Non-CO_2 Greenhouse Gases: High-GWP Gases

Source/Sectors: Substitution of ODS/Motor Vehicle Air Conditioners

Technology: Use of CO_2 (C.1.1.3.4)

Description of the Technology:
Use of CO_2 as the refrigerant in motor vehicle air conditioners (MVAC) is a significant technical option with high emission reduction potentiality. This technology uses a transcritical vapor cycle which differs from conventional MVAC systems, hence requiring innovative design and engineering; the study on such new systems are ongoing by many vehicle manufacturers in cooperation with system suppliers (USEPA, 2006b; IEA, 2003). The system is believed to have comparable energy efficiency to HFC-134a systems, and moreover, it has the lowest GWP among any candidate refrigerants (IEA, 2003). Major development is needed for system components to accommodate the extremely high CO_2 pressure level. However, studies have also been carried out to develop a "low-pressure" CO_2 hybrid system (IEA, 2003). These technological options are being evaluated by the industry and new information is continuously being developed (CEC, 2005).

Effectiveness: Since it has a GWP of 1, it can potentially reduce total emissions by 100%.

Implementability: Potentially applicable to all regions

Reliability: Further development on safety systems may be required to detect and vent accidentally released CO_2 in order to ensure the passengers safety (IEA, 2003).

Maturity: Further development in performance and safety is needed before the CO_2 system is commercialized and replaces HFC-134a. It is assumed that the first systems will be commercialized within 4 - 7 years (IEA, 2003).

Environmental Benefits: HFCs emission reduction

Cost Effectiveness:

Technology	Lifetime (yrs)	MP (%)	RE (%)	TA (%)	Capital cost	Annual cost	Benefits
Use of CO_2[1]	12	0	100	15	$611.97	$0.00	$86.03

Note: MP: market penetration; RE: reduction efficiency; TA: technical applicability; costs are in year 2000 US$/$MT_{CO2\text{-}Eq.}$
1: CEC (2005) & IEA (2003)

Industry Acceptance Level: Future market penetration will vary based on user acceptance, and it is possible that some regions may not adopt this technology depending on perceived risks of CO_2 systems. Due to the high capital costs, it will not be able to be adopted in developing countries until later years (USEPA, 2006b).

Limitations: There are still many limitations for this technology due to the technical immaturity (IEA, 2003; USEPA, 2001).

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