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Other matters

Making the transition to low-global-warming-potential alternatives in motor vehicle air conditioning

Note by the secretariat

The annex to the present note contains information submitted by the United States of America about making the transition to low-global-warming-potential alternatives in motor vehicle air conditioning. It has been reproduced as received, without formal editing.

* UNEP/OzL.Pro.22/1.

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Annex

TRANSITIONING TO LOW-GWP ALTERNATIVES IN MVACs

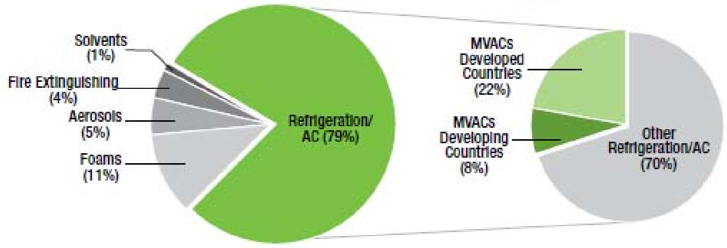
Background

This fact sheet[1] provides current information on low-Global Warming Potential (GWP) alternatives in newly manufactured Motor Vehicle Air Conditioners (MVACs) relevant to the *Montreal Protocol on Substances that Deplete the Ozone Layer.*

MVACs cool passenger cars, light duty trucks, buses, and rail vehicles. They have been produced in the United States since the 1960s and in Japan since the 1970s. MVACs were not widely used in Europe or developing countries until the 1990s. Charge sizes are 0.5–1.2 kg and average lifetimes are 12–16 years.

2010 HFC Consumption

(Estimates Presented in $MMTCO_2eq.$)



Global HFC Consumption Total: 1,087 $MMTCO_2eq.$
Global Refrigeration/AC Sector Total: 858 $MMTCO_2eq.$
Global HFC Consumption MVAC: 257 $MMTCO_2eq.$

MVACs in passenger cars, light duty trucks, buses, and rail vehicles account for an estimated 24% of today's global HFC consumption. In the refrigeration/air conditioning (AC) sector, these MVACs account for an estimated 30% of refrigeration/AC HFC consumption. Developing countries account for an estimated 68 million metric tons of carbon dioxide equivalent ($MMTCO_2eq.$) or 26% of global HFC consumption in these MVAC end-uses.

HFC Alternatives and Market Trends

CFC-12 refrigerant was historically used in MVACs. HFC-134a replaced R-12 in new equipment in the early 1990s. Today R-134a is the dominant refrigerant used in cars worldwide. In buses and trains, about 50% of global equipment uses HCFC-22 refrigerant; the remainder uses R-134a or HFC-407C (a blend of HFCs). Some low-GWP alternatives are summarized below.

HFO-1234yf[2]

- Cooling performance and fuel use comparable to R-134a
- Potential use as a direct substitute in R-134a systems
- Approved in Japan and for small volumes in Europe
- Proposed as acceptable by the U.S.; final decision expected in 2010
- Production update:
  - A pilot R-1234yf production facility is anticipated to be operational in less than two years with large-scale capacity by 2015
  - A production facility in China is scheduled to begin operation in 2011
- General Motors plans to manufacture some models with R-1234yf in model year 2013

Europe's Experience

The existing fleet of cars in Europe uses R-134a for AC. New European Union (EU) regulations require cars sold in the EU to use refrigerants with GWPs less than 150 beginning in 2011 for new vehicles and in 2017 for all vehicles. EC Directive 2006/40/EC requires the EC to consider extending this regulation to AC in buses, coaches, and trucks.

R-152a

- Good energy efficiency and cooling performance
- Requires additional safety requirements; other components remain the same as standard R-134a systems
- To date, no vehicle manufacturer has committed to using R-152a

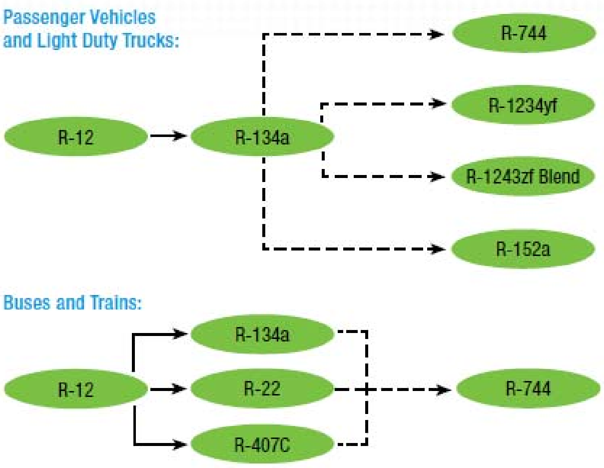
Carbon Dioxide (R-744)

- Cooling performance, energy efficiency, and fuel use comparable to R-134a systems in most cars
- Prototype R-744 systems are in use in buses and trains in Europe; commercialization is expected within two years
- Verband der Automobilindustrie expressed interest in R-744 for passenger vehicles

HFO-1243zf[3]/R-32/R-134a Blend

- Flammability similar to that of R-1234yf
- Energy efficiency is expected to be equal or better than R-134a
- Toxicity expected to be low
- Not currently produced in high volumes

Refrigerant Transition in the MVAC End-Use*



*Solid arrows represent alternatives already available in the market for these systems; dashed arrows indicate those likely to be available in the future.

Refrigerant	GWP	ODP[a]
R-12	10,900	1
R-22	1,810	0.055
R-407C	1,774	0
R-134a	1,430	0
R-1243zf/R-32/R-134a Blend	<150	0
R-152a	124	0
R-1234yf	4	0
R-744 (CO_2)	1	0

[a] ODP = ozone depletion potential

Challenges to Market Entry and Potential Solutions

The following table summarizes the challenges associated with the various alternatives as well as potential solutions to overcoming them.

Alternative	Challenges to Market Entry	Potential Solutions
R-1234yf	• Slight Flammability Risks • Limited Production Capacity • Regulatory Approval • Limited Availability May Prevent Full Market Penetration in the Near-Term	• Safety System Installation • Engineering Design • Increase Production Capacity • Currently Under EPA's Significant New Alternatives Policy (SNAP) Program Review • Currently Under EU Registration, Evaluation, Authorisation, and Restriction of Chemicals (REACH) Review for High Volume Applications
R-152a	• Higher Flammability Risks • Limited Production Capacity	• Safety System Installation • Engineering Design • Increase Production Capacity
R-744	• Needs New Servicing Infrastructure • Asphyxiation Risks • High Operating Pressures • Regulatory Approval • System Reliability and Leak Reduction	• Engineering Design • Training and Education • Inclusion of Odorant in Formulation as a Warning System • SNAP Proposed Use Conditions to Address Risks
R-1243zf/R-32/ R-134a Blend	• Slight Flammability Risks • Not Currently Manufactured • Needs Regulatory Review and Approval	• Safety System Installation • Engineering Design

Future Outlook

Together, the suite of known alternative chemicals, new technologies, and better process and handling practices can significantly reduce HFC consumption in both the near and long term, while simultaneously completing the HCFC phaseout. Although much work remains to fully adopt these chemicals, technologies, and practices, and some unknowns still remain, the industries currently using HCFCs and HFCs have proven through the ODS phaseout that they can move quickly to protect the environment.

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[1] The four fact sheets in this series (October 2010) cover domestic refrigeration, commercial refrigeration, motor vehicle air conditioning, and unitary air conditioning. These four end-uses represent about 85% of HFC consumption in the refrigeration/AC sector. The remaining HFC consumption in the refrigeration/AC sector comes from other end-uses including chillers, cold storage, industrial process refrigeration, and refrigerated transport. Any service-related consumption is attributed to the specific end-use.

[2] HFOs (hydrofluoro-olefins) are unsaturated HFCs. HFO-1234yf refrigerant is also commonly referred to as HFC-1234yf or R-1234yf, as it is referred to in the remainder of this fact sheet.

[3] HFO-1243zf is also commonly referred to as HFC-1243zf or R-1243zf.

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