Options to Reduce GHG Emissions from Mobile AC

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European Climate Policy

- Europe is committed to a binding cap that represents real effort
- Drastic reductions needed in coming decades: partial solutions are inadequate
- Commitment to reduce vehicle emissions

MAC concerns

- HFC 134a has a high GWP
- MAC systems leak during operation and maintenance
- MAC systems lead to higher energy use due to weight and operation
- There are more cars on the road
- More of these cars have MAC systems

Options: improved HFC-134a

- Pro:
  - Some reduction in direct and indirect GHG emissions
  - Familiarity
- Con:
  - Retains all the inherent disadvantages of 134a
- Evaluation: Compared to other options, improvements are limited: most improvements to 134a systems would be beneficial if applied to other substances as well, so there's no comparative advantage.

Options: HFC-152a

- Pro:
  - Systems around 10% more efficient
  - 90% lower GWP than 134a
- Con:
  - As drop-in replacement is not as efficient as others
  - GWP still 7 x hydrocarbons and 140 x CO_2
  - Similar toxicity to 134a/synthetic lubricant systems
  - Flammable
- Evaluation: Better than 134a, not as good as hydrocarbons while sharing the disadvantage of flammability, not as good as CO_2 in terms of performance and climate impact.

Hydrocarbons

Pro:

- Low GWP
- High efficiency
- Potential drop-in replacement
- Uses standard mineral oil lubricants
- Low charge
- Non-patented, widely available

- Con:
  - Flammable
- Evaluation: There are already millions of operating hours as drop-in replacements, but perception of risk hinders adoption. Direct systems designed for hydrocarbons would have tiny charges and be very efficient.

CO_2

- Pro:
  - Low GWP
  - Supply heating and cooling
  - Well-suited to emerging vehicle technologies
- Con:
  - Requires commercialization of substantially different system
- Evaluation: CO2 systems will likely be at least as efficient as enhanced 134a systems and direct emissions will be low. It or HC systems are best suited to new vehicles, but non-flammability is attractive. No impact on the current fleet.

Issues

- Energy Efficiency
  - Alternatives as good or better
- Recovery and recycling
  - Not as successful as needed
- Costs of alternatives
  - 50 euros is 0.2% of the price of a 20,000 euro vehicle
- Market Penetration
  - Slow introduction inadequate
- Influence on DC markets
  - High-growth, less climate policy, different climatic conditions, different economic potential

Overall assessment

- CO_2 and HCs are superior performers, with reduced direct and indirect climate impacts
- Lab development has reached its limits
- HFC-134a can start being replaced immediately
- Need to consider options for existing 134a systems

Improving certainty of regulatory impact

- There are many variables to MAC emissions to allow continued reliance on a high-GWP substance
- We know where to head: early action by industry welcome but regulatory action preferable to a VA.

Possible strategy

- 2008 (previously 2005, 2007):
  - no HFC -134a refrigerants in new systems
  - With appropriate standards for fuel use
- In the meanwhile, and for existing cars:
  - Enforcement of end of life vehicle directive
  - Improvement of servicing practice
  - Consideration of drop-in replacements
  - Standardization of best available technologies

NGO participation

- NGOs instrumental in getting climate policy up and running
- Have backed widely-used domestic refrigeration system
- Are working with different manufacturers on new systems for mobile and stationary refrigeration
- Welcome opportunities to support industry in successful transition