MONTREAL PROTOCOL

ON SUBSTANCES THAT DEPLETE

THE OZONE LAYER

UNEP

Technology and Economic Assessment Panel

SUPPLEMENTARY REPORT
TO

"ASSESSMENT OF THE FUNDING REQUIREMENT FOR THE REPLENISHMENT OF THE MULTILATERAL FUND FOR THE PERIOD 2000-2002"

August 1999

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IN. Introduction

IN.1 Terms of Reference

Decision X/13 of the Tenth Meeting of the Parties requested the Technology and Economic Assessment Panel (TEAP) to submit a report to the Eleventh Meeting of the Parties (Beijing, December 1999) through the Nineteenth Meeting of the Open-Ended Working Group (Geneva, June 1999), to assist the Parties in reaching a decision on the level of the 2000-2002 Replenishment of the Multilateral Fund for the Implementation of the Montreal Protocol.

IN.2 Scope and Coverage

Decision X/13 directed the TEAP to take into account the following factors:

(a) All control measures, and relevant decisions, agreed to by the Parties to the Montreal Protocol, including decisions by the Tenth Meeting of the Parties, in so far as these will necessitate expenditure by the Multilateral Fund during the period 2000-2002;

(b) The need to allocate resources to enable all Article 5(1) Parties to maintain compliance with the Montreal Protocol;

(c) Agreed rules and guidelines for determining eligibility for funding of investment projects (including the production sector) and non-investment projects;

(d) Approved country programmes;

(e) Financial commitments in 2000-2002 relating to sectoral phaseout projects agreed by the Executive Committee;

(f) Experience to date, including limitations and successes of the phaseout of ozone depleting substances achieved with resources already allocated, as well as the performance of the Multilateral Fund and its Implementing Agencies;

(g) The impact that the controls and country activities are likely to have on the supply and demand for ozone depleting substances, and the effect that this will have on the cost of ozone depleting substances and the resulting incremental cost of investment projects during the period under examination;

(h) Administrative costs of the Implementing Agencies, taking into account paragraph 6 of decision VIII/4, and the cost of financing the secretariat services of the Multilateral Fund, including holding meetings.

In undertaking this task, Decision X/13 asked the Technology and Economic Assessment Panel to consult widely with relevant persons and institutions and other relevant sources of information deemed useful. The Decision also asked the Panel to strive to complete its work in time to enable its report to be distributed to all Parties two months before the Nineteenth meeting of the Open-ended Working Group (15-18 June 1999).

IN.3 The Process

The TEAP established a Task Force to prepare the report on the 2000-2002 replenishment of the Multilateral Fund, in consultation with the full TEAP membership. The members of the Task Force were **Dr Tom Batchelor** (Australia, co-chair MBTOC), **Dr Lambert Kuijpers** (The Netherlands, co-chair TEAP, co-chair RTOC), **Mr Jose Pons Pons** (Venezuela, co-chair ATOC), **Mr Sateeaved Seebaluck** (Mauritius, Senior Expert), **Dr Robert Van Slooten** (United Kingdom, co-chair EOC) and **Dr Shiqiu Zhang** (China, co-chair EOC).

The Task Force prepared the final draft of the Replenishment Report on the 2000-2002 Replenishment of the Multilateral Fund and submitted it to the TEAP meeting in Maastricht (April 1999). The report was reviewed by the full TEAP and subsequently revised, edited and printed for distribution.

IN.4 The Ad Hoc Group on Replenishment

The Tenth Meeting of the Parties (Cairo, November 1998) established the Ad Hoc Group on Replenishment within the framework of the Procedures agreed by the Parties to progress the negotiations on the 2000-2002 replenishment of the Multilateral Fund. The Ad Hoc Group consists of seven Article 5(1) Parties (China, Cuba, India, Iran (Islamic Rep of), Nigeria, Venezuela and Zimbabwe) and seven non-Article 5(1) Parties (Canada, Germany, Japan, Poland, Switzerland, United Kingdom and the USA).

IN.5 Distribution of the 2000-2002 Replenishment Report

The April 1999 report was despatched:

- via e-mail and courier to the members of the Ad Hoc Group on Replenishment at the earliest possible date;
- via copies in conference document format to 200 special addresses; and
- via air mail in the official UNEP printed format to all Parties to the Montreal Protocol and to all other participants involved in the process.

The Replenishment Task Force met with the Ad Hoc Group on Replenishment on 14 June 1999 in Geneva immediately prior to the 19th Open-Ended Working Group (Geneva, 15-18 June 1998).

IN.6 The First Meeting of the Ad Hoc Group on Replenishment

The first meeting of the Ad Hoc Group on Replenishment was a full day meeting in Geneva on 14 June 1999. Participants included the fourteen members of the Ad Hoc Group, the six members of the TEAP Task Force on

Replenishment, representatives of the Multilateral Fund Secretariat and the Treasurer of the Multilateral Fund. The meeting was chaired by Dr. Abdel-Gelil and by Mr. Uosukainen, the co-chairs of the 19th Open-Ended Working Group Meeting; and the Ozone Secretariat assisted the meeting.

The report on the replenishment was introduced by Dr. Lambert Kuijpers, the co-chair of the TEAP. Further presentations were given by the other members of the Task Force. In their presentations, the members of the Task Force outlined the methodology and assumptions used in preparing the report and highlighted the key findings.

All members of the Ad Hoc Group expressed their satisfaction at the clarity and transparency of the TEAP report and presentations. Following the presentations, members of the Ad Hoc Group requested and received clarification from the Task Force on the following issues:

- The basis for the projections of ODS consumption;
- The costs of projects per ODP tonne phased out;
- The impact of domestic policies on ODS consumption levels;
- Additional costs for projects if HCFCs are not used;
- Costs for SMEs and LVCs;
- Benefits of the sectoral approach;
- Costs of implementing refrigerant management plans;
- Costs for new Parties classified as developing countries;
- The effect of updates to country programmes;
- The costs of methyl bromide alternatives;
- The costs of new sub-sectors approved by the Executive Committee;
- The justification for funding the level of US$ 200 million as advanced funding, and
- The funding implications of "concessional lending".

Following discussion, the Ad Hoc Group on Replenishment recommended that the TEAP submit a Supplementary Report on a number of aspects. It was agreed that the report on aspects to be specified would be finalised by the Task Force before the end of August 1999 and despatched as soon as possible to all the members of the Ad Hoc Group. It was also decided that the Ad Hoc Group on Replenishment would meet once again with the TEAP Replenishment Task Force on 30 September and 1 October 1999 in Washington, D.C. to discuss the Supplementary Report and to negotiate on the 2000-2002 replenishment.

IN.7 The Supplement to the April 1999 Assessment Report on the 2000-2002 Replenishment of the Multilateral Fund

In the Geneva meeting, the Ad Hoc Group on Replenishment requested the TEAP to submit a Supplementary Report on the following aspects to facilitate the Parties' consideration of the issue of replenishment:

1. Cost-effectiveness levels for methyl bromide projects;
2. Sensitivity analysis on growth rates for consumption of ODS, for example using an assumption of 0-2 per cent growth instead of 8-10 per cent;
3. Better justification for the benefits of non-investment activities, including possible quantification;
4. Quantifying the benefits of advanced funding in monetary terms;
5. Sensitivity analysis of cost-effectiveness thresholds, particularly for LVCs and SMEs;
6. More detailed analysis of the cost of refrigerant management plans;
7. Outcome of the discussions of the Executive Committee at its July 1999 meeting on innovative financing, including concessional loans, and on other pertinent issues;
8. New sub-sectors, such as transport, approved by the Executive Committee;
9. Cost of avoiding the use of HCFCs in the projects to be approved by the Fund;
10. Opportunity costs associated with expenditures to favour hydrocarbons in Fund projects.

These aspects were assessed by the TEAP Replenishment Task Force. The draft Supplementary Report was issued in August 1999 for review by the full TEAP. Following approval by the full TEAP, the report was submitted to the Ad Hoc Group on Replenishment at the end of August 1999, and, subsequently, to all Parties to the Montreal Protocol.

IN.8 Adjustment to the Base Case Funding Requirement as Determined in the April 1999 Report on Replenishment of the Multilateral Fund for the Period 2000-2002

The TEAP Replenishment Task Force has made small adjustments in the funding for methyl bromide projects and in the funding for non-investment projects (see annexes to the sections 1 and 3 of this Supplementary Report). Consequently, the funding requirement of US$ 306.3 million, as determined in the Base Case in the April 1999 report, has been reduced to the value of **US$ 301.4 million.** A similar adjustment has been made to the Advanced Funding Case.

S. Summary of Findings in Sections 1 - 10

S1. Cost-Effectiveness Levels for Methyl Bromide Projects

The cost-effectiveness of projects approved by the Executive Committee varies from projects clustered around US$ 31.15 per kg to those around a high cost-effectiveness value of US$ 97.53 per kg. The latter are closely associated with the elimination of relatively small volumes of MB, typically less than 5 ODP tonnes. For crops such as tomatoes, flowers, melons and strawberries an average cost-effectiveness value of US$ 14.33 per kg has been put forward by an implementing agency expert.

The TEAP Replenishment Task Force has taken the view that an overall cost-effectiveness value of US$ 12 per kg may be a reasonably achievable performance target over the next few years as experience is gained in implementing MB reduction projects. Other types of projects such as those that develop domestic policies might have substantially lower cost-effectiveness values.

S2. Sensitivity Analysis on Growth Rates for Consumption of ODS - For Example, Using an Assumption of 0-2 per cent Growth instead of 8 to 10 per cent

The Ad Hoc Group on the Replenishment considered "net growth percentages" of +10% in CFC consumption to be extremely large in this phase of the Montreal Protocol process. The TEAP Replenishment Task Force was requested to calculate the difference in funding if these high growth percentages were restricted to 0% to 2% over the period for which data had not yet been submitted.

For the 2000-2002 replenishment period, the assumptions of 2 per cent and 0 per cent net growth percentages result in US$ 7 million and US$ 10 million reductions, respectively, in the estimated funding requirement of US$ 39.5 million for investment projects in the CFC consumption sector. Larger differences were calculated for the 2003-2005 replenishment period. The corresponding estimates for 2003-2005 were US$ 57 million and US$ 88 million, respectively, in the estimated funding requirement of US$ 591.8 million.

S3. Further Justification for the Benefits of Non-Investment Activities

Experience suggests that ODS reductions on a country basis are more cost-effective if the investment and non-investment projects are designed and implemented as mutually reinforcing elements of a comprehensive domestic policy framework. The strengthening of institutional capacities has been

found to be necessary to ensure effective co-ordination between domestic policies and Multilateral Fund projects; some countries have already achieved ODS reductions in the absence of investment projects. Refrigeration management plans (RMPs) and halon management plans (HMPs) have also been found to be necessary in order to manage refrigerants in the servicing sector and halons in the fire control sector. Training is an essential component of these management plans to ensure the capacity to control the risks attached to complex processes resulting from ODS substitution in the refrigeration sector and flammability risks in the fire control sector.

The TEAP Replenishment Task Force reviewed the evidence for actual ODP reductions that have been achieved through the implementation of non-investment projects. The Task Force concluded that, while there is informal evidence of ODP reductions associated with non-investment projects, it has not been possible to quantify these reductions. An exception may be an estimate by the Multilateral Fund Secretariat that 1,852 ODP tonnes have been phased out through refrigerant recovery and recycle programmes.

S4. Elaboration on the Benefits of Advanced Funding

The TEAP submits the following rationales for its proposed additional funding of US$ 200 million for the 2000-2002 replenishment period in the form of an advance drawn on the estimated funding requirement for the 2003-2005 replenishment period.

The *environmental rationale* argues that the advanced funding proposal is consistent with the application of the precautionary principle to the vulnerability of the ozone layer during the coming decades. The *business rationale* argues that sharp variations in project approvals by the Executive Committee of the Multilateral Fund would, from one replenishment period to another, be inefficient in economic terms. The *administrative rationale* argues that, in the absence of advanced funding, the capacities of the Article 5(1) countries and of the Multilateral Fund and its Implementing Agencies could be seriously challenged in meeting the resulting fluctuations in project approvals and implementation. The *rationale for low volume consuming countries* argues that additional resources are required for particular Article 5(1) countries that could be inadequately funded due to the determination of funding requirements on the basis of country categories as a whole rather than those of individual countries. The *domestic policies' rationale* argues the potential for reductions in the overall funding requirement due to the implementation of domestic policies that are more effective in achieving ODS reductions.

S5. Sensitivity Analysis for Cost-Effectiveness Thresholds for SMEs and LVCs

In carrying out the following calculations, the TEAP recognises the substantial degrees of uncertainty that must be attached to both the assumptions and the results reported below.

Analysis for SMEs. Sensitivity analyses were carried out for different SME percentages and cost-effectiveness values. Although the calculated differences in the funding requirement for the 2000-2002 replenishment period were not large in absolute terms, they were substantial in percentage terms. If there were no projects for SMEs, the 2000-2002 funding requirement would decrease by approximately US$ 7.0 million compared to the Base Case. However, as the SME percentage and the investment percentage are raised, the estimated funding requirements increase substantially relative to the Base Case. Innovative approaches in the SME sector, such as umbrella projects, would be necessary to reduce the estimated funding requirement.

Analysis for LVCs. Sensitivity analyses for the funding requirement were carried out for assumed changes in cost-effectiveness for countries in categories 4 and 5. The cost-effectiveness assumptions were varied between 0.5 and 2.0 times the difference between larger countries and LVCs/VLVCs as used in the Base Case. For the country categories 1, 2 and 3, the SME cost-effectiveness values were assumed to be the same as in the Base Case. For an LVC increase of 200 per cent of the Base Case increase for country categories 4 and 5 relative to categories 2 and 3, the funding requirement is increased by US$ 1.7 million and US$ 13.6 million, respectively, for the 2000-2002 and 2003-2005 replenishment periods.

S6. More Detailed Analysis of the Cost of Refrigerant Management Plans

The TEAP recognises that a substantial degree of uncertainty must be attached to the estimates presented below.

Overall, total funding of approximately US$ 10 million is required for all remaining RMP activities in country categories 3, 4 and 5. The total funding required can be broken down to an additional US$ 7 million for the investment component and a further US$ 2.5 to 3 million for the supporting activities component. These more detailed cost estimates are consistent with the advanced funding proposal which makes provision for US$ 10 to 20 million for RMPs for all countries in categories 3, 4 and 5 during the 2000-2002 replenishment period.

S7. Outcome of the Discussions of the Executive Committee at its July 1999 Meeting on Innovative Financing, including Concessional Loans and Other Pertinent Issues

The TEAP Replenishment Task Force has noted the Executive Committee approvals for two concessional loan approvals for chiller substitutions in Thailand (26th Executive Committee Meeting) and Mexico (28th Executive Committee Meeting); and Decision 28/48 on the principles of concessional lending projects. Having taken note of these Decisions, the TEAP has taken the view that it would not be useful at this stage, in the absence of agreed Executive Committee guidelines, to take into account the possibility of concessional lending. The TEAP will continue to monitor developments, including the possibility that the funding requirement for 2003-2005 might have to be revised to take into account any future developments in concessional lending.

S8. New Sub-Sectors, such as Transport, Approved by the Executive Committee

Transport refrigeration has been recognised as a new sub-sector by the Executive Committee due to the extent of the difference in its ratio of investment to operating costs relative to other forms of refrigeration. However, assuming good practice and the supply of components for CFC substitute refrigerants, the assembly of the cooling units is, in principle, the same as for CFC refrigerants; and the additional investment and operational costs are small. Therefore, the TEAP Replenishment Task Force has not adjusted the cost-effectiveness values in the replenishment calculations to take this sub-sector into account; the funding requirement for the refrigeration sector as a whole is sufficient to cover this new sub-sector.

S9. Cost of Avoiding the Use of HCFCs in Investment Projects Submitted for Approval by the Executive Committee

On the basis of the analysis presented and, assuming similar patterns of project proposals during future replenishment periods, the funding increases required to implement a policy of avoiding the use of HCFCs in investment projects are estimated to be 10%, 4% and 0.9% for the foam sector, the domestic refrigeration sector and commercial refrigeration sector, respectively. These results imply that for each US$ 100 million for HCFC-based investment projects in the consumption sector, an additional US$ 15 million would be required to avoid the use of ODP (i.e., HCFC) solutions. These conclusions depend on the requisite increases in the funding requirements for subsequent replenishments of the Multilateral Fund. Since it concerns a relatively small amount of ODP tonnes that is phased out per unit of funding, the cost-effectiveness rises steeply, e.g. to approximately US$ 130 per ODP kg in the

commercial refrigeration sector. However, the overall cost-effectiveness for the one- step "CFC-11 to hydrocarbon" conversion would be approximately US$ 36 per ODP kg.

Disclaimer: *The Replenishment Task Force has responded to this request of the Ad Hoc Working Group on the Replenishment with best endeavours. However, the Task Force does not - and cannot - know the future, i.e., costs could be substantially higher if the Task Force's assumptions do not include all possible HCFC projects.*

S10. Opportunity Costs Associated with Expenditures to Favour Hydrocarbons in Multilateral Fund Projects

On the basis of historic experience, the TEAP estimates full conversion of all projects to isobutane in the refrigeration component and cyclopentane in the foam component would cause an increase of 2.5% in the total funding requirement for investment projects. On this basis, for each US$ 100 million for investment proposals in the consumption sector, an additional US$ 17.5 million would be required to introduce hydrocarbons (this is the sum of the amount of US$ 15 million determined in section 9 plus the US$ 2.5 million mentioned above). This corresponds to a saving of 14.9% per US$ 100 million investment.

A further calculation was made for all domestic refrigeration projects that were approved by the 21st through the 27th Meeting of the Executive Committee on the assumption that the cyclopentane used in the foam component and the isobutane used in the refrigeration component were to be replaced by HCFC-141b and HFC-134a. This would lead to an additional reduction of 2.8%; the result is a total reduction in the funding requirement of 17.7%, i.e., a reduction of US$ 17.7 million per US$ 100 million. These cost savings would be sufficient to phase out about 1,600 ODP tonnes in other sectors.

Disclaimer**:** *The Replenishment Task Force has responded to this request of the Ad Hoc Working Group on the Replenishment with best endeavours. However, the Task Force does not - and cannot - know the future, e.g., the Task Force's assumptions regarding future costs could be falsified by events that cannot be taken into account at this time.*

1. Cost-Effectiveness Levels for Methyl Bromide Projects

The first meeting of the Ad Hoc Group on Replenishment requested the TEAP Replenishment Task Force to further consider the cost-effectiveness figure (US$ per kg) for eliminating MB to meet the Montreal Protocol controls as this influences the estimated expenditure by the Multilateral Fund for the 2000-2002 triennium.

At the time the April 1999 Replenishment Report was drafted, only two projects had been approved by the Executive Committee - one to eliminate MB use in the tobacco sector of Cuba and the other to eliminate the use of MB for treatment of peanut seed in Senegal. The cost-effectiveness values for these projects were discussed in the April 1999 Report. More recently, other projects, which aim to eliminate MB have been approved by the Executive Committee and these have assisted the Task Force in its consideration of an appropriate cost-effectiveness figure.

Following the April 1999 Replenishment Report, a meeting of methyl bromide experts was held in Montreal during 9-10 June 1999 to discuss mainly the categories of incremental costs associated with implementing alternatives to MB. Information presented at that meeting has been useful to the Task Force in its consideration of the appropriate cost-effectiveness figure to be used in the calculation of the funding required to enable compliance with the MB control schedule under the Montreal Protocol.

1.1 Projects that Eliminate Methyl Bromide

As of August 1999, a total of nine projects have been approved by the Executive Committee. These projects are associated with various cost-effectiveness figures according to the crop, the location, the alternative proposed and the amount of MB that is to be eliminated:

1. A cost-effectiveness figure of US$ 27.79 per kg for tobacco in Brazil to phase out at least 84.4 ODP tonnes over a period of three years from when the project commences (UNEP/OzL.Pro/ExCom/28/57, Annex III 16 July 1999). The total MB consumption in this sector in Brazil is about 420 ODP tonnes. The project proposes to use the floating tray technology which, during the project review process, was found to be very cost-effective, labour-saving, reliable and sustainable compared to the current method for raising seedlings using MB.

   The Executive Committee of the Multilateral Fund approved this project as a national incentive and, on an exceptional basis, approved funding at 20% of the amount originally requested to phase out at least 20% of the MB in this sector in Brazil. Furthermore, The Executive Committee requested

UNIDO to report back 3 years after project initiation with information on the experience gained in the phase-out, including related costs and remaining ODS consumption in the sector.

2. A cost-effectiveness figure of US$ 38 per kg for a project in the tobacco sector in Cuba to phase out 48 ODP tonnes over 4 years (CUB/FUM/26 /INV/11, Annex V, MLF, March 1999). This was the first phaseout investment project approved by the Executive Committee (November 1998) which was approved without modification.

3. Table 4 of the Consolidated Business Plan, approved by the Executive Committee at its 27th meeting (UNEP/OzL.Pro/ExCom/27/5) reported a figure of US$ 23.47 million for demonstration and investment projects to phase out 558 ODP tonnes of MB, equivalent to a cost-effectiveness of US$ 42.1 per kg. Further evaluation, however, shows that the 558 tonnes are related to five projects valued at US$ 15.72 million, equivalent to a cost-effectiveness of US$ 28.2 per kg (Fund Secretariat, personal communications 25 August 1999).

4. A cost-effectiveness value of US$ 101 per kg for peanut seed fumigation in Senegal to phase out 0.7 ODP tonnes (SEN/FUM/26/INV/12, Annex V, MLF, March 1999). Although this investment project has been designed to eliminate the use of MB in Senegal, the Fund Secretariat regards it as a demonstration project designed to demonstrate the feasibility of replacing MB with phosphine in the fumigation of peanut seed (Fund Secretariat, personal communications 25 August 1999). Implementation by a single fumigation company is regarded as giving this project a high probability of success.

5. A project on alternatives for eradication of tea nematodes in Sri Lanka has a cost-effectiveness value of US$ 94.06 per kg to phase out 3.9 ODP tonnes of MB in tea plantations. This project was approved at the 27th Meeting of the Executive Committee (UNEP/OzL.Pro/ExCom/27/48, Annex II, page 16), subject to the Government of Sri Lanka providing a letter to the Executive Committee prior to its 28th Meeting stating that no further funding requests regarding tea plantations will be made after the phase-out of methyl bromide in this sector.

The information presented above suggests that the projects approved by the Executive Committee were grouped according to whether their cost-effectiveness values were considered to be moderate (see Part A of Table 1.1, projects A1 to A3) or high (see Part B of Table 1.1, projects B1 and B2). Projects with higher cost-effectiveness values were associated with the elimination of relatively small amounts of MB (i.e., 4.6 ODP tonnes with an average cost-effectiveness value of US$ 97.53 per kg). This result skewed the

overall average cost-effectiveness value compared with those projects having larger amounts of MB to be eliminated (i.e., 690 ODP tonnes) with much more moderate cost-effectiveness values (i.e., US$ 31.15 per kg).

Table 1.1 *The average cost-effectiveness of projects aimed at eliminating methyl bromide approved by the Executive Committee (as at August 1999)*

Projects approved by ExCom aimed at eliminating MB	ODP tonnes	US$ per kg
A) Moderate cost-effectiveness:		
A1 Elimination of more than 20% of the MB in 3 years in the tobacco sector in Brazil	84.4	27.29
A2 Elimination of 100% of the MB used in tobacco in Cuba	48.0	38.00
A3 Five demonstration and investment projects (UNIDO) approved, total US $15.72 m	558.0	28.17
TOTAL	690.4	
AVERAGE		31.15
B) High cost-effectiveness:		
B1 Replacement of MB with phosphine for peanut seed treatment in Senegal	0.7	101.00
B2 MB alternative for the eradication of nematodes in tea plantations in Sri Lanka	3.9	94.06
TOTAL	4.6	
AVERAGE		97.53

1.2 Experts Meeting, Montreal (9-10 June 1999)

To facilitate the production of recommendations to the Executive Committee by the Multi-Party Working Group's consideration of the existing guidelines for funding projects in the MB sector, the Fund Secretariat convened a Meeting of Experts that met 9-10 June 1999 in Montreal. The meeting was attended by representatives of the Fund Secretariat, the implementing agencies, MBTOC and other experts with interests in the implementation of alternatives to MB. The objectives of the meeting were to:

(a) review the results of demonstration projects funded by the Multilateral Fund, specifically technologies and practices for the phase out of MB in soil, storage and structure applications;

(b) advise on alternative applications for which readily transferable technologies exist;

(c) identify categories of incremental costs related to the phase out of the use of MB; and

(d) discuss policy, legislative framework and other requirements that should be put in place at the national level in order to ensure the sustainability of the implementation of MB phase out projects.

During the meetings, a representative from an implementing agency provided notes on preliminary estimates of incremental costs for each alternative per crop. Typically, five alternatives to MB were reported per crop. The results are presented in Table 1.2.

Table 1.2 *Incremental costs estimated by one implementing agency that attended the Experts Meeting, 9-10 June 1999, Montreal.*

Crop	Estimate of non-QPS methyl bromide consumption per crop (%)	No of alternatives with their incremental costs estimated	US$ per kg (range)	US$ per kg (average)
Tomatoes	39	5	6.80 - 13.20	10.38
Tobacco seedbeds	19	1	53.30	53.30
Flowers	12	1	23.50	23.50
Melons	11	5	6.30 - 20.80	12.72
Durable commodities	10	NA	NA	NA
Strawberries	7	5	8.20 - 12.60	10.70
Vegetable seedbeds and other crops	2	3	4.00 - 314.50	119.40
TOTAL	100%		AVERAGE	US$ 55.53

The source of the results in Table 1.2 stated that "…available data are limited and that variations …in incremental costs… of about +/- 30% should be expected". The average of these incremental costs was US$ 55.53 per kg, indicating the average range when multiplied by +/- 30% could extend from US$ 38.87 to US$ 72.19 per kg.

While appreciating the above preliminary estimates, the Task Force notes that they have yet to be peer reviewed; and that some categories of incremental costs, such as training, may have been omitted in some of the calculations. In addition, as the Executive Committee has yet to consider the recommendations of the Working Group which in turn will examine the report of the Experts

Meeting, it may be premature for the Task Force to attempt to define the incremental costs more precisely.

The conclusions of the Experts Meeting were summarised in the official report of the meeting (UNEP/Ozl.Pro/ExCom/28/52). The experts acknowledged the difficulties associated with data collection in this sector and recommended that consumption data should be obtained from as many sources as possible. As a further check, the experts recommended that MB consumption should be estimated based on total area fumigated for a particular crop in each country at an average fumigation rate.

Pertinent to the TEAP Supplementary Report, the experts also acknowledged that:

- The transfer of knowledge (including the know-how) and skills related to the proposed alternative technologies are the most important components of any MB project. Integration of the proposed technology within an overall pest management system usually requires the training of all stakeholders involved in the process (farmers, contractors, importers, associations, agricultural extension personnel, government officials and even purchasers of crops), and depends mainly on the MB alternative proposed and the national agricultural infrastructure.

- Elimination of MB may be time consuming, depending on the region, the infrastructure, the pest, crop and alternative proposed.

- Risk associated with implementation of alternative technologies is inherently higher than in industrial processes due to climatic and pest/crop variability and, therefore, it needs to be carefully assessed and managed while taking into account that the target group is largely composed of individual farmers who are legitimately risk-averse.

- Unlike other sectors, where it may be sufficient to only change the manufacturing equipment to ensure phase out on a one off basis, the phaseout of MB must take place for every crop cycle. The possibility of back-tracking, i.e., reverting to MB, must be addressed.

- While the unit costs of equipment and farm input materials may generally be low, the total cost could be high when the large number of potential end-users is considered, particularly in soil treatment.

- Depending on the technology chosen, incremental costs may include operating costs or may result in operating savings. Operating costs would be associated with increase in energy consumption (steam and heat generation), chemicals, other raw materials and seeds. Operating savings

would result from reduced labour and land use, elimination of MB and/ or lower amounts of chemicals. However, up-front resources might be needed at the initial stages of implementation of a new technology.

- In certain circumstances, alternative technologies will require a longer period of time to be effective compared with MB; this may result in longer downtime and increased cost.

1.3 Other Information

At the suggestion of the Executive Committee, the Task Force also examined a report commissioned by the UK government that investigated the likely impact of phasing out the use of MB, a gas that affects about 40% of the stored product industry in the UK. This report makes a useful contribution to determining the overall cost of replacing the use of MB in the stored product industry. However, it did not provide information on the likely costs of implementing individual alternatives in the UK (Taylor *et al.* 1998) and, therefore, was not able to contribute to the Task Force's consideration of the incremental costs of alternatives in this sector.

1.4 Conclusions

The Task Force notes that the cost-effectiveness of projects approved by the Executive Committee varies from projects clustered around a moderate figure of US$ 31.15 per kg to those clustered around the high cost-effectiveness figure of US$ 97.53 per kg. It appears that those with the high cost-effectiveness values are associated with the elimination of relatively small volumes of MB, typically less than 5 ODP tonnes.

Assuming that the majority of the projects approved in the future will aim to eliminate more than 5 ODP tonnes of MB, it may be reasonable to regard US$ 31.15 per kg as an appropriate cost-effectiveness value, given the track record for projects recently approved by the Executive Committee. On the other hand, preliminary incremental cost data supplied by an implementing agency representative, showed an average cost-effectiveness value of US$ 14.33 per kg for crops such as tomatoes, flowers, melons and strawberries that consumed 69% of the MB (see Table 1.2). However, the Task Force noted that other incremental costs produced by this implementing agency were much higher depending on the specific alternative and crop; some were over US$ 100 per kg.

The Task Force notes the following outcomes of the MB Experts Meeting: that there are differences in the estimated consumption of MB per crop;

that adoption of MB alternatives depends more on knowledge and technology transfer than on relatively inexpensive farming materials; that elimination of MB can be time consuming depending on the crop and location; and that incremental cost categories for MB projects have yet to be defined, let alone accepted, by the Executive Committee.

The Task Force notes that US$ 12 per kg was the *highest* cost-effectiveness value that was produced as a proposed indicative performance target for MB *in general* by the Consolidated Draft 1999 Business Plans of the Implementing Agencies (UNEP/OzL.Pro/The Executive Committee/26/8; 12 October 1998, Table 5, page 7). This estimate also closely approaches the average incremental costs estimate of about US$ 14 per kg presented in the Experts Meeting by an implementing agency.

Having considered the above issues on the cost-effectiveness of MB projects, the Task Force has decided to use US$ 12 per kg as an indicative cost-effectiveness figure for elimination of MB for the purposes of estimating the funding requirement for the methyl bromide sector.

The cost-effectiveness value of US$ 12 per kg for projects that seek to eliminate MB may be a reasonably achievable performance target over the next few years as experience is gained with respect to the implementation of MB reduction projects. This view draws support from the evidence provided by the track records of other ODSs that have shown lower cost-effectiveness values as experience has been gained in selecting and implementing alternatives.

Conversely, other types of projects, such as those that develop policies at domestic level, may be *more* cost-effective than assumed in the Base Case at a cost of US$ 12 per kg. However, the empirical studies that would be required to substantiate the relative cost-effectiveness of such domestic policies (i.e., awareness campaigns, regulatory controls, taxes, import bans, consumer policies and pricing policies) have yet to be produced.

The Task Force supports the requirement placed on many projects approved recently by the Executive Committee on MB elimination that require the funding recipient to report back to the Executive Committee on "…related costs…" experienced during project in order to better define incremental costs. The Task Force also recommends further work being undertaken to establish the cost-effectiveness value for eliminating MB as this work is beyond the scope of this report.

Annex to Section 1

Adjustments to the Methyl Bromide Chapter in the April 1999 TEAP Replenishment Task Force Report

A number of adjustments to the April 1999 TEAP Replenishment Task Force Report are reported in this Annex. Reference is made to the tables in Annex 6 of the TEAP Replenishment Task Force report. The adjustments are as follows:

1. There are *three* Article 5(1) Parties that produce MB and who reported data to the Ozone Secretariat (China, India and Romania), not just *one* (China) as stated in the original report.

   There are two plants currently producing MB in China: Lianyungang Seawater Chemical 1st Plant, with a projected annual capacity of 3,000 metric tonnes (1,800 ODP tonnes) and a maximum capacity of 4,000 metric tonnes (2400 ODP tonnes); and Changui Chemical Plant with a projected capacity of 300 metric tonnes (180 ODP tonnes). Other production facilities have been closed: Canyi Chemical Industry Plant closed in 1995 due to pollution problems; and Jianxin Chemical Industry and Guanxi Salt Works closed due to financial difficulties (UNEP-China Government Report on "Strategic Framework for Control of Methyl Bromide in China", July 1999).

   India reported a production of 74 ODP tonnes to the Ozone Secretariat in 1991. India has not reported data for 1994, 1995 and 1996 (Ozone Secretariat November 1998).

   The Romania country programme, approved at the 17th Executive Committee Meeting in July 1995, did not provide information on MB production probably because Romania understood that MB was not a controlled substance for Article 5(1) Parties and was not obliged to provide information.

   Based on the above, China's production of MB is the most significant of all the Article 5(1) Parties. In the absence of production data supplied by China for 1998 (as at 1 September 1999), a linear extrapolation provided an indicative use in 1998 of 1,627 ODP tonnes. This allowed calculation of an estimated baseline of 833 ODP tonnes.

   Given China's current high consumption of MB for agricultural crops and that China has yet to sign the Copenhagen Amendment, it is reasonable to assume that China's production base would increase to its maximum capacity of 2,580 ODP tonnes commencing in 1999. Under this scenario, the total

amount of MB that would need to be eliminated to meet the freeze on production in 2002 would be approximately 1,750 tonnes.

The costs of reducing production of MB by 1,750 ODP tonnes to meet the freeze would be US$ 7 million, based on US$ 4 per kg (US$ 2 per kg cost, and US$ 2 as per kg compensation for future sales) (TEAP 1999). These values were arbitrarily based on US$ 4 per kg, based on the current costs of MB. Further study would be required to determine more precise values as this was considered by the Task Force to be beyond the scope of this report.

2. The change in the control schedule for methyl bromide that was agreed at the 9th Meeting of the Parties (Montreal 1997) is an Adjustment, not an Amendment as stated in the April 1999 TEAP Report. The MLF funding required to eliminate the amount of MB to meet the 20% reduction step will be determined by those Parties that are signatories to the Copenhagen Amendment. This is discussed further in paragraph 3 below.

3. The revised Table A6.3 is based on the assumption that *all* Parties meet the freeze in 2002 and therefore *less* MB would need to be eliminated for the 20% reduction in 2005 than is reported in the April 1999 Report. In addition, a project in the tobacco sector in Brazil approved by the Executive Committee at its 28th Meeting (refer to section 1) is expected to eliminate 84 ODP tonnes in the triennium 2000-2002. This value has been subtracted from the cell in the revised Table A6.3 that contains five Parties. The amended version of Table A6.3 is presented below.

Table A6.3 (revised) *The volume of methyl bromide that would need to be eliminated to meet the 20% reduction in 2005. High-Consumers are those Parties that consume > 100 ODP tonnes and Low-Consumers are those that consume < 100 ODP tonnes.*

Ratification of Copenhagen Amendment	**High-Consumers** ODP tonnes (number of Parties)	**Low-Consumers** ODP tonnes (number of Parties)	**TOTAL** ODP tonnes (number of Parties)
Parties signatory to the Copenhagen Amendment	964 (5)	245 (10)	1,209 (15)
Parties not currently signatory to the Copenhagen Amendment	1,776 (2)	115 (7)	1,891 (9)
TOTAL	2,740 (7)	360 (17)	3,100 (24)

4. Table A6.5 contained errors in adding up the rows. However, as the text and the final estimate of the funding required were not derived from this table in the April 1999 Report, only Table A6.5 requires adjustments. The amended Table A6.5 is presented below.

Table A6.5 (revised) *Estimated cost of meeting the freeze in 2002, based on methyl bromide consumption data for Parties provided in Table A6.2. For the purpose of this estimate, the cost of eliminating methyl bromide was assumed to be US$12 per ODP kg.*

Ratification of Copenhagen Amendment	**High-Consumers** US$ (No. of Parties)	**Low-Consumers** US$ (No. of Parties)	**Estimated Total** US$ (No. of Parties)
Parties signatory to the Copenhagen Amendment	12.1 million (4)	2.2 million (8)	14.3 million (12)
Parties not currently signatory to the Copenhagen Amendment	31.7 million (1)	2.6 million (7)	34.3 million (8)
TOTAL	43.8 million (5)	4.8 million (15)	48.6 million (20)

5. A new Table A6.6 is required as a consequence of the revisions in Table A6.3 above (see below).

Table A6.6 (revised) *Based on methyl bromide consumption data provided in Table A6.3, the estimated cost of meeting the 20% reduction in 2005. For the purpose of this estimate, the cost of eliminating methyl bromide was assumed to be US$12 per ODP kg*

Ratification of Copenhagen Amendment	**High-Consumers** US$ (No. of Parties)	**Low-Consumers** US$ (No. of Parties)	**Estimated Total** US$ (No. of Parties)
Parties signatory to the Copenhagen Amendment	11.6 million (5)	2.9 million (10)	14.5 million (15)
Parties not currently signatory to the Copenhagen Amendment	21.3 million (2)	1.4 million (7)	22.7 million (9)
TOTAL	32.9 million (7)	4.3 million (17)	37.2 million (24)

6. The "Conclusions" as presented in the April 1999 Report require updating to reflect the change in Table A6.6 and a final cost estimate of US$ 64.3 million (instead of US$ 69.1 million). They are revised to read as follows:

"Based on the model and the previous discussions, the estimated costs to the MLF for elimination of MB can be determined by consideration of the *quantity* of MB that would need to be eliminated to meet the freeze on consumption and production in 2002, the 20% reduction step in consumption and production in 2005, and the *cost* per kg of eliminating these quantities of MB."

This country-by-country analysis of the MB consumption data reported to the Ozone Secretariat showed 36 out of the 56 Parties that were analysed in detail would be likely to meet the freeze on the basis of recent trends. The other 20 Parties were estimated to consume 4,054 ODP tonnes of the MB that would need to be eliminated to meet the freeze. There could be a case for excluding countries that are not signatories, but if the largest non-signatory were to ratify the Amendment before 2000, 92% of the estimated consumption from non-signatory Parties would be eligible for funding. A further 24 Parties, which have reported infrequently (and therefore were not able to be analysed statistically) were estimated to consume about 600 ODP tonnes. Therefore, the total amount of MB that would need to be eliminated to meet the freeze was estimated to be 4,654 ODP tonnes for consumption (excluding 1,750 ODP tonnes for production at this stage).

The figure of 4,654 ODP tonnes appears to be very large when intuitively it appears that 1,600 ODP tonnes (20% of 8,000 ODP tonnes) would need to be eliminated from the plateau expected in 2005 of 8,000 ODP tonnes for all Article 5(1) countries combined (April 1999 Report, page 81). However, such an analysis based on all countries combined would not be accurate as the calculation would be 'averaged' due to the majority of these countries meeting the freeze and 20% reduction or remaining relatively unchanged, while relatively few countries contribute to a significant increase in MB consumption. The tables in the text and the description in the April 1999 Report confirm that the analysis of MB consumption *at the individual country level* is the most appropriate and accurate methodology for estimating the amount of MB that would need to be eliminated to meet the control schedule.

The Task Force emphasises that all data for the April 1999 Report and the Supplementary Report were based on those submitted by Parties to the Ozone Secretariat. However, major discrepancies in consumption data reported to the Ozone Secretariat and data reported in project proposals were found for 26 countries (personal communications 25 August 1999). In addition to the sources of inaccurate reporting listed in the April 1999 Report (pages 80 and 84), some of these discrepancies could have been due to a misunderstanding of the term "consumption" when reporting MB use to the Ozone Secretariat.

If the effect of Demonstration, Investment and Non-Investment projects commissioned prior to 1999 is assumed to be a 10% *indirect* reduction in the amount of MB that would need to be eliminated, then this would leave *4,188 ODP tonnes* (4,654 less 10%) of MB to be eliminated to meet the freeze in 2002.

For Parties that are likely to ratify the Copenhagen Amendment, the total amount of MB that would need to be eliminated to meet the 20% reduction step in 2005 was estimated to be *1,125 ODP tonnes*.

Based on the cost-effectiveness figure of US$ 12 per kg, the costs of eliminating MB to meet the freeze for Article 5(1) Parties that have and have not signed the Copenhagen Amendment would be US$ 50.3 million for eliminating 4,188 ODP tonnes of MB. To this cost, the costs of reducing production to meet the freeze of US$ 7.0 million to eliminate 1,750 ODP tonnes could be added.

The costs of reducing MB consumption to meet the 20% reduction step in 2005 for those Article 5(1) Parties that are likely to have signed the Copenhagen Amendment would be US$ 13.5 million for eliminating 1,125 ODP tonnes of MB. The MLF funding required to meet this reduction step could be less than US$ 13.5 million - say about 50% or US$ 7 million - as some MB would have been eliminated prior to 2005 and some projects could be funded later than 2002.

The total amount of funding required:

- for the elimination of MB to meet the freeze in 2002 for all Parties having significant consumption and production at that time; and
- to meet the 20% reduction in consumption of MB in 2005

would be US$ 57.3 million (for signatories and non-signatories to the Copenhagen Amendment) and US$ 7 million for the reduction in production to meet the 2005 freeze (signatories to the Copenhagen Amendment only). This yields a total for MB of *US$ 64.3 million.*

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2. Sensitivity Analysis on Growth Rates for Consumption of ODS, for example Using an Assumption of 0-2 per cent Growth instead of 8-10 per cent

2.1 Introduction

The April 1999 TEAP Report reported that ODS consumption growth over the period 1995/96-1999 will be reduced and could be negative in many Article 5(1) countries. However, this applies to the consumption pattern as a whole. Many Article 5(1) countries show growth in consumption in uses that have not yet been addressed by investment projects under the Multilateral Fund.

It was also reported that in several cases negative growth rates could be used, whereas in other cases large positive "net growth percentages" produced a best fit. In some cases "net growth percentages" in the order of 15-30% had to be applied to simulate sudden consumption increases. Since this cannot be realistic for the period after 1995, the Task Force has limited the "net growth percentage" to 8-10% and applied a best ('smooth') fit to the 1995-1997 period.

The April 1999 Replenishment Report presented the following table (Table A5.2, page 46 of this report):

Relative consumption trends (periods 1995-99 and 1999-future years) for the different categories of countries as used in the model for the Base Case for the 2000-2002 Replenishment (Table A5.2, Replenishment Report, April 1999)

Country Category/Country type (ODP tonnes consumption)	**Relative consumption trend (% net growth) 1995-1999**	**Relative consumption trend (% net growth) 1999 – future years**
Category 1 (>5,200)	-10% to +8%	0%
Category 2 (1,000 - 5,200)	-8% to +10%	0%
Category 3 (360 – 1,000)	+6%	0%
Category 4 (100 – 360)	-5%	0%
Category 5 (< 100)	+5%	0%

The above table shows that some countries had large negative and others had large positive "net growth percentages" over the period 1995-1999. The Ad Hoc Group considered growth percentages up to plus 10% as extremely large in this phase of the Montreal Protocol process. The Ad Hoc Group asked the Task Force to calculate the resulting difference in funding if these high positive growth percentages were restricted to 0 to 2% over the period for which data had not yet been submitted.

It is not possible to simulate growth percentages of 2% or 0% for those years for which data have already been submitted. Therefore, the "net growth percentages" had to be used on the basis of " best-fit" extrapolations applied to the reported data. Since virtually all countries have submitted 1997 data, the 0% and 2% growth percentages were only applied to trends after 1997 through 1999, the freeze year.

Therefore the TEAP Replenishment Task Force made two sets of calculations:
1. One set of calculations in which all "net growth percentages" larger than 2% were fixed at 2%; and
2. One set of calculations in which all "net growth percentages" larger than 0% were fixed at 0%.

2.2 Results of Calculations

The results of the calculations are given in the following table.

Table 2.1 *Investments (US$ million) calculated by country category for cases where the "net growth percentage" is fixed at maximum 2% or 0% (cost-effectiveness values are given in Table A5.3 of the April 1999 Replenishment Report and in Table 5.1 of this Supplement).*

Countries	Cat. 1	Cat. 2	Cat. 3	Cat. 4	Cat. 5	Total
("Base Case", cost-effectiveness, Table A5.3 Replenishment Report)						
2000-2002	0	35.1	0	0	4.4	39.5
2003-2005	316.0	178.4	62.5	21.8	13.1	591.8
(all "net growth percentages" larger than 2% fixed at 2%)						
2000-2002	0	31.8	0	0	0.9	32.7
2003-2005	281.2	166.2	51.6	21.8	14.2	535.0
(all "net growth percentages" larger than 0% fixed at 0%)						
2000-2002	0	29.5	0	0	0	29.5
2003-2005	259.5	162.0	46.3	21.8	13.9	503.5

If the growth is limited to 2%, the funding requirement for the period 2000-2002 will be reduced by about US$ 7 million, due to savings in the category 2 countries and in the small LVCs category (less than 100 ODP tonnes annual consumption). The latter countries are characterised by a 5% "net growth" in the "Base Case". For those countries for which "zero" funding is calculated (country categories 1, 3 and 4) the figure does not change. If the growth is limited to 0% this implies a reduction in the funding requirement for the period 2000-2002 of US$ 10 million.

Larger differences in the funding requirement are calculated for the period 2003-2005. If growth is limited to 2%, the funding requirement is reduced by about US$ 57 million. The saving increases to approximately US$ 88 million if growth is restricted to 0%. The largest saving in funding comes from the category 1 countries (US$ 56 million, i.e., about 64% of total savings) and from countries in categories 2 and 3 (US$ 16 million, i.e., about 18% of total savings).

The reduction in funding required for the consumption sector when applying low or zero "net growth percentages" is quite moderate for the 2000-2002 replenishment period in absolute terms. This particularly holds true when considered against the total funding requirement for this period. However, in percentage terms there is a reduction of 25% in the total funding required compared to the Base Case if growth would be restricted to 0%; this is quite substantial.

The figures given above for the replenishment period 2003-2005 show that a zero to 2% "net growth percentage" in all country categories during 1997-1999 contributes to a significant reduction in the funding requirement during the period 2003-2005 (10 to 15% for 2 and 0 per cent "net growth percentages", respectively). This is due to the fact that the freeze consumption and the 50% reduction are determined using the average 1995-1997 consumption. A lower growth during the years after 1997 implies less efforts to phase out this growth in consumption again, in a later phase.

3. Better Justification for the Benefits of Non-Investment Activities

3.1 Introduction

The primary objective of non-investment projects is to facilitate the implementation of policy frameworks that are designed to enable the implementation of the Montreal Protocol in the Article 5(1) countries. In this document, the following categories of non-investment projects have been used: (1) clearing-house and information-exchange activities (2) preparation work on country programmes and institutional strengthening projects; (3) demonstration projects; and (4) training projects; refrigerant management plans (RMPs) and halon management plans (HMPs). Experience has shown that it is not generally possible to estimate the cost-effectiveness of non-investment projects in the same way as for investment projects, i.e., cost per ODP tonne phased out. However, efforts have been made to estimate the proportion of global ODP tonnes phased out that can be attributed to non-investment projects. These estimates, and other less formal evidence of the cost-effectiveness of non-investment projects, provide support for their substantial contribution to ODS phaseouts in Article 5(1) countries.

3.2 Strengthening Institutional Capacities for ODS Phaseouts in Article 5(1) Countries

The evidence indicates that cost-effective ODS phaseouts in Article 5(1) countries require the assistance of the Multilateral Fund to complement domestic resources in the design and implementation of national policies and programmes. Investment projects that phase out specified quantities of ODS, in conformity with the Multilateral Fund cost-effectiveness guidelines, are not sufficient on their own. Indeed, the cost-effective implementation of investment projects is greatly facilitated by the application of integrated policy frameworks that embrace both investment and non-investment projects. Such a framework should include initiatives funded by domestic resources. For example, the implementation of public awareness and information campaigns have helped to motivate individuals and organisations to exert political and economic pressure for early implementation of investment projects designed to phase out ODS.

Success in securing consumer acceptance of non-ODS products can have important effects on ODS consumption and thereby on ODS production and/or imports. Moreover, non-investment projects disseminate information that is needed by the public, business, enterprises, and governments to respond constructively to local concerns and responsibilities with respect to stratospheric ozone protection. The funding estimates for non-investment

projects, as set out in the TEAP Report, are needed to establish domestic policy frameworks and to provide guidance for Article 5(1) countries so as to enable them to co-ordinate their respective ODS phaseout policies and programmes. In particular, the Parties have recognised that the successful completion of investment projects and their subsequent operation requires not only technology, equipment and funding, but also effective domestic policy frameworks, including management and monitoring systems.

3.3 Achieving Actual Reductions of ODS

The Replenishment Task Force has reviewed the evidence for actual ODP reductions being achieved through the implementation of non-investment projects. Discussions with the Multilateral Fund Secretariat and other experts, with experience in non-investment projects, have led the Task Force to conclude that, while there is informal evidence of ODP reductions associated with non-investment projects, it has not been possible to quantify these reductions. The only known exception relates to the technical assistance activities in the context of recovery and recycling programmes for refrigerants. The Multilateral Fund Secretariat has estimated that 1,852 ODP tonnes have been phased out in this way.

Various assertions have been made to the effect that the implementation of domestic policies can be highly cost-effective in achieving ODP reductions. While there is substantial support for this proposition, both in general and in relation to specific Article 5(1) countries, the documentation of these achievements is rather limited. For example, regarding the methyl bromide sector, it has been argued that domestic policies could be more cost-effective than investment projects in achieving ODP reductions. However, the quantification of these arguments has yet to be achieved.

3.4 Improving the Cost-Effectiveness of ODS Phaseouts

Experience suggests that ODS reductions on a country basis are more cost-effective if the investment and non-investment projects are designed and implemented as mutually reinforcing elements of a comprehensive country programme. Furthermore, it is likely to be the case that non-investment projects, in their current applications, are more cost-effective than investment projects. At least to this extent, non-investment projects make a direct contribution to the overall cost-effectiveness of ODS phaseouts on a country basis. Yet it is clear that this advantage is bounded in the sense that an increasing dependence on non-investment projects would eventually lead to declining cost-effectiveness. In the April 1999 Report, the TEAP made reference to the results of some illustrative quantitative exercises that were reported in its June 1996 Replenishment Report. Those results suggested that

domestic policies could be 4 to 7 times less costly than the implementation of investment projects to reduce ODS consumption. However, it remains the case that the TEAP does not yet have the data to verify those stylised estimates. Nevertheless, the TEAP remains of the view that, overall, non-investment projects are still likely to be more cost-effective than investment projects. Projects that have already been implemented might not remain viable if these policies do not support ODS phaseouts. Furthermore, non-investment projects, such as RMPs and HMPs, are necessary to address sectors such as refrigerant servicing and fire control, whereas training is essential in all areas where flammability risks or complex processes result from ODS substitution.

Annex to Section 3

Adjustments to the Non-Investment Chapter in the April 1999 TEAP Replenishment Task Force Report

New data makes it necessary to revise some of the estimates for investment projects. These are reported below.

Regarding section 4.6.5 of the April 1999 report, National Training Projects, RMPs and HMPs, there are another 13 countries which will require RMP preparation at an average cost of US$ 30,000. Therefore, an additional US$ 390,000 will be required for this purpose during the 2000-2002 replenishment period.

On making these adjustments, the total funding required for non-investment projects is estimated to be **US$ 41.49 million**. The revised estimates for the Implementing Agencies that are presented in the table below, include the estimate for RMP preparation.

Implementing Agencies	US$ (million)
UNEP	**29.45**
Clearing-house and Information Exchange Activities	12.5
Country Programmes	1.26
Institutional Strengthening	7.0
National Training Projects	1.5
RMP preparation	0.39
HMP	1.8
Methyl Bromide	5
UNIDO	**6.04**
UNDP	**5.0**
World Bank	**1**
Total	**41.49**

Note: The amount determined for supporting activities for the Base Case in the April 1999 report was US$ 41.1 million.

4. Elaboration on the Benefits of Advanced Funding

4.1 Introduction

In the April 1999 Replenishment Report, the TEAP determined that US$ 306 million is the minimum funding requirement for compliance with the control schedules of the Montreal Protocol. To ensure that the full amount of US$ 306 million would be available for disbursement to the Article 5(1) Parties, the TEAP pointed out that all assessed contributions to the Multilateral Fund would have to be paid in full and on time.

The TEAP noted that the minimum funding requirement for the 2000-2002 replenishment period is substantially lower than the replenishments that were agreed for 1994-1996 and 1997-1999, respectively, as well as for the estimated replenishment for the period 2003-2005.

The funding profile over the five replenishment periods, including the estimate for the period 2006-2008 is as follows (in rounded figures):

Period	Funding Requirement
1994-1996	US$ 510 million
1997-1999	US$ 540 million
2000-2002	US$ 300 million
2003-2005	US$ 850 million
2006-2008	US$ 350 million

Having regard to this funding profile, the TEAP proposed that an additional US$ 200 million be “advanced” to the 2000-2002 replenishment period from the 2003-2005 replenishment period. This level of Advanced Funding is proposed to ensure that the 2000-2002 replenishment “maintains the momentum” of the phaseout effort in the Article 5(1) countries.

If the Advanced Funding proposal were to be adopted by the Eleventh Meeting of the Parties, then the revised funding profile would be as follows:

Period	Funding Requirement
1994-1996	US$ 510 million
1997-1999	US$ 540 million
2000-2002	US$ 500 million
2003-2005	US$ 650 million
2006-2008	US$ 350 million

The detailed rationale for TEAP's Advanced Funding proposal is presented below.

4.2 Environmental Rationale for "Advanced Funding"

The TEAP assumed that the proposed advanced funding of US$ 200 million would be allocated to projects in the CFC consumption sector. Under the assumption of 0% net growth following the 1999 freeze, CFC consumption would be reduced by approximately 75% of the 1999 base level in 2005 for all Article 5(1) countries. This reduction could be achieved without taking the effects of projects funded after 2002 into account. The US$ 200 million Advanced Funding proposal would phase out approximately 16,500 ODP tonnes, on the basis of the average cost-effectiveness of US$ 11 per ODP kg determined in the April 1999 report (this excludes administrative costs; this cost-effectiveness is different from the average cost-effectiveness of about US$ 8.3 per ODP kg in projects approved so far). In this way, on a cumulative basis consumption of 52,000 ODP tonnes would be eliminated over the period 2002 – 2006.

The US$ 200 million advanced funding for projects in the CFC consumption sector would prevent a future cumulative ozone loss of 1.3%. To put this into perspective, if Parties decided to reduce the HCFC "cap" from the existing 2.8% to 2.0% in the year 2000, in combination with advancing the HCFC phaseout from 2030 to 2015 for the developed countries, a future cumulative ozone loss of 1.6% could be avoided. However, such an adjustment in the HCFC control schedule is estimated to cost many US$ billions that would be incurred largely for early replacement of HCFC equipment. This figure is based on the total number of HCFC equipment of more than 300 million that is currently in use in the developed countries only. From an environmental perspective, the TEAP proposal for "advanced funding" of US$ 200 million as part of the 2000-2002 replenishment would be a far more cost-effective option.

The TEAP and recognises that the coming decades will be the most vulnerable period for the stratospheric ozone layer. This is due to the conjuncture of peak levels of chlorine and bromine loading with rising atmospheric concentrations of greenhouse gases. In these circumstances, the risks to the ozone layer could be exacerbated by unusually low Arctic and/or Antarctic temperatures, and/or large volcanic eruptions, which could delay the recovery of the ozone layer. Having regard to this threat to the recovery of the ozone layer, the Parties might wish to consider the "precautionary principle" that supports TEAP's Advanced Funding proposal for the 2000-2002 replenishment.

4.3 Business Rationale for "Advanced Funding"

A 2000-2002 replenishment of about US$ 300 million would slow the pace of investment in ODS alternatives, non-ODS substitutes and in the supply of

non-ODS-based equipment. Such an unexpected deterioration in business conditions would impact adversely on business plans. The business response would be that the suppliers of ODS alternatives, ODS substitutes and ODS-free equipment could encounter commercial difficulties that would lead to staff lay-offs and the reassignment of critical management, technical and sales personnel. Similarly, a subsequent rapid acceleration in the pace of investment in ODS alternatives, ODS substitutes and ODS-free equipment would generate inefficiencies in the implementation process as businesses sought to re-build their respective supply capacities. Faced with these challenges, it would take time for businesses to adjust to the new market conditions.

Advanced Funding would accelerate the conversion of enterprises to non-ODS equipment. The result would be larger than expected reductions in ODS consumption in Article 5(1) countries. As ODS market prices fall relative to supply costs, profitability and supply would also decline. However, some producers might continue to supply the ODS as long as market prices cover current supply costs. In such cases, domestic policies could be used to ensure that supply costs are raised sufficiently to limit demand in conformity with national ODS phaseout strategies. In managing this intervention process, ODS production and consumption would have to be monitored closely in relation to national ODS phaseout schedules.

Some of the advanced funding proposed by the TEAP could be used to reduce ODS production, thereby reducing the risk of "dumping" low-cost ODSs. To the extent that ODS prices would rise in the Article 5(1) countries, conversions to non-ODS technologies would be accelerated and the incremental operational costs of conversions would be reduced.

4.4 Administrative Rationale for “Advanced Funding”

If the 2000-2002 replenishment were to be limited to strict compliance with the July 1999 freeze and the first reduction steps of all controlled substances, then the funding requirement for the 2000-2002 replenishment would be low relative to recent and projected replenishments of the Multilateral Fund. Therefore, a funding carry-over to the 2003-2005 replenishment period would be unlikely. In this case, the TEAP concluded that compliance with the future reduction steps for CFCs, assuming current cost-effectiveness values, will lead to a very sharp rise in the funding requirement for the 2003-2005 replenishment.

These circumstances would challenge the capacities of the Article 5(1) countries, the Multilateral Fund and its Implementing Agencies, respectively, to generate sufficient project approvals to meet the next reduction steps of the Montreal Protocol. Furthermore, if project implementation lags lengthen with

increased efforts to generate sufficient project approvals, the challenge to the Fund and its Implementing Agencies would be even greater. In responding to this challenge, the Parties would face the growing risks that either cost-effectiveness would deteriorate or that non-compliance will increase.

The operational efficiency of the Multilateral Fund and its Implementing Agencies depends on the pace of investment activity being consistent with their respective institutional and financial capacities. Reductions in funding would require temporary down-sizing which would make subsequent staff recruitment even more difficult in future. National Ozone Units could lose public support and their effectiveness if they were required to discourage new investment projects and to defend what might be regarded as a diminished environmental and political priority for ozone layer protection.

In most countries, environmental regulatory processes require elaborate procedures and widespread public and governmental consultations. Reduced financial support for Article 5(1) efforts to comply with the Montreal Protocol would slow the enactment and enforcement of new laws designed to facilitate ODS phaseouts. The consequent loss in regulatory momentum would be difficult to retrieve.

Furthermore, given the implementation of appropriate domestic policies, Advanced Funding would generate further benefits beyond 2002 in that the funding requirement for the 2003-2005 replenishment would be reduced.

4.5 Low Volume Consuming Countries Rationale for "Advanced Funding"

In the April 1999 TEAP Replenishment Report, Article 5(1) countries with ODS consumption levels lower than 1,000 ODP tonnes were grouped into three categories. This approach differs from the approach used for countries in categories 1 and 2, i.e., only the total consumption of the countries in categories 3, 4 and 5 is considered. It implies that only the funding required for each category (i.e., 3, 4 and 5) to meet the Montreal Protocol control schedules is determined as a whole, i.e., the individual countries are not addressed separately. This approach may have the consequence – dependent on the type and size of projects to be implemented – that certain countries might be able to do more than would be strictly required while others might not be able to achieve compliance. For this reason, an additional US$ 10-20 million might be required to enable each country within these categories to achieve compliance with the control schedules.

4.6 Domestic Policies Rationale for "Advanced Funding"

The business and administrative perspectives indicate that the Advanced Funding proposal of US$ 200 million for the 2000-2002 replenishment would make it possible to lower the funding required for the 2003-2005 replenishment from US$ 850 million to US$ 650 million. In the April 1999 report, the funding requirement for the period 2002-2003 was based upon 0% net growth in the years after the freeze. Assumptions of 1-2% reduction in annual growth due to the implementation of effective domestic policies would reduce the total funding requirement by US$ 50-100 million. Given the difficulty of estimating the cost-effectiveness of domestic policies, the following ranges for the funding requirements for the replenishment periods 2003-2005 and 2006-2008 are provided to reflect specific assumptions about the effectiveness of domestic policies:

Period	Funding Requirement
2000-2002	US$ 500 million
2003-2005	US$ 600-650 million
2006-2008	US$ 280-350 million

4.7 Conclusions

The TEAP submits that its Advanced Funding proposal is amply justified by the perspectives elaborated above. In particular, the environment perspective is for a clear "win-win" outcome by advancing the recovery of the ozone layer and increasing the efficiency of the implementation process.

Secondly, the TEAP draws the attention of the Parties to a possible extension of the Advanced Funding proposal. Such an extension could be the basis for implementing a shorter phaseout period for the Article 5(1) Parties, at least with respect to Annex I, Group 1 controlled substances. If the Parties so decided, the recovery of the ozone layer would be advanced and substantial financial and human resources could be released for allocation to other high priority environmental issues. The TEAP Task Force estimates that for each year of reduction in the CFC phaseout, these cost savings would be likely to exceed US$ 10-15 million per year. The Parties may wish to give further consideration to the development of this extended application of the concept of Advanced Funding.

5. Sensitivity Analysis for Cost-Effectiveness Thresholds, Particularly for LVCs and SMEs

5.1 Analysis for SMEs

The April 1999 Replenishment Report calculations were based upon a 15% SME share in the total baseline consumption; and upon a 80% increase in equivalent cost-effectiveness thresholds (i.e., investments in equivalent ODP tonne reductions would cost 1.8 times the investments in larger companies). This implies an overall increase of 24% in the funding requirement calculated for the countries in categories 1, 2 and 3.

Table 5.1 below lists, in the second column, the cost-effectiveness thresholds agreed by the Executive Committee for the approval of projects (in certain cases averaged over sub-sectors). The third column presents the cost-effectiveness values used for countries in categories 1, 2 and 3. These values were based on projects approved to date to which an additional influence of SMEs (with higher investments per ODP tonne) was added.

Table 5.1 *Cost-effectiveness threshold values and cost-effectiveness values applied in the April 1999 study (US$/kg ODP) (including the influence of SMEs); percentages given denote the percentage of the threshold applied*

Country	**CE** Threshold	**Large/Medium Scale (ODP 360 – 5,200)** Category 1/2/3	**LVC (ODP 100 – 360)** Category 4	**LVC (ODP < 100)** Category 5
Sector				
Aerosols	4.40	3.52 (80%)	6.16 (140%)	6.16 (140%)
Foams	9.53	6.39 (67%)	9.53 (100%)	9.53 (100%)
Halons	1.48	0.53 (36%)	1.12 (76%)	1.12 (76%)
Refrigeration	15.69	15.69 (100%)	25.10 (160%)	25.10 (160%)
Solvent 113	19.73	16.77 (85%)	33.54 (170%)	33.54 (170%)
Solvent TCA	38.50	38.50 (100%)	65.45 (170%)	65.45 (170%)

In the calculations, this implied an increase of cost-effectiveness values by 24% (1.24 times the value without SME influence). Finally, the last two columns provide the cost-effectiveness values for countries with consumption levels (a) between 360 and 100 ODP tonnes and (b) lower than 100 ODP tonnes. These cost-effectiveness values were also estimated from approved projects.

Calculations were performed for different SME percentages and different cost-effectiveness values. Table 5.2 presents a number of cases. Although the differences calculated for the replenishment period 2000-2002 are not very

large, the changes are substantial in percentage terms. Compared to a calculation that assumes no projects for SMEs – therefore no difference in cost-effectiveness– the funding requirement is decreased by approximately US$ 7 million compared to the Base Case calculation (15% SMEs, 1.8 times costs).

Table 5.2 *Sensitivity of funding requirements (in US$ million) to differences in the percentage SME activity assumed as well as the sensitivity due to differences in cost-effectiveness*

Countries	**Cat. 1**	**Cat. 2**	**Cat. 3**	**Cat. 4**	**Cat. 5**	**Total**
"Base Case", cost-effectiveness values given in Table 5.1 (15% SME; 80% higher costs)						
2000-2002	0	35.1	0	0	4.4	39.5
2003-2005	316.0	178.4	62.5	21.8	13.1	591.8
No SME%; no decrease/ increase in cost-effectiveness						
2000-2002	0	28.3	0	0	4.4	32.7
2003-2005	254.7	143.8	50.4	21.8	13.1	483.8
(30% SME; 150% higher costs)						
2000-2002	0	53.8	0	0	4.4	58.2
2003-2005	484.0	273.1	95.8	21.8	13.1	887.8

In the case of the 2003 – 2005 replenishment period, the Base Case calculation yields US$ 108 million higher costs (i.e., US$ 591.8 – US$ 483.8 million) compared to the calculation in which no SMEs are assumed.

Increasing the SME percentage to 30% and costs at 2.5 times the cost if no SMEs were involved, produced the following results. Compared to the Base Case, the increases in the funding requirement are approximately US$ 19 million and US$ 296 million for the replenishment periods 2000-2002 and 2003 -2005, respectively.

Table 5.3 *Sensitivity of funding requirements (in US$ million) for the two replenishment periods 2000-2002 and 2003-2005 for different SME percentages in the base level consumption and different cost-effectiveness value increases (the Base Case is shown as number 3 in this table)*

Number	**1**	**2**	**3**	**4**	**5**	**6**
	SME 0% CE +0%	**SME 15% CE +40%**	**SME 15% CE +80%**	**SME 15% CE +150%**	**SME 30% CE +40%**	**SME 30% CE +80%**
Total funding requirement levels for the two replenishment periods considered						
2000-2002	32.7	36.1	39.5	45.4	39.5	46.3
2003-2005	483.8	537.7	591.8	686.0	591.8	699.3

The latter value implies that the total funding requirement for the period 2003-2005 would increase to US$ 1,150 million for the Base Case (compare section 4.1, US$ 850 plus US$ 296 million).

Since LVC cost-effectiveness has not been varied and the majority of the changes take place in the category 1, 2 and 3 countries, one could derive an approximate linear formula for the investment for CFC projects:

*Investment = BI (1 + 0.002 (SME (%) * CE increase (%) / 10)) + RI*

BI = US$ 28.3 million, RI = US$ 4.4 million for the period (2000-2002)

BI = US$ 448.9 million, RI = US$ 34.9 million for the period (2003-2005)

Investment values for different combinations of the percentage SMEs and the percentage cost increase are depicted in Table 5.3.

As mentioned above, these costs will increase substantially relative to the Base Case if the SME and investment percentages are further increased. This emphasises the need to reduce SME costs by umbrella projects, innovative approaches etc., if the total costs are to be brought down substantially.

5.2 Analysis for LVCs

In the case of LVCs (countries with ODP consumption lower than 360 ODP tonnes, i.e., categories 4 and 5) the cost-effectiveness values can be modified to demonstrate their influence on total costs. Results are given in Table 5.4.

If the LVC cost increase is 200% of the Base Case increase for country categories 4 and 5 relative to categories 2 and 3, then the funding requirement is increased by US$ 1.7 million and US$ 13.6 million, respectively, for the replenishment periods 2000-2002 and 2003-2005 (see Table 5.4, last case). In both cases, the effect on the total funding requirement is relatively modest.

However, it should be noted that the increase in investment calculated applies to the sum of all countries lumped together.

Funding requirements may be higher if LVC countries, project sizes and compliance schedules are considered separately.

Table 5.4 *Sensitivity of funding requirements (in US$ million) to differences in cost-effectiveness for countries in categories 4 and 5; cost-effectiveness was varied between 0.5 and 2.0 times the difference between larger countries and LVCs/VLVCs as used in the Base Case (see Table 5.1). In categories 1,2 and 3, the SMEs cost-effectiveness values are assumed to be the same as in the Base Case calculations.*

Countries	**Cat. 1**	**Cat. 2**	**Cat. 3**	**Cat. 4**	**Cat. 5**	**Total**
"Base Case", cost-effectiveness values given in Table 5.2						
2000-2002	0	35.1	0	0	4.4	39.5
2003-2005	316.0	178.4	62.5	21.8	13.1	591.8
LVC cost increase 50% of Base Case increase						
2000-2002	0	35.1	0	0	3.6	38.7
2003-2005	316.0	178.4	62.5	17.5	10.5	584.9
LVC cost increase 150% of Base Case increase						
2000-2002	0	35.1	0	0	5.2	40.4
2003-2005	316.0	178.4	62.5	26.1	15.5	598.6
LVC cost increase 200% of Base Case increase						
2000-2002	0	35.1	0	0	6.1	41.2
2003-2005	316.0	178.4	62.5	30.4	18.1	605.4

Disclaimer

The sensitivity analysis described in this section investigates the influence of different SME percentages and different cost-effectiveness threshold values and presents the results of a number of calculations. These calculations are a variation to the calculations performed for the April 1999 report. Assumptions for these calculations are purely hypothetical and are not the result of an in-depth practical analysis. They should therefore be considered as supporting material for the Base Case calculation and could be used as material in a future analysis when more data on SME percentages and the applicable cost-effectiveness threshold values will be available.

6. More Detailed Analysis of the Cost of Refrigerant Management Plans

The Executive Committee has approved Refrigerant Management Plans (RMPs) for a number of countries in categories 3, 4 and 5; many training projects and technical assistance programmes (including recovery and recycle components) were approved for category 1 and 2 countries.

The RMPs for the categories 3, 4 and 5 countries consist of a preparation component (sometimes considered separately), monitoring and training components, and an investment component (recovery and recycling equipment etc.). Training can be provided by all the implementing agencies or via bilaterals. Where it concerns LVCs and VLVCs, UNEP TIE has a specific task in relation to the preparation component of refrigerant management plans.

Some projects have been approved that only contain supporting activities (training of trainers, certification, customs officers training etc.). However, most of the projects that have been approved contain both the supporting activities and the investment component.

The cost of the supporting activities component (this does not apply to either the preparation component of the plan or the agencies' administrative costs) of the RMPs is largely independent of the country category in the case of category 3 and 4. This supporting activities component is smaller for the average category 5 country. The reports of the Executive Committee Meetings indicate that this cost is of the order of US$ 80,000 to 140,000 for most countries in categories 3 and 4, of the order of US$ 25,000 to US$ 45,000 for most countries in category 5.

From projects approved to date, it can be shown that the investment component (for recycle and recovery) varies from an approximate average of US$ 130,000 for country category 5, to US$ 220,000 for country category 4, and to US$ 250,000 for country category 3. Exceptions are noted, for countries in all categories; this applies both to the total investment and to the ODP tonnes addressed.

The following examples can be given: a project for Tunisia (category 3) has been approved to phase out 72 ODP tonnes at a cost of US$ 760,000; a project for Peru (category 4) 60 ODP tonnes at a cost of US$ 619,000; several countries in category 5 have investment components in excess of US$ 200,000 (e.g. Gabon total cost US$ 320,500 -investment at a value of US$ 262,691-, Moldova total cost US$ 386,500). These costs are only weakly correlated with a country's ODS consumption in refrigeration or to the ODP tonnes phased out by the implementation of the project.

The cost-effectiveness of the investment component is on average US$ 8 per ODP kg for countries in categories 3 and 4; and US$ 12 per ODP kg for the countries in category 5. These figures are comparable to the project costs for the CFC phaseout for refrigeration as presented in the April 1999 Replenishment Report. Some exceptions can be observed for projects for countries in categories 3 and 4. Several exceptions exist for the cost-effectiveness of the investment components for category 5 countries where costs are approximately US$ 25/ ODP kg, but still within the range of cost-effectiveness values considered for LVCs. It should be noted that cost-effectiveness values that exclude the supporting activities, have not yet been considered in Multilateral Fund operations.

If non-investment activities were to be included, particularly the training and monitoring components, the average cost-effectiveness values would be about US$ 10, US$ 8.5 and US$ 18 per ODP kg for RMPs in the countries in categories 3, 4 and 5, respectively.

Evidence from the consumption of refrigerants that is addressed through RMPs suggests that, on average, approximately 6%, 10% and 30% of a country's total 1997 consumption is being addressed by the RMPs approved for the countries in categories 3, 4 and 5, respectively.

For many of the approved projects, the Executive Committee mentioned to "not proceed with the disbursement of funds approved until regulatory and legislative requirements to control imports and certain fiscal steps are put into place".

The absence of data on the implementation costs for most of these policies prevents a more detailed analysis of the total cost of RMPs. Therefore, the TEAP was unable to draw firm conclusions on these aspects of RMPs.

The TEAP calculations for country category 3 were based on 19 countries (e.g., Jordan, Romania and Sudan for which RMPs were approved in the 28th Executive Committee Meeting). There are also 19 countries in country category 4; and 57 countries in the country category 5. The total consumption in the year 1997 was 10,240, 3,370 and 1,205 ODP tonnes for the countries in categories 3, 4 and 5, respectively.

According to the reports of the Executive Committee, 13 RMPs have been approved for countries in category 3; 11 for countries in category 4; and 28 for countries in category 5. These RMPs include the investment component. For a small number of countries only the supporting activities component has been approved so far.

On the basis of the above analysis, the following assessment can be made:

1. on the basis of the cost-effectiveness values for the investment component as mentioned above, an additional US$ 7.0 million for investment projects in country categories 3, 4 and 5, for those countries that have so far not been addressed (6 countries in category 3, 8 countries in category 4 and 29 countries in category 5, which represent funding for RMPs of approximately US$ 1.5 million, US$ 1.7 million, and US$ 3.8 million, respectively); and

2. regarding the funding required for the supporting activities component as given above, an additional amount of US$ 2.5 to 3 million would be required to address all the countries in categories 3, 4 and 5.

Overall, total funding of approximately US$ 10 million is required for all remaining RMP activities in country categories 3, 4 and 5.

The US$ 2.5 to 3 million required for the supporting activities component of the RMPs will not phase out ODS directly; it is assumed that only the investment projects of US$ 7 million can phase out can phase out ODS directly. This is the underlying assumption for the data presented in the project proposals.

These estimates are consistent with the Advanced Funding proposal, which makes provision for a further US$ 10 to 20 million for RMPs approvals for all countries in categories 3, 4 and 5 during the period 2000-2002.

Addendum

Many training projects and technical assistance programmes, including the recovery and recycle component, have been considered for countries that have a consumption higher than 1,000 ODP tonnes (i.e., the category 1 and 2 countries). Four countries in category 1 have been addressed in projects that have been approved to phase out between 4 and 8% of the consumption in the refrigeration sector; the average cost is in the order of US$ 1.5 million. Seven countries in category 2 have been addressed in projects that have been approved to phase out between 1 and 10% of a country's consumption in refrigeration. An exception is Malaysia where 25% of the consumption in the refrigeration sector is being phased out via a project in the servicing sector. The average cost of a project in the servicing sector for countries in category 2 amounts to US$ 900,000; and the average cost-effectiveness is US$ 6.5 per ODP kg.

In the case of RMPs for the category 1 and 2 countries, it would be possible to calculate, on the basis of historic experience, any further requirements. For

some countries in category 2, the supporting activities component might have already been carried out. These calculations would yield funding requirements for RMPs in category 1 and 2 countries of approximately US$ 9 million.

On the basis of the information available from RMP projects for countries in categories 1 and 2, one could raise the question of whether the amounts of refrigerant addressed are adequate; in some cases 1% or less of a country's consumption in the servicing sector. If they are not adequate, extra technical assistance projects would be required which would raise the funding required substantially.

In summary, the TEAP cannot, at present, give an accurate description of a Refrigerant Management Plan for a country that consumes more than 1000 ODP tonnes. Furthermore, it is not possible to make a reliable estimate of the costs for RMPs in these countries.

Please note that the guidelines for RMPs in country categories 1 and 2 have yet to be addressed by the Executive Committee; and it is uncertain whether such guidelines will be considered within the 2000-2002 replenishment period.

7. Outcome of the Discussions of the Executive Committee at its July 1999 Meeting on Innovative Financing, including Concessional Loans, and on Other Issues

The TEAP Replenishment Task Force has noted the approvals of two projects for chiller substitutions in Thailand and Mexico at the 26th and 28th (July 1999) Executive Committee meeting. The first project is a concessional lending project with a revolving fund to finance new replacements and, subsequently, to pay the money back into the Multilateral Fund. The second concessional lending project also introduces a revolving fund, but the first phase of the project is based on a bilateral grant.

The TEAP has noted the principles put forward in the 28th Executive Committee meeting on concessional lending projects (Decision 28/48). The TEAP has also noted that the Executive Committee members were invited to submit comments on these principles to the Multilateral Fund Secretariat. These comments will be incorporated in a broad framework document that is to be discussed at the 29th meeting of the Executive Committee.

Having regard to the progress made to date, the TEAP has taken the view that it would not be useful at this stage, in the absence of agreed Executive Committee guidelines, to take into account the possibility of concessional lending. The results of forthcoming demonstration projects can be expected to shed more light on the feasibility of concessional lending projects. The TEAP will monitor developments with a view to re-visiting the issue of concessional lending at the appropriate time.

The TEAP has noted that the funding requirement for the 2003-2005 replenishment period presented in its April 1999 report might have to be revised to take into account any future developments in concessional lending.

8. New Sub-Sectors such as Transport Approved by the Executive Committee

8.1 New Sub-Sectors

There are several new sub-sectors that are being considered by the Executive Committee where, however, firm guidelines are still lacking. This applies to e.g. sterilants and process agents. The Replenishment Task Force has considered CTC (process agent) projects in its April 1999 report and used a cost-effectiveness of US$ 3.5 per ODP kg, lacking further supporting information. The final value to be decided for this sub-sector will be very much dependent on eligible baseline conversion costs for equipment that uses process agents, where guidelines have so far not been decided.

8.2 The Transport Refrigeration Sub-Sector

Transport refrigeration has been considered as a new sub-sector by the Executive Committee due to the extent of the difference in its ratio of investment to operational costs relative to other forms of refrigeration. In particular, the installation of cooling units in transport vehicles is quite different from the manufacture of domestic or commercial refrigeration units.

However, assuming good practice methods and the supply of components for CFC substitute refrigerants, in principle, the assembly of the cooling units is the same as it is for CFC refrigerants.

Investment costs would consist of new or retrofitted evacuation and charging units and some additional tools. Incremental operational costs would consist of differences in investments for components. Training and testing components in a "transport refrigeration" project would be similar to training and testing in domestic and commercial refrigeration projects.

The Executive Committee has noted the similarity of the transport refrigeration sub-sector to the on-site installation of larger scale commercial refrigeration units (Decision 27/74). The Decision mentions:

- Activities characterised by the assembly, installation and charging of refrigeration systems may be treated as a new sub-sector distinct from the already established domestic and commercial refrigeration sectors, which primarily deal with manufacture;
- This new sub-sector has yet to be fully defined and the activities of enterprises within it can overlap with the commercial refrigeration sub-sector;
- Where the activities are consistent with those found in typical commercial refrigeration projects approved by the Executive Committee, the projects

may continue to be considered as part of the commercial refrigeration sub-sector;

- Incremental costs for capital equipment should continue to be eligible for funding on the same basis as the commercial refrigeration sub-sector, provided that the ODS-based equipment is destroyed.

Some issues associated with this new sub-sector are still pending, including how to quantify the consumption in the sub-sector and subsequently define the incremental operating costs or savings.

Therefore, the TEAP has not adjusted the cost-effectiveness values in the replenishment calculations for the transport refrigeration sub-sector given that the funding requirement for the refrigeration sector as a whole is regarded as being adequate to provide funding required for the “transport refrigeration” sub-sector.

The TEAP Replenishment Task Force therefore does not perceive a reason to adjust cost-effectiveness values in the replenishment calculations, as the funding requirement that has been calculated for refrigeration is adequate to include this sub-sector.

9. Cost of Avoiding the Use of HCFCs in Projects Submitted for Approval to the Executive Committee

9.1 Introduction

The TEAP has considered this issue in depth. It has also taken careful note of the applicable decisions of the Executive Committee, which can be found in the 16th – 20th Executive Committee Meeting Reports. It should, however, be noted that these decisions refer to projects approved in the past and to specific issues typical for the projects approved at that stage.

The cost of avoiding the use of HCFCs is a particularly difficult issue to progress due to the following factors:

1. the number of "business-as-usual" projects involving HCFCs or their substitutes, to be submitted during the period 2000 – 2002 is not known; and
2. these costs can only be assessed on the basis of submitted projects which are not currently available to the TEAP.

Therefore, the TEAP's preliminary conclusion is that the costs of a "total" policy of avoiding the use of HCFCs in projects to be submitted during the 2000-2002 replenishment period cannot be calculated at this time.

9.2 Methodology

Given these circumstances, the TEAP Replenishment Task Force has approached this issue indirectly by estimating the percentage increase in costs of the "business-as-usual" projects if non-HCFC solutions, rather than HCFC solutions, had been implemented in virtually all cases. It should be clear that this estimate gives a first impression of extra costs to avoid HCFCs. It does not present all financial consequences since one has to exclude at this stage unique projects (e.g., certain CFC compressor conversions to HCFCs, or the use of HCFCs in very small foam projects where the cost-effectiveness of hydrocarbons would be enormous).

The above defined first estimate was made on the basis of combined experience in the following three sub-sectors:

a) rigid foam and other foam types;
b) commercial refrigeration;
c) domestic refrigeration.

Having identified these projects over a specified time period and determined the increases in their respective costs due to the assumed use of HCFC substitutes rather than HCFCs, the total additional cost can be determined. For this purpose, the TEAP Replenishment Task Force has selected all relevant projects approved during the 21st through the 27th Executive Committee Meeting.

With this information, the percentage increase in the aggregate costs of these projects, due to a policy for avoiding the use of HCFCs, could be determined. Subsequently, the increase of the necessary funding can be calculated and this increased funding can be compared to the total investment project expenditure in the consumption sector. Finally, an increase in funding for a certain standard amount of funding can be calculated. The next question is how to relate this estimate to the funding requirement for the 2000-2002 replenishment period. This could be done by the use of the assumption that that the percentage increase in costs to avoid HCFC applications would be comparable to the total increase in costs for HCFC investment projects in the consumption sector submitted during the replenishment period 2000-2002 (and/or later periods). It should be noted that this is a very important assumption, which cannot be checked earlier than after the next replenishment period.

Draft documents from Executive Committee meetings exist on the increase of costs due to safety. Since the issues addressed and the figures derived in these documents are based on historic experience that may have changed already and will further change in future, these have not been taken into consideration.

The main issue that has been investigated is the increase in costs for the foam component in the projects in the relevant sub-sectors (see above). Rather than to base the estimates for the increase in costs on historic experience, the Replenishment Task Force has based its estimates on information provided by experts from the TOC Foams under the TEAP. This information specifically relates to the increase in costs when using non-HCFC solutions (i.e., hydrocarbons).

What has been applied is a function that describes the increase in total costs when going from HCFC to non-HCFC / hydrocarbon solutions in foams. Two formulas were derived to describe the percentage increase:

Amount < 100 ODP tonnes *(increase) = -0.0187 (ODP tonnes) + 3.043*

Amount > 100 ODP tonnes *(increase) = -0.0009 (ODP tonnes) + 1.270*

The table below shows the estimated average costs for foam projects as a function of the amount of ODP tonnes involved. Although costs may vary on

a project by project basis, it is expected that no substantial inaccuracies are involved in the percentage increases as given.

ODP-tonnes	HCFC (US$ - US$/kg)		Non-HCFC (HC) (US$ - US$/kg)		Increase
	Full costs	CE	Full costs	CE	
20	150,000	7.50	400,000	20.00	267%
60	330,000	5.50	500,000	8.33	152%
100	510,000	5.10	600,000	6.00	118%
300	870,000	5.44	810,000	5.06	100%

In this analysis, all projects have been investigated separately and, in the case of application of HCFCs, the increase in costs has been determined. Costs have then been given for a number of cases:

1. if costs would be restricted by the existing cost-effectiveness threshold values;
2. if costs would be restricted by a cost-effectiveness threshold value that is a result of discounting the numerator by 35%, which, in fact, is an increase by 54% (1.0 / (1.0 – 0.35)); and
3. if costs would not be restricted.

In a first instance, this approach has been applied for foams and for the foam part of the commercial and domestic refrigeration projects where the cost-effectiveness values apply to the entire project, i.e. to the sum of the foam and the refrigeration components. Secondly, it has also been applied to the refrigeration part of domestic refrigeration (in section 10, use of isobutane instead of HFC-134a).

In this study the TEAP Replenishment Task Force has investigated projects approved by the 21st through the 27th Meeting of the Executive Committee. Details such as foreign ownership, exports to Article 5(1) countries, etc. have not been considered. It has been assumed that this is a typical parameter, which may be at least equally valid in future projects to be submitted for approval to the Executive Committee.

Information from the Multilateral Fund Secretariat shows that a total of US$ 257 million was approved for the projects in the aerosol, foam, multi-sector, tobacco, refrigeration (domestic and commercial), “several”, solvent and sterilant sectors by the 21st through the 27th Meeting of the Executive Committee (US$ 290.5 million if implementing agency support costs are included). The largest costs are in the refrigeration and foam sectors (US$ 120.6 million and US$ 96.1 million, respectively).

In the next sections, each of the three sub-sectors is analysed separately.

9.3 Rigid Polyurethane Foam and other Foam Types

The Multilateral Fund Secretariat has provided information on rigid foam projects approved by the 21st through the 27th Meeting of the Executive Committee. However, this information only applies to projects with a consumption higher than 45 ODP tonnes.

Cost-effectiveness US$/kg	Cost-effectiveness Capital costs only US$/kg			Cost-effectiveness based on full costs US$/kg		
	Non-HC	HC	Increase	Non-HC	HC	Increase
7.83	3.25	5.44	67.4%	5.47	6.91	26.3%

Since the average values in the table have been determined from information available between 1997 and 1999 and apply only to projects with a consumption higher than 45 ODP tonnes, it is not useful to apply this information to future projects. Furthermore, it should be noted that by the 21st through the 27th Meeting of the Executive Committee many projects were approved in which the ODP tonnes involved were substantially lower than 50 ODP tonnes.

Therefore, the percentage increase factors given in the table in section 9.2 have been applied to all rigid foam projects on HCFC-141b approved by the 21st through the 27th Meeting of the Executive Committee. This has been done independently from whether the cost-effectiveness factors calculated were higher or lower than the ones given in the table above. It also includes those projects where the cost-effectiveness threshold factor had to be applied, and where the actual costs would have been higher (in the case of rigid foam projects, the cost-effectiveness threshold equals US$ 7.83/ ODP kg).

Similar calculations have been made for other types of foam projects that applied HCFC-141b, where other cost-effectiveness threshold factors apply. However, it should be noted that the number of cases in which HCFC-141b is applied in the non-rigid foam sub-sector is very small. It will only be of marginal influence on the figures given below.

Using a list of projects in the rigid foam sector approved by the 21st through the 27th Meeting of the Executive Committee, as provided by the Multilateral Fund Secretariat, the following can be established (all values exclude agency support costs) and these figures are also summarised in Table 9.1 below:

- the total costs for all rigid foam projects approved by the 21st through the 27th Meeting of the Executive Committee (which used both HCFC-141b and non-ODP substances, i.e., pentane) amounted to US$ 34.4 million;

- since, to date, no cost-effectiveness value larger than US$ 7.83 per ODP kg can be approved for rigid foam projects the maximum allowable amount involved in avoiding HCFCs would be US$ 37.2 million (if the threshold of US$ 7.83 per ODP kg would be applied);

- if it would be possible to increase the cost-effectiveness threshold by a factor of 1.54, the maximum allowable cost of avoiding HCFCs would be US$ 46.7 million;

- if all these rigid foam projects would use hydrocarbons, the total cost would be US$ 60.6 million, if no cost-effectiveness threshold value would be applied.

These values are also presented in Table 9.1 below.

The increase in funding required for rigid foam projects that only use HCs were to be very moderate (US$ 2.8 million, 8% increase), if the cost-effectiveness threshold value would be applied. This is due to the fact that in many projects approved to date the funding involved was already at the maximum allowable level, i.e., at the CE threshold level.

However, it is unlikely that a pure HC conversion would be possible using the current cost-effectiveness thresholds. An increase of the threshold by 54% - or more- would at least be necessary to encourage this total HC conversion. This 54% increase results in an increase of 35.8% in funding, since this analysis is carried out on a project by project basis with each specific cost-effectiveness characteristics.

A 50% increase in funding could be considered as a sort of average value for the extra funding required for avoiding HCFCs, and this would be about US$ 16.5 million.

The same considerations apply if all foam projects are considered (all sub-sectors, using both HCFC and non-ODP options). The amount involved in the projects approved by the 21st through the 27th Meeting of the Executive Committee equals US$ 89.7 million.

Costs to “guarantee” the use of non-ODP solutions vary between US$ 104 million and US$ 122 million in all cases, i.e., corresponding to a 16.6% and 36% increase, respectively.

A 27% increase in the funding for all foam projects is likely to result in the application of non-ODP solutions only (i.e., extra funding of US$ 22.5 million compared to the funding approved at a level of US$ 89.7 million).

Table 9.1 *Costs (in US$ million) and percentages increase for rigid foam projects, (i) as approved, (ii) in case no cost-effectiveness limit would apply, (iii) in case the present cost-effectiveness threshold would apply, and (iv) in case a 54% higher cost-effectiveness threshold than the present one would apply*

Rigid foam projects on HCFC/HC			
Approved (HCFC and HC)	*If all on HCs without CE*	*If all on HCs with CE*	*If all on HCs with 1.54 * CE*
34.4	60.6	37.2	46.7
0%	76%	8.1%	35.8 %
All foam projects on HCFC and other non-ODP substances			
Approved (HCFC and HC)	*If all on non-ODP without CE*	*If all on non-ODP with CE*	*If all on non-ODP with 1.54*CE*
89.7	122.1	93.9	104.6
0%	36%	4.7%	16.6%

If one considers the fact that 37% of the funding required for all projects approved by the 21st through the 27th Meeting of the Executive Committee has been allocated to the foam sector, this would imply that about 10% extra funding in the total would be required for conversion to non-ODP solutions only.

If this were to be transferred to future replenishment periods, it would imply that for each US$ 100 million an extra US$ 10 million would be required to avoid the use of ODP solutions (i.e., HCFCs) in the foam sector.

The total amount of HCFCs involved in the projects analysed in the foam sector amounts to approximately 5,250 tonnes, i.e., 525 ODP tonnes at an ODP of 0.10 for HCFC-141b. US$ 22.5 million would be required to avoid the use of HCFCs in this sector, which leads to a cost-effectiveness for avoiding HCFCs of about US$ 43 per ODP kg (it implies a “total” cost-effectiveness for both conversions, i.e. CFCs and HCFCs in ODP tonnes, of approximately US$ 50 per ODP kg). Overall cost-effectiveness for direct conversion from CFCs to non-ODP solutions, however, would be approximately US$ 11 per ODP kg.

9.4 Commercial Refrigeration

A similar calculation was carried out for the foam part of commercial refrigeration projects, as described for the rigid foams above. On the basis of a study of a large number of commercial refrigeration projects the share of the funding needed for the foam part was derived.

In a second instance, estimates were made concerning the increase in funding required to avoid ODP solutions. One should bear in mind here that the cost-effectiveness threshold can be increased by maximum 54% for safety related investments in the case of the application of flammable substances.

Table 9.2 below shows the consequences for the projects approved by the 21st through the 27th Meeting of the Executive Committee (the cost-effectiveness threshold applicable to the use of non-flammable substances equals US$ 15.21 per ODP kg).

Table 9.2 *Costs (US$ million) and percentages increase for commercial refrigeration projects (i) as approved, (ii) in case no cost-effectiveness limit applies, (iii) in case the 35% higher cost-effectiveness threshold than the normal one would apply*

Commercial refrigeration projects on HCFC/HC		
Approved	*If all on HC/HFCs Without CE*	*If all on HC/HFCs with 1.54 * CE*
20.4	35.7	26.2
0%	75.3%	29.0 %

The amount approved by the 21st through the 27th Meeting of the Executive Committee for commercial refrigeration projects equals US$ 20.4 million. Costs to "guarantee" the use of non-ODP solutions vary between US$ 26.2 million and US$ 35.7 million dependent on the applicable cost-effectiveness threshold (corresponding to a 24% and 75% increase, respectively).

A 50% increase in the funding for all commercial refrigeration projects would probably result in non-ODP solutions only (i.e., extra funding of US$ 10 million compared to the funding approved at a level of US$ 20.4 million). Considering the fact that about 8% of the funding required for all projects approved by the 21st through the 27th Meeting of the Executive Committee has been for the commercial refrigeration sector, this would imply that an increase of about 4% in total funding would be required.

This 4% may seem low, it is, however, quite significant when considering the total share of 8%.

If this were to be transferred to future replenishment periods, it would imply that for each US$ 100 million, an additional amount of US$ 4 million would be required to avoid the use of ODP solutions (i.e., HCFCs) in the commercial refrigeration sector.

In the projects analysed in the commercial refrigeration sector approximately 850 tonnes of HCFC-141b are involved, i.e., 85 ODP tonnes at an ODP of 0.10. US$ 10 million is supposed to be needed to avoid the use of HCFCs,

which implies a cost-effectiveness of US$ 118 per ODP kg for avoiding HCFCs (it implies a "total" cost-effectiveness for both conversions, i.e. CFCs and HCFCs in ODP tonnes, of approximately US$ 130 per ODP kg). Overall cost-effectiveness for direct conversion from CFCs to non-ODP solutions, however, would be approximately US$ 36 per ODP kg.

9.5 Domestic Refrigeration

Considerations similar to those applied to the commercial refrigeration sector have been applied to the domestic refrigeration projects approved by the 21st through the 27th Meeting of the Executive Committee. It should be noted that the vast majority of these projects involved the use of cyclopentane in the insulation with only a small share for HCFC-141b.

The actual and potential funding allocations for domestic refrigeration projects that apply in this case are as follows:

US$ 44.6 million was allocated to approved projects;
US$ 45.2 million could have been allocated if the cost-effectiveness threshold had been increased by 54% for all projects (an increase of 1.4% on actual approvals); and
US$ 47.2 million could have been allocated if no cost-effectiveness threshold had been applied to projects that were designed to introduce non-ODP solutions (an increase of 5.8% on the actual project approvals).

Having regard to the above estimates, an increase of about 5% in the funding for all domestic refrigeration projects would be sufficient to implement non-ODP solutions only in all domestic refrigeration projects. The additional funding would be about US$ 2.2 million compared to the approved funding of US$ 44.6 million.

Given that about 17% of the funding required for all projects approved by the 21st through the 27th Meeting of the Executive Committee was allocated to the domestic refrigeration sector, additional funding of about 0.9% would have been required for conversions to non-ODP solutions only.

If this result were to be applied to future replenishment periods, it would imply that for each US$ 100 million allocated to the domestic refrigeration sector only an additional US$ 0.9 million would be required to avoid the use of ODP solutions (i.e., HCFCs).

For the projects analysed in the domestic refrigeration sector, approximately 610 tonnes of HCFC-141b are involved, i.e., 61 ODP tonnes at an ODP of 0.10. Given that US$ 2.2 million is required to avoid the use of HCFCs, the cost-effectiveness value is about US$ 36 per ODP kg. This result implies a

"total" cost-effectiveness for both conversions, i.e. CFCs and HCFCs in ODP tonnes, of approximately US$ 50 per ODP kg. This cost-effectiveness value is more favourable than in the case of commercial refrigeration because, on average, the projects in the domestic refrigeration sector are of a larger size. Overall cost-effectiveness for direct conversion from CFCs to non-ODP solutions, however, would be approximately US$ 14.5 per ODP kg.

9.6 Concluding Remarks

Given the preceding analysis and assuming similar project patterns during future replenishment periods, increases in the total funding requirement of 10%, 4% and 0.9% would be required in order to implement the non-HCFC options for the foam, the commercial and the domestic refrigeration sectors, respectively.

This result implies that for each US$ 100 million of funding for investment projects in the consumption sector, an additional US$ 15 million would be required to avoid the use of ODP (i.e., HCFC) solutions. However, the above conclusions depend on the requisite increases in the funding requirements, which, in many cases, might still not be large enough to "guarantee" the implementation of non-ODP conversions only. As a consequence, counterpart financing by certain companies would still be required in a number of cases, which could make it prohibitively costly for them to implement non-ODP solutions only.

On the above analysis, it is clear that the use of HCFCs cannot be avoided in all projects. Firstly, to introduce hydrocarbons in operations where only very small amounts of HCFCs are applied, the cost-effectiveness value could be unacceptably high. This outcome has already been shown in certain commercial refrigeration projects where an average "total" cost-effectiveness of *US$ 130 per ODP kg* has been determined (however, overall cost-effectiveness for direct conversion from CFCs to non-ODP solutions would be US$ 36 per ODP kg). Secondly, some projects relate to a conversion from CFCs to HCFCs (e.g., HCFC-22 in certain compressor types) where the cost-effectiveness value of avoiding this conversion by redesigning for HFC use could be unacceptably high.

Furthermore, since it is not known how many projects in the foam and refrigeration sector will be submitted and what the sizes will be the above mentioned increase of US$ 15 million per US$ 100 million is a first estimate. The required funding could well be substantially higher if future projects were to become considerably smaller than they have been so far, i.e., if more SME projects were to be considered during the replenishment period 2000-2002.

In summary, the total funding requirement for completely avoiding the use of HCFCs in future projects is expected to be at least US$ 15 million per US$ 100 million of future replenishments of the Multilateral Fund.

10. Opportunity Costs Associated with Expenditures to Favour Hydrocarbons in Multilateral Fund Projects

The TEAP established in section 9 that it is currently not possible to estimate the funding required to avoid the use of ODP solutions in specific projects, such as the use of hydrocarbons in specific compressor conversions. However, percentage increases in the funding required to enable non-ODP (i.e., non-HCFC) solutions can be derived for what has been referred to as "business-as-usual" projects in the foams and refrigeration sectors.

10.1 Use of Hydrocarbons Where Currently Not Applied

For hydrocarbons, the only example, other than those presented in section 9, is the conversion of all domestic refrigeration projects to isobutane rather than to HFC-134a.

The funding requirement for domestic refrigeration projects would only moderately increase if cyclopentane alone were to be used (US$ 46.8 million compared to US$ 44.6 million), assuming that no cost-effectiveness threshold would apply.

Investigations have been carried out to derive the extra funding required for converting to isobutane rather than to HFC-134a in projects, on the basis of information available from the projects approved by the 21st through the 27th Meeting of the Executive Committee. The additional funding that would be required has been established as a factor of 2.0 for the refrigeration part, independent of the number of ODP tonnes involved, as long as the amount is not larger than 50 ODP tonnes.

Total funding for the conversion to cyclopentane and isobutane would be US$ 51.2 million for projects that include both the foam and the refrigeration components, assuming no cost-effectiveness threshold values for projects as a whole, i.e., projects that include both the foam and the refrigeration component. The total funding would be decreased to US$ 48.4 million if the cost-effectiveness threshold value (1.54 times the applicable value of US$ 13.76 / ODP kg) were to be applied.

The TEAP regards that funding at a level of US$ 51 million would be required to enable full conversion of all projects to isobutane in the refrigeration component and cyclopentane in the foam component. This implies a 14.8% increase in the funding required for the domestic refrigeration sector in project approvals. Taking into account that 17% of the funding required for all projects approved by the 21st through the 27th Meeting of the Executive Committee has been for domestic refrigeration, this implies that about 2.5% of additional funding would be required.

For each US$ 100 million for investment proposals in the consumption sector, an additional US$ 17.5 million would be required to introduce hydrocarbons in all relevant projects. This estimate is the sum of US$ 15 million, reported in section 9, plus US$ 2.2 million determined in the preceding paragraph (2.5% increase in funding equals US$ 2.5 million per US$ 100 million).

The above implies that, if one would consider the reduction in costs by applying both HCFC-141b and HFC-134a (where currently applied) instead of hydrocarbons in the applicable sub-sectors as determined in section 9, it would lead to a reduction in costs by 14.9% (the share of US$ 17.5 million in the total of US 117.5 million). This equals a reduction of US$ 14.9 million per US$ 100 million funding. This would enable to phase out about 1,300 ODP tonnes in equipment in other sectors per US$ 100 million of funding. This value has been determined using the assumption of an average cost-effectiveness of US$ 11/ ODP kg. Of course, the actual number of ODP tonnes in question would depend on the specific cost-effectiveness values for each sector.

10.2 Use of Non-Hydrocarbon Solutions Instead of Hydrocarbons Currently Applied

One could further consider the reduction in costs for all domestic refrigeration projects that have been approved by the 21st through the 27th Meeting of the Executive Committee, using cyclopentane in the foam and isobutane in the refrigeration component, by the replacement of these substances by HCFC-141b and HFC-134a. This would yield an extra reduction of 2.8% (the reduction is rather moderate, since it concerns some large cyclopentane projects, which are assumed to have a better cost-effectiveness than HCFC-141b). The total reduction would then equal 17.7%, i.e., a reduction of US$ 17.7 million per US$ 100 million funding.

This amount would make it possible to phase out about 1,600 ODP tonnes in sectors elsewhere per US$ 100 million of funding.