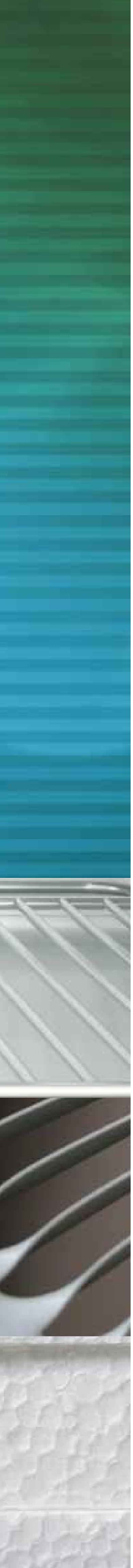
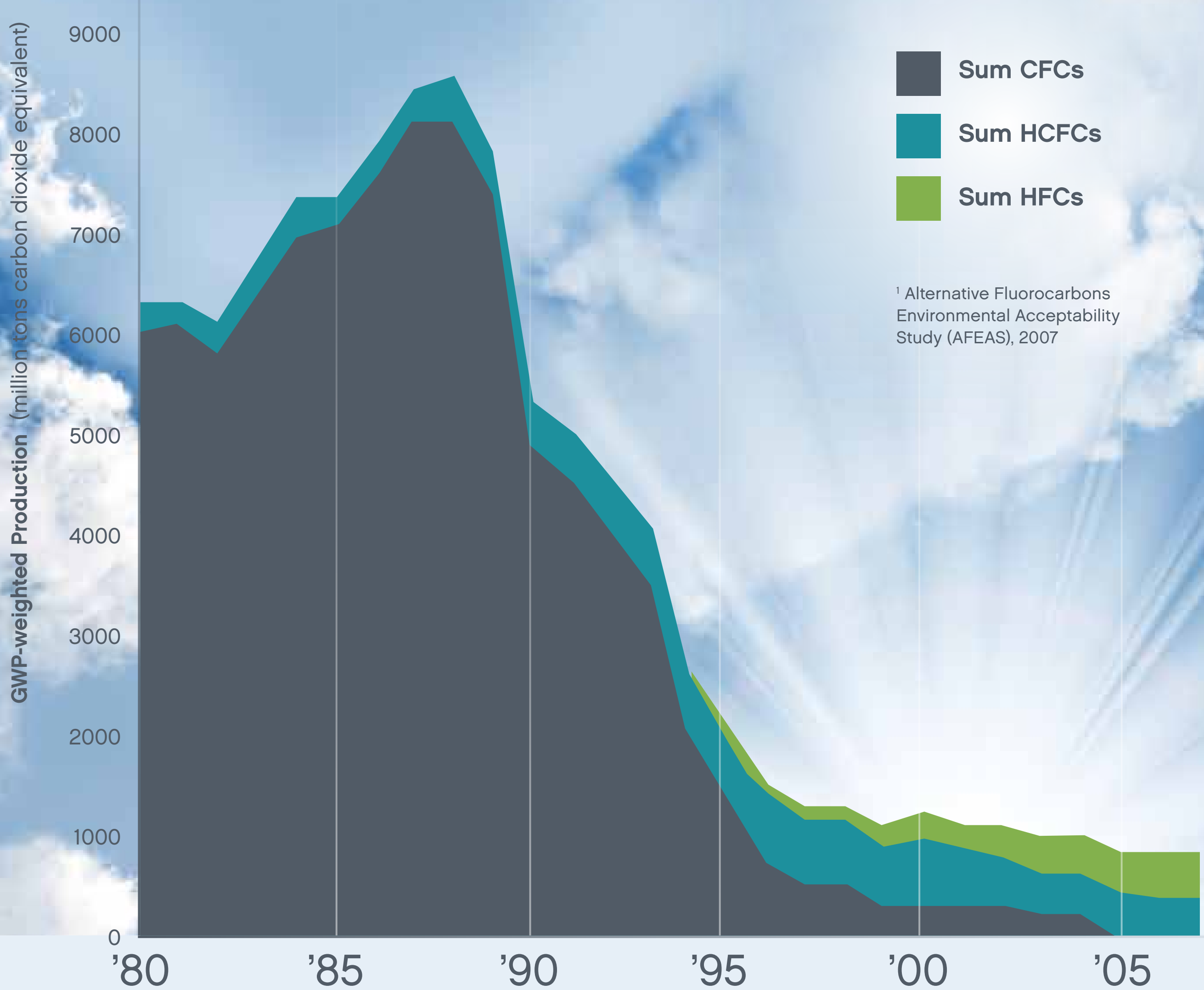


INDUSTRY'S ACTIONS TO RESPONSIBLY MEET SOCIETY'S NEEDS:

Refrigeration, Air Conditioning, Thermal Insulation and Other Applications

THE ALLIANCE
for Responsible Atmospheric Policy

Reduced GWP Impact of Fluorocarbons[1]



[1] Alternative Fluorocarbons Environmental Acceptability Study (AFEAS), 2007

Actions taken under the Montreal Protocol have led to the replacement of CFCs with HCFCs, HFCs, and other substances and processes. Because replacement species generally have lower Global Warming Potentials (GWPs), and because **total halocarbon emissions have decreased, their combined CO_2-equivalent (direct GWP-weighted) emission has been reduced.** The combined CO_2-equivalent emissions of CFCs, HCFCs, and HFCs derived from atmospheric observations decreased from about 7.5 ± 0.4 $GtCO_2$-eq per year around 1990 to 2.5 ± 0.2 $GtCO_2$-eq per year around 2000, equivalent to about 33% and 10%, respectively, of the annual CO_2 emissions due to global fossil fuel burning.[2]

[2] Intergovernmental Panel on Climate Change (IPCC / Montreal Protocol Technology and Economic Assessment Panel (TEAP) Special Report, 1995

THERE IS NO SINGLE IDEAL COMPOUND FOR ALL APPLICATIONS.

Current and future options will strike a balance between energy efficiency, environmental impact, and consumer benefit—each with its own trade-offs based on application requirements.

The fluorocarbon-producing and -using industries have contributed greatly to the success of the ***Montreal Protocol on Substances that Deplete the Ozone Layer*** and is continuing this progress through the development of new compounds and technologies to enhance quality of life while at the same time minimizing environmental impacts on the stratospheric ozone layer and the climate. Over the years, this industry has improved technology in food-preserving refrigeration, air conditioning, and insulation systems, as well as in technical aerosols, metered dose inhalers, and other applications.

The Alliance for Responsible Atmospheric Policy (Alliance) supports a planned, orderly global phasedown of substances with high global warming potentials (GWPs), improved application energy efficiency, leakage reduction, and recovery/reuse or destruction at application end-of-life.

ODP | GWP 99% 90% REDUCTION

Transitions from CFCs to HCFCs to HFCs to HFOs and other low GWP alternatives have significantly reduced both the ODP and GWP impacts.

	ODP[1] OZONE DEPLETION POTENTIAL	GWP[2] GLOBAL WARMING POTENTIAL
CFCs	~1.0	4,750 – 14,400
HCFCs	0.055 – 0.11	77 – 2,310
HFCs	0	124 – 4,470
HFOs/HCs CO_2/ammonia	0	<20

In the chart listings, the ODP was reduced to zero and the GWP was reduced to less than 1% of the original CFC. More importantly, refrigeration and other applications energy efficiency continues to improve approximately 1% per year, despite transitions in fluid alternatives.

The major suppliers reduced (1988 peak to 2007) ODP production by 99% and GWP by 90% when alternatives were introduced[3].

[1] ODPs from Handbook for Montreal Protocol on Substances that Deplete the Ozone Layer, Eighth edition (2009), p25-27

[2] GWPs from Scientific Assessment of Ozone Depletion 2010, pages 5.47-5.49

[3] Alternative Fluorocarbons Environmental Acceptability Study (AFEAS), 2007

Applications

Chlorofluorocarbons (CFCs) were developed in the late 1920s. A decade later, in the 1930s, hydrochlorofluorocarbon (HCFC)-22 was invented for refrigeration systems. Concerns about ozone depletion were raised in the 1970s and 1980s, and, in response, the Montreal Protocol rapidly phased out CFCs and established a timetable for reducing HCFCs. Hydrofluorocarbons (HFCs) were commercialized in the 1990s as non-ozone-depleting alternatives to CFCs and HCFCs.

REFRIGERATION & AIR CONDITIONING

Over the past four decades, the most widely used chemicals for refrigeration and air conditioning have been CFC-11, CFC-12, HCFC-22 and ammonia. **The establishment of a timetable for the phaseout of HCFCs led to HFCs, and industry is now developing fourth generation hydrofluoroolefins (HFOs).**

Today, HFCs have replaced CFCs and HCFCs in many refrigeration and air conditioning applications.

Hydrocarbons are being widely used in refrigerators and small charge appliances. Ammonia continues to be used in larger facilities and CO_2 has shown some recent growth, although in fairly complex systems compared to those in which the fluid was used a century ago. Newly developed HFO refrigerants are being deployed in mobile air conditioning and are being evaluated in other applications.

Each application's characteristics determine the best refrigerant or fluid. Choice and fluid flexibility maximize energy efficiency, minimize environmental impacts and emphasize safety where needed.

THERMAL INSULATION

Foam products include extruded polystyrene (XPS), polyisocyanurate (PIR) and polyurethane (PUR) foams. All were deemed both safer than asbestos and better insulating. Several other alternatives have become available including paper cellulose, sheep's wool and even recycled cotton. XPS and PIR/PUR trap blowing agents in the foam, significantly increasing their thermal properties compared to non-blown products.

XPS and PIR/PUR foams have undergone significant changes in blowing agent technologies over the last few decades with a movement toward more sustainable solutions, while still achieving enhanced thermal insulation properties.

As new technologies are evaluated, many variables associated with geographic and socio-economic factors will need to be considered and the focus on overall energy efficiency–Life Cycle Climate Performance (LCCP), should be a key element in this effort.

OTHER APPLICATIONS

Although refrigeration, air conditioning and thermal insulation are by far the largest markets, other critical applications also **converted from CFCs to alternatives. These include: technical aerosols, metered dose inhalers and solvents.**

HISTORY OF REFRIGERANTS >
1900s + EARLIER
CO_2, HCs, and ammonia
1910s
1920s
development of CFCs
1930s
HCFC-22 invented
1940s
1950s
1960s
1970s
concerns for ozone depletion grows
1980s
HCFCs enable CFC reduction
1990s
HFC alternatives commercialized
2000s
Re-emergence of HCs, CO_2
2010s
development of HFOs
MAKING RESPONSIBLE PROGRESS >

A RESPONSIVE INDUSTRY A RESPECTED VOICE

Industry has proven to be consistently responsive to the global challenge of lowering environmental impact while maintaining and enhancing product safety, reliability, energy efficiency, and consumer benefit.

Through its participation in the the Montreal Protocol, the Alliance and its members succeeded in ensuring an appropriate and responsible global phasedown of ozone-depleting CFCs while catalyzing the development of safe, efficient non-ozone depleting alternatives.

The technical achievements of producing more environmentally sound compounds while still maintaining high safety and efficiency standards are significant. **It is important to note that the global phasedowns of existing compounds were initiated only after suitable alternatives had been developed and rigorously tested.** Enacting policies to restrict use of existing compounds before safe, efficient alternatives are available could force nations to choose technologies and build infrastructure ill-suited for their specific needs, introducing safety concerns, unreasonably high cost, and the potential for an overall increase in GHG emissions.

Furthermore, the success of Industry in lowering environmental impact has been achieved not solely through the development of new compounds with lower Ozone Depletion Potentials (ODPs) and Global Warming Potentials (GWPs), but equally, if not more importantly, through spearheading the development of policies that specify best practices for the proper usage and handling of these compounds throughout their lifecycle including reuse, recycling, and reclamation. Industry strongly supports refrigerant reuse through responsible recovery, recycling, and reclamation programs, thereby minimizing new fluid requirements and maximizing fluid choice. **Flexibility in fluid choice maximizes energy efficiency, minimizes environmental impacts, and enhances safety.**

RESPONSIBLE USE

Equipment Requirements

Contain all refrigerants in tight systems and containers minimizing releases

Size equipment to match specific needs

Minimize refrigerant amount without sacrificing performance

Design, install and operate to optimize energy efficiency

Leak test new installations

Monitor application performance to minimize operational leaks

Minimize the number of fittings through which refrigerant flows

Fluid Requirements

Recover, recycle and reclaim where chemical properties allow safety

Train personnel in proper chemical handling, leak repair and recovery/recycling/reclamation

Comply with all applicable chemical standards

Continue to develop alternatives in all sectors





PRINCIPLES & BEST PRACTICES

General Principles

Provide technically feasible insulation products with favorable LCCP

Promote technology and processes that provide financially sound societal investments

Minimize manufacturing emissions using best available, affordable technology

Minimize losses during container filling

Ensure worker and community safety

Comply with all transportation regulations

Design plants and facilities with a goal of zero fugitive emissions

Minimize all byproduct formation and emissions cost-effectively

Hold management accountable for potential safety, health and environmental impact

While important, the GWP of a compound is just one small piece of a much larger, more complex system that ultimately determines its environmental impact.

To accurately judge impact, therefore, it is essential to use a metric in which the totality of a compound's life cycle is considered.

LCCP

[LIFE CYCLE CLIMATE PERFORMANCE]

LCCP: A COMPREHENSIVE MEASURE

LCCP measures ALL of the elements - both direct and indirect - that comprise a product's life cycle including creation, energy efficiency, use, re-use, transportation, and destruction.

GWP is a measure of only the direct emissions of a compound into the atmosphere. By significantly reducing charge sizes, tightening systems, reducing leaks, containing and recovering refrigerants, and conducting other responsible best practices, there is considerably less direct emissions of these compounds into the atmosphere. **GWP does not take into consideration the large amount of indirect emissions that occur from compound usage** such as the power plant emissions that are a result of the electrical use of the appliance. **Indirect emissions such as an application's energy usage can contribute as much as 95% of an appliance's total climate change impact.**

Therefore, there is a more logical focus on a number of other elements - especially energy efficiency - in determining the selection process of a refrigerant or blowing agent. Life Cycle Climate Performance (LCCP) is a proven methodology that incorporates all of these elements and is critical to evaluate the performance of refrigeration, air conditioning, and foam insultation. LCCP incorporates the impacts of energy consumption as a result of the refrigerant choice or foam blowing agent, and emissions at end of life. Consequently, **LCCP gives policymakers and professionals a clear picture of the global climate change impact of a refrigerant.**

LCCP is critical in the selection process of a compound and should be a primary metric for assessing climate change impact. In addition, **other contributing factors go into selection of a refrigerant or foam blowing agent such as availability, cost, and safety**. Studies have shown that compounds with the lowest cost or GWP often may not be the best choice for the environment, or provide the best energy efficiency. Creating policies based solely on GWP could increase a society's total greenhouse gas emissions and its energy consumption.

THE PATH FORWARD

As industry continues to respond to society's needs, it supports a stable policy framework for transitioning to new compounds. The framework should be based on cumulative environmental impact and lead to orderly transitions that allow sectors adequate time to develop and implement alternatives.

Industry has demonstrated through the ODS phaseout that it responds to policymakers' calls for new developments. Mandating reductions at a rate faster than technology evolves could result in societies being forced to choose less-than-optimal alternatives.

But the planning and development cycle is extensive, and, in many cases, stretches over a decade or more. The development of successful and appropriate alternatives requires process and attribute evaluation, including energy efficiency, environmental impact, toxicity, flammability, and application-specific parameters, which could include operational pressures, process development and costs.

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Responsible Policy for a Responsive Industry