

HFCs and other F-gases: The Worst Greenhouse Gases You've Never Heard Of

Glossary

F-gases: CFCs, HCFCs and HFCs are all part of a family of gases known as F-gases or fluorocarbons. The regulatory control of F-gases is split between the Montreal Protocol and the Kyoto Protocol.

CFCs: Chlorofluorocarbons (and their close cousins HCFCs) are ozone layer depleting substances and are regulated by the Montreal Protocol. These are also strong greenhouse gases but were excluded from the Kyoto Protocol because they were already being regulated.

HFCs: Hydrofluorocarbons are strong greenhouse gases and are regulated by the Kyoto Protocol. HFCs are not ozone-depleting and were developed as replacements for CFCs.

Kyoto Protocol: A 1997 international treaty to solve global warming by curtailing emissions of greenhouse gases.

Montreal Protocol: A 1987 international treaty to heal the ozone layer by controlling ozone depleting substances.

Natural Refrigerants: Common natural refrigerants include isobutane and other hydrocarbons, ammonia, water, air, and carbon dioxide.

GDP: Global Warming Potential is the relative power of a given pollutant to cause global warming over a given timescale, factoring its ability to trap the sun's heat and its atmospheric lifetime. GDPs are measured relative to carbon dioxide, which is given a GDP of 1.

ODP: Ozone Depleting Potential is a factor indicating a substance's relative ozone damaging power.

What are HFCs?

HFCs are man-made greenhouse gases developed by the chemical industry to replace CFCs, HFCs' ozone-killing cousins, which were banned in 1992 by the Montreal Protocol. Unfortunately, despite their PR spin, HFCs are NOT an environmental alternative to anything. CFCs and HFCs are all part of a family of gases known as F-gases. F stands for fluorine, the chemical element shared by all of them. Their regulatory control is split between the Montreal Protocol (responsible for regulation of ozone depleting substances) and the Kyoto Protocol (responsible for regulation of greenhouse gases that cause climate change). The major applications that use F-gases are refrigeration, air conditioning, foam blowing agents, aerosols, fire protection and solvents. HFCs are used primarily in refrigeration and air conditioning, with these sectors accounting for 90% of F-gas use.

Are HFCs environmentally friendly?

HFCs are often misleadingly portrayed by their manufacturers and users to be 'environmentally friendly' because they do not deplete the ozone layer. However, they are highly potent greenhouse gases and contribute significantly to climate change.

How can we measure the harm to the climate created by HFCs?

The most common measurement is called the Global Warming Potential or GWP—a calculation of how powerful a greenhouse gas is over a specific timescale compared to carbon dioxide, which has a GWP of one. The GWP of any greenhouse gas will differ depending on whether its potency is measured on a 20 year, 100 year or 500 year timescale. The 100 year timescale is the most commonly used in policy circles when a given emission of HFCs is converted to CO₂ equivalent emissions. The GWPs of HFCs range from 53 to almost 15,000. The most commonly used is HFC 134a with a GWP of over 100 years. However, 134a has a short atmospheric lifetime (~14-16 years) making its 20 year GWP over 3000 times that of CO₂. If you bought your home refrigerator or your car within the last 10 years, it almost certainly uses HFC 134a to keep your food cold and cool your vehicle. For comparison, with a GWP of 1430, the 300 grams (roughly 10.6 ounces) in your refrigerator is equivalent to 945 pounds carbon dioxide, or the amount an average car emits over 1600 miles. If you bought your refrigerator in Europe in the last ten years, it most likely uses a hydrocarbon refrigerant with a GWP of less than 3; technology that was designed, prototyped and open-sourced by Greenpeace in 1992.

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Where are HFCs being used and emitted to the atmosphere?

Ninety percent of HFCs today are used in refrigeration and air conditioning units. So it is not surprising that these are the two main sources of global HFC emissions. Automobile air conditioning tops the list. Unlike CO₂ that is emitted as a product of burning fossil fuels to generate energy, most HFCs are contained within equipment. Any emissions are the result of old equipment, faulty maintenance, leakage during maintenance, or escape at the end of the product's lifetime. One would expect the US government to have a network of HFC recycling plants and recapture centers, as well as increased efficiency standards and maintenance regulations. This is not the case. Recapture regulations are on the books but enforcement is difficult and under funded. Industry data show that 59% of HFC 134a ever produced has already been release into the atmosphere (along with 80% of the main HCFC in the market, HCFC 22). According to recent investigations, about 60% of HFC emissions arise from routine leaks from refrigeration and air conditioning.

What will be the overall impact of F-gases and HFCs to global warming?

The Montreal Protocol is often dubbed the most successful environmental treaty. However, despite its best efforts, the cumulative CFC, HCFC and HFC pollution now in the atmosphere was directly responsible for 17% of man-made global warming in 2005. Over the next 20 years, HFCs will make up 8.6% of global greenhouse gases emissions, according to a German research institute (see footnote xi). If HFCs are chosen as the Business-As-Usual replacement for the popular HCFC-22, HFC production will hit the equivalent of 6.85 billion tons of CO₂ in 2050. Production will peak at 7.97 billion tons of CO₂ in 2070, almost 10 times the projected CO₂ emissions of the US in 2010. If HFC 134a production alone is allowed to continue at the same rate as it is now, production will peak at approximately 1.83 million tons in 2070. That's the equivalent of 2.61 billion tons of CO₂, 5 times the projected CO₂ emissions of Australia in 2010. Carbon dioxide is the biggest piece of the climate puzzle. If we get the job done and do everything possible to reduce our carbon dioxide emissions, by phasing out coal, reducing oil consumption, investing heavily in renewable energy and increased energy efficiency, but continue to increase HFC-134a emissions as we do now, they will make up over 12% (12.56%) of our global carbon footprint in 2050.

How fast are HFC emissions increasing throughout the world?

Between 1995 and 2000, HFC 134a emissions increased by 421%. In a more recent study, HFC 134a and HFC 125 (another common HFC) emissions were shown to be growing at a rate of 20% per year. This rapid increase was measured in a seemingly untouched part of our planet: Svalbard (an island archipelago midway between Norway and the North Pole).

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Who are the main HFC producers?

The fluorocarbon-producing industry includes companies such as: Honeywell, DuPont, Carrier, Solvay, Arkema, Mexichem, INEOS (ex ICI) and Rhodia. These are all large chemical companies from countries as varied as Belgium, France, Mexico, Spain, the United Kingdom and the United States. This industry exerts tremendous lobbying power. It is represented by trade groups such as the 'Alliance for Responsible Atmospheric Policy' (ARAP), the Air-Conditioning and Refrigeration Institute (ARI) and 'European Partnership for Energy and the Environment' (EPEE). Their members include both manufacturers and businesses that rely on CFC, HCFC and/or HFC gases, such as Ford Motor Company, Dow Chemical, Fujitsu, General Motors Company and Hitachi. Greenpeace is counteracting the lobbying power of these groups by teaming with corporations looking for solutions under the coalition, Refrigerants, Naturally! which is presented in detail in our fact sheet on natural refrigerants.

What countries contribute most to HFC emissions?

According to recent UNEP (United Nations Environment Program) reports, 80% of current HFC (but also of CFC and HCFC) emissions originate from industrialized countries. The United States, Europe, Russia, Japan and Australia mark the biggest percentages. However, developing countries in East Asia, South Asia, and South America are catching up quickly.

Has any government taken actions against HFCs and F-Gases?

So far, the European Union is the only governmental body that has actively worked to reduce HFC emissions. In particular, starting in 2011 HFCs are banned from mobile air conditioning in cars in the EU. However, the EU primary approach has been based on containment and recovery of HFCs rather than forcing the use of alternatives. Recently, EU member states Denmark and Austria both enforced more stringent measures, banning the import, sale and use of new products containing F-gases as well as banning the import, sale and use of F-gases, new and recovered.

Are containment and recovery an adequate solution to the climate-harming HFCs?

So far the effort to recycle, recapture and destroy F-gases has been an absolute failure. The chemical industry's own data on F-gas emissions shows 59% of all HFC 134a ever produced is already in the atmosphere, so this number could be much higher. In 2004 the report, HFC Containment Has Already Failed, by renowned chemist Eric Johnson, indicates that HFC-134a from automobile air conditioning has continued to leak at around 25-30% annually over the past decade. This contradicts claims by the auto industry that the leakage rates have averaged 10-15% over the same period and calls the EU strategy into question. Many experts agree that all F-gases produced will eventually be released into the atmosphere. This will certainly happen unless the international community sets up a global network for the safe recapture and destruction of F-gases.

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Can HFCs easily be replaced?

Alternatives to climate-harming HFCs have been available on the market for a long time. Please refer to the Greenpeace fact sheet 'Natural Refrigerants: The Solutions' for more details.

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- i. In order to explain their use, the following passage describes their usage in a refrigerator. Some refrigerators use specific substances such as CFCs or HFCs to absorb heat, in order to cool products. These substances start as a liquid, before the pump pushes them through pipes into the freezer area, and turn them into vapour, which helps absorb heat from the freezer compartment. As the pipes get colder and the freezer begins to cool, the pump sucks the CFCs and HFCs in vapour form and forces them through thinner pipes located outside the refrigerator. The compression turns the vapoured CFCs and HFCs back into liquid form—during this process, heat is released which is absorbed by the air around it.
- ii. IPCC Special Report on Ozone and Climate (SROC), Ch.11 Table 11.2, 2006
- iii. HFC 152: 53, HFC 23: 14760 – WMO 2006 'Scientific Assessment of Ozone Depletion', Chapter 8, p.10
- iv. WMO 2006 *ibid.*
- v. IPCC SROC 2006 *ibid.*
- vi. IPCC/TEAP Special Report 'Safeguarding the Ozone Layer and the Global Climate System: Issues Related to Hydrofluorocarbons and Perfluorocarbons –Summary for Policymakers, 2005, p.13
- vii. Derived from http://www.afeas.org/data.php?page=emission_hfc134a - the numbers on this site are provided by industry so they could be much higher
- viii. http://www.afeas.org/data.php?page=emission_hcfc22
- ix. Schwarz, Winfried. The high and still growing share of fluorinated greenhouse gases in overall global warming emissions-summary of an O-ko-Recherche study (including special remarks on commercial refrigeration), Frankfurt, June 2004, on behalf of Greenpeace
- x. IPCC Special Report on Ozone and Climate (SROC), Ch.2 p.164 2006
- xi. W. Schwarz 'The rise and rise of fluorinated greenhouse gases as a share of global warming emissions', O-ko-Recherche 2004, p.3
- xii. D. Kanter *ibid.*
- xiii. http://globalis.gvu.unu.edu/indicator_detail.cfm?country=US&indicatorid=197
- xiv. Numbers derived from SRES and AFEAS data for D. Kanter 'HFC-134a Production Projections', Greenpeace International 2008
- xv. http://globalis.gvu.unu.edu/indicator_detail.cfm?country=AU&indicatorid=197
- xvi. D. Kanter *ibid.* xv
- xvii. IPCC SROC Ch.11 Table.11.7, p.414
- xviii. 'Greenhouse Gas Monitoring at the Zeppelin Station' Annual Report 2002, reported in ENDS Daily News, 6 February 2004
- xix. UNEP, Production and Consumption of Ozone Depleting Substances under the Montreal Protocol, 1986-2000, Ozone Secretariat, UNEP, Nairobi, 2002
- xx. F.e. on Denmark: Official Journal of the European Union, L32/130, 6 February 2007