

## **BRIEFING ON THE CLIMATE THREAT POSED BY F-GASES**

### **Summary**

**F-gases are growing faster than other greenhouse gases, and are far more powerful. They are potent industrial greenhouse gases with no natural sources, and deliberately manufactured, mostly for use in refrigeration and air conditioning, even though there are better alternative technologies on the market. Governments allowed f gases such as HFCs to replace ozone-damaging CFCs but now they are bowing to chemical industry lobbying and allowing completely new uses and HFCs, which through damaging the climate, have become the 'new CFCs'. Although they are largely ignored, the impact of F-gases could soon overwhelm any other progress made under the Kyoto Protocol. They could readily be eliminated.**

### **No Natural Sources**

F-gases listed under the Kyoto Protocol are PFCs, HFCs and SF<sub>6</sub><sup>1</sup>. They are all manufactured. 'F' stands for fluorine. The most significant group are the HFCs, widely promoted from the early 1990s by the chemical industry as a substitute for their chlorine-containing gases CFCs and HCFCs. HFC134a the most widely used, is 1300 times more powerful than CO<sub>2</sub> (100yr horizon; 3300 times on 20yrs). SF<sub>6</sub> is 23,900 more powerful than CO<sub>2</sub>.

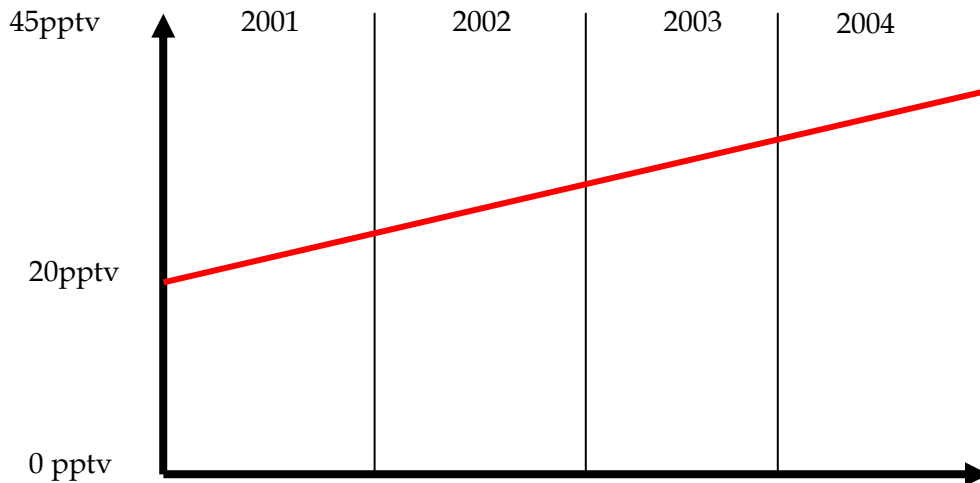
### **A Rapidly Growing Problem**

The Intergovernmental Panel on Climate Change (IPCC) said in 2001: HFC-134a emissions 'have grown from near zero in 1990 to an estimated 0.032 Tg/yr in 1996. The abundance continues to rise almost exponentially as the use of this HFC increases'<sup>2</sup>. Over 60% of HFC emissions result from routine leaks from refrigeration and air conditioning<sup>3</sup>. As use has grown, so too have emissions and f-gas pollution in the air.

Atmospheric levels of HFC 134a over Svalbard (Spitsbergen) doubled over the four year period 2001 – 4, monitoring<sup>4</sup> by the Norwegian Institute for Air Research (NILU) has shown. Another report has found that HFCs leak as rapidly as did CFCs<sup>5</sup>. HFCs from mobile air conditioning (mainly cars)<sup>6</sup> already has the same impact as all of Sweden's greenhouse gas emissions<sup>7</sup>.

Although alternatives are available (below), governments are allowing HFCs to be used to replace uses of CFCs and HCFCs<sup>8</sup>. So far only about 30% of uses have been so substituted, and resulting HFC emissions comprise about 1.5% of total global warming. If all HCFCs and CFCs are replaced with HFCs, the figure will not be 1.5%, but 4.1% (the impact over 100 years), and over the critical next 20 years, 5.2%.<sup>9</sup>

By 2050, a 20 year time horizon in HFCs are expected to make up 8.6% of total global warming, doing as much damage to the climate as the traffic fumes of all the worlds private cars.



Atmospheric concentrations of HFC 134a measured at Zeppelin research station, Svalbard, Northern Norway (NILU) have doubled over the past four years

### **Alternative Commercial Technologies Are Abundant – Regulation Would Work**

Austria, Denmark, Sweden and Switzerland have all adopted policies which outlaw specific uses of HFCs, PFCs and SF6. Established commercial alternatives exist for HFCs in refrigeration and air conditioning<sup>10</sup>, fire extinguishing and insulation. Over 120 million domestic fridges using hydrocarbons (alternatives to HFCs) have operated successfully since 1992 but HFCs are widely used in the USA and in larger shop and office systems, due to the lobbying power of the chemical (fluorocarbon) industry.

A database of alternative technologies is online at [www.mpiggs.org](http://www.mpiggs.org)

In 2004<sup>11</sup> American multinationals Coca Cola and MacDonalDs<sup>12</sup> and Anglo-Dutch giant Unilever are all actively adopting non-HFC technologies (mostly hydrocarbons) for chilling, cooling and air conditioning, in ice cream, restaurant, drinks and other applications.

The new<sup>13</sup> (in Europe and the UK) use of HFCs in car air conditioning could be avoided by requiring use of proven CO<sub>2</sub>-based technologies<sup>14</sup> or not fitting mobile air conditioning to cars. Existing mobile air conditioning uses HFC

134a. US car companies use also advocate HFC 152a, (140 times more powerful than CO<sub>2</sub>).

In 2004 a report<sup>15</sup> by the German EPA concluded that 'In almost all areas of application, it is possible to replace fluorinated greenhouse gases (HFCs, PFCs and SF<sub>6</sub>) by halogen-free alternatives' and that 'Taking all aspects into account ... CO<sub>2</sub> is the best refrigerant' for mobile air conditioning.

### **A Unique Lobby To Create Climate Changing Gases**

Unique among pollutants that cause climate change, there is a powerful industrial lobby favouring the *deliberate* production and use of HFCs – the fluorocarbon industry - fronted by trade groups such as the *Alliance for Responsible Atmospheric Policy* and *European Partnership for Energy and the Environment* (EPEE). These groups are supported by companies such as Mitsui-Dupont, Daikin, Ineos (ex ICI), Solvay, Atofina, Ausimont, Rhodia and Toshiba. In its newsletter EPEE reveals its strategy is to 'promote HFCs as part of the solution to meet the environmental goals of climate change'<sup>16</sup>.

In 2002 eight major new HFC factories were proposed or under construction in France, USA, Asia, UK and Spain, with others in India and China. The Kyoto Protocol on climate protection had not stopped construction of any HFC factory<sup>17</sup>.

In 2004 the UK Government reversed previous policy that HFCs should only be used as substitutes for CFCs, where essential, and instead allowed them in entirely new uses, such as car air conditioning.

### **Largely Ignored But Overwhelming Kyoto<sup>18</sup>**

A 2002 internet study found 'F-gases' occupied less than 1% of the total 'attention' devoted to greenhouse gases, whereas 'CO<sub>2</sub>' scored 22% and 'carbon dioxide' 51%. Of 300-plus 'pressure groups' and environmental organisations campaigning on climate issues, fewer than ten (none from the USA) had campaigns that could reduce pollution from F- gases.

NGOs have probably ignored HFCs and other f-gases because they see them as representing less than 2% of the problem, although this is a misconception, as shown above.

In America, some policy makers still seem to see HFCs as a solution rather than a problem – US EPA has given prizes to HFC manufacturers as part of its ozone policy. For policy purposes most governments have dealt with HFCs (do not deplete ozone, contain no chlorine) along with the chlorine-containing CFCs and HCFCs, and as a result, many politicians and officials do not appreciate the threat to the climate posed by HFCs.

Between 1992, when Greenpeace demonstrated the viability of 'invented' greenfreeze hydrocarbon alternative refrigerators, and 2002, global HFC production increased more than twenty-fold.

Policy observers committed to making the Kyoto 'Clean Development Mechanism' work have expressed concern that its projects (to abate industrial greenhouse gas emissions such as CO<sub>2</sub> from fossil fuels) are being swamped by schemes to cut HFCs<sup>19</sup>, some of which are already funded by other pollution laws. DuPont argues that Ineos Fluor is over counting HFC cuts threefold<sup>20</sup>.

### **HFCs Less Efficient**

Hydrocarbons and other alternatives are often more efficient and cheaper than HFCs. For example in 2004 a study of the type of refrigerant used in appliances labelled energy category A+ or A++ in the EU showed that just four out of 866 used HFCs, the vast majority using hydrocarbons instead<sup>21</sup>.

### **Directive<sup>22</sup> Ineffective**

In order to comply with the Kyoto Protocol the European Union has agreed a Regulation on f-gases<sup>23</sup>. It has also passed an allied Directive on mobile air conditioning (mainly cars and trucks).

Unfortunately the Regulation did not build on the controls on f-gases already introduced in Austria, Denmark and Sweden. Nor did it emulate the encouragement in those countries of alternative technologies – it does nothing to require them. Instead it reflected vigorous lobbying by US and EU chemical companies, their allies in the refrigeration industry and car firms and will allow an extended period needless continued growth in the use of HFCs.

Moreover, instead of banning the main uses of f-gases, it aims to reduce pollution by reliance on 'containment' – a system<sup>24</sup> of record keeping, leak detection systems for major users, and setting leakage rates (in cars) – based on the Dutch STEK system. As noted above, containment has already been shown to fail and so it is unlikely that the rules will prove effective in cutting HFC pollution. The EU claims the measures will reduce f-gas emissions 20 per cent on 1995 levels by 2012 but as alternatives are available, f-gas production could be banned altogether in which case emissions would become impossible.

In a retrograde move the Regulation also prevents countries going further than it does in controlling f-gases and requires that existing national measures will cease to apply after 2012. This was aimed at Denmark and Austria, the leaders in alternative technologies.

## EU - Mobile Air Conditioning<sup>25</sup>

For car air conditioning systems f-gases with a global warming potential (GWP) of more than 150 are banned in new models coming out of factories but not until 2011. This effectively rules out the use of HFC-134a but allows the less potent HFC-152a, which has a global warming potential of 120. (CO<sub>2</sub> = 1 on GWP scale). No cars can use f-gases with GWP of more than 150 from 2017. This allows the widespread use of HFCs over decades – at a time when urgent action is needed to eliminate climate-changing emissions. The Directive also sets maximum leakage rates.

Alternative car air conditioning systems which don't use HFCs already exist, notably those based on CO<sub>2</sub>.

## EU - Stationary Refrigeration and Air Conditioning Systems And Other Uses

The EU legislation does not phase out HFCs or limit production but requires leak detection equipment in major installations such as cold stores using 300kg or more of f-gas refrigerants. Instead it merely requires regular checks by inspectors trained to EU-wide standards, and sets rules on containment, reclamation and/or safe destruction of f-gases, import and export<sup>26</sup>. Minor applications, notably self-chilling drink cans, 'air technology' trainer shoes and party aerosols, are banned. SF<sub>6</sub> in magnesium die-casting is limited to 850 kg per year. National guidance on implementation is due to be issued in 2006, with reporting and inspection measures in force by 2007.

## Review Clauses

The mobile air conditioning Directive stipulates a review allowing the Commission to make further proposals before the end of 2008 "in the light of existing and new international commitments regarding the reduction of greenhouse gas emissions".

For the Regulation on stationary uses, the EC will review requirements by end of 2007 and can propose legislation by the end of 2008, to extend the containment requirements to transport refrigeration. The EC will report within 5 years – 2011 - on whether the Regulation is not reducing emissions.

MIPIGGs believes the EU should change the Regulation and Directive urgently, to require use of alternatives and ban f-gases.

The Regulation also fails to require recovery of HFCs from discarded fridges. Because it fails to require the use of alternative technologies it means the EU is being less progressive than MacDonaldis, Coca Cola or California (see below).

## Californian Bans On Greenhouse Gases<sup>27</sup>

In August 30, 2006, Governor Schwarzenegger and the California Legislature agreed AB32<sup>28</sup>, the Global Warming Solutions Act. This caps California's greenhouse gas emissions at 1990 levels by 2020. In the case of HFCs this would effectively mean a complete ban because HFCs were almost unknown in 1990. However the Bill speaks about 'aggregate' emissions rather than reducing each gas so it can be expected that the f-gas lobby will make vigorous attempts to focus any reductions on other gases<sup>29</sup>. The Bill also includes a possible loophole on 'significance':

'(1) "Greenhouse gas emission source" or "source" means any source, or category of sources, of greenhouse gas emissions whose emissions are at a level of significance, as determined by the state board, that its participation in the program established under this division will enable the state board to effectively reduce greenhouse gas emissions and monitor compliance with the state-wide greenhouse gas emissions limit.'

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<sup>1</sup> These three f-gases are, with CO<sub>2</sub>, CH<sub>4</sub> and N<sub>2</sub>O, contained in the 'basket' of gases whose emissions are controlled under the 1997 Kyoto Protocol to the United Nations Framework Convention on Climate Change. States are able to reduce one or another more or less to produce an overall result, all compared by reference to the warming impact of CO<sub>2</sub>, which is given a value of "1", hence the term 'CO<sub>2</sub> equivalent' is often seen. See also [www.unfccc.int](http://www.unfccc.int)

<sup>2</sup> IPCC Assessment Report 2001 *Climate Change: The Scientific Basis*

<sup>3</sup> The high and still growing share of fluorinated greenhouse gases in overall global warming emissions - Summary of an Öko-Recherche study (including special remarks on commercial refrigeration), Frankfurt, June 2004, on behalf of Greenpeace

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<sup>4</sup> ] Hermansen, O., Schmidbauer, N., Lunder, C., Stordal, F., Fjæraa, A.M., Schaug, J., Wehrli, C., Pedersen, I.T., Holmén, K., Braathen, O.-A. and Ström, J. (2005) Greenhouse gas monitoring at the Zeppelin station. Annual report 2004. ISBN: 82-425-1677-4

[http://www.nilu.no/index.cfm?ac=publications&folder\\_id=4309&publication\\_id=12767&view=rep](http://www.nilu.no/index.cfm?ac=publications&folder_id=4309&publication_id=12767&view=rep)

<sup>5</sup> HFC containment has already failed *Atlantic Consulting*, [www.ecosite.co.uk](http://www.ecosite.co.uk) February 2004 report at [www.mipiggs.org](http://www.mipiggs.org)

<sup>6</sup> In 2004 UK Government figures showed HFCs to be far greater than previously admitted. HFC industry sources suggested the picture is similar Europe-wide. Most of this involves HFC 134a. Written Parliamentary Answers (Hansard, Mon 4 October 2004) revealed HFC emissions from mobile sources 63% greater than previously acknowledged and those from static sources 16% greater. The Government Minister put this down to more car air conditioning than anticipated and 'changes in emission factors' ie leaks.

<sup>7</sup> [http://www.shecco.com/artikler/automotive\\_climate\\_control.htm](http://www.shecco.com/artikler/automotive_climate_control.htm) citing GRID-Arendal

<sup>8</sup> chlorine-containing gases controlled under the Montreal Protocol of the Vienna Convention on the ozone layer

<sup>9</sup> The high and still growing share of fluorinated greenhouse gases in overall global warming emissions - Summary of an Öko-Recherche study (including special remarks on commercial refrigeration), Frankfurt, June 2004, on behalf of Greenpeace

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<sup>10</sup> For example the wide range of air conditioning, refrigeration and chilling systems sold and installed by Earthcare Products [www.earthcareproducts.co.uk](http://www.earthcareproducts.co.uk), and the CARE range of refrigerants [www.care-refrigerants.co.uk](http://www.care-refrigerants.co.uk) sold by Calor Gas, the non HFC fire extinguisher range marketed by Wormald <http://www.wormald.co.uk>, and yellow, white and rock wool mineral insulation [www.insulation-installers.co.uk](http://www.insulation-installers.co.uk)

<sup>11</sup> <http://www.greenpeace.org.uk/contentlookup.cfm?CFID=1171131&CFTOKEN=81946584&UCIDParam=20040622143346>

<sup>12</sup> In 2003 Danish Minister of the Environment, Hans Christian Schmidt, opened the first "HFC-free restaurant" in Vejle, Denmark. A by the Danish Technological Institute has found the HFC-free system uses less energy and produces less CO<sub>2</sub> in its operation. The world's first McDonald's restaurant using natural refrigerants, paper at 6th IIR Natural Working Fluids Conference, Glasgow, 2004: Kim G. Christensen\* Danish Technological Institute, Kongsvang Allé 29, 8000 Aarhus C, Denmark Phone: +45 7220 1265, Fax: +45 7220 1212, E-mail: [kim.gardo.christensen@teknologisk.dk](mailto:kim.gardo.christensen@teknologisk.dk) and Sang Chun McDonalds Corporation, Dept. 111 · Kroc Drive · Oak Brook, IL 60523 USA Phone: +1 (630) 623-5785, Fax: +1 (630) 623-3903, E-mail: [sang.chun@mcd.com](mailto:sang.chun@mcd.com)

<sup>13</sup> In Germany, 9.4% of all cars sold in 1992 were equipped with AC; in 1998 the figure was 68%, rising to a predicted 90% in 2001 (Schwarz & Leisewitz 1999 cited in Keeping cool without warming the planet: Cutting HFCs, PFCs, and SF<sub>6</sub> in Europe Jason Anderson [Climate Network Europe](http://www.climnet.org) [www.climnet.org](http://www.climnet.org))

<sup>14</sup> **World's First CO<sub>2</sub> Air Conditioning System** by Satoshi Itoh, Denso in Auto Technology 1, 2004; and, [BMW ?] and a French firm expects its CO<sub>2</sub> technology to be marketed in 2009: Valeo develops environmentally friendly R744 air conditioning system [http://www.valeo.com/gb/news/news\\_04.20\\_29072004.asp](http://www.valeo.com/gb/news/news_04.20_29072004.asp). These CO<sub>2</sub> technologies use CO<sub>2</sub> recovered from the air or waste gases.

<sup>15</sup> 'Fluorinated Greenhouse Gases in Products and Processes: - Technical Climate Protection Measures' – Report of the Federal Environmental Agency, Germany 20 February 2004 Federal Environmental Agency (Umweltbundesamt) <http://www.umweltbundesamt.de> (Katja Schwaab et al)

<sup>16</sup> Detailed in *F For Forgotten* 2002 by Chris Rose, report at [www.mipiggs.org](http://www.mipiggs.org)

<sup>17</sup> Detailed in *F For Forgotten* 2002 by Chris Rose, report at [www.mipiggs.org](http://www.mipiggs.org)

<sup>18</sup> Under the Kyoto Protocol of the UN Framework Convention on Climate Change, most industrialised (Annex B) countries have committed to reduce their collective emissions of greenhouse gases by an average of 5.2% by the commitment period of 2008 to 2012. Few are on course to meet even these commitments.

<sup>19</sup> ENDS Report 353, p 4 [www.endsreport.com](http://www.endsreport.com)

<sup>20</sup> ENDS Report 354, July 2004, p 6

<sup>21</sup> [http://eu.greenpeace.org/issues/news.html#040715\\_a](http://eu.greenpeace.org/issues/news.html#040715_a)

<sup>22</sup> Regulation 842/2006 on 'certain fluorinated greenhouse gases' see EP briefing at [http://www.europarl.eu.int/comparl/envi/pdf/externalexpertise/easac/greenhouse\\_gases.pdf](http://www.europarl.eu.int/comparl/envi/pdf/externalexpertise/easac/greenhouse_gases.pdf) and EC page on the regulation at [http://europa.eu.int/prelex/detail\\_dossier\\_real.cfm?CL=en&DosId=184911](http://europa.eu.int/prelex/detail_dossier_real.cfm?CL=en&DosId=184911)

<sup>23</sup> This covers use of 17 hydrofluorocarbons (HFCs), seven perfluorocarbons (PFCs) and sulfur hexafluoride (SF<sub>6</sub>). For useful papers and updates see

<http://www.eu.greenpeace.org/issues/climate.html> ; <http://www.climnet.org/EUenergy/Fgas.html> and [www.mipiggs.org](http://www.mipiggs.org).

<sup>24</sup> Euractiv.com summarises the rules as follows:

<http://www.euractiv.com/en/sustainability/fluorinated-gases-climate-change/article-117491>

**1) A regulation (directly enforceable at national level)** covering **air conditioning** systems and **industrial refrigeration** equipment as well as other 'stationary' industrial applications (heat pumps, fire extinguishers, high-voltage switchgear, F-gas containers, etc.). Domestic refrigerators - the large majority of which function on hydrocarbons - are excluded from the scope of the text. The regulation deals with the following aspects:

- A **containment** obligation to minimise leakages from refrigeration, air conditioning and heat pump equipment on industrial premises. Checks need to be done by certified personnel at least once a year.
- **Recovery** of used equipment to ensure it is recycled or destroyed.
- **Certification** and training of personnel in charge of maintenance to ensure EU-wide minimum standards are respected.
- **Labelling** of products and equipment becomes compulsory (industrial applications only).
- **Reporting** of emissions data to the Commission on an annual basis (applies to producers, importers, exporters).
- **Ban** on SF6 (magnesium die-casting, vehicle tyres) and other F-gases for specific uses where containment is not feasible (non-refillable containers, windows, footwear, self-chilling drinks cans, etc.).
- **Legal basis:**
  - environment (Article 175 of EC Treaty) for containment, recovery, certification and reporting. This means that member states are allowed to adopt more stringent rules for these.
  - internal market (Article 95 of EC Treaty) for use bans, prohibitions and labelling.

**2) A directive on car air conditioning (to be transposed at national level)**

- **As of 2011:** ban on F-gases with a global warming potential (GWP) of more than **150** for new models coming out of factories. This effectively rules out the use of HFC-134a but allows the less potent HFC-152a, which has a global warming potential of 120 (CO<sub>2</sub> = 1 on GWP scale).
- **As of 2017:** ban on F-gases with GWP of more than 150 for all cars.
- **Legal basis:** internal market (Article 95 of EC Treaty).

<sup>25</sup> The Regulation will enter into force on the 4 July 2006 and 'shall apply with affect' from 4 July 2007.

<sup>26</sup> Users of amounts down to 3kg of controlled refrigerants face new record-keeping obligations

<sup>27</sup> [http://www.pewclimate.org/what\\_s\\_being\\_done/in\\_the\\_states/ab32/index.cfm](http://www.pewclimate.org/what_s_being_done/in_the_states/ab32/index.cfm)

<sup>28</sup> [http://www.aroundthecapitol.com/billtrack/text.html?file=ab\\_32\\_bill\\_20060831\\_enrolled.html](http://www.aroundthecapitol.com/billtrack/text.html?file=ab_32_bill_20060831_enrolled.html)

<sup>29</sup> due to the 'basket' approach – see ref 1