

FACT SHEET

Natural Refrigerants: The Solution

1. So what is the solution? What are the alternatives to using CFCs, HCFCs and HFCs?

The switch from CFCs and HCFCs to HFCs represents a classic example of industry replacing one harmful chemical with another. All these chemicals contribute to climate change, each with global warming potential (GWP) thousands of times higher than CO₂.

Greenpeace believes that these chemicals can and should be replaced with **climate-friendly alternative refrigerants**. This is the only responsible, sensible and precautionary course of action. A good example of climate-friendly alternative substances is **natural refrigerants**, many of which are commercially available today.

2. What are natural refrigerants?

Natural refrigerants are **naturally occurring** substances that can be used as cooling agents in refrigerators and air conditioners. These substances include hydrocarbons (propane, iso-butane, and cyclopentane), CO₂, ammonia, water and air. They are sometimes referred to as 'the Gentle Five', each with a different area of application. Natural refrigerants are **ozone- and climate-friendly** substances. There are many other refrigeration techniques that use environmentally benign, or even no refrigerants, such as thermo-acoustic, Stirling cycle, pulse-tube and magnetic cooling technologies.

3. How is CO₂, whose emissions are killing the earth, considered a good natural refrigerant? The same goes for ammonia – isn't ammonia toxic?

Carbon dioxide has no ozone depletion potential (ODP=0) and negligible direct global warming potential (GWP=1), compared to the HFCs which have GWPs typically around 1,500 – 4,000. CO₂ is harmful to human health only in high concentrations. Ammonia has both no ozone depletion potential (ODP = 0) and no global warming potential (GWP=0). It is considered a natural refrigerant because although produced synthetically for refrigeration, it occurs in nature's material cycles. Ammonia is toxic, but has a characteristic, sharp smell which gives a warning below concentration levels that endanger health.

4. What is the Global Warming Potential (GWP) of F-gases and natural refrigerants?

Below is a chart¹ that compares the GWP of CFCs and HCFCs to natural (CO₂ and hydrocarbon) technology:

Common refrigerants	Composition	Ozone depletion potential	Global warming potential (100 years, verified in 2007)
R22	HCFC	0.055	1810
R134a	HFC	0	1430
R404A	HFC blend	0	3920
R407C	HFC blend	0	1770
R410A	HFC blend	0	2090
R290	Propane	0	~ 3
R600a	Iso-butane	0	~ 3
R744	CO ₂	0	1
R717	Ammonia	0	0

5. Are natural refrigerants more expensive?

Natural refrigeration technologies are also **worthwhile** from an **economic** standpoint. Many natural refrigerants are inexpensive, and always less expensive than HFCsⁱⁱ. In addition, natural refrigerants often boast the most energy efficient technologies, some up to 25% more **energy efficient** than HFCs.

There is wide assumption that companies and plants using natural refrigerants need investments between 10 to 20 percent higher than those using HCFCs or HFCs, but this assumption is misleading and must be put into perspective. Depending on the type and size of the system, a company may indeed incur additional expenses, but they also offset this in the mid- to long-term with reduced costs. For one, operating costs are lower than its HCFCs and HFC counterparts because of lower leakage-related costs, the low cost of maintenance, and most importantly low energy consumption. There is the additional advantage that comes from the relatively inexpensive disposal of natural refrigerants at the end of a refrigerators' lifecycle.

6. Why are natural refrigerants particularly suitable for developing countries such as China?

In developing countries such as China, there are more financial incentives for companies to switch to natural refrigeration technology. Unlike HCFCs and HFCs, which require expensive processing and licensing—natural refrigeration technology can be purified cheaply from stocks of raw gases already widely available in China.

7. Many governments and companies believe containment of HFCs will solve the problem. What is Greenpeace's opinion?

Greenpeace **opposes containment** policies, because these policies fail to deliver the suggested results, and leakage rates tend to be much higher than industry claimsⁱⁱⁱ.

Containment policies are even more difficult to implement in developing countries because (1) many developing countries lack well-trained personnel who can ensure that fluorine gases will be properly handled (2) adequate disposal facilities are almost non-existent in most developing countries, although this latter point applies to most developed countries as well, and (3) containment relies solely upon the conscience and the thoroughness of individual technicians when handling equipment.

Greenpeace thinks that governments should therefore **promote** the use of natural refrigerants and endorse **phase-out** dates for HFCs in refrigeration and air-conditioning. These gases have to be **eliminated**—not just 'contained'.

8. What is the history of natural refrigeration technology and Greenpeace's role in developing it?

In the early 90s, Greenpeace set out to find climate-friendly alternative technologies, convinced that there was a way to avoid HFCs through innovation. The result is the creation of **Greenfreeze**, which uses **hydrocarbons** for both the blowing of the insulation foam and the refrigerant and are entirely free of ozone-depleting and global warming chemicals.^{iv}

The creation of Greenfreeze was one of the first-ever attempts made by an NGO to actively participate in technology innovation to transform an industry. Greenpeace worked behind the scenes to acquire government, scientific, and consumer endorsement for Greenfreeze technology, which in turn secured the capital investment needed to commercially roll out Greenfreeze refrigerators. Other major household appliance manufacturers, such as Bosch, Siemens, Liebherr and Miele recognized the market appeal of a 100% climate-friendly refrigerator, and introduced their own line of Greenfreeze models in 1993. Greenpeace's achievement was recognised by UNEP in 1997, when Greenfreeze received the prestigious **UNEP Ozone Award**.

9. What is the current market situation of natural refrigeration technology?

Greenfreeze technology has spread extensively throughout Europe, Japan, Russia and parts of China. To date over 200 million Greenfreeze refrigerators have been produced, and most large manufacturers - including Bosch-Siemens, Electrolux, Whirlpool, Samsung, LG, and Haier—now produce and sell Greenfreeze refrigerators in many parts of the world.

Unfortunately, Greenfreeze is still illegal in the United States, thereby making the United States one of the few places in the world where Greenfreeze technology has not been introduced into the domestic refrigerator market. Moreover, throughout the world, the diffusion of natural refrigeration technology in commercial refrigerators and air-conditioners has been much slower.

10. Tell us more about the obstacles behind introducing natural refrigerants into the United States.

The chemical industry has used its influence in the United States—and continues to do so—to **obstruct** the introduction of **hydrocarbon technology (Greenfreeze)**, effectively limiting competition to HFC technology. Although hydrocarbon technology is widely spread throughout Europe, China and other countries, moreover its effectiveness and safety has been confirmed, hydrocarbon technology is yet to be approved by the US government, thereby denying American consumers the right of access to a climate-friendly appliance.

Greenpeace is currently working with various parties, including technology experts, refrigerator manufacturers, refrigerator-using companies and the US Environmental Protection Agency (EPA) to overcome the obstacles associated with introducing hydrocarbon technology into the United States.

11. Can Greenfreeze be found in China?

Greenpeace played a big role in developing and commercializing hydrocarbon (Greenfreeze) technology in China. Greenpeace believed that the diffusion of Greenfreeze into China aligned with China's sustainable development goals, allowing a transitional economy to skip using dirty and unsustainable technologies and to move directly into cleaner innovations.

Back in 1993, Chinese officials asked Greenpeace to facilitate technology transfers and help catalyze joint ventures between Chinese and German manufacturers. By mid-1995 three of the four largest refrigerator-manufacturing sites in China had partially converted to Greenfreeze technology. By 2000, 35 percent of all **domestic refrigerators** sold in China used Greenfreeze technology. Since then, the technology's market share has steadily risen^Y. **Unfortunately, the diffusion of natural refrigeration technology in commercial refrigerators and air-conditioners has been much slower so far, both in China as well as in other places in the world.**

12. What is the current situation with regards to commercial refrigeration in China?

There is currently increased activity within China to spread natural technology beyond the domestic refrigeration market. For instance, Chinese universities and companies have invested large amounts of resources in recent years to explore new natural working fluids in refrigerants, such as CO₂, ammonia, water, and air. Many companies that are part of the Refrigerants, Naturally! Alliance (mentioned below) are also looking into possibilities of bringing in natural refrigeration technology into commercial refrigeration in China.

13. How about the use of natural refrigerants in air-conditioning, both in China and throughout the world?

The application of natural refrigerants in air-conditioning has unfortunately been extremely slow. However, in 2007, the German Automotive Industry Association (VDA) announced that it will choose CO₂ as the replacement to the current refrigerant, HFC 134a, in mobile air conditioning. This decision is an attempt to comply with the EU Directive banning high global warming refrigerants starting from 2011.

14. So are companies taking up the challenge?

Greenpeace believes that any company that uses refrigeration in its business has the responsibility to use natural technology. While there have been positive developments over the past few years, unfortunately, most companies are still heavily dependent on HFC technology.

15. Can you tell us more about Refrigerants, Naturally!?

In 2004, McDonalds, The Coca-Cola Company, and Unilever launched **Refrigerants, Naturally!**, a multi-stakeholder initiative dedicated to promote a shift in the point-of-sale cooling technology towards alternative HFC-free refrigeration technologies. In doing so, Refrigerants, Naturally! became the first corporate alliance to make an official position against HFC technology in favor of natural refrigerants. These companies have over the last years, together with their suppliers, developed and tested innovative, commercially viable HFC-free refrigeration technologies. In 2006, three more companies—Carlsberg, Ikea, and the Pepsi-Cola Company—joined the initiative.

Refrigerants, Naturally! is publicly **supported by UNEP and Greenpeace**. Refrigerants, Naturally! received the US EPA's Climate Protection Award in 2005. Members of Refrigerants Naturally! call upon other companies to join the initiative to underline the need for sustainable refrigeration solutions. The initiative also helps to send out a strong signal to the supply chain to make the necessary developments and investments to move HFC-free technologies to successful commercial propositions.

ⁱ IPCC 4th assessment report, November 2007.

ⁱⁱ For instance, ammonia is much less expensive than its HFC counterpart HFC404a, and hydrocarbons have prices comparable to HFCs.

ⁱⁱⁱ For more information, please consult the 2004 report, *HFC Containment Has Already Failed* by chemist Eric Johnson.

^{iv} During these years there were no conspicuous switches yet from CFCs to hydrocarbons. For more information, please consult:

Andersen, Stephen O, Sarma, Madhaya. *Protecting the Ozone Layer*, UNEP, 2002

^v **R290** and **R600a** are the most common types of Greenfreeze domestic refrigerators and can be found easily in the Chinese and European markets at electrical appliances stores.