

“Fluorocarbons: Balanced Solutions For Society”

Household Refrigerators...A Working Example

A Worldwide Perspective

Mass production of modern refrigerators began after World War II. Food was previously refrigerated with snow, ice, cool streams, caves and cellars, but with significant deficiencies. Refrigerators, today, are the most used home appliance and many believe refrigerators are the most important consumer product. Household refrigerators provide for convenient, safe food preservation and help to sustain modern life.

Environmental Considerations for Household Refrigerators

Household refrigerators consist of two critical components:

a refrigerant and thermal insulation. Both require safe, energy efficient chemicals. A refrigerant absorbs heat from the refrigerator cabinet space and transfers it outside. Thermal insulation requires highly energy efficient foam blowing agents to limit heat transfer to refrigerated cold spaces and reduce energy consumption.

Since the mid-1980s, household refrigerators have transitioned from chlorofluorocarbons (CFCs), to low or non-ozone depleting compounds such as hydrochlorofluorocarbons (HCFCs), and then to hydrofluorocarbons (HFCs) and hydrocarbons (HCs). Many products initially used HCFC-141b blowing agent and HFC-134a refrigerant, although some countries have emphasized isobutane refrigerant and cyclopentane blowing agent options. Recently most HCFC-141b uses have been replaced with HFCs such as HFC-245fa or HFC-134a.

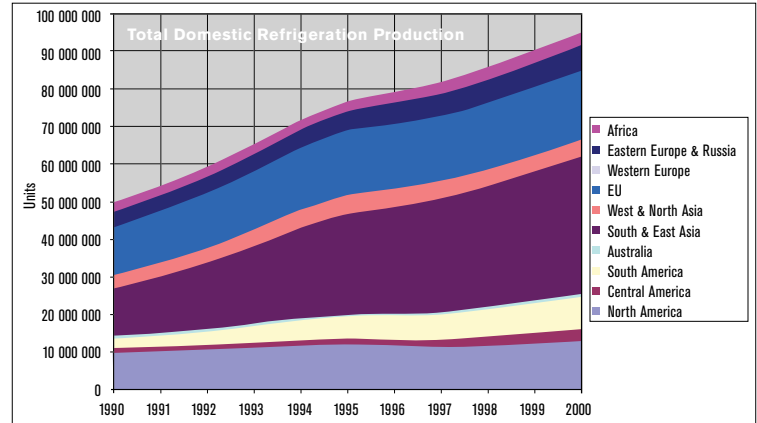
Life Cycle Climate Performance (LCCP)

Life Cycle Climate Performance (LCCP) is an application’s measure of global warming contribution. LCCP is expressed as kilograms of carbon dioxide (CO₂) emitted. This includes both the greenhouse gas emissions from the refrigerant and blowing agent (direct effect), and the resultant CO₂ emissions from producing energy using fossil fuels to power the refrigerator (indirect effect). In the past, a household refrigerator’s environmental impact has been principally a result of energy consumption and CFC emissions. Recently, more efficient products and new refrigerant fluids such as HFCs have reduced this impact over 80%.



Today, the indirect effect can represent more than 90% of the refrigerator’s impact. Less relevant is the possibility of refrigerant emissions during use and decommissioning. These product life-time emissions are rare with modern highly efficient refrigerators. It is common practice to recover fluorocarbon refrigerants during decommissioning. Additionally, recent research indicates that only a small amount of fluorocarbon blowing agent is emitted from the foam insulation after decommissioning. The total direct effect is less than 10% of the product’s climate change impact.

Refrigerator environmental impact reduction opportunities exist by improving energy consumption. This can involve both the quality of insulation and choice of refrigerant fluid. Good insulation reduces heat gain to refrigerated cold spaces. Studies show that insulation using HFC blowing agents is inherently more efficient (up to 10%) and longer-lasting than that using other blowing agents such as HCs, water or CO₂.



The perfect refrigerant does not exist. Key choice factors include safety and thermodynamic efficiency to extract heat. Ammonia and HCs are excellent refrigerants but are flammable or toxic, demanding safety precautions.

After World War II, household refrigerators used CFC-12 as refrigerant and CFC-11 as the insulation blowing agent. With the CFC phaseout, other options were adopted:

- For refrigerant: HFC-134a and isobutane
- For blowing agents: HCFC-141b and cyclopentane

Laws and regulations vary by country. The phaseout of HCFC-141b as an insulation blowing agent has resulted in additional changes. HFC-134a and HFC-245fa blown foam insulation and HFC-134a refrigerant primarily are used in the United States. Various options are used by other countries.



HFCs – The Balanced Solution for the Future



Commercially available throughout the world, HFCs are energy efficient, low in toxicity, cost-effective, can be used safely and are reusable. Using HCs requires additional considerations such as:

- Costs of modifying manufacturing facilities for fire safety and Volatile Organic Compounds compliance
- Additional energy consumption and operating costs using insulation with HC blowing agents.
- HCs may not be recoverable and reusable.

HFC refrigerants provide excellent, cost effective, environmentally acceptable solutions while avoiding the considerations noted above.

Industry Principles

- Contain refrigerants in tight systems and containers minimizing atmospheric releases;
- Recover, recycle and reclaim refrigerants;
- Train all personnel in proper refrigerant handling;
- Design, install and operate to optimize energy efficiency;
- Minimize emissions during refrigerator manufacture

Balanced Solutions for Society

Energy Efficiency, Reduced Carbon Dioxide Emissions, Availability, Affordability. HFCs - the RIGHT Choice for Household Refrigerators

The Alliance for Responsible Atmospheric Policy is a leading industry voice which coordinates industry participation in the development of reasonable international and U.S. Government policies regarding ozone protection and global climate change.



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