

HFCs: Ozone-Saving Gas Targeted for Climate Effect

The use of Hydrofluorocarbons in cooling systems may save the ozone layer - but it will harm the climate. The Montreal Protocol, set in action in 1987, forced the phase-out of ozone-depleting gases chlorofluorocarbons (CFCs) and later hydrochlorofluorocarbons (HCFCs). But the hydrofluorocarbons (HFC) that are replacing them could have an equally negative impact on climate change.

HFCs are used as refrigerants and foam-blowing agents and emitted as leakage from air conditioning and refrigeration systems. They have a global warming potential similar to that of HCFCs and hundreds to thousands of times greater than carbon dioxide.

Unless action is taken, the Intergovernmental Panel on Climate Change (IPCC) predicted that emissions of HFCs will triple from 0.4 billion tons carbon dioxide equivalence in 2002, to 1.2 billion tons in 2015. The Environmental Investigation Agency (EIA) expects HFC emissions to be considerably higher in light of the accelerated phase-out of HCFCs agreed by the Montreal Protocol in September 2007.

The biggest emitters of HFCs are mobile air conditioning (MAC) systems in cars (66% of all HFC emissions according to 2002 data from US EPA and ADEME); followed by commercial refrigeration, and particularly supermarket refrigeration (23%); and finally stationary air conditioning systems (6%) such as found in retail units and offices.

Cooling cars

In 2006, the European Union's MAC Directive banned the use of mobile air conditioning refrigerants with a GWP over 150 in new model cars by 2011 and in all cars by 2017. Since then, there has been a flurry of activity by manufacturers looking for alternatives.

The two contenders are the chemical HFO-1234yf and carbon dioxide, known as R744 as a refrigerant. According to the Alliance for CO2 Solutions, a grouping of organisations that support the use of CO2 Technology in car air conditioning, there is an estimated \$14.5 billion global market for car air conditioning to fight for.

On one side are chemical giants DuPont and Honeywell, that have jointly developed HFO-1234yf. Its selling point to car manufacturers is that it is a near drop-in replacement to HFC-134a and doesn't require a complete MAC system redesign.

CO2, on the other hand, operates at higher pressure so requires a new system with new components and tooling. New technology will spell unwanted costs and hassle for car makers.

But costs will come down once mass volumes are achieved, say CO2 manufacturers. Frank Wolf, CEO of Obrist Engineering that develops R744/ CO2 technology for MAC systems, says a R744 MAC system will add just 20 euros to the cost of a car on a run of one million. CO2 itself is cheap and readily available.

R744 manufacturers also argue that, unlike HFO-1234yf, CO2 is proven, safe, natural and sustainable. In a letter to German OEMs in May, Greenpeace Germany raises concerns over the chemical's flammability, stating that "the claim that 1234yf will be an alternative is not only wrong but also life threatening; the legal consequences not calculable".

HFO-1234yf is "mildly flammable", says Taner Eryilmaz, DuPont global marketing manager, but adds that all risk assessments undertaken by the Society of Automotive Engineers (SAE) International Cooperative Research Program, and additional tests by OEMs, have concluded that 1234yf is safe in mobile air conditioning. "They have gone to extreme, unrealistic conditions just to see what it takes to ignite 1234yf and their conclusion remains the same," he says (opponents question the independence of tests.)

As the debate rumbles on, car manufacturers are not placing orders. As a result, it is looking increasingly likely the 2011 deadline for the MAC directive will be delayed.

Without the politics to battle with, the commercial refrigeration industry is making faster progress towards climate-friendly alternatives.

Fridges

Refrigerants, Naturally! is a corporate alliance of Coca-Cola, McDonalds, Unilever, Carlsberg, Ikea, and the PepsiCo, with support from Greenpeace and the United Nations Environment Programme, to replace HFC technology in favour of natural refrigerants.

Coca Cola plans to install 100,000 cold drink coolers and vending machines using CO2 as refrigerant by the end of 2010. (Coca Cola has 10 million coolers in operation.) "CO2 works. It's more efficient, and importantly, it is safe. It is the future, and now we are taking steps to making it a reality" Neville Isdell, Coca-Cola chairman and CEO at a

speech in Beijing last year.

By early 2009, Unilever had 400,000 hydrocarbon freezer cabinets in use, and plans to double this figure by 2010 to generate 80,000 tonnes GHG emissions savings per year, according to calculations from Refrigerants, Naturally! US restrictions against the use of hydrocarbon (which is flammable) in the US are holding back progress. But in 2008, Ben & Jerry's, part of Unilever, received federal permission to install and test the first hydrocarbon-based freezers in the United States.

Drink coolers are just the beginning. Much greater emissions savings can be achieved by switching supermarket fridges and freezers over to climate-friendly alternatives. Research from EIA has revealed that supermarkets are the biggest source of HFC emissions in the UK. And refrigerants account for around a quarter of a supermarket's GHG emissions (20% in the case of Tesco for 2008/09).

But supermarkets are lagging. In a survey carried out by EIA in summer 2008, it found that none of the UK's seven largest supermarket chains had more than four stores using HFC alternatives.

But there are signs of progress. From 2010, Marks & Spencer has pledged to only install climate-friendly CO2 systems. It is also trialling a new HFC with lower global warming impact that, if successful, will replace all existing HFC systems by 2012.

Cool air

The move to climate-friendly alternatives in stationary air conditioning has been slower. Hydrocarbon and ammonia systems exist, but only in "dozens" of buildings in the UK, says Nick Cox, MD of environmentally-friendly air conditioning supplier Earthcare Products. "But there is enough out there to prove the technology," he adds. Earthcare's hydrocarbon systems are being used by companies and government departments "that implement their environmental policies rather than ignore them," he says. Enquiries are also coming in from supermarkets that are already using natural refrigerants in fridges.

But Cox says it will take regulation to prompt a wholesale move away from HFCs in stationary air conditioning.

A credible goal?

Cost is the major barrier. Most companies are only using HFC-free solutions in new equipment rather than replace existing. But the cost of doing this is still high. The cost of the natural refrigerants themselves is low, sometimes lower than HFC. But because the technology is newer, the costs tends to be higher, says Daniel Colbourne from the Refrigerants, Naturally! Secretariat. He estimates that a CO2 point-of-sale chiller could cost around twice as much as an HFC equivalent.

But as Cox says, "if we were able to achieve the same volumes [as existing mass produced systems], the equipment wouldn't cost any more. It is all volume driven."

Cost is not the only factor. "The whole industry needs to change," says Bob Arthur, refrigeration technology specialist at Marks & Spencer. "The refrigeration industry needs to be able to support the alternative fluids in terms of equipment availability, quality trained operatives, and understanding of the alternatives' application." Regulatory horizon

Challenging or not, this isn't something companies dare ignore with global regulation for HFCs on the horizon. EIA is calling for a global HFC phase out that would cover all sectors. It believes the Montreal Protocol is a good mechanism to co-ordinate this.

With the Obama administration recently expressing support for a clamp down on HFCs, and with HFCs being formally discussed at the climate meeting in Bonn this week, Fionnuala Walravens, EIA global environment campaigner, thinks a global phase could be on the cards. "So much has happened in the last six months that it looks like it could become a political reality. Some sort of agreement on HFCs would be a positive outcome at Copenhagen."

Natural refrigerants

Carbon dioxide (R744) - used as a refrigerant before the discovery of CFCs. Global warming potential (GWP) of 1, non-ozone depleting, non-toxic, non-flammable. CO2 operates at a higher pressure than HFCs, which means it requires new system design and components.

- Hydrocarbon (isobutane (R600a) and propane (R290)) - negligible GWP, non-ozone depleting, non-toxic, flammable. US and Canada places restrictions on the use this flammable gas. But it is used in over 300 million household fridges across Europe, Japan, Russia and China. Unlikely to be appropriate for use in large applications such as supermarket fridges as a result of its flammability.

- Ammonia - No GWP and non-ozone depleting. It is a hazardous substance, but used safely around the world in large-scale industrial cooling systems such as food processing and building air conditioning.

Fluorocarbons (F-gases)

- CFCs and HCFCs - Chloroflourocarbons and hydrochlorofluorocarbons are ozone layer-depleting substances (as well as potent greenhouse gases) regulated by the Montreal Protocol.
- HFCs - Hydroflourocarbons are non ozone-depleting and were developed as replacements for CFCs. But they are strong greenhouse gases and are regulated by the Kyoto Protocol. HFC-134a , that accounts for the bulk of HFCs used, has a GWP of 1,430 over a 100-year lifetime.

SOURCE: ClimateChangeCorp.com | Technology, 12 Jun 2009, Author: Emma Clarke,
<http://www.climatechangecorp.com/content.asp?contentid=6183>