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REPORT ON THE DESK STUDY ON HALON PROJECTS

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1. Executive Summary

1. Halons, due to their high ODP value (factor 3 for Halon 1211 and factor 10 for Halon 1301), have received priority attention by the Multilateral Fund and allowed for very good cost-effectiveness of conversion projects. To date, US $61.8 million have been approved including three regional projects for 43 investment and 56 non-investment projects. This has resulted in the phase-out of 28,024 ODP tonnes of halon consumption and 25,515 ODP tonnes of halon production. The consumption of all Article 5 countries was brought down from 40,403 ODP tonnes (baseline) to 23,845 ODP tonnes (latest reported data).

2. 34,187 ODP tonnes of halons was the baseline consumption in China which obtained 72.2% of all approved funding in the sector and reduced its consumption to 18,602 ODP tonnes in 1999. After early investment and non-investment projects showed variable degrees of success, the Executive Committee approved at its 23rd meeting in November 1997 in principle US $ 62 million for a sector plan. So far five annual tranches with a total funding of US $ 43.5 million have been transferred to China. Under the sector plan, total phase-out of consumption and production of Halon 1211 will be realized in 2006, and of Halon 1301 in 2010.

3. In the early years, emphasis was placed on fire extinguisher projects. 23 projects were approved for a total of US $ 3,2 million 19 of these projects have been completed and phased-out 5,209 ODP tonnes of halon with an average cost-effectiveness of US $ 0.61/kg of ODP which is far below the threshold of US $ 1.48 per kg of ODP.

4. This was complemented by non-investment projects (recovery/recycling and halon banking, training, and technical assistance) in a number of countries, implemented to a large extend by bilateral agencies, in particular the USA, and by UNDP and UNEP. While in the early years the emphasis was on training and technical assistance combined with a few recovery and recycling activities, since 1999 halon bank management projects, often combined with recovery and recycling, have become the most important type of projects. So far, 23 halon banking projects have been approved (10 as investment and 13 as non-investment projects), with a total funding value of almost US $5,2 million. Four of these projects (2 surveys each in the West Asia region and in Syria, implemented by France in cooperation with Germany) have been completed. Some follow-up activities in this region are planned to be completed soon, while the other on-going halon banking projects are foreseen to be completed in the years 2003 to 2005.

5. The proposed evaluation aims at:

(a) Verifying the cost-effectiveness and sustainability of halon phase-out and production of substitute products in a few selected fire extinguisher projects;

(b) Analyse the progress achieved in implementing the halon sector plan in China and identify the lessons learnt in terms of implementation modalities and monitoring methods which can be of use for other sector plans, following this first example.

(c) Examine the experiences made in selected completed or advanced halon recovery/recycling and banking projects, in order to generate lessons learnt for the other on-going projects.

2. Background

6. As foreseen in the 2002 Monitoring and Evaluation Work Programme, a desk study has been prepared by a consultant on halon projects (Mr. Robert Tapscott, GlobeTech Inc., New Mexico, U.S.A.). The present document is a summary of the desk study.

7. A brief overview of halon projects from the beginning of the Fund's operations until today is followed by a presentation of the main findings of the desk study, evaluation issues identified and an outline of the evaluation methodology to be used in the main phase of the evaluation. A description of technical characteristics of various halons and conversion projects and detailed statistical information on halon projects funded so far is given in annexes 1 and 2 respectively.

8. As usual for desk studies, the findings are preliminary, except for the assessment of the quality of project documents and project completion reports (PCR). The problems found in project preparation and implementation needs further analysis and corroboration during field visits and discussions with stakeholders concerned, primarily the companies and the implementing agencies.

3. Overview of the Halon Sector

9. As of May 2002, 43 halon investment projects have been approved. Total funding approved for these projects (including adjustments) is US $54,015,210 of which US $33,630,008 has been disbursed and 27 projects have been completed (see tables A1 and A2 in Annex II). The largest number of investment projects has been approved for fire extinguisher projects (20) followed by halon banking projects (10). However, the largest amount of funding has been approved for sectoral phase-out plans. US $43.5 million was approved so far for 5 annual tranches of a sector plan in China, for which the 23rd Meeting of the Executive Committee approved in principle US $ 62 million. In the 34th Meeting, US $2.6 million have been approved for an umbrella project for the closure of two halon plants in India.

10. As of May 2002, 56 non-investment halon projects have been approved. Total funding including adjustments is US $7,047,695 of which US $4,924,534 have been disbursed. 45 projects have been completed. Technical assistance and support projects (34), halon banking projects (13), and training projects (8) accounted for the majority of non-investment projects (see tables A1, A2 and A6 in Annex II).

11. Completed investment projects have achieved the phase-out of 53,465 ODP tonnes (27,950 ODP tonnes of halon consumption and 25,515 ODP tonnes of halon production). In addition, one completed non-investment project in China reported the phase-out of 74 ODP tonnes. The ODS phase-out planned and achieved as reported in the PCRs corresponded in most cases to quantities planned for in the project documents.

12. Some implementation delays occurred. Six of 19 completed fire extinguisher projects had delays between 7 and 12 months and three between 13 and 24 months. On the other hand, 7 projects were completed before the scheduled completion date. Halon Banking and Recovery and Recycling projects show a similar picture (See tables A8 and A9 in Annex II).

13. The latest reported Halon consumption of all Article 5 countries is 24,172 ODP tonnes. If the approved but not yet implemented ODP phase-out is deducted (7,387 ODP tonnes plus China's remaining consumption of 15,866 ODP tonnes which is covered by the sector plan), the remaining reported consumption not covered by approved projects is 2,871 ODP tonnes. Comparing this figure to the baseline consumption of 40,393 tonnes, it becomes apparent, that the phase-out in the Halon sector has made great progress and that there are only a few more projects in a small number of countries required. More detailed statistical information and an analysis linking the remaining reported consumption to compliance by country is given in document UNEP/OzL.Pro/ExCom/37/18 (the section on Halons is in paragraph 46 to 56 and the statistics in the first part of Annex II).

4. Fire Extinguishers Projects

14. For 19 completed fire extinguisher projects, a phase-out of 5,209 ODP tonnes was reported (see table 1). The average cost-effectiveness figures for completed fire extinguisher projects are way below the threshold of 1.48 US$ per kg of ODP and constitute the lowest figures by far for all sectors which is mainly due to the high ODP values of Halons.

Table 1: RESULTS AND COST-EFFECTIVENESS OF FIRE EXTINGUISHER PROJECTS (According to the 2001 Progress Reports)

Agency	Completed Projects	Approved Halon Phase-Out (ODP Tonnes)	Actual Halon Phase-Out (ODP Tonnes)	Average planned cost per kg of Halon phased-out (US$/kg)	Average actual cost per kg of Halon phased-out (US$/kg)
IBRD	2	1,665	1,882	0.75	0.65
UNDP	16	1,846	1,847	0.88	0.80
UNIDO	1	1,110	1,480	0.45	0.33
Total	**19**	4,621	5,209	0.73	0.61

15. The technologies chosen for portable extinguisher conversion projects appear appropriate. In all completed projects, the halon replacement agents for portables are ABC powder, sometimes combined with carbon dioxide, or (rarely) foam/water spray. These technologies are easily introduced and ABC powder, and for some situations, foams are known to be highly effective—as effective as halons in many scenarios. These three technologies are well understood.

16. Although ABC powder, carbon dioxide, and foams are well understood technologies, this does not imply that they are easily introduced. A plant not making ABC powder extinguishers may well find a lack of expertise in handling these materials, which are highly susceptible to moisture contamination and other problems. Similarly, a plant used to handling only low-pressure halon extinguishers may find a serious lack of expertise (and risk assessment knowledge) in manufacturing high-pressure carbon dioxide extinguishers. Training is always needed when a company introduces a technology new to that enterprise, and the costs and time for such training must be included.

17. There are indications that some companies lacked expertise for the conversion, at least at the initiation of a project. However, lack of expertise is never stated explicitly in project documents or PCRs and must be deduced from such things as delays and implementation problems. Some companies were on a sharp learning curve and have reportedly acquired the needed expertise by the end of the project. CPR/HAL/07/INV/18 (Beijing) does not appear to have been completed satisfactorily due to a variety of factors including availability of counterpart funds and contractor performance; however, there may have been some problems with expertise on the part of Beijing Fire Equipment Factory, too.

18. The Halon Sector 1999 Annual Program for China (CPR/HAL/26/INV/261), indicates that the ABC powder used in the past by China was of insufficient quality for present needs and that there was, in 1998 at least, a shortage of good powder, partly due to the insufficient quality of ABC powder produced by the plant converted by project CPR/PRO/07/INV/18, Beijing. This was overcome by creating additional production capacities for ABC Powder funded under the sector plan. Similar problems may be encountered elsewhere. As mentioned above, ABC powder is easily contaminated. This document also indicates a need for light weight carbon dioxide extinguishers. Owing to the high pressure contained, carbon dioxide extinguishers of carbon steel construction are very heavy and, for that reason, more difficult to use. Newer technologies allow the construction of lighter weight carbon dioxide extinguishers; however, this new technology requires considerable expertise to employ. A project to introduce such technology in China is under implementation, funded under the Sector Plan.

19. Few investment projects are geared towards fixed system extinguishers. CPR/HAL/07/INV/17 (Zhejiang) has proposed the use of carbon dioxide in “certain applications”, apparently for normally unoccupied areas, but this is not spelled out. Some projects have given consideration to the use of water misting systems; however, there is no evidence from PCRs that this technology, which requires specialized training and expertise to use appropriately, has actually been put into place as a result of an MLF project. HFCs are coming under increasingly stringent regulation due to their global warming contributions. Nevertheless, for some fixed systems, the only feasible alternative is another halocarbon agent such as an HFC (FM 200). The PCRs on fire extinguisher projects implemented by UNDP in India, where FM 200 was planned to be one of the alternative technologies, do not report on its actual use.-

20. There are indications that some conversion technologies were chosen with too little information about resulting problems in production lines. For example, extinguisher manufacturers working with halons may not be aware of problems in producing extinguishers for carbon dioxide, which require much higher pressures. Manufacturers working with ABC powder for the first time may face unrecognized problems with powder contamination. In a number of cases, there were indications of delays due to technical problems; however, the problems were usually not described in detail.

21. In several cases (e.g. CPR/HAL/07/INV/17, Zhejiang, and CPR/PRO/07/INV/18, Beijing), there was difficulty in marketing extinguishers with new technologies. In addition to assuring adequate product quality, during project preparation the market prospects for converted products should be considered; public awareness activities would help to educate the users about the applicability of the new products.

22. Potential pollution due to discharge of chrome wastes, oils, dry chemical (phosphates, a major constituent of ABC powder, can cause algae bloom), and petroleum products should be examined during project preparation. Such problems should be addressed to the extent that they are related to the conversion. The statement "Costs associated with mitigation of adverse environmental impact are to our knowledge not relevant in this project" in the Technical Review for the extinguisher project CPR/Hal/15/INV/104 (Nanjing) might not be correct.

5. Recovery and Recycling (R&R) and Halon Banking Projects

23. Four projects have been completed where R&R was the principal activity. These projects were approved in the years 1992 to 1994 and aimed at the establishment of recovery and recharging centers by providing equipment and training (see table 2 below).

Table 2: HALON RECOVERY AND RECYCLING PROJECTS

Code	Agency	Status	Type	Sector	Date Approved	Date Completed *	ODP To Be Phased Out	ODP Phased Out*	Total Funds Approved Including Adjustments	Funds Disbursed *
MAL/HAL/06/INV/04	IBRD	COM	INV	HAL	Feb-92	Sep-98	900	900	720,000	610,083
GLO/HAL/07/DEM/25	UNDP	FIN	DEM	HAL	Jun-92	Sep-93	0	0	250,000	250,000
CPR/HAL/12/INV/66	UNDP	FIN	INV	HAL	Mar-94	Dec-96	0	0	155,000	155,000
CPR/HAL/12/INV/59	USA	FIN	INV	HAL	Mar-94	Dec-95	200	231	807,000	807,000

* According to the 2001 Progress Report

24. The project in Malaysia had been operational for several years before it was relocated to another institution in the year 1999 and had not restarted in May 2000 when it was visited by a consultant in the context of the desk study on R&R projects (document UNEP/OzL.Pro/ExCom/ 31/18). Of the 40 Halon 1211 recycling machines supplied by UNDP in the global project, the two supplied to Malaysia have never been used and will probably not be used. The PCR does not state whether the other countries have been using the equipment. A summary paper on experiences made in R&R projects implemented with support from the USA, provides the following lessons to which the consultant agrees:

(a) Deployment of recycling machines can raise public awareness and can provide a focus for training on conservation.

(b) Widespread R&R in countries where halon is highly dispersed or is available at low cost is not likely to give cost-effective ODS reduction. Introduction into remote sites, where halons are low in costs, are likely to lead to low utilization of equipment and lapses in training and maintenance.

(c) Success in halon projects is facilitated by advanced government coordination, government desire for phase-out, public perception that R&R is useful and profitable, and an appropriate infrastructure.

(d) An assessment of halon use patterns is important in planning for R&R programmes.

(e) For success, one must make clear to public, users, and manufacturer/sellers the compelling business and environmental benefits of R&R. One must make an early determination of the willingness of a firm (whose primary product may have been newly produced halon) to participate.

(f) Willingness to participate can be judged by willingness to pay for initial training, and/or by charging a fee for the rental of the recycling equipment. Given the significant savings that are possible/likely from robust use, a charge for use of the machine is very viable. In any case, a plan must be in place to assess use and redeploy machines that are being under utilized.

(g) Delivery of machines with spare parts is critical, as is training in local languages. Further, control panel labels that identify machine functions in local languages are very useful to ensuring continued effective operation.

25. In addition, success is depending on an attractive cost margin between new and recycled halon and a diminished availability of new halons as a result of reduced production.

26. In later years, R&R activities were integrated into other projects, mainly into halon banking and management projects. So far, 23 halon banking projects have been approved, including three regional projects (10 as investment and 13 as non-investment projects), with a total funding value of almost US $5,2 million. Four of these projects (2 surveys each in the West Asia region and in Syria, implemented by France in cooperation with Germany) have been completed. Some follow-up activities in this region are planned to be completed soon, while the other on-going projects foresee completion in the years 2003 to 2005.

27. Several halon banking projects plan to collect halons in a central depository. However, for fixed systems, halons are best left in their original containers until needed elsewhere or until destroyed. This is the consensus reached by the Halon Technical Options Committee after extensively debating the issue. There is little or no reason to remove Halon 1301 from such systems to store it in large centralized tanks. In fact, this can lead to losses and cross contamination. Halon for fixed systems is best transferred in the original containers, which can be connected into new systems. Collection to a centralized location may be useful for portable, primarily Halon 1211 extinguishers, particularly where recovery and recycling is difficult in remote locations (see the PCR for CPR/HAL/12/INV/59, Deployment of recovery/recharge machines, implemented with support of the USA). The most important offerings of a halon bank are usually not storage, however, but databases (giving locations of supplies and contacts), technical assistance, public awareness, technical expertise, distribution systems, and coordination between users. This is offered, for example, by the Halon trading scheme implemented by UNEP, and by several other projects.

28. Health, safety, and environmental concerns must be addressed for banking operations if recycling and storage is carried out. Procedures to guard against accidental halon loss should be established. Safety can be a serious problem with storage of pressurized cylinders. In some cases, safety concerns can be mitigated by selecting a facility where workers are already familiar with pressure tanks and halon transfer (selecting Sonatrach in the project ALG/HAL/35/INV/51 for the establishment of a Halon bank, is a good example).

6. Sector Programmes

29. The Executive Committee at its 23rd Meeting (Nov. 1997) decided to approve in principle US $62 million for the implementation of the China Halon Sector phase-out plan, the first one of this kind. So far five annual tranches with a total funding of US $ 43.5 million have been transferred to China. Under the sector plan, total phase-out of consumption and production of Halon 1211 will be realized in 2006, and of Halon 1301 in 2010. Military uses and phase-out plans have not been included in the sector plan. The tranches are annually approved by the Executive Committee after independent auditing has confirmed that the targeted phase-out has been reached which so far has been the case (see table A7 in Annex II).

30. The halon production phase-out programme for India was approved at the 34th Meeting of the Executive Committee in July 2001. It aims at closing two relatively small Halon production facilities and has a funding volume of US $2.6 million. Before this, a halon phase-out strategy and six fire extinguisher projects to be implemented by UNDP had been approved by the 28th Meeting, followed by two halon management and banking projects with Australia and Canada, approved at the 32nd Meeting. Earlier on, one extinguisher project had been approved at the 18th Meeting and another seven at the 24th Meeting.

31. Technology assistance (non-investment) projects provided in most cases, according to the documentation available, valuable support to the investment projects. A major example are projects covering standards making activities which are for example part of the China Sector Plan. Non-ODS technologies require new standards to enable their application. In some countries, these standards are already in place, but in others they are not. For example, construction safety standards often still foresee the use of halons and need to be changed accordingly.

7. Documentation

32. Some ODP phase-out data are not consistent or transparent. In the project document concerning CPR/HAL/07/INV/17 (Zhejiang), factors of 4 and 16 were used to calculate the ODP value for the sector consumption, rather than the customary factors of 3 for Halon 1211 and 10 for Halon 1301. For CPR/HAL/15/INV/104 (Nanjing), a factor of 4 was used in the project proposal (370 MT resulting in 1480 ODP). While the projects were approved using the correct factors, the PCR for CPR/HAL/15/INV/104 reported again approval and actual phase-out of 1,480 ODP tonnes and the 2001 progress report also shows 1,480 ODP tonnes phased-out. In another example, the PCR for CPR/HAL/07/INV/18 (Beijing) gives an originally planned ODS phase-out of 2000 ODP-tonnes and an accomplished phase-out of 3000 ODP-tonnes. The documentation for these amounts is virtually non-existent (the final figure appears to be some type of extrapolation), and the amount reported was lately corrected in the progress report 2001

to 1200 ODP tonnes. In all cases, transparent information should be provided how the ODP values and cost-effectiveness have been calculated.

33. Better and more complete descriptions of baseline conditions (existing equipment, how it is used, specific ODS and non-ODS products) are needed both in project documents and PCRs. PCRs and technical reviews should also provide more details on technical problems and approaches. Knowledge about these problems would aid in ensuring success of future projects. Among the questions that should be answered (and usually were not) are, for example (1) what specific problems arose in extinguisher construction and how were they solved, (2) were there problems with agent contamination and what was done about this, (3) what difficulties arose in recycling operations.

34. Environmental, health, and safety issues need more consideration and discussion in both the proposals and the PCRs. The health and safety risks of carbon dioxide (primarily high pressure) and dry chemical powders (primarily inhalation) are seldom mentioned. There is no need to discuss the global environmental impacts of these technologies (the impacts are zero and this is well known), but there is need to consider the terrestrial environmental impacts of manufacturing. Converted products and compare them to the baseline conditions.

35. In many PCRs little or no information was provided on the destruction or disposal of equipment designed for ODS use. In a number of cases, it was claimed that the equipment was modified to allow utilization with non-ODS technologies. Equipment destruction should not be required when it is possible to convert the equipment to manufacture and/or use of non-ODS materials. In many cases, however, such a conversion may be difficult or impossible. For example, documentation for the project CPR/HAL/07/INV/17 (Zhejiang), claims that halon equipment has been converted to CO_2 equipment. While not impossible, the much higher pressures found for CO_2 make this conversion difficult. PCRs for projects IND/HAL/24/INV/165 (Vijay), IND/HAL/24/INV/168 (Nitin), IND/HAL/24/INV/170 (Atkins), state that equipment is being retained for use with recycled halons. The best way to verify whether old or new equipment is used to produce or use halons is through site visits.

8. Focus of Field Evaluations

36. The proposed evaluation aims at:

(a) Verifying the cost-effectiveness and sustainability of halon phase-out and production of substitute products in a few selected fire extinguisher projects;

(b) Analyse the progress achieved in implementing the halon sector plan in China and identify the lessons learnt in terms of implementation modalities and monitoring methods which can be of use for other sector plans, following this first example.

(c) Examine the experiences made in selected completed or advanced halon recovery/recycling and banking projects, in order to generate lessons learnt for the other on-going projects.

37. Site visits are recommended in China, selected countries in Asia and Latin America as well as in the Middle East and in some low volume consuming countries. The mission to China should not only include an evaluation of the sector programme, but also look at a few long completed projects to determine their sustainability.

38. Among the items which must receive careful attention in any assessment visit are the following:

(a) Is there still halon equipment on site and, if so, how is it being utilized? In many cases, little or no information is provided on the disposal of equipment designed for ODS use. In a number of cases, it is claimed that the equipment was modified to allow utilization with non-ODS technologies. For halon recycling, halon equipment is still necessary.

(b) How is product reliability? Serious difficulties and delays in carrying out conversion may indicate a lack of expertise, which could be reflected in product quality. Does condition and utilization of equipment indicate that the enterprise has the experience needed for sustainable operation?

(c) Are there environmental problems resulting from the conversion? Examine safety and environment issues, including baseline conditions, in project preparation, implementation as well as in reporting.

(d) For halon banking and recovery/recycling projects it will be most interesting to identify successful approaches and the factors determining such success as well as the reasons for failures. The implications and impact of the halon banking guidelines approved on an interim basis by the 18th meeting of the Executive Committee should be analyzed (UNEP/OzL.Pro/ExCom/18/75, Decision 18/22, para. 51; supporting document: UNEP/OzL.Pro/ExCom/18/16).

(e) Verify actual incremental capital and operating costs or savings and compare them with the eligibility criteria defined in the guidelines established by the Executive Committee at its 16th Meeting (UNEP/OzL.Pro/ExCom/16/20, para. 82; supporting document: UNEP/OzL.Pro/ExCom/16/16) and at its 20th Meeting (UNEP/OzL.Pro/ExCom/20/72, Decision 20/46, para. 69; supporting document: UNEP/OzL.Pro/ExCom/20/66). Identify implications of incremental operating savings (IOS) for the mobilisation of counterpart funding, competition in the sector and the readiness of industries to present project proposals.

(f) Analyze the complementary role of Government regulations to reduce the consumption and use of halons as well as the impact of cost and availability of substitute products for successful phase-out at country level.

Annex I: Technical Characteristics of Halons and Main Usages

1. Halons are highly effective fire suppressants, which function primarily by chemically interrupting the combustion process. They have relatively low toxicities, and usually cause little or no secondary damage due to the extinguishant itself. Halons, however, are also potent depleters of stratospheric ozone, with Ozone Depletion Potentials (ODPs) for the most common agents ranging from approximately 3 to 10 (see Table 1A).

2. Two halons are in widespread use today. Halon 1211 is primarily used in portable, handheld fire extinguishers while halon 1301 is primarily used in fixed systems. A third halon, Halon 2402, has had significant use in only a few countries and generally has properties and uses similar to those of Halon 1211. A few other halons such as Halon 1011 and Halon 1201 have had extremely limited use in very specialized applications. It should be noted that the application of halon varies from country to county. Thus, some countries often use Halon 1211 in fixed systems, and, in a few cases, Halon 1301 is used in portable, handheld extinguishers.

TABLE 1A: HALONS

Halon	Name	Formula	System	ODP
1211	bromochlorodifluoromethane	$CBrClF_2$	Portable	3
1301	bromotrifluoromethane	$CBrF_3$	Fixed	10
2402	1,2-dibromotetrafluoroethane	$CBrF_2CBrF_2$	Portable	6
1011	chlorobromomethane	CH_2BrCl	Specialized	0.1
1202	dibromodifluoromethane	CBr_2CF_2	Specialized	1

3. Two major types of extinguishers are in use. Portable, handheld, manually activated extinguishers discharge an extinguishing agent directly onto a fire. This is sometimes referred to as a “streaming” application. Fixed systems are stationary, installed systems that are usually total-flood and often automatic. Total-flood means that the extinguishing agent is discharged into an enclosed volume to give a concentration that will extinguish any contained fire. Agent toxicity requirements for a streaming application, where the agent is directed away from the user, are not as stringent as those for total-flood applications, where people present in the enclosed volume can be immersed in the gaseous agent. Though these are the two primary uses, there are a large number of modifications for more specialized applications.

4. Fire extinguishing agents include (1) aqueous agents and foams, (2) inert gases (such as carbon dioxide and nitrogen), (3) halocarbons (which include halons and HFCs), and (4) dry chemical agents or powders (such as ABC powder, ammonium phosphate, termed “ABC” because it can be applied to solid fuel fires, liquid fuel fires, and fires involving activated electrical circuits). Although the term “halon” can be applied to any gaseous or volatile liquid, halocarbon fire extinguishant, it is most commonly used for bromine-containing extinguishants, and that is the way it is used in this report.

Annex II: Statistical Information on Halon Projects funded by the Multilateral Fund

1. The number of approved investment and non-investment projects, the funding volume and the average project size per year for both type of projects are shown in Table A1. The peak in funding in 1997 is due to the initiation of a Sector Programme for China.

TABLE A1: HALON PROJECTS APPROVED

Year Approved	Investment Projects			Non-Investment Projects		
	Projects	Funding $US	Average $US	Projects	Funding $US	Average $US
1992	3	2,365,000	788,333	10	1,518,555	151,856
1993	0	0	0	8	1,366,475	170,809
1994	4	1,957,592	489,398	12	679,666	56,639
1995	5	607,805	121,561	5	200,437	40,087
1996	0	0	0	3	791,685	263,895
1997	1	12,400,000	12,400,000	2	174,000	87,000
1998	8	10,640,073	1,330,009	2	468,030	234,015
1999	10	11,858,140	1,185,814	9	1,241,847	137,983
2000	6	6,527,400	1,087,900	3	285,000	95,000
2001	6	7,659,200	1,276,533	2	322,000	161,000
Total	**43**	**54,015,210**	**1,256,168**	**56**	**7,047,695**	**125,852**

2. 15 of the 43 approved investment projects were or are implemented by the World Bank, 20 by UNDP, 2 by UNIDO and 6 projects by Bilaterals (see table A2 below). Total funding approved for these projects amount to US $54 million representing 5.5% of the total funding approved so far for all investment projects. 27 projects or 63% of the approved investment projects were completed by the end of 2001 (8 by the World Bank, 17 by UNDP and one project each by UNIDO and a Bilateral).

TABLE A2: PROJECTS AND FUNDING BY AGENCY

Agency	Investment				Non-Investment			
	Total	Funding	Completed	Funding	Total	Funding	Completed	Funding
IBRD	15	48,350,736	8	40,065,000	2	776,820		
UNDP	20	2,811,282	17	1,774,367	15	1,878,641	14	1,790,641
UNEP					14	718,000	13	668,000
UNIDO	2	745,292	1	495,592	1	25,000		
Bilateral	6	2,107,900	1	807,000	24	3,649,234	18	2,403,649
Total	**43**	**54,015,210**	**27**	**43,141,959**	**56**	**7,047,695**	**45**	**4,862,290**

3. Bilateral agencies have been very active in implementing halon projects, in particular the USA, Canada and Germany (see table A3 below).

TABLE A3. BILATERAL PROJECTS AND FUNDING

Participant Country	Investment				Non-Investment			
	Total	Funding	Completed	Funding	Total	Funding	Completed	Funding
Australia	1	245,700	0	0	0	0	0	0
Canada	1	245,700	0	0	4	1,244,595	3	1,067,185
France	0	0	0	0	5	817,911	2	28,236
Germany	2	609,500	0	0	4	306,736	2	28,236
Sweden	1	200,000	0	0	0	0	0	0
USA	1	807,000	1	807,000	11	1,279,992	11	1,279,992
Total	**6**	**2,107,900**	**1**	**807,000**	**24**	**3,649,234**	**18**	**2,403,649**

4. In terms of geographical distribution, most investment projects are in larger countries mainly in Asia (36 approved and 25 completed projects). UNDP completed 15 projects in Asia and 2 in Latin America, followed by the World Bank with 8 projects completed in Asia (see Table A4). No projects were yet completed in Africa and Europe.

Table A4: Halon Investment Projects By Region and Implementing Agency
(According to 2001 Progress Reports)

Agency	Africa	Asia and the Pacific		Europe	Latin America and the Caribbean		Total	
	Approved	Approved	Completed	Approved	Approved	Completed	Approved	Completed
IBRD		15	8				15	8
UNDP	1	16	15		3	2	20	17
UNIDO		1	1	1			2	1
Bilateral	2	4	1				6	1
Total	**3**	**36**	**25**	**1**	**3**	**2**	**43**	**27**

5. In terms of funds approved per project, 4 of 27 completed halon investment projects (apart from the 5 annual tranches for the halon sector plan in China) received funding of more than US $1,000,000, while 5 projects had a funding level of between US $500,000 and 1 million. The remaining 18 projects had budgets of less than US $500,000.

6. The largest number of investment projects were fire extinguisher conversions (20 or 47%), followed by halon banking projects (10 or 23%). However, the largest amount of funding has been approved for the sectoral phase-out plan in China so far (US$43.5 million for 5 annual tranches). Most projects were approved for phasing out of Halon-1211 (54 or 71%), followed by Halon-1301 (21 or 28%). The most frequent substitute was ABC dry powder (27 cases) followed by recycling (15 projects).

TABLE A5: HALON INVESTMENT PROJECTS BY SUBSECTOR

Sub-sector	Bilateral	IBRD	UNDP	UNIDO	Total	Funds, US$	Average, US$
Banking	5	2	2	1	10	3,058,600	305,860
Extinguisher		3	17		20	3,248,018	162,401
Extinguisher/fixed system		2		1	3	1,626,592	542,197
Halon conversion		1			1	900,000	900,000
Recovery/recycling	1	1	1		3	1,682,000	560,667
Sectoral phaseout plan		6			6	43,500,000	7,250,000
Total	**6**	**15**	**20**	**2**	**43**	**54,015,210**	**1,256,168**

7. 7 million US $ were approved for 56 non-investment projects; 2 of these projects were or are implemented by the World Bank, 15 by UNDP, 14 by UNEP and 22 by bilateral agencies. Technical assistance and support projects (34) accounted for the majority of non-investment projects. Banking and training projects (13 and 8) were also numerous. Only one project was an explicit recovery and recycling project; however, such activities were also included in some investment projects and in halon banking projects.

TABLE A6: HALON NON-INVESTMENT PROJECTS BY SUBSECTOR

Sub-sector	Bilateral	IBRD	UNDP	UNEP	UNIDO	Total	Funds, US$	Average, US$
Banking	10	2		1		13	2,128,877	163,760
Recovery/recycling			1			1	250,000	250,000
Technical assistance/support	9		12	12	1	34	3,524,964	103,675
Training programme/workshop	5		2	1		8	1,143,854	142,982
Total	**24**	**2**	**15**	**14**	**1**	**56**	**7,047,695**	**125,852**

Table A7: CHINA HALON SECTOR PHASE-OUT PLAN

Chemical	Year Approved	Agreement		Approved		Actual[1]	
		Consumption (ODP Tonnes)	Production (ODP Tonnes)	Consumption (ODP Tonnes)	Production (ODP Tonnes)	Consumption (ODP Tonnes)	Production (ODP Tonnes)
Halon-1211	1998	5,370	5,970	9,939	11,739	9,939	11,739
	1999	5,370	5,970	5,370	5,826	5,370	5,826
	2000	5,370	5,970	3,712	5,970	3,712	5,970
	2001	1,389	1,989	1,389	1,980	1,389	1,980
	2002	1,389	1,989	1,389	1,980		
	2003	2,292	1,992				
	2004	0	0				
	2005	0	0				
	2006	5,670	5,970				
	2007						
	2008						
	2009						
	2010						
Total		**26,850**	**29,850**	**21,799**	**27,495**	**20,410**	**25,515**
Halon-1301	1998	0	0	0	0	0	0
	1999	0	0	0	0	0	0
	2000	0	0	0	0	0	0
	2001	0	0	0	0	0	0
	2002	1,500	180	1,500	180		
	2003	0	0				
	2004	0	0				
	2005	0	0				
	2006	500	4,500				
	2007	0	0				
	2008	0	0				
	2009	0	0				
	2010	1,000	1,500				
Total		**3,000**	**6,180**	**1,500**	**180**	**0**	**0**

[1]According to 2001 Progress Report

8. Of the 27 completed investment projects, 7 were completed ahead of schedule, 7 were completed on time (one of these had been given approval for a revised date), one was delayed 1-6 months, 6 had delays of 7 to 12 months, 5 of 1 to 2 years, and 1 had a delay of more than 2 years (see Table A8 below). Thus, half of the completed projects, some of which had approved revised dates, were delayed. All delays were calculated based on the approved revised date, if any.) Of the uncompleted investment projects, 1 has a delay of 1 to 2 years compared to the approved date of completion, and 3 show delays of 2 or more years.

Table A8: Implementation Delays of Completed Fire Extinguisher Projects

Agency	Implementation Delays					
	Early Completion	On Time	1-6 months	7-12 months	13-24 months	Grand Total
IBRD		1	1			2
UNDP	7			6	3	16
UNIDO		1				1
Grand Total	7	2	1	6	3	19

Table A9: Implementation Delays of Completed Halon Banking and Recovery and Recycling Projects

Agency	Implementation Delays				
	On time	1-6 months	7-12 months	13-24 months	Grand Total
IBRD				1	1
UNDP		1		1	2
Bilateral	3		1	1	5
Grand Total	3	1	1	3	8
