Non-CO_2 Greenhouse Gases: High-GWP Gases

Source/Sectors: Substitution of ODS/Residential Air-conditioners and Heat Pumps

Technology: Refrigerant recovery/recycling (C.1.1.2.1)

Description of the Technology:
Practicing refrigerant recovery for reuse or destruction can significantly reduce HFC emissions. Recovery options apply a refrigerant recovery device that transfers refrigerant into a storage container prior to servicing or disposing equipment. After the recovery process, the refrigerant contained in the storage container either is recharged back into the source equipment, cleaned through the use of recycling devices, purified for resale at a reclamation facilities, or disposed safely in an environmentally-safe manner (IEA, 2003; USEPA, 2001).

Effectiveness: It can reduce emissions by 95% (USEPA 2006b; CEC, 2005).

Implementability: Technically applicable in all regions

Reliability: No risk and uncertainty associated with this option is recognized (IEA, 2003).

Maturity: This option is assumed to be practiced at 80% in the baseline in developed countries, and 30% in developing countries (USEPA, 2006b).

Environmental Benefits: HFCs emission reduction

Cost Effectiveness:

Technology	Lifetime (yrs)	MP (%)	RE (%)	TA (%)	Capital cost	Annual cost	Benefits
Refrigerant recovery/recycling[1]	-	10	95	10	$26.19	$3.40	$1.69

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

Industry Acceptance Level: Although this option is widely accepted in developed countries, the penetration remains low in many developing countries, due to a lack of available capital infrastructure as well as a lack of legislation design. Therefore, further growth is especially expected in developing countries (IEA, 2003).

Limitations: Reduction efficiency is uncertain because it may vary depending on technician technique and equipment type (IEA, 2003).

Sources of Information:

1. California Energy Commission (2005) "Emission Reduction Opportunities for Non-CO_2 Greenhouse Gases in California", a report prepared by ICF Consulting for California Energy Commissions, CEC-500-2005-121, July 2005.
2. International Energy Agency (2001) "Abatement of Emissions of Other Greenhouse Gases - Engineered Chemicals", Report Number PH3/35, IEA Greenhouse Gas R&D Programme, Cheltenham, United Kingdom, February 2001.

3. International Energy Agency (2003) "Building the Cost Curves for the Industrial Sources of Non-CO_2 Greenhouse Gases", Report Number PH4/25, IEA Greenhouse Gas R&D Programme, Cheltenham, United Kingdom, October 2003.
4. Kruse, H. (1996) "The State of the Art of Hydrocarbon Technology in Household Refrigeration", *Proc. International Conference on Ozone Protection Technologies*, October 21-23, Washington, D.C.
5. Mathur, G.D. (1996) "Performance of Vapor Compression Refrigeration System with Hydrocarbons: Propane, Isobutane, and 50/50 Mixture of Propane/isobutane", *Proc. International Conference on Ozone Protection Technologies*, October 21-23, Washington, D.C.
6. Paul, J. (1996) "A Fresh Look at Hydrocarbon Refrigeration: Experience and Outlook", *Proc. International Conference on Ozone Protection Technologies*, October 21-23, Washington, D.C.
7. Sand, J.R.; Fischer, S.K.; Baxter, V.D. (1997) "Energy and Global Warming Impacts of HFC Refrigerants and Emerging Technologies". Prepared by Oak Ridge National Laboratory for Alternative Fluorocarbons Environmental Acceptability Study and U.S. Department of Energy, Oak Ridge, TN.
8. U.S. Climate Change Technology Program (2005) "Technology Options for the Near and Long Term", U.S. Department of Energy, http://www.climatetechnology.gov/index.htm, August 2005.
9. U.S. Environmental Protection Agency (2001) "U.S. High GWP Gas Emissions 1990 – 2010: Inventories, Projections, and Opportunities", Office of Air and Radiation, U.S. Environmental Protection Agency, EPA 000-F-97-000, June 2001.
10. U.S. Environmental Protection Agency (2004) "Analysis of Cost to Abate Ozone-depleting Substitute Emissions", Office of Air and Radiation, U.S. Environmental Protection Agency, EPA 430-R-04-006, June 2004.
11. U.S. Environmental Protection Agency (2006a) "Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990 to 2004" Office of Atmospheric Programs, United States Environmental Protection Agency, EPA-430-R-06-002, June 2006
12. U.S. Environmental Protection Agency (2006b) "Global Mitigation of Non-CO_2 Greenhouse Gases", Office of Atmospheric Programs, United States Environmental Protection Agency, EPA-430-R-06-005, June 2006.
13. UNEP - United Nations Environment Programme (1998) "Report of the Refrigeration, Air Conditioning and Heat Pumps", Technical Options Committee; Nairobi, December 1998.
14. van Gerwen, R.; Vervoerd, M. (2000) "Emission reduction of non-CO_2 Greenhouse Gases Used as Refrigerants" in Non-CO_2 Greenhouse Gases: Scientific Understanding, Control and Implementation (edited by J. Van Ham *et al.*), Kluwer Academic Publishers, London.
15. Walker, D. (2000) "Low-charge Refrigeration for Supermarkets", IEA Heat Pump Center Newsletter, vol. 18, no. 1, p. 13-16.