, and most recently the state of California—have all moved to curtail releases of F-gases by variously banning new uses, phasing out old ones, and providing incentives to reduce leakage of high-GWP F-gases. Governments have made these moves by passing regulations, providing incentives for technology upgrades, levying taxes on imports of HFCs based on their warming impact, and providing refunds for destruction of captured used F-gas. These bold moves have led to increased awareness and adoption of alternatives.[12]

The global solutions to this potentially devastating problem are quite clear and available. The Kyoto Protocol and the Montreal Protocol both could, in complementary ways, act swiftly to reduce and eliminate uses of F-gases. For example, the Montreal Protocol's practice of pushing developing countries to replace HCFCs with HFCs should be stopped immediately. And the treaty could be used to stimulate the recovery of millions of tons of "banked" HFCs, CFCs, and HCFCs sitting in old cooling equipment that need to be safely recovered at the end of the equipment's life and destroyed.

Meanwhile, the parties to the Kyoto Protocol are in the midst of serious and complex negotiations leading up to their next conference, in Copenhagen in late 2009, when new emissions reduction targets should be on the table. Negotiators are having a difficult time setting targets and commitments for reducing carbon dioxide, the largest greenhouse gas, and shaping a renewed commitment to limit deforestation-related greenhouse gas emissions. As of late 2008 the parties to the treaty had not found a path to develop strong specific incentives and actions on HFCs.

Some observers are now proposing that HFCs be regulated under the Montreal Protocol instead of the Kyoto Protocol. They call for HFCs to be phased out of production over time just as other F-gases were and simultaneously be removed from the Kyoto Protocol basket entirely. The argument is made that Montreal Protocol participants have more expertise with F-gases and assessment of alternatives and that developing countries already participate strongly in the treaty.[13]

This approach—removing agreed greenhouse gases or sectors from the climate change treaty at this point—risks weakening the Kyoto agreement. In addition, it would kill a strong financial incentive to reduce F-gas emissions by removing HFCs from the rapidly evolving GHG emissions trading schemes, erasing potentially lucrative carbon credits that adopters of non-HFC technology could earn and trade under the Kyoto Protocol. It is hoped that an effective approach will evolve during the treaty negotiations of 2009 and beyond, making efficient use of the best capacities of both treaties. Until then, the Kyoto Protocol arena remains the best place to kick-start and deal with this growing threat to the climate.

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