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# “Fluorocarbons: Balanced Solutions For Society”

## Vehicle Air Conditioning...A Working Example

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### A Worldwide Perspective

Vehicle air conditioning is an important part of an integrated system which provides cooling, heating, defrosting, demisting, air filtering and humidity control for both passenger comfort and vehicle safety<sup>1</sup>. Its reliability and convenience are often taken for granted, but it is key to keeping the passenger safe and comfortable in over 350 million vehicles worldwide.

### Environmental Considerations for Vehicle Air Conditioning



The dramatic vehicle air conditioning environmental improvements during the past decade represent one of the most rapid and important success stories for responsible environmental stewardship. In the early 1990's, chlorofluorocarbons were completely eliminated by global automakers from use in new vehicle air conditioners, replaced by hydrofluorocarbons (HFCs). This eliminated the potential contribution to ozone depletion from new autos and reduced over 80% of the global warming potential. The current generation of vehicle air conditioners is being improved through refinements yielding additional significant reductions in total greenhouse gases - over 40% in some cases.

Vehicle safety is enhanced through comfort cooling and dehumidifying; drivers are more alert and have better visibility when window demisting becomes necessary. At highway speeds, vehicle air conditioning can lower greenhouse gas output compared to open window driving, which increases fuel consumption due to aerodynamic drag. This trade off between air conditioning and additional carbon dioxide generation due to lost fuel efficiency is frequently overlooked.

### Life Cycle Climate Performance

Life Cycle Climate Performance (LCCP) is a measurement that includes both direct air conditioning refrigerant emission and the indirect vehicle energy consumed. System leakage and refrigerant loss during installation, commissioning, servicing and decommissioning must be minimized.

In modern vehicle air conditioners with proper refrigerant recycling, approximately 60% of greenhouse gas releases relate to system energy consumption and 10% relate to transporting the system weight. Only about 30% is refrigerant related, based on typical U.S. driving patterns and conditions. Weight or energy efficiency changes significantly affect system greenhouse gas contributions.

HFC potential alternatives include carbon dioxide (used as a refrigerant) and hydrocarbons, as well as low Global Warming Potential (GWP) options under development. Much development work remains to make these alternatives viable, and it is currently unclear whether they ultimately will surpass state-of-the-art HFC-134a systems at comparable passenger safety, cost and performance.



Air conditioners using carbon dioxide as a refrigerant are less energy efficient than HFC systems, according to evaluations conducted by the technical consulting firm Arthur D. Little. They require more energy for compression and bulkier hardware for increased heat transfer area. Carbon dioxide system costs are estimated at least 20% more than HFC systems and need further materials compatibility, durability, reliability and safety development. A.D. Little has estimated that annual additional consumer energy costs could be almost \$7 billion in the U.S. and another \$9 billion worldwide. Additionally, higher manufacturing costs could be \$100 per air-conditioned vehicle.

Hydrocarbons are another alternative refrigerant, but safety concerns remain. Safety related modifications are likely to further increase system cost, potentially eliminating any environmental advantages.

## HFCs – The Balanced Solution

HFC-134a currently provides the best overall environmental, safety and comfort performance balance. Commercially available throughout the world, HFCs are energy efficient, low in toxicity, cost-effective, can be used safely and are reusable. Vehicle air conditioning environmental performance is advancing rapidly, but new technologies have not yet proven superior. Automotive manufacturers, suppliers and the service industry have recently invested many billions of dollars globally for the new HFC-based technology.



A multistakeholder group has recently completed an initiative to make HFC-134a even more environmentally acceptable thru the IMAC (Improved Mobile Air Conditioning) project. The goals of IMAC, an industry-wide effort led by the Society of Automotive Engineers (SAE), was to reduce leaks by 50% and improve system efficiency by 30% in mobile air conditioning. The IMAC teams successfully used a comprehensive combination of technological system improvements, thermal load reduction, customer and repairmen education and improved service practices to meet these goals. Upon implementation, the IMAC initiatives will further improve HFC-134a LCCP.”



While industry remains committed to evaluation of all alternatives, any future adoption of new technologies must be clearly justified by meaningful advantages in environmental protection, passenger safety, performance and cost.

## Industry Principles

The vehicle air conditioning industry is committed to responsible use and management of CFC and HFC refrigerants. The industry actively promotes the following principles:

- Contain air conditioning refrigerants in tightened systems to minimize atmospheric releases;
- Recover, recycle and reclaim all refrigerants;
- Train all personnel in proper handling of air conditioning refrigerant;
- Design equipment to minimize refrigerant amount;
- Design, install and operate to maximize energy efficiency;
- Minimize leakage of refrigerant during initial filling of vehicle air conditioners;
- Continue research, development and evaluation of all alternatives.

## Balanced Solutions for Society...Vehicle Air Conditioning is a Perfect Example of The Concept. Energy Efficiency, Reduced Carbon Dioxide Emissions, Availability, Affordability. HFCs – The Right Choice for Vehicle Air Conditioning.

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.

<sup>1</sup>”Technical Options for Motor Vehicle Air Conditioning Systems,” S.O. Andersen, W. Atkinson, J.A. Baker, S. Oulouhojian, and J.E. Phillips: Society of Automotive Engineers, [www.sae.org](http://www.sae.org)



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