



# U.S. EPA Perspectives on Environmentally Sound AC

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# The Importance of Efficient Mobile Air Conditioning (MAC) to Climate Protection

- Road vehicles are 75% of transportation's 25% share of global CO<sub>2</sub> greenhouse gas emissions
- MACs contribute direct emissions of HFC-134a and indirect emissions from fuel combustion to power the system and transport its weight
- Electric, hybrid, fuel cell, and direct-injection vehicles depend on efficient heating and cooling for market penetration

# Vehicle AC Leadership Timeline

- 1884 W. Whiteley wheel-driven ice cooling
- 1939 1939 Packard HCFC-22 AC
- 1950s CFC-12 vehicle AC proliferates
- 1974 Molina and Rowland ozone hypothesis
- 1977 Reduce CFC charge and leakage
- 1985/87 Vienna Convention/Montreal Protocol
- 1992/97 FCCC/Kyoto Protocol
- 1991/94 Global shift to HFC-134a
- 2002+ Improved HFC-134a
- 2005-08? CO<sub>2</sub>, HC, HFC-152a?

# HFC Unequivocal 1990 Choice

- Mobile AC Emissions
  - High vehicle refrigerant leaks and service venting
  - Rejecting toxic, flammable, and high-pressure options
- HFC-134a Was Familiar but Daunting
  - Easy: physical properties, non-flammable, low toxicity
  - Hard: lubrication, materials, price, supply...
- Global Consensus by Industry
  - Saved the ozone layer: R&R plus zero ODP HFC-134a
  - Six times lower GWP than CFC-12 plus containment
  - No disruption of vehicle markets, comparable performance, increased reliability, unnoticed cost

# EPA Approach to Vehicle AC

- Performance, Not Prescription
- Environmental Cost-Effectiveness
- Partnerships at the Speed of Business
- Cooperation on Standards and Testing
- Customer Clout (e.g. U.S. Army)
- Government As Proactive Authority on Transportation Safety and Environment

# Enhanced Life-Cycle Climate Performance (LCCP)

- Direct Refrigerant Emissions:
  - Critical to energy efficiency, safety, and reliability
  - Climate impact depends on GWP
- Indirect Fuel Emissions:
  - Compare with enhanced, not current, HFC systems
- Empowered Platform Benefits
  - DI, Hybrid, Fuel Cell, Electric
- Integrated Emission Management
  - Optimal warm up and operating temperatures of fuel injection, engines, catalysts, transmission, etc.
- For Vehicles Designed for Less Cooling
  - Less horizontal glazing, optimized insulation, control air infiltration, exploit thermonomics (like ergonomics)

# HFC-134a: Where the Rubber Meets the Road

- Even Aggressive CO<sub>2</sub> Introduction Scenarios Highlight Importance of Improved HFC Systems
- MAC Fuel Use Under Increased Regulatory Scrutiny with Pending Testing and Disclosure
- No Recharge w/o Repair; R&R at Service and Disposal, Worldwide—No Excuses
- Strive for Zero Emissions—Better Design, Components, Service, and Replacement Parts
- Improve Energy Efficiency!

# Global MAC Partnerships Speed New Technology

- The Mobile Air Conditioning Climate Protection Partnership (MAC-CPP)
- Alternate Refrigerants Task Force of the Society of Automotive Engineers (SAE) Interior Climate Control Standards Committee
- SAE Cooperative Research Program (CRP)
- Europe RACE and U.S. PNGV/Freedom Car