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Executive Committee of
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THE APPLICATION OF HYDROCHLOROFLUOROCARBONS (HCFCs) IN PROJECTS FUNDED BY THE MULTILATERAL FUND

PART I: INTRODUCTION

1. When considering projects involving conversion to HCFCs at its Nineteenth Meeting in 1996, the Executive Committee decided, among other things:

> "To request the Secretariat to prepare for examination by the Executive Committee at its Twentieth Meeting a paper on:
>
> (i) the historical background to HCFC conversion projects;
>
> (ii) what information on alternatives to HCFCs had been provided by the implementing agencies to the applicant countries, and how that information had been received and acted upon; and
>
> (iii) the justifications given for the choice of one technology over another." (UNEP/OzL.Pro/ExCom/19/64, Decision 19/2, para. 17 (c)).

2. This paper was prepared by the Fund Secretariat with input from the implementing agencies in response to the above request. The paper begins with a review of the relevant decisions by the Parties and the Executive Committee with regard to HCFC technologies, as well as an analysis of the investment projects applying such technologies.

3. Following that, the paper presents the process which has been followed by implementing agencies in the choice of CFC replacement technologies, especially in cases involving HCFCs. Finally the paper provides a sampling of the circumstances and justifications which have been given by implementing agencies when HCFC technologies are chosen. These last two parts are prepared on the basis of input from implementing agencies.

PART II: HISTORICAL BACKGROUND TO HCFC CONVERSION PROJECTS

(1) Policy framework of the Multilateral Fund for the application of HCFCs

4. The following is a chronological listing of the decisions which have been adopted by the Fifth Meeting of the Parties in 1993 and the Executive Committee from the Twelfth to Nineteenth Meetings on the application of HCFC technologies.

5. The Fifth Meeting of the Parties decided that:

> "1. Each Party is requested, as far as possible and as appropriate, to give consideration in selecting alternatives and substitutes, bearing in mind, inter alia, Article 2F, paragraph 7, of the Copenhagen Amendment regarding hydrochlorofluoro-carbons, to:

(a) environmental aspects;
(b) human health and safety aspects;
(c) the technical feasibility, the commercial availability and performance; and
(d) economic aspects, including cost comparisons among different technology options taking into account:
    (i) all interim steps leading to final ODS elimination
    (ii) social costs
    (iii) dislocation costs, etc.; and
(e) country-specific circumstances and due to local expertise.

2. To note that the Executive Committee is taking the above considerations into account as far as information is available."

(Source: UNEP/Ozl.Pro/5/12 Decision V/8 (paras 1 and 2))

6. At its Twelfth Meeting, the Executive Committee adopted the following recommendations on the use of transitional substances as substitutes for ozone depleting substances:

(a) "in view of the ongoing review requested of the Technology and Economic Assessment Panel by the Parties to the Montreal Protocol, the paper on The Use of Transitional Substances as Substitutes for Ozone Depleting Substances (UNEP/OzL.Pro/ExCom/12/34) may not be considered as a policy guideline but as a possible input to the work of the Open-Ended Working Group of the Parties to the Montreal Protocol;

(b) meanwhile, consideration of the use of HCFC in the Multilateral Fund projects should be sector-specific and approved for use only in areas where more environment-friendly and viable alternative technologies are not available."

(Source: UNEP/Ozl.Pro/Excom/12/37 (para. 168))

7. At its Fifteenth Meeting, the Executive Committee stated that, whenever possible, HCFCs should not be used. It further requested that "the applicability of HCFCs in commercial refrigeration projects should be examined by an expert group, possibly the OORG, which should prepare a report for submission to the Executive Committee."
(Source: UNEP/Ozl.Pro/15/45(para. 90))

8. Again at its Fifteenth Meeting, the Executive Committee requested implementing agencies to take the following issue into consideration when preparing projects for domestic refrigerator insulation foam conversion:

(a) "as HCFCs were not controlled substances for Article 5 countries, incremental costs for conversion of HCFC-141b plants were not eligible for funding;

(b) implementing agencies should note a presumption against HCFCs when preparing projects; and

(c) where HCFC projects were proposed, the choice of this technology should be fully justified and include an estimate of the potential future costs of second-stage conversion."

(Source: UNEP/Ozl.Pro/Excom/15/45 (para. 129))

9. At its Nineteenth Meeting, the Executive Committee, noting the recommendation of the Sub-Committee (UNEP/OzL.Pro/ExCom/19/5, para. 12), decided:

(a) "to take note of Decision VII/3 of the Seventh Meeting of the Parties to control HCFCs and to note further that projects involving conversion to HCFCs should be considered in the light of that decision, as well as other relevant factors;

(b) that in the future, in cases where conversion to HCFCs was recommended, the implementing agencies should be requested to provide a full explanation of the reasons why such conversion was recommended, together with supporting documentation that the criteria laid down by the Executive Committee for transitional substances had been met, and should make it clear that the enterprises concerned had agreed to bear the cost of subsequent conversion to non-HCFC substances; and

(c) to request the Secretariat to prepare for examination by the Executive Committee at its Twentieth Meeting a paper on:

(i) the historical background to HCFC conversion projects;

(ii) what information on alternatives to HCFCs had been provided by the implementing agencies to the applicant countries, and how that information had been received and acted upon; and

(iii) the justifications given for the choice of one technology over another."

(Source: UNEP/Ozl.Pro/19/64 Decision 19/2 (para. 17))

10. It must be noted here, however, that prior to 1994 HCFCs were considered the most viable substitutes for CFCs. This fact is reflected in the country programmes and projects approved in 1991-1993.

(2) A Statistical Analysis Of the Projects Involving HCFCs in the Approved Portfolio

11. Annex I presents the distribution of the ODP tonnes to be phased out by the approved portfolio of the Multilateral Fund investment projects between HCFCs and non-HCFCs on a

sector/sub-sector, annual and regional basis. It could be observed from the portfolio statistics that:

- HCFC technologies have been used only in the foam and refrigeration sectors. On a sub-sector level, the integral skin foam (39%) and rigid foam (35%) are the two sub-sectors in the foam sector which have the overwhelming majority of cases of HCFC applications. For the refrigeration sector HCFCs have been used almost exclusively as foam blowing agents in commercial and domestic refrigeration sub-sectors. However, insignificant amounts of HCFCs were almost exclusively used as refrigerants.

- In geographical terms, Latin America comes first, both for the foams and refrigeration in the application of HCFCs as a replacement of CFCs followed by Asia and Pacific region and by the Africa region.

PART III: THE PROCESS OF TECHNOLOGY CHOICES

12. This section examines the process the implementing agencies follow in the choice of replacement technologies, especially in cases involving HCFCs. This process includes controls at the policy, institutional and procedural levels. The information in the section is synthesized from the input provided by implementing agencies with attribution given where direct quotes are used.

(1) Policy Level

13. In various forms, all three implementing agencies involved in investment projects have established in-house policy guidelines for the application of HCFC technologies. These policy guidelines regulate the choice of technology along a number of considerations, which are articulated by UNDP as follows:

- "Proven and reasonably mature
- Cost effective
- Locally available, preferably in blends
- Acceptable physical properties
- Meeting established (Government, Company, UNDP) standards on environment and safety:"

(Source: UNDP)

14. In cases where a permanent system (water, hydrocarbons) is still not available locally on a commercial scale, such as the water-based foam blowing systems, an interim HCFC option has to be adopted:

"In these cases it is UNDP policy to the extent possible to install equipment for the permanent technology and make arrangements with suppliers to assure that this permanent technology indeed will be offered in the foreseeable future."

(Source: UNDP)

15. In the case of the World Bank, the policy is laid down in its Operational Guidance M.P. ENVGC under Choice of a Transitional Substance as Blowing Agent in Foam ODS-Phaseout Projects:

"As a matter of policy, the Bank through ENVGC, would encourage the use of zero-ODS blowing agents (e.g. methylene chloride, water, carbon dioxide, cyclopentane, etc.) for foaming applications in Montreal Protocol projects to be submitted for Multilateral Fund financing. If, after an investigation on zero-ODS options the enterprise selects a low-ODS transitional substance (i.e., HCFCs), it must document that the low-ODS substance is the most suitable option based on genuine technical or/and commercial considerations. These considerations include:

- cost considerations
- performance
- safety aspects
- technical implications"

(Source: World Bank)

16. To implement the applicable policy of the Multilateral Fund on the application of HCFC technologies, UNIDO has put in place the following parameters and criteria on the control of HCFCs in project development:

- "national policy and strategy on ODS phase out
- market requirements
- actual techno-economic situation of a recipient enterprise
- requirements of the Multilateral Fund on application of HCFCs."

(Source: UNIDO)

(2) Institutional Level

17. Independent project review has been institutionalized by implementing agencies for all investment project proposals before they are submitted to the Executive Committee for funding. These reviews cover, among other things, the choice of technologies.

18. This is stipulated by the World Bank as follows in Choice of a Transitional Substance as Blowing Agent in Foam ODS-Phaseout Projects:

"If a low-ODS (HCFC) blowing agent is chosen, a technical review and a full explanation of the reasons must be included in to the project proposal and the OORG reviewer should

comment specifically on sufficiency of the justification. Alternative cost calculations should be presented for conversion to low-ODS (transitional substance) and zero-ODS blowing agents. The Bank reserves the right to accept or reject the choice of the technological option based on merit."

(Source: World Bank)

(3) Procedural Level

19. Exposure of the recipients to all technological options with full elaboration of the advantages and disadvantages of each option and involving the recipients in the choice of the technology has been the practice followed by implementing agencies in the field. This was done both by on-site visits (study tours) and technical presentations (workshops and demonstration projects).

20. On the involvement of the recipient in the choice of foaming technologies, UNDP has this to report:

"The enterprises are always informed about all technologies available and it is stressed that it is in the interest of the enterprise as well as of the environment to use permanent, ODS-free technologies to the extent possible.

Classification	Liquid technology	Gas technology
Low ODS Technologies ("Interim")	HCFC-141b	HCFC-22, -142b HCFC-22/142b
ODS-free technologies ("Permanent")	(Cyclo)pentane All water blown HFC-356, HFC-245 isomers	HFC-134a

It should be emphasized that the technology selected is always based on the enterprise's choice, of course within the Multilateral Fund's framework of policies."

(Source: UNDP)

21. In its submission, the World Bank cites a case where it assisted five Indonesian refrigeration companies with affiliation to a transnational corporation to choose between cyclopentane and HCFC 141b as the foam blowing technology:

> "The effect of this intervention was revealed in the companies' technology choices. Two of the five companies decided to continue in the path laid down for them by their parent company, i.e., convert first to HCFC-141b and then shift to cyclopentane at a later date. However, three opted to skip the interim step to HCFC-141b altogether (which had initially been advocated by their parent companies), and developed proposals to convert directly to cyclopentane."

(Source: World Bank)

22. UNIDO reports that in the 14 foam and refrigeration projects, where HCFCs have been used, it has always made sure:

> "During the formulation of the above projects, the counterparts were provided with the relevant technical and other information, advice as well as comparative analysis of available alternative technologies which might be recommended at specific conditions of the recipient enterprises."

(Source: UNIDO)

PART IV: JUSTIFICATIONS FOR THE CHOICE OF HCFCs TECHNOLOGY

23. Justifications have been articulated by implementing agencies for the use of HCFCs on grounds of technical acceptability, cost, safety and commercial linkage. As in Part III the following is a synthesis of the input provided by implementing agencies with attributions given where necessary.

(1) Technical Acceptability

24. Technical acceptability is defined as the local availability of the chemicals involved and technical back-up for the application of a certain technology, and the performance of the technology, based on its physical properties.

25. In the choice of alternatives to CFC-11 as a refrigerant in the commercial refrigeration sector, for example, the World Bank believes:

> "that the single most important factor was ... a determination of whether or not the appliance in question is either factory-charged or field-charged. The first reason is that factory-charged commercial refrigeration manufacturing imparts greater capacity for intensive monitoring and control of the manufacturing process. Secondly, factory-charged appliances tend to be smaller and thus require smaller refrigerant charges which lessens the safety risk when using flammables such as hydrocarbons. For these reasons, the OORG Commercial Refrigeration Working Group recommended HFC-134a and isobutane for conversion of factory-charged commercial refrigeration manufacturing.

> The recommended option for all types of field-charged low temperature systems is HCFC-22, or HCFC-22 based blends (where it is necessary to maintain compressor discharge temperature control)."

(Source: World Bank)

26. Again on the subject of choice of refrigerant technology for commercial refrigeration, the World Bank states that:

> "contrary to popular impression, there is no technical basis for maintaining that zero-ODS alternatives (HFCs or hydrocarbons, for example) are superior to low-ODS HCFC-based options in terms of performance, energy efficiency, or reliability. By contrast, HCFC-based options have a major near-term competitive advantage in terms of service availability and installation capacity due to the existence of an already well established and dedicated cadre of trained technical servicing personnel."

(*Source: World Bank*)

27. In the early days of the Multilateral Fund operation, some of the technologies were still in their developmental stage with regard to their physical properties and UNDP justified its choice of HCFCs as a foaming agent in those days, as follows:

> "A permanent foam blowing system is not (yet) providing the necessary product requirements. This is the case with water based systems in view of insulation value, shrinkage, adhesion and with hydrocarbons in view of insulation value."

(Source: UNDP)

28. UNIDO emphasizes the availability of local technical back-up for the introduction of a certain technology and justifies its choice of a HCFC option as follows:

> "Usually the general technical level of these companies including service and maintenance of equipment is poor, the operational personnel is unqualified and industrial safety arrangements are also a very low level."

(Source: UNIDO)

(2) Costs

29. All three implementing agencies responsible for investment projects report that cost is a very important factor in the choice of technology. This is especially true in the application of hydrocarbon foaming technology in small-scale enterprises:

> "The cost-effectiveness utilizing permanent technology is higher than applicable thresholds. This is the case with water based systems in view of the incremental operating costs and hydrocarbons in view of the investments.

> Hydrocarbon foam projects lower than US $300,000 are not possible. About 80% of the potential recipients uses less than 10 tonnes CFCs per annum. This translates to a CE of US $30.00/kg/year. Even assuming 35% safety related expenses to be exempted from the CE calculations, the CE would still amount to US $20.00/kg/year!! Rather than 'penalizing' the environment by doing nothing or the enterprise for being small, the use of HCFCs provides a solution that assures that 90-95% of the goal is immediately achieved.
>
> Cost-effectiveness threshold constraints at this small-scale enterprise also precluded the selection of cyclopentane technology because of the need to supply cyclopentane storage, and polyol/cyclopentane pre-mixing equipment."

(Source: UNDP)

30. UNIDO cites the financial burden on the recipient, especially a small enterprise, for converting to hydrocarbon technology:

> "Due to small consumption of CFCs, the eligible project budget is too little compared to the total conversion costs. It means that the financial responsibility of the counterpart is unproportionally high when converting to pentane technology."

(Source: UNIDO)

(3) Safety

31. The introduction of flammable hydrocarbons and the associated safety hazards weighs heavily in the choice of technologies. Assessments have to be made of the appropriate operating environment before the implementing agencies can agree to the choice of a certain technology. For instance, for refrigerant alternatives in commercial refrigeration projects, the World Bank reports:

> "Due to safety hazards, however, hydrocarbons are not recommended options for field-charged commercial refrigeration installations due to the generally large charges involved and concerns about existing electrical components, both of which raise serious safety risks."

(Source: World Bank)

32. In its reports, UNDP emphasizes the readiness of the recipient for the introduction of a certain technology.

> "The degree of sophistication or the housekeeping at a particular recipient is such that the required operational safety is not sufficiently guaranteed. This may be the case with hydrocarbons. UNDP cannot take a risk and allow the implementations of technology if it is not convinced that this can be operated by the enterprise in a safe way."

(Source: UNDP)

(4) Commercial Linkage

33. Commercial and technology affiliations to some traditional markets and suppliers influence heavily the choice of technology by the recipients. What is reported by UNDP represents a typical situation.

> "It can then be clearly understood that even with knowledge of all of the current technology options, the selection of CFC 11 replacement technology in Article 5 countries will also be strongly influenced by the following:
>
> - the countries traditional source of technology and technical assistance
> - the presence of a non-Article 5 country investment partner, or technology licenser
> - the existence of, or pending, appliance energy efficiency regulations
> - the regulations or adopted technology in existing, or potential, export markets
> - the historical situation regarding the influence and adoption of other non-Article 5 country regulations.
>
> It would not then be surprising if Article 5 countries closer geographically, and with closer affiliations to Europe in refrigerator design, regulatory affairs, and technology in general, took their lead from Europe, whereas Latin American countries followed the USA, and Asia Pacific countries followed Japan."

(Source: UNDP)

ANNEX I

HCFC Applications in Approved Portfolio of the Multilateral Fund

Sub-sector	HCFC	Non-HCFC	Total	%HCFC	%Non-HCFC
1992					
Flexible	55.0	859.0	914.0	6.0%	94.0%
Integral skin					
Rigid					
Insulation refrigeration	175.0	530.0	705.0	24.8%	75.2%
TOTAL	**230.0**	**1,389.0**	**1,619.0**	**14.2%**	**85.8%**
1993					
Flexible	-	450.0	450.0	0.0%	100.0%
Integral skin	50.0	-	50.0	100.0%	0.0%
Rigid	200.0	46.0	246.0	81.3%	18.7%
Insulation refrigeration	881.0	1,036.0	1,917.0	46.0%	54.0%
TOTAL	**1,131.0**	**1,532.0**	**2,663.0**	**42.5%**	**57.5%**
1994					
Flexible	25.0	2,539.0	2,564.0	1.0%	99.0%
Integral skin	36.0	14.0	50.0	72.0%	28.0%
Rigid	345.0	541.0	886.0	38.9%	61.1%
Insulation refrigeration	1,451.3	1,957.2	3,408.5	42.6%	57.4%
TOTAL	**1,857.3**	**5,051.2**	**6,908.5**	**26.9%**	**73.1%**
1995					
Flexible	2.0	1,510.1	1,512.1	0.1%	99.9%
Integral skin	129.0	319.0	448.0	28.8%	71.2%
Rigid	386.3	1,980.0	2,366.3	16.3%	83.7%
Insulation refrigeration	964.2	2,936.3	3,900.5	24.7%	75.3%
TOTAL	**1,481.5**	**6,745.4**	**8,226.9**	**18.0%**	**82.0%**
1996					
Flexible	-	539.8	539.8	0.0%	100.0%
Integral skin	115.9	185.2	301.1	38.5%	61.5%
Rigid	671.6	437.0	1,108.6	60.6%	39.4%
Insulation refrigeration	351.1	848.0	1,199.1	29.3%	70.7%
TOTAL	**1,138.5**	**2,010.0**	**3,148.6**	**36.2%**	**63.8%**
GRAND TOTAL					
Flexible	82.0	5,897.9	5,979.9	1.4%	98.6%
Integral skin	330.9	518.2	849.1	39.0%	61.0%
Rigid	1,602.9	3,004.0	4,606.9	34.8%	65.2%
Insulation refrigeration	3,822.6	7,307.5	11,130.0	34.3%	65.7%
TOTAL	**5,838.3**	**16,727.6**	**22,565.9**	**25.9%**	**74.1%**

Geographic distribution

Sub-sector	HCFC	Non-HCFC	Total	%HCFC	%Non-HCFC
Africa					
Foam	173.0	1,954.8	2,127.8	8.1%	91.9%
Insulation refrigeration	244.8	1,221.5	1,466.3	16.7%	83.3%
Asia and the Pacific					
Foam	1,205.5	5,621.3	6,826.8	17.7%	82.3%
Insulation refrigeration	1,615.7	4,420.6	6,036.3	26.8%	73.2%
Europe					
Foam	-	797.0	797.0	0.0%	100.0%
Insulation refrigeration	204.0	909.5	1,113.5	18.3%	81.7%
Latin America and the Caribbean					
Foam	637.3	1,047.0	1,684.3	37.8%	62.2%
Insulation refrigeration	1,783.1	885.9	2,668.9	66.8%	33.2%