Reducing emissions of F-gases as a means of avoiding dangerous climate change – a background briefing, September 2011

What are F-gases and HFCs?

F-gases are a type of fluorinated greenhouse gas, many hundreds or thousands of times more powerful than carbon dioxide (CO_2). They are a large family of chemicals used in industrial processes such as refrigeration, air-conditioning, foam production, aerosols, semi-conductors and insulation. While there are many kinds of F-gases, the most important from a climate perspective are the hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF6), of which the HFCs make the largest contribution to climate change.

HFCs were developed to replace the ozone-destroying CFCs and HCFCs, and are used in millions of applications across Europe and throughout the world. In 2005, the emission of HFCs accounted for around 560 million tonnes of CO_2-equivalent, and this is expected to increase rapidly in the future.

F-gases contribute significantly to climate change and emissions are rapidly growing

Current estimates suggest that the release of F-gases accounts for **2% of global greenhouse gas emissions, about the same as the entire air transport sector**.[i] This proportion is set to grow rapidly in the future, as HFCs become more widely used in developing countries and demand for air-conditioning and cooling soars. At current rates F-gases could be responsible for **9%-19% of annual greenhouse gas emissions by 2050** (5.5-8.8 GT CO_2-equivalent per year),[ii] seriously undermining attempts to halt runaway climate change. Of this, HFC use for air-conditioning and refrigeration will likely account for around 80% of total F-gas emissions.[iii]

HFCs are 'super greenhouse gases'

HFCs have such a large impact on the climate because they are much more powerful greenhouse gases than CO_2. For example, one commonly used HFC (HFC-134a) has a 100-year global warming potential (GWP) almost 1400 times that of CO_2 (its 20-year GWP is over 3800).[iv] **This means that the amount of coolant in a domestic fridge could have as much impact on the climate as driving a car from London to Berlin and back again.**[v] Another common F-gas, HFC-23, is produced as a by-product of the manufacture of the ozone depleting chemical HCFC-22. HFC-23 has a 100-year global warming potential nearly 15,000 times that of CO_2.[vi]

HFC emissions occur through leakages or venting

Unlike CO_2, HFCs are not the 'unavoidable' by-product of industrial activity (the exception is HFC-23, see below). Instead they are manufactured by a small number of multinational companies for a specific role, despite the availability of climate-friendly alternatives. While some are released directly, for example those used as propellants in aerosols, most are contained in closed systems (i.e. as a refrigerant) and are not intended to be released into the atmosphere. However, significant emissions of HFCs do occur through leakages of coolant, improper disposal and accidents. **EIA's research into the supermarket sector in the UK indicated a minimum leakage rate of around 11% per year,[vii] while studies from other countries indicate emission factors of 5%-22% per year for commercial refrigeration.**[viii] End of life leakage, either through improper disposal, storage or accidental release is also a significant problem that has not yet been resolved for the precursors of HFCs, CFCs and HCFCs, which continue to leak into the atmosphere from old cooling equipment and foams.

The other major source of HFC emissions is the release of HFC-23. HFC-23 is the unwanted by-product of the manufacture of HCFC-22. While some of this waste HFC-23 is captured and destroyed, a large amount is still vented into the atmosphere during manufacture. Recent studies suggest annual emissions of HFC-23 account for 200 million tonnes of CO_2-equivalent.[ix]

Current methods to control F-gases releases are not working

The use of F-gases within the European Union **is largely controlled by the F-gas Regulation (2006)**. This sets out which sectors can use F-gases and how they must be handled. While the use of F-gases in some small industrial sectors has been banned, current efforts to reduce the majority of emissions,

which stem from refrigeration, foams and air-conditioners, focus on better training of operators and tighter controls to prevent leakage during installation, operation and disposal.

EIA is supportive of containment measures in the F-gas Regulation since clearly there is a need to ensure that emissions from the current bank of equipment relying on HFCs are reduced to an absolute minimum.

However**, more assertive action is needed if HFCs are to be dealt with in a meaningful way**. Indeed, simply getting companies to comply with their obligations under the F-gas Regulation, and certify their engineers, has been a challenge. In July 2011, one of **the UK's F-gas registrars revealed that 20% of known companies operating in the field may not hold the required certification**.[x] Awareness of the requirements of the Regulation across Europe is also very low, with some countries reporting that **only 50% of companies were even aware of their obligations**.[xi]

Containment controls have also proven expensive to implement and enforce, with full implementation estimated to cost €759 million in 2010, rising to €992 million per year for EU-27 by 2015.[xii] Higher than expected leakage rates have lead to significantly higher abatement costs than that originally predicted.

Most importantly, these problems mean that the **current F-gas Regulation has reduced the EU's F-gas emissions by only 2.6% over the last 5 years, and emissions look set to grow in the coming years.**[xiii] A more ambitious approach is clearly needed.

Alternatives to F-gases are available in most sectors

Despite industry assertions that F-gases are irreplaceable, efficient and genuinely environmentally friendly alternatives are available in many sectors, and many more will be coming to market in the next few years. In domestic and industrial refrigeration **the use of 'natural' refrigerants such as hydrocarbons or ammonia is already well established,**[xiv] and in some countries such as Germany F-gas use in domestic refrigeration is almost completely phased out.

The use of hydrocarbons and CO_2 in supermarket chillers and commercial applications is rapidly expanding. More than 400 consumer giants including Coca-Cola and Tesco have already pledged to start phasing out HFCs in from 2015.[xv] Unilever, the world's largest ice-cream producer, started replacing HFC units with hydrocarbons in 2004, and has found that the new systems have 10% greater energy efficiency.[xvi] Indeed many **installers of natural refrigerant systems have reported greater energy efficiency,** in sharp contrast to claims by the F-gas industry that alternative refrigerants will lead to higher energy use. [xvii]

EIA supports a global phase out of HFCs

The most cost-effective way to reduce the impact of F-gases on the global climate is a rapid phase-out of production and use of HFCs across all sectors. Our work within the supermarket sector has shown just how quickly HFC-free technologies can be brought to market with the right incentives. Containment measures must be improved; however they alone will not achieve the levels of mitigation required for the EU to meet its ambitious and much needed greenhouse gas reduction targets. An aggressive HFC phase out across Europe will ensure the large scale commercialisation of low-GWP technologies, and help Europe lead the world in tackling the urgent climate challenge.

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[i] Becken & De Graaf et al. **2011** '*Avoiding fluorinated greenhouse gases – Prospects for phasing* out' published by the German Federal Environment Agency (Umweltbundesamt).

[ii] Velders et al. **2009** '*The large contribution of projected HFC emissions to future climate forcing*' PNAS Vol. 106, No. 27, pp.10949-10954

[iii] Becken & De Graaf et al. **2011** '*Avoiding fluorinated greenhouse gases – Prospects for phasing* out' published by the German Federal Environment Agency (Umweltbundesamt).

[iv] Intergovernmental Panel on Climate Change Fourth Assessment report: Climate Change 2007 (AR4)

[v] Assuming a refrigerant charge of 250g of HFC 134a, with a GWP of 1400, and vehicle emissions of 159g C02/km. Distance calculated as 1097 km.

[vi] Intergovernmental Panel on Climate Change Fourth Assessment report: Climate Change 2007 (AR4)

[vii] EIA 2010 '*Chilling Facts III – Supermarkets are reducing the climate impact of refrigeration*'.

[viii] Interim report to European Commission on review of F-gas Regulations – OKÖ Recherche (2011)

[ix] EIA 2001, The Montreal Protocol in 2011, *Dynamic Action for Ozone and Climate Protection*, after Montzka et al (2010). Recent increases in global HFC-23 emissions, Geophys,. Research let., 37, Lo2808, doi:10.1029/2009gLo41195

[x] http://www.epeeglobal.org/epeedocs/internet/docs/Case_study_F-Gas_Regulation_in_the_UK_5224.pdf

[xi] Interim report to European Commission on review of F-gas Regulations – OKÖ Recherche (2011)

[xii] Interim report to European Commission on review of F-gas Regulations – OKÖ Recherche (2011)

[xiii] Interim report to European Commission on review of F-gas Regulations – OKÖ Recherche (2011)

[xiv] Becken & De Graaf et al. **2011** '*Avoiding fluorinated greenhouse gases – Prospects for phasing* out' published by the German Federal Environment Agency (Umweltbundesamt).

[xv] http://www.ciesnet.com/pfiles/press_release/Press_Release_2010/2010-11-29-ClimateProtection.pdf

[xvi] http://www.unilever.com/sustainability/environment/climate/refrigeration/

[xvii] EIA 2009 '*Chilling Facts II – The supermarket refrigeration scandal continues*'.