HFCs FOR THERMAL INSULATION

A SOLUTION ADDRESSING THE CLIMATE CHANGE CHALLENGE

Visit our web site

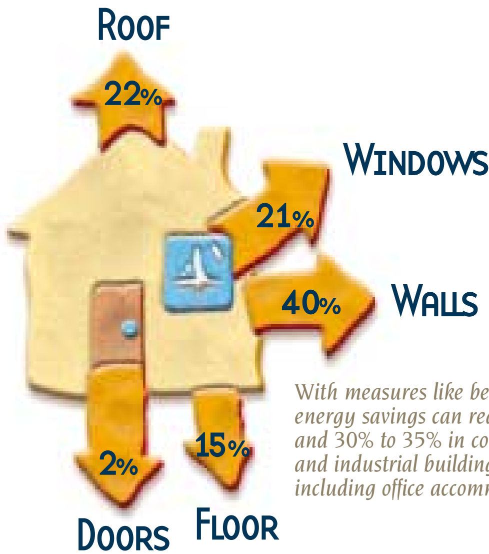
www.fluorocarbons.org

EFCTC - European FluoroCarbon Technical Committee
Avenue E.van Nieuwenhuyse 4
B-1160 Brussels - Phone : +32 2 676 72 11

PROGRESS FOR OUR QUALITY OF LIFE...

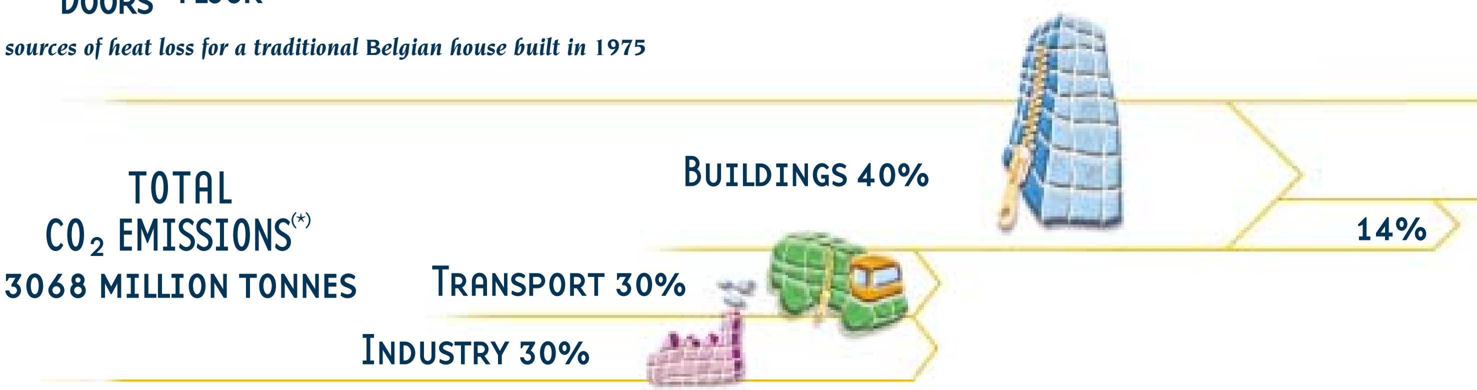
Could we do without heating or air conditioning? Refrigeration, air conditioning and heating are often essential to life particularly in public areas such as in hospitals and laboratories, for food products in the cold chain, for medical and computer equipment.

But we have also to consider the impact of the wide-spread use of these services on the global environment.



With measures like better insulation, energy savings can reach 20% in housing and 30% to 35% in commercial and industrial buildings, including office accommodation.

Main sources of heat loss for a traditional Belgian house built in 1975



(*) FOR EUROPE IN 2000; SOURCE: ECOFYS REPORT FOR THE EU COMMISSION

...AND CLIMATE PROTECTION

The greenhouse effect to a great extent determines the climate on earth. Growth in emissions of greenhouse gases associated with human activities threa tens the climate balance. Carbon dioxide (CO_2) - the main greenhouse gas - is emitted when fossil fuels are burnt to produce energy and increasing energy demands have led to rapid growth in the amount of CO_2 in the atmosphere. Heating, air conditioning and refrigeration have contributed to this growth.

If no action is taken at all, greenhouse gas(*) emissions could be expected to further increase in EU Member States by 17% between 1990 and 2010, while the target set by the Kyoto Protocol for the period is to reduce the emissions by 8%.

Fortunately, it is possible to reduce energy consumption and the associated CO_2 emissions in heating and air conditioning by one third by using more or better insulation.

Thermal insulation: The single largest opportunity to save energy

Better insulation is possible in a great variety of areas: buildings and water heating, refrigerated transport and installations for storing, or preserving foodstuffs and medicinal products.
The insulation techniques used vary greatly: weatherboarding panels, cavity wall insulation, sprayed foam, lagging for heating pipes, etc.

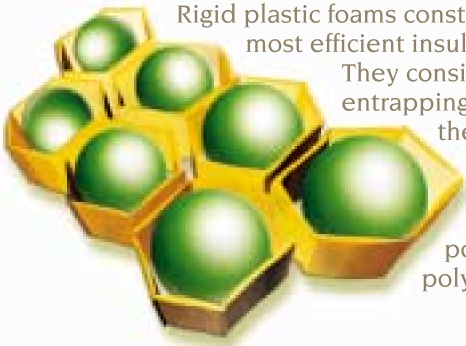
Development and wide-spread use of high-performance thermal insulation products help significantly to safeguard of our climate in the future.

26% **Heating and air conditioning**

Lighting and electrical equipment

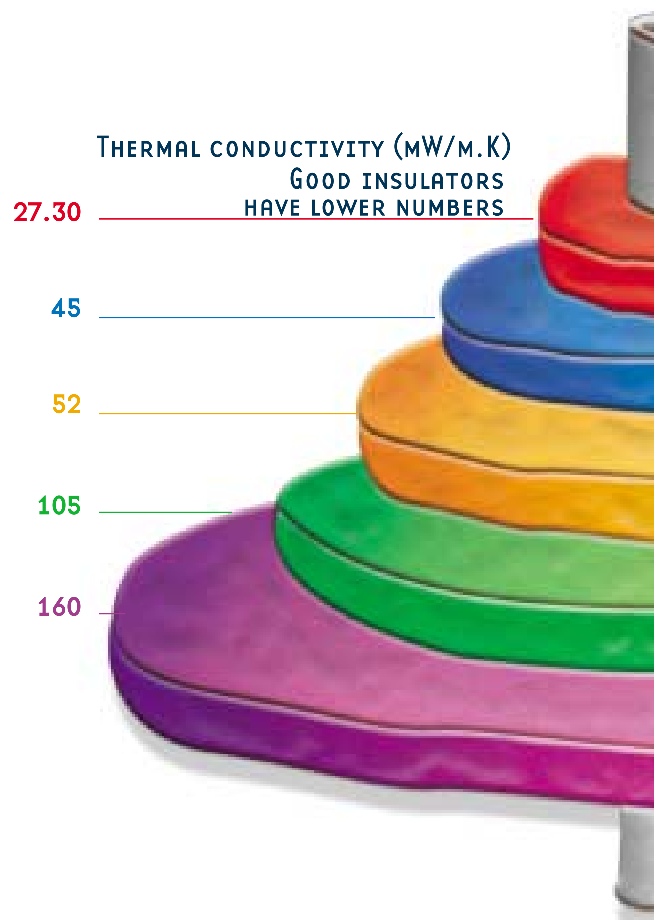
(*) The greenhouse gases covered by the Kyoto Protocol are carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6)

Thermal insulation saves energy and reduces CO_2 emissions



Rigid plastic foams constitute one of the most efficient insulating materials. They consist of closed “cells” entrapping a gas that is actually the real insulator.

There are several types of rigid foams : polyurethane (PUR), polyisocyanurate (PIR), extruded polystyrene (XPS) and phenolic foams.



What makes a good thermal insulator? An efficient insulating gas held in a gas-tight structure.

Did you know that a common pull over is so warm because of the dry air it contains?

Whether you look at animal wool or glass wool, cork, synthetic fibers, plastic foams or double glazing, the true insulator is the gas trapped inside the material.

The better the gas is retained in the material and the less this insulation gas conducts heat, the more effective it is.

Air and the three main cell gas

Dry air

ADVANTAGES:

- *cheap*
- *simple to use*

DISADVANTAGES:

- *poor insulation value*
- *loses its qualities when the material gets wet*
- *not suitable as foam blowing agent*

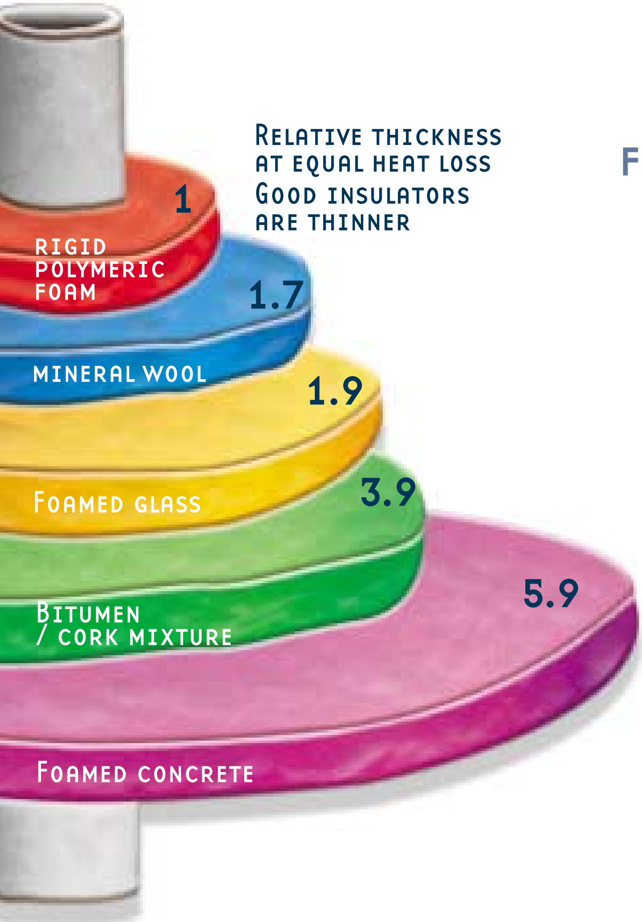
CO_2 / water

ADVANTAGES:

- *often used for insulating foams with no special requirements* (CO_2 *for XPS;* CO_2 */ water for PUR*)

DISADVANTAGES:

- *moderate insulation value*
- *fast diffusion of* CO_2 *out of the material*
- *limited effectiveness over time*
- *higher thickness of foams necessary (space constraints)*



Selection criteria for insulating materials

The choice of an insulating material depends on a number of factors :

Technical factors

- the insulator's thermal conductivity, which must be as low as possible
- the material's ability to prevent diffusion of the insulating gas
- the ease of using the material in renovating buildings (space availability)

Socioeconomic factors

- the safety characteristics of the material and its insulating gas (flammability, toxicity, etc.)
- the cost-effectiveness of the material
- regulation of thermal insulation requirements and materials

Environmental factors

- the overall performance over the whole life cycle of the application
- resources – particularly energy- efficiency
- other environmental impact (on water, air ..)
- availability of options for end of life recovery.

Options for blowing insulation foams

Hydrocarbons (HCs)

ADVANTAGES:

- *good insulation value*
- *low cost*

DISADVANTAGES:

- *flammability in production and use*
- *volatile organic compounds (VOC) emissions*
- *not suitable for all types of foam*
- *investment required for safety during production (prohibitive to most SMEs)**
- *diffusion of the gas during lifetime*

**SMEs are small and medium sized entreprises*

Hydrofluorocarbons (HFCs)

ADVANTAGES:

- *the best insulating capacity*
- *retain insulation properties over many years*
- *good where space is limited*

DISADVANTAGES:

- *contribution to greenhouse effect if released into the atmosphere*
- *relatively high product price*

HFCs: THE COMPARISON ARGUES IN THEIR FAVOUR

Life-cycle analysis: the meaningful comparison

Energy-related life cycle assessments for insulating materials take account of everything that happens from when the material is manufactured until the end of its life (when it is recycled or destroyed).

Account is also taken of the energy saved by the application where the material is used during its lifetime (e.g.: a building or a refrigerator). In many cases this impact is the greatest of the assessment. (ref.1)

Principle of climate impact analysis of a foam in its application (building insulation)

The analysis compares the net balance of the various greenhouse gas emissions over the whole life cycle of the application for the various alternatives.

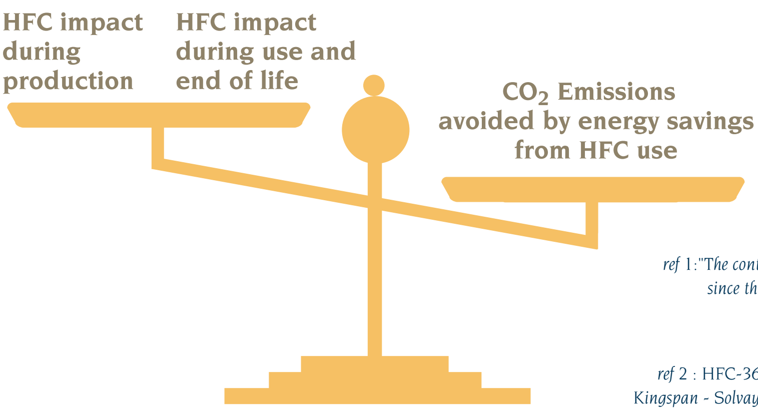
A comparative life-cycle analysis demonstrates that over 25 years the overall climatic impact of buildings using high-performance foams blown with HFC is 5-10% better than with foams using hydrocarbons and 15-20% better than that obtained with foams using a CO_2/water combination (ref 2). This is a substantial difference. Indeed

- the HFC has optimal insulating performance
- the closed cells of the polyurethane foams prevent the HFC from escaping
- the treatment of the foam at the end of its life can prevent loss of the insulating gas

The most sustainable solution

Limited gas losses and the greater energy savings enable HFC_S to be, overall, a solution that can significantly reduce the greenhouse effect. With responsible use and control over potential emissions, objective life cycle assessments for HFCs in high performance insulating materials argue positively in their favour.

HFCs in their applications reduce energy demand and thus CO_2 emissions during product use



ref 1:"The contribution of the foam to the overall energy efficiency of the appliance [refrigerator] is important since the energy used to operate the appliance accounts for the majority of the global warming impact"

Report of the Intergovernmental Panel on Climate Change
http://www.ipcc.ch/pub/tar/wg3/149.htm

ref 2 : HFC-365 mfc and high performance rigid polyurethane insulation. Life cycle assessment Elastogran-Kingspan - Solvay Fluor - Synthesia Española - Summary and full LCA report available from project partners.

HFCs COMPLY WITH SAFETY STANDARDS

Because of their low flammability in insulation foams and lack of health risk, HFCs offer unparalleled safety. By meeting increasingly stringent safety standards, they better protect people and goods in both private and public buildings in the event of fire.

Safety of working conditions is also improved for the many workers in smaller firms. Use of non-flammable insulating gases allows production and application (spray) of high-performance foams, without elaborate infrastructure and heavy capital costs.

HFCs: WHERE HIGH PERFORMANCE INSULATION IS A MUST

The relatively high cost of HFCs limit their use to applications where they present, significant advantages, alone or in blends, with others gases:

- for technical reasons: durability, optimal insulating capacity and space or weight restrictions (transport, refurbishing)
- for safety reasons: lower flammability or flame-spread is particularly important for sprayed foams
- for economic reasons: the investment in fire-prevention measures, essential when using flammable gases, is a real deterrent.

Finding the best sustainable compromise: the example of extruded polystyrene (XPS) foams

HFCs have proven necessary to produce XPS foams with the ideal cell structure, low densities and a thickness up to 18 cm that are required for some applications. The HFCs provide the best sustainable compromise between safety, flammability, insulation efficiency, environmental impact and economic performance.

HFCs: GREENHOUSE GASES THAT LIMIT THE GREENHOUSE EFFECT!

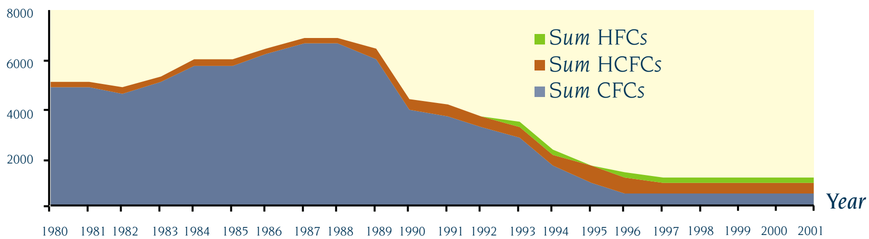
Whilst HFCs undeniably can have an impact on the climate…

HFCs do not harm the ozone layer but are Greenhouse Gases. However, they have a climatic impact only if they are released.

…their considerable assistance in replacing CFCs is the main practical contribution to reducing emissions of greenhouse gases…

CFCs represented nearly 25% of the emissions of greenhouse gases in 1990. So, by assisting in the elimination of CFCs, HFCs will have helped reduce the total greenhouse gas emissions by at least 20%*.
By contrast, by 2050 the impact of HFCs in all uses will, at worst, amount approximately to 2% of that of CO_2.

GWP-*weighted* Production (12 *million metric tonnes* CO_2 *equivalent*)



Comparative evolution of main fluorinated gases shows the much lower potential impact of HFCs as compared to the CFCs they replace.

…and thanks to their energy efficiency, energy savings will be made and CO_2 emissions will be reduced still further.

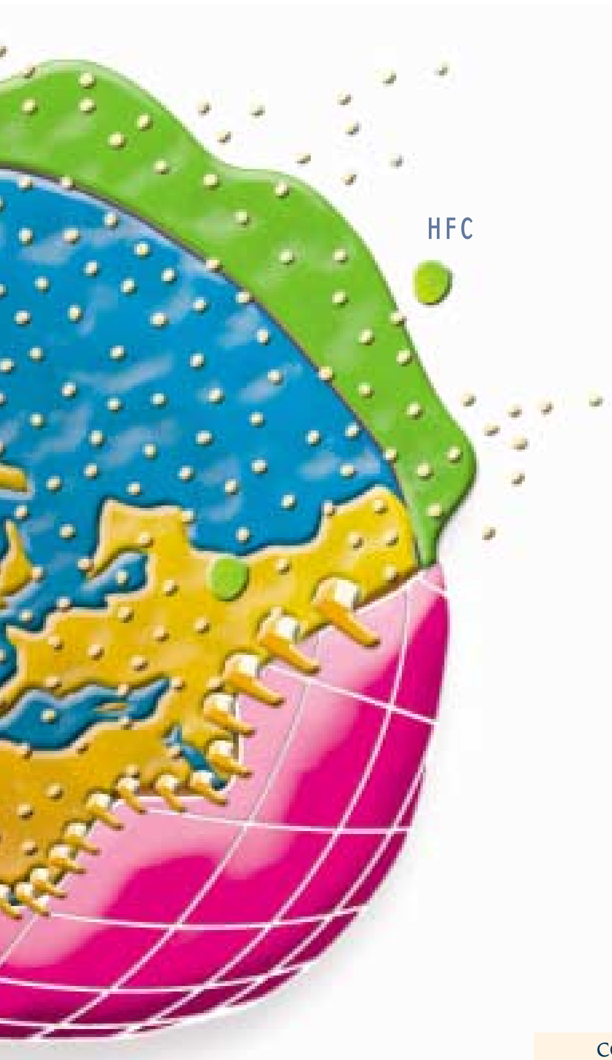
HFCs contribute indirectly to the reduction in global climate impact.
Used in more efficient installations, total emissions of HFCs are also lower than CFCs.
Their own direct impact when emitted is greatly compensated by energy savings and the reduced CO_2 emissions they make possible. For example, in the case of insulation alone, 200 million tonnes of CO_2 emissions could be saved by HFCs that have potential emissions equivalent to only 1.49 million tonnes of CO_2. (ISOPA, European Foam Association)

What is the GWP? The GWP (*Globa*
the climatic warming potential of a
of carbon dioxide, whose GWP by co
is calculated as the warming potential
one kilogram (kg) of the gas relative

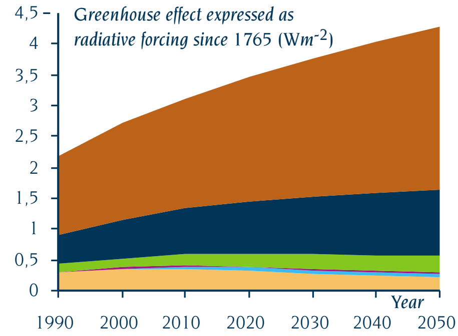
** Paradoxically, this large reduction in the climatic impact attributable to HFCs is not generally apparent in debates because the Kyoto Protocol does not include the greenhouse impact of CFC and HCFC emissions in the calculations.*

The Special Report on Emissions Scenarios, published by IPCC*, describes several possible scenarios for future emissions.

All scenarios show that CO_2 emissions will remain the main issue in climate change to which HFCs can provide some solution.



The scenario of the future used to construct this figure envisages an imperfect implementation of controls to limit climate change. In any case the absolute impact of HFCs will remain insignificant.



Clearly the GWP as a measure does not satisfactorily describe the climate impact of a greenhouse gas. Despite its low GWP, CO_2 has a far greater impact on climate than HFCs because of the quantities emitted.

The relative impact of HFCs : small quantities released and limited lifetime in the atmosphere make all the difference!

	Relative Global Warming Potential (GWP)*	Quantities released (tonnes/year) "Q"	Persistence in the atmosphere "P"	Relative climate impact (combines GWP, Q and P)
CO_2	1 (by convention)	30,800,000,000	over 500 years	+/- 68%
methane	21	350,000,000	12 years	~20%
HFCs	Typically between 140 and 2,000 in foams applications	140,000	less than 100 years	< 2%

Note : World emissions. The balance to 100% is due to CFCs, nitrous oxide, PFCs and SF_6. Compared to CO_2, in either absolute or relative terms, the global climatic impact of HFCs is virtually negligible. Not only is the climate impact of CO_2 higher but also it persists over a much longer period than the 100 years used in calculating the GWP, while HFCs persist generally much less than 100 years.

pal Warming Potential) index expresses a greenhouse gas relative to that convention is set at 1. The GWP l over 100 years following release of e to that of one kilogram of CO_2.

** Ref: Report of Intergovernmental Panel on Climate Change http://www.ipcc.ch*

HFCs: THE WAY FORWARD

The aim of the Kyoto Protocol is to limit *emissions* of greenhouse gases rather than limiting their production or their uses.

To achieve this objective, HFC producers and the foam industry must act jointly to minimise HFC emissions at all steps of the life cycle. Increasing environmental awareness and the growing attention paid to avoidable emissions, through to the processing of foams at the end of their life, will reduce direct HFC emissions to a minimum.

For example, the polyurethane and XPS industries will develop emission reduction targets relative to the baseline emissions. They will establish programmes for the verification of emissions in practice which will cover the production, use and end-of-life phases.

Harmonized EU regulations should specifically encourage voluntary and verifiable initiatives on emissions of fluorinated gases, including HFCs.

A key objective of any efficient regulatory initiative should be to put in place systems that ensure monitoring and verification of emissions.

By contrast, inappropriate restrictions on the use of HFCs could impede important opportunities where HFCs can practically contribute to decreasing the climate impact of CO_2, by far the major greenhouse gas.

FIVE SUGGESTIONS TO ASSIST IN THE EFFECTIVE MANAGEMENT OF CLIMATE CHANGE

1. Encourage improvements in energy efficiency of new and existing buildings through optimal use of insulation. This initiative will reduce the CO_2 emissions produced by this activity sector.

2. Use life cycle analysis of buildings as one of the tools on which to base any regulatory developments on emission reduction of greenhouse gases.

3. Together with a verification procedure, stimulate commitments allowing speedier and more effective development of technologies that reduce HFC emissions throughout the life cycle of the foams.

4. Develop and encourage the initiatives facilitating the end-of-life management capturing/destroying HFCs.

5. Maintain public and workers' safety as a primary consideration.