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**STRATEGIC OPTIONS FOR RETROFITTING OF MOBILE AIR CONDITIONERS
AND CHILLERS**

(An Interim Report)

STRATEGIC OPTIONS FOR RETROFITTING OF MOBILE AIR CONDITIONERS AND CHILLERS

(An Interim Report)

1. Pursuant to a request from the Executive Committee (UNEP/OzL.Pro/ExCom/10/40, paragraph 123), the following paper was prepared as an Interim Report on a possible strategy for funding projects in the mobile air conditioner and chiller refrigeration sub-sectors. Main sources of information are: industry, developed countries experience, published literature and the Co-Chair of UNEP's Technology and Economic Assessment Panel, among others. The report addresses chillers and mobile air conditioners (MAC) separately. The interim nature of this report was dictated by time constraints and accessing the relevant information.

Chillers

2. Chillers vary in design, operating refrigerants, efficiency and capacity. Chillers have an average useful life time of 25-30 years. Before the Montreal Protocol, and with unlimited supply of CFCs, considerable amounts of the latter were vented to the atmosphere in the course of normal maintenance and servicing practices.

3. As a result of the Montreal Protocol, chiller manufacturers in developed countries geared up to develop new chillers based on HCFCs or HFC-134a. They also perfected the technology for retrofitting existing chillers to be compatible with the new refrigerants. It is to be emphasized that more than 90 per cent of the chillers are produced in these countries.

4. Some developed countries enacted legislation to prohibit the intentional venting of CFCs from existing chillers. The penalty for non compliance starts at US \$25,000 per day.

5. Developed countries will phase out most of the controlled substances by the end of 1995.

6. Some developed countries have levied taxes on the sale of CFCs which resulted in high prices of these chemicals which are the mainstay of most of chillers in use in these countries.

7. The approach, in developed countries, to deal with the impact of phase out of CFCs, the high cost and decreasing availability of these chemicals on existing chillers is multivariate.

8. Chiller manufacturers have developed criteria such as: age, tube condition, last overhaul, amount of refrigerant, changes in capacity needs, energy consumption, and maintenance history to recommend one of three options to deal with existing CFC-based chillers. They have also rated the different options according to these criteria.

9. The options are:

- recycling and reclamation, with a cost effectiveness of US \$10-45/kg
- retrofit, with a cost effectiveness of US \$80-400/kg
- replacement, with a cost effectiveness of US \$10-80/kg.

10. Generally speaking, and because of the impending scarcity and high cost of CFCs in developed countries, recycling and reclamation is the recommended option, followed by replacement and retrofitting options.

11. Industry sources have indicated that new chillers are energy efficient, and that savings achieved may result in a pay-back period as short as five years. This is also the case with a good retrofit.

Observations/Recommendations

12. Based on the above, the following observations/recommendations may be applicable to developing countries:

- Chiller retrofits may be unattractive except in special cases (to be evaluated on a case by case basis).
- Early replacement may be economically attractive and should be the outcome of an overall business plan to be made in cooperation with the chiller manufacturer or qualified specialists.
- Project proposals to improve containment (purge units) and the application of recycling and reclamation in the case of servicing deserve full attention.
- Both early replacement and containment improvement (recycling and reclamation) are 5-10 times less expensive per kg of CFC saved than retrofits.

Mobile Air Conditioning

13. While the technology to retrofit chillers is proven in developed countries, retrofitting MACs to accommodate HFC-134a as the only refrigerant of choice is far from being a proven technology. This difference belies the functionality of the appliance itself.

14. MACs vary from one car manufacture to the other, and their servicing is done in many car dealerships and other certified workshops within a country. Furthermore, safety is an essential factor in retrofitting MACs due to the different operating conditions of vehicles.

15. Retrofitting MACs is under serious consideration in developed countries due to the 1995 phase-out date for CFCs. However, there is not a single proven technology that can be employed to retrofit the existing automobiles fleet. Developed countries are beginning the testing of retrofits in a limited numbers of cars, and are approaching a cautious phase-in approach.

16. Costs associated with this retrofit are currently estimated to be in the range of US \$200 to US \$800/auto. Given the fact that MACs typically hold a charge of one kilogram of refrigerant, the cost effectiveness of retrofits run from US \$200,000 to US \$800,000 per tonne, making them extraordinarily costly. Significant experience will be gained over the next several years that will lead to the perfection of techniques for retrofits and a significant reduction of retrofit costs. Additionally, drop-in substitute for MACs are currently being developed and may result in a viable alternative to retrofits.

17. Developed countries are also aggressively implementing recycling and reclamation programme for MACs, which will reduce the need to retrofit.

18. Developed countries have started the production of HFC-134a MACs as early as 1992, and the Executive Committee will consider, at this meeting, three projects from developing countries for the production of HFC-134a based MACs.

Observations/Recommendations

19. Given:

- the very poor cost effectiveness of MACs retrofits,
- the possibility of finding a drop in substitute prior to the developing country phase out requirement, and
- the certainty of reduced cost of retrofits through experience gained through millions of retrofits in developed countries;

it is, therefore, recommended that Article 5 countries should be encouraged to pursue a more aggressive recycling and reclamation programme (the Executive Committee has approved several projects in this area). A decision on funding MAC retrofit projects in developing countries should await further development of the technology and be based on experience gained in developed countries.