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FINAL REPORT ON THE EVALUATION OF AEROSOL PROJECTS

1. In accordance with the Monitoring and Evaluation Work Programme 2002, the Senior Monitoring and Evaluation Officer organized an evaluation of projects in the aerosol sector.

2. The report of the consultant, Dr. Montfort A. Johnsen, is attached.

FINAL REPORT ON THE EVALUATION OF THE AEROSOL PROJECTS

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Executive Summary, including Lessons Learnt and Recommendations

1. This report provides an overview of the proceedings of the aerosol sector evaluation as well as a synthesis of the findings and recommendations. The team visited 35 aerosol projects in seven countries (India, P.R. of China, Vietnam, Algeria, the Ivory Coast, Lebanon, and Jordan). Good support was received from the NOUs and implementing agencies. The projects selected represent a balanced mixture, in terms of size, region, year of approval and implementing agencies. The only hydro-treatment refining plant funded by the MLF was included (JOR/ARS/07/INV/12).

2. With a few exceptions, the fillers visited had converted from CFC to HAP (Hydrocarbon Aerosol Propellant), or were well into the process of doing so and had terminated their use of CFCs. There was no indication of a return to the use of CFC in aerosol productions in converted plants, except in two cases, where the continued use of CFC could not be confirmed, but also not excluded. These are the basically good news which have to be kept in mind when in the following the many difficulties are described which companies, agencies and their consultants faced in implementing and completing the conversion. In view of these difficulties, which were larger than expected, most projects have been rated highly satisfactory or satisfactory, although a number of problems remain which have been addressed in the individual and in the country reports as well as in the present synthesis.

3. Three companies had not managed the conversion well and were facing bankruptcy or distress sale. Several others had very low production volumes, operating for only 1 to 4 months per year, but their financial situations were bolstered by the plethora of non-aerosol products they were producing. The low utilization of production capacities was also caused by the significant expansion and modernisation many companies realised through the projects. Fillers whose sole products were aerosols faced more difficulties to complete the conversion successfully and to survive in increasingly competitive markets, characterised in all countries by reduced sales prices and increased imports.

4. Many companies went through a difficult transition period during and after conversion. The safety training of workers, the adaptation of formulas and convincing of customers to accept lighter cans with some odour takes time and usually caused a slump in production and sales, which lasted from a few months to a year or more. Some clients changed to suppliers who still use CFC's, inspite of significant price reductions for HAP products, or they started to buy imported products with no odour problem and better image (brand name). The latter is particularly pronounced for perfumes and personal hygiene items, air fresheners etc., and much less for insecticides, cleaning and industrial products.

5. The MLF made a major investment (US $801,071) for a hydro-treating facility (in Jordan), but the product still has a substantial off-odour, requiring all the fillers in that country to install molecular sieves as a partial remedy. Although the hydro-treater was designed to benefit the whole region, in practice it only services Jordan. Consequently, it operates only a few weeks per year. Besides restrictions for transporting HAP's by road, JOPETROL has no marketing division and did not really explore the export opportunities. Production costs might be lower elsewhere for HAP with less remaining odours, thus restricting export possibilities from Jordan. JOPETROL nevertheless should further examine the possibilities to reduce the remaining odour and to identify export markets.

6. In all Art. 5 countries except Lebanon and parts of the P.R. of China the disagreeable odour of HAP contaminants has adversely affected the aerosol industry. (Lebanon imports all HAPs from Europe). Odour reduction methods are often not working well, due to significant investment and operating cost required for a well functioning molecular sieve and lack of know-how to efficiently operate it. Also, even with the best molecular sieve some olefin odours remain. While bad odour is less important for products such as insecticides, it limits sales of all cosmetic and personal care aerosols, leaving the door open for European and Chinese imports. The outlook for better odour control is quite bleak, causing the aerosol business in nearly all Art. 5 countries to stagnate and even diminish. As a corollary, imports from countries such as the U.K., France and Italy are at an all time high, since consumers increasingly realize these products are both well formulated and have good odours. Moreover, the production rates in Europe are 5 to 20 times as fast as those in virtually all Art. 5 countries, making European export products quite competitive, despite custom duties, higher labour and transportation costs.

7. Once completed, the conversion is usually self sustaining, based on lower costs, regulatory constraints, and client habits. For perfumes and colognes, many companies switched to handpumps, in order to avoid odour problems, but generally faced higher cost and limited acceptance by consumers. Destruction of CFC gassers is not a significant deterrent to reversion, since CFC aerosols could be run on the new HAP aerosol equipment, if desired. However, such equipment destruction limits to some extent the increase of production capacity and prevents its possible unsafe use with HAP as well as potential sales of old equipment for use elsewhere.

8. When the conversion programme was in its early stages, some advocates felt they were doing the beneficiaries a favour by providing the equipment to use a much less costly propellant. However, capital costs for the company have often significantly exceeded the value of the grant from the MLF, in particular in cases where a relocation of the plant became necessary for safety reasons. Also, while the propellant cost indeed decreased, sometimes drastically, operating costs for safety measures, plant insurance, transportation, HAP odour reduction and other items, have increased. Finally, marketers have been quick to reduce the buying price of the HAP aerosols, claiming there is less product per can, the odour is sometimes objectionable, and the flammability potential is worrisome. As soon as most fillers in a country were selling HAP aerosols, sales prices dropped, and profit margins actually were reduced in most cases. In brief, the capital cost for the enterprises were often higher and the operational savings less than expected, and realised not as increased profits for the enterprise but as decreased cost for the consumers. Thus many fillers visited were less than enthusiastic about the conversion and the support received. On the other hand, the conversion was unavoidable for them anyway, not only in the long-term when CFCs will disappear, but in order to survive in a market with decreasing prices and increasing competition, and for this adaptation the grants were a welcome help.

9. The majority of the projects evaluated had no problem to meet the cost-effectiveness threshold of US $4.40/kg ODP but several came close to it. Four projects evaluated had an approved and actual cost-effectiveness between US $4.00 and $4.40/kg ODP, like another seven completed aerosol projects. Some companies with small CFC-consumption had to bear substantial parts of the eligible capital cost, after incremental operating savings (IOS) had been deducted. In future projects, very small fillers (under 10 tonnes of annual CFC consumption) might have to pay their conversion largely themselves with the risk that safety measures will be neglected. In such cases, the conversion to HAP aerosols might not be a viable option, even with increased technical assistance.

10. The practice of subtracting incremental operating savings (IOS) in the aerosol sector should be reviewed for future projects on a case by case basis. Non-contract fillers, like contract fillers already now, might be exempted from deductions of incremental operating savings if such savings are not realized on the company level, but only by the clients (reduced selling prices). By bringing in more realism into the calculation of IOS, the companies and Implementing Agencies might become less inclined to exaggerate the baseline CFC consumption in order to justify a project budget covering the full or at least a substantial part of the incremental capital cost.

11. The extreme flammability of the HAPs necessitated the purchase of highly specialised "explosion-proof" gassing equipment, ventilation systems, gas detection and alarm systems, leak detectors, water baths and other items. The beneficiary must sometimes move to a less populated area, engage in specialised site preparation, and so forth. The preponderance of MLF and beneficiary contributions is spent on flammability control, and so far no fire occurred in any of the aerosol projets funded by the MLF, thanks to the attention brought to this matter in project preparation and implementation. Technical advice given to companies, brochures distributed and seminars successfully held in various regions of the world also played a positive role. However, some plants were seen operating under very unsafe conditions, and their managers seemed relatively nonchalant about hazard control. A guidebook in several languages (with illustrations) could help to dispel this complacency.

12. Implementation delays were frequently encountered, with several well over a year and one now over four years and still unresolved. Delays are most often engendered by government requirements, such as safety inspections and certificates and in some cases customs procedures. Others are the responsibility of the beneficiary, and may relate to poor planning, contractor delays, revisions, financial constraints or delays in getting items that are ordered by the firm. In a few cases, an equipment supplier caused some delays by not wishing to send engineers to Algeria, where foreigners were for years not able to travel safely. Finally, a few disputes between beneficiary companies and the implementing agency have occurred concerning equipment prices, missing items, delivery terms, etc. For those firms who only fill aerosols, protracted production down-time is financially devastating. Overhead costs continue, while both customers and key employees may be lost forever. Projects with these fillers need to pay particular attention to minimize delays and transitional downtime.

13. The equipment purchased under the projects was always of good quality but implied often a significant increase of capacity and a technological up-grade not discounted from project cost. This was usually justified by the implementing agencies as minimum replacement technology available. While indeed the leading equipment producers offer little in between very slow, laboratory type manual gassers and so-called semi-automatic machines, the inflexible premise that "all CFC gassers leak and must be destroyed" might profitably be re-examined --- unless the units are too old and worn out and the company has not the technical capacity to retrofit them. Assuming good maintenance and proper execution of the retrofitting which might not always be easy to arrange or too lengthy to be of interest to the company owner, CFC gassers will work perfectly well with HAPs after re-gasketing and changing the motors to explosion-proof or air. It needs to be mentioned that, items purchased by the beneficiary, such as tanks and molecular sieves, were often insufficiently specified or second hand and have caused problems, such as delays and rejections by fire authorities or refineries.

14. Frequently, language differences between engineers from equipment suppliers and beneficiary companies rendered communication during visits difficult. The problem was compounded by the fact that supplier texts, manuals, lay-outs, check-lists and so forth were usually in English and could not be understood by many recipients.

15. In the selection of project equipment, consultants or agency staff usually suggest to the company what should be purchased, always from a short list of seven approved suppliers in the USA (2) and Europe (5). The implementing agency then issues bid invitations, and almost always selects the lowest bidder. UNIDO as a rule has to choose the technically acceptable offer with the lowest cost. This does not allow the beneficiary to pay the difference for more expensive equipment (in contrast to World Bank and UNDP/UNOPS practices). With UNIDO, the beneficiary company may not know what equipment they are getting until it is shipped and they do not see the contract with the supplier and the cost per equipment items. Many companies criticised this procedure since they look at a broader picture, also considering supplier service, change-over time, safety, mechanical complexities, quick availability of change parts, the need for accessories, and other important factors. In many cases, they would prefer getting the project equipment from firms they are familiar with, even if they were asked to pay the cost differential. In at least one instance, site preparation had to be revised, when the parameters of the project equipment were finally disclosed. More flexibility and beneficiary involvement is recommended.

16. Total remaining CFC consumption in the aerosol sector of all Art. 5 countries, according to the latest data reported by them to the Multilateral Fund Secretariat, is 4,982 ODP tonnes, corresponding to 5% of the latest reported CFC consumption (95,627 ODP tonnes). The approved phase-out of ODS for all aerosol projects is 24,228 ODP tonnes, and the actually achieved phase-out is 21,628 ODP tonnes. The approved but not yet implemented phase-out in on-going projects is 2,835 ODP tonnes, leaving a remaining CFC-consumption yet uncovered by projects of 2,835 ODP tonnes. While in most countries the aerosol sector has a marginal role for future compliance, in several small countries the conversion of a few remaining fillers could make a difference.

17. Based on the findings and conclusions of the evaluation, it is recommended:

(a) To assess in each future project the feasibility of retrofitting the CFC-gassing equipment and to justify cases where this is deemed not to be possible.

(b) That incremental operating savings in future aerosol projects should be deducted only when such savings actually increase profitability at company level and are not just transferred to marketers and consumers via decreased selling prices.

(c) To allow the beneficiary company to pay the cost difference for equipment from high priced bidders.

(d) To ensure that in the bidding specifications for equipment orders prepared by implementing agencies, the provision of manuals in a language understood by the engineers of the beneficiary company is foreseen, as well as interpreters during equipment installation, if necessary.

(e) To prepare, translate and distribute by the relevant agencies a manual on safety, formula adaptations, and effective destenching methods for aerosol productions using Hydrocarbon Aerosol Propellants (HAP).

18. A number of other recommendations to be taken into consideration by the implementing agencies, the National Ozone Units and the beneficiary companies, and/or calling for the full implementation of earlier decisions of the Executive Committee, are to be found in various sections that follow.

I. Introduction

19. This paper gives an overview of the evaluation approach and provides a synthesis of the main findings and recommendations of the evaluation team, who visited 3 countries in Asia, 2 in the Middle East and 2 in Africa, to evaluate 35 Aerosol projects (for details about the sample of projects visited see Section IV below).

20. The country evaluation reports (CER) and project evaluation reports (PER) are available on request, and can also be found on the Secretariat's web site, in the section "Executive Committee", evaluation reports.

II. Evaluation Process

21. The evaluation proceeded with the following steps:

(a) in-depth desk review by the consultant studying the documentation, identifying evaluation issues and proposing projects for field visits;

(b) preparation of a summary by the Senior Monitoring and Evaluation Officer and presentation to the Monitoring, Evaluation and Finance Sub-committee at the 32^{nd} Meeting of the Executive Committee (Section IV of document UNEP/OzL.Pro/ExCom/35/11), which took note of the proposed evaluation approach;

(c) visits of the consultant and the Senior Monitoring and Evaluations Officer to the selected sample comprising 35 projects in Asia, the Middle East and Africa during the first half of 2002;

(d) preparation by the consultant of draft evaluation reports on each project and country reports on each country visited; the country reports analyze the aerosol sectors of the countries in terms of past achievements and remaining tasks for ODS phase out;

(e) Sending draft/country evaluation reports (CER) and draft project evaluation reports (PER) to the countries and Implementing Agencies concerned for comments.

(f) Integrate the comments received into the final versions and prepare the draft synthesis report by the consultant in cooperation with the Senior Monitoring and Evaluation Officer.

(g) Sending the draft synthesis report to the Implementing Agencies concerned for comments, and integrating comments received into the present final synthesis report.

III. Evaluation Team, Support by the Ozone Offices and Implementing Agencies

22. The consultant has been recruited on the basis of a direct search for appropriate candidates. One consultant from U.S.A. was chosen for his:

(a) More than 40 years of experience in the aerosol industry and his first-hand experience with conversion from ODS-based production of aerosols to non-ODS substitutes;

(b) neutrality in terms of not being a consultant to the Montreal Protocol units of the Implementing Agencies.

23. The governments of all countries visited had been informed beforehand, and their concurrence had been obtained. The evaluation missions were very well received and supported by the Ozone Offices in the countries visited. The Ozone Officers prepared the visits to the companies and accompanied the evaluation team. Information requested on companies and national policies, including experiences gained during project implementation, were readily provided. In most visits, representatives of the companies were cooperative and accessible, although sometimes not prepared to provide exact figures on previous years performance and cost.

24. The Implementing Agencies were supportive as well. UNIDO sent a Project Officer to accompany the evaluation mission on visits to companies in Lebanon, Algeria and Ivory Coast. The UNDP Project Officer accompanied the mission during some project visits in India. Staff of the World Bank's financial intermediaries met the missions when required and accompanied them on some company visits. The main aerosol consultant for the World Bank and UNDP participated in visits in India and Jordan. Another consultant for UNDP joined the mission in Vietnam.

25. The Implementing Agencies submitted project completion reports (PCRs) for all but six projects, some of them shortly before the visits. The PCRs were useful in terms of preparing and structuring the discussions in the enterprises, in spite of the fact that they often lacked important quantitative information. In some cases they were misleading by suppressing problems and providing wrong data (see section XVIII below).

IV. Sample of Projects Visited

26. The total number of 35 projects visited represents a good coverage by region, implementing agency, size, year of approval and sub-sector. The 35 projects evaluated represent 45% of all 77 Aerosol projects completed until the end of 2001, and 32% of 108 Aerosol projects approved until July of 2002 (37^{th} Executive Committee Meeting).

27. Most Aerosol projects visited were in Asia (18), followed by Africa (10) and the Middle East (7) (see Table 1). Latin America and Europe have very few completed aerosol projects (one each in Ecuador, Croatia, Romania and Turkey) which were not visited in order to limit the travel expenses.

28. While focussing on completed projects, six on-going projects were also visited in order to complete the information about the phase-out in the respective countries and to learn about the technology or project modality employed. Among those, two projects had been reported as completed, but found uncompleted (for more details see Section VII). On the other hand, one project which had been reported as on-going in the 2001 Progress Report, was completed in the meantime. Furthermore, three project candidates in different states of project preparation were visited in Jordan, Ivory Coast and Vietnam.

Table 1: By Region

Region	Latin America & Caribbean	Asia (with Middle East)		Africa		Europe
Projects Evaluated		China	2	Algeria	8	
		India	13	Cote d'Ivoire	2	
		Jordan	5			
		Lebanon	2			
		Vietnam	3			
Total	**0**		**25**		**10**	**0**
All Projects Completed	**1**		**52**		**21**	**3**

29. The evaluation covered projects implemented by all three Implementing Agencies (see Table 2).

Table 2: By Implementing Agency

Implementing Agency	Number of Projects Completed As per 2001 Progress Report	Number of Projects Evaluated	Percentage
Germany	1	0	0%
UNDP	25	12	48%
UNIDO	31	12	39%
World Bank	20	11	55%
Total	**77**	**35**	**45%**

30. The sample included projects of all sizes in terms of funding. Although the emphasis was on projects of small and medium size, some relatively large projects were also included.

Table 3: By Size

	Under US $ 100,000	US $ 100,000-500,000	US $ 500,000-1,000,000	Above US $ 1,000,000	Total
Number of Projects Completed as per 2001 Progress Report	28	41	5	3	77
Number of Projects Evaluated*	15	16	3	1	35
% of projects evaluated	**54%**	**39%**	**60%**	**33%**	**45%**

*Five projects evaluated are still on-going and one is cancelled.

31. As the following table shows, care was taken to select projects that were approved and completed in different years in order to identify trends and the effects of policy changes.

Table 4: By Year Approved

Year of Approval	Number of Projects Approved*	Number of Projects Completed As per 2001 Progress Report	Number of Projects Evaluated	Percentage (evaluated / approved)	Percentage (evaluated / completed)
1992	6	6	2	33%	33%
1993	2	2	0	0%	0%
1994	4	4	1	25%	25%
1995	14	12	4	29%	33%
1996	17	15	11	65%	73%
1997	25	23	10	40%	43%
1998	13	11	5	38%	45%
1999	11	3	2	18%	67%
2000	10	1	0	0%	0%
2001	4	0	0	0%	0%
2002	2	0	0	0%	0%
Total	**108**	**77**	**35**	**32%**	**45%**

*Excluding three cancelled projects

32. Care was also taken to include as much as possible different types of projects into the sample, as shown in Table 5 below:

Table 5: Selected Projects for Evaluation by Sub-sector

Aerosol Sector	Total No. of Projects Approved* (As of July 2002)	Total No. of Projects Completed (end of 2001)	Selected Projects for Evaluation 2002	% of all Approved Aerosol Projects	% of all Completed Aerosol Projects	MLF Disbursed Grant for Projects Evaluated (end of 2001, in US $)	% of Disbursements (evaluated / completed)
Contract filler	31	23	12	39%	52%	2,629,456	26%
Filling plant	76	53	22	29%	42%	3,469,075	38%
LPG purification	1	1	1	100%	100%	799,341	100%
Total	**108**	**77**	**35**	**32%**	**45%**	**6,897,872**	**35%**

*Excluding three cancelled projects

V. Evaluation Issues and Data Collection Approach

33. Detailed evaluation issues and terms of reference for the evaluation were presented to the 35[nd] Meeting of the Executive Committee in Section IV of document UNEP/OzL.Pro/ExCom/35/11, p. 28:

(a) Analyze cases where the ODS phase out does not appear to be transparent, or is inconsistent or less than approved; assess the viability of technology chosen, and the risk of returning to the use of ODS, particularly in countries facing difficulties to obtain hydrocarbons at reasonable price and sufficiently low odour quality.

(b) Analyze experiences made with small projects in order to generate lessons of how to deal in future with such projects that might become more frequent. This would be useful in particular for countries with large numbers of small fillers, like India.

(c) Analyze experiences gained with the implementation of the only terminal umbrella project approved so far for Malaysia, and explore the obstacles for such projects and other innovative approaches which were called for by the 25[th] meeting of the Executive Committee, in order to deal with the remainder of the aerosol sector in the Article 5 countries (dec. 25/20).

(d) Identify the reasons for the frequent implementation delays, systematize them and propose solutions to overcome repeated bottlenecks.

(e) Establish actual incremental operating costs or savings for which information provided to the Multilateral Fund Secretariat is generally poor. Identify implications of incremental operating savings (IOS) for the mobilization of counterpart funding and resulting implementation delays. Verify the distribution of actual IOS in case of "contract filler" projects for which decision 17/15 of the Executive Committee was applied.

(f) Examine safety and environmental issues, including baseline conditions, in project preparation, implementation as well as in reporting. This is of particular importance as the substitutes used for the conversion are in almost all cases highly flammable hydrocarbons.

(g) Trace the fate of the old equipment, which is supposed to be destroyed and discuss possible and cost effective ways of rendering such equipment unusable or assigning it to non-ODS applications, in order to improve the chances for making the conversion irreversible.

(h) Identify successful management approaches to organize the conversion efficiently within companies and in cooperation with the relevant Government authorities, the Implementing Agencies and the suppliers of equipment and materials. A particular interesting feature is the early phase-out in several Art. 5 countries, mainly by voluntary agreements of local industries and multinational companies.

34. The format used for the project evaluation reports (PERs) is largely identical with sections I, II and III of the revised project completion report (PCR) format for investment projects. It served as an interview guideline in the companies visited and as a format for entering the data collected.

VI. Project Completion

35. According to Decision 28/2 of the Executive Committee, completion of a project means:

(a) "No further use of CFCs is in evidence;

(b) that the alternative product is being produced and/or production has begun; and

(c) that the CFC-using equipment has been destroyed/dismantled/rendered unusable with CFCs."

36. Using this decision as a reference, the new overall assessment scheme in the revised project completion format for investment projects has been designed in a way that 20 points are given for each of these criteria if they are fulfilled (see overview table in Annex I which applies this new rating scheme to the projects evaluated). For the 31 projects reported as completed (of the 35 projects evaluated) the results are shown in Tables 6a and b below:

Tables 6 a and b: Completion of Projects Evaluated According to Decision 28/2 of the Executive Committee

a) For 14 Projects Reported as Completed Before July 1999

Completion criteria	Number of projects fulfilling these criteria		
	Yes	No	N/A*
a) No further use of CFCs is in evidence	13	0	1
b) Alternative product is being produced and/or production has begun	11	2	1
c) CFC-using equipment has been destroyed/dismantled/rendered unusable with CFCs	8	5	1

*Not applicable

b) For 17 Projects Reported as Completed After July 1999

Completion criteria	Number of projects fulfilling these criteria		
	Yes	No	N/A*
a) No further use of CFCs is in evidence	15	2	0
b) Alternative product is being produced and/or production has begun	16	1	0
c) CFC-using equipment has been destroyed/dismantled/rendered unusable with CFCs	13	4	0

*Not applicable

37. Tables 6 a and b show that not all criteria for project completion have been fulfilled in a number of projects reported as completed before and also after Decision 28/2 taken in July 1999. In two cases, the continued use of CFC could not be excluded but also not be confirmed. In three projects, alternative production has not yet started, and in 9 projects the old equipment has not been destroyed. One project had been reported as completed in December 1998 and was then cancelled by the 37th meeting of the Executive Committee (ALG/ARS/20/INV/18). Another project reported as still on-going could be confirmed as completed although new production has not yet gone beyond extended trials (for more details see Sections VII, VIII and XVI below).

38. 22 projects had been financially closed at the time of the 2001 Progress Reports. In 16 cases shown in the overview table in Annex I, small balances have been returned to the Multilateral Fund. For one financially completed project, there are still funds to be returned (JOR/ARS/07/INV/14). 8 projects are awaiting financial completion, two of them almost three years after being reported as physically completed (in December 1999). In one case, financial completion is due after the project has been cancelled at the 37th meeting of the Executive Committee.

VII. CFCs Phased-out and New Production Started

39. The main positive result is that with only two exceptions, where doubts about continued use of CFCs remained, the companies visited have successfully phased out the targeted volume of ODS. Successful phase-out means that no more CFCs are used in the company. In this case, the original baseline consumption of CFC as confirmed or corrected by the evaluation, has been eliminated, irrespective of the current production level and quantities of substitutes used. One company used limited quantities of CTC (ODP value of 1.1) as propellant in some revised formulas. While project equipment was employed, this had not been approved nor reported in the PCR.

40. The baseline ODS consumption figures in the project document appeared in many cases as high compared to actual on-going production which often used only a fraction of the installed new capacities. While some companies still struggled to overcome the adverse effects of the conversion in terms of the light weight of cans and bad odours of HAP aerosols, others were affected by increased competition due to low demand, reduced sales prices and rising imports.

41. Participation of National Ozone Units or local Consultants in the collection of ODS consumption data is crucial, especially when verification of data involves checking the enterprise's records, available only in local languages. The ODS consumption calculated in the enterprise should be corroborated by information on ODS imports, available from importers and customs records as soon as an import licensing scheme has been put in place. Invoices for the purchase of ODS presented by the enterprises should, as much as possible, be certified by the National Ozone Unit and should be kept on record for future verification, in accordance with decision 33/2 of the Executive Committee.

VIII. Remaining CFC Consumption and Sustainability of Conversion

42. Total remaining CFC consumption in the aerosol sector of all Art. 5 countries, according to the latest data reported by them to the Multilateral Fund Secretariat, is 4,982 ODP tonnes, corresponding to 5% of the latest reported CFC consumption (95,627 ODP tonnes). The approved phase-out of ODS for all aerosol projects is 24,228 ODP tonnes, and the actually achieved phase-out is 21,628 ODP tonnes. The approved but not yet implemented phase-out in on-going projects is 2,835 ODP tonnes, leaving a remaining CFC-consumption yet uncovered by projects of 2,835 ODP tonnes. While in most countries the aerosol sector has a marginal role for future compliance, in several small countries the conversion of a few remaining fillers could make a difference.

43. The NOUs of the Art. 5 countries visited have generally quite a good idea of remaining CFC consumption for aerosols, particularly when there are a limited number of aerosols fillers in a given country. Most have a dozen or less. Nevertheless, in Algeria and Ivory Coast, the reported remaining consumption seems too high in the first case and too low in the second, as explained below. The monitoring is more difficult when there are numerous fillers, many of whom are part of the informal sector. India with about 90 fillers identified thus far, plus many small units still unknown, and similarly China, present formidable problems of monitoring and control.

44. Monitoring by the NOUs is also more difficult when the country has domestic CFC production facilities (India and P.R. of China), or where the illegal importation of relatively cheap CFCs is significant (Ivory Coast). The small, clandestine fillers, sometimes known as "cottage industries", operate in a very localized fashion. They may order a cylinder or two of CFC-12 from a local refrigeration dealer and use them to produce aerosols on a manual line set up in their house, garage or barn. They sometimes use also LPGs, but lack purification facilities and safety provisions and are therefore in risk of fire or explosions. Most of these fillers continue to use CFCs, and in many cases, it might not be possible to convert them to safe and viable users of HAP.

45. In India an estimated 70% of aerosol CFC consumption has been converted. This means that about 16,000,000 CFC-based aerosols are still being produced each year. Consultants for UNDP are busy, trying to monitor and further reduce this consumption with technical assistance and safety inspections for remaining CFC users and half converted units. The preparation of a terminal umbrella project for about 50 SME’s is underway.

46. China has banned the use of CFCs for aerosols since 1997, but is apparently limiting enforcement. Although a recent survey by the Shanghai Perfume Research Institute failed to identify CFC aerosol cans in a sample of market outlets, there are indications of significant numbers passing through informal market channels, in particular in rural areas. An estimated number of 32,000,000 aerosol cans might still be produced annually using CFC.

47. For Algeria, funding of US $25,000 was approved for the preparation of 8 additional aerosol projects at the 36th Meeting of the Executive Committee. There is no list of these companies, however, and it is doubtful that 8 such companies can be found. The NOU has stated that only one or two small fillers in Algeria are still producing CFC aerosols. In any event, with the extremely low price of LPG in Algeria (about US $0.05 per kg) it is almost certain that the IOS would be higher than the presumed project capital cost. Further investigation seems appropriate -- perhaps starting with a better identification of other Algerian fillers through the new Association of Cosmetic and Aerosol Industries (ACAI).

48. The Ivory Coast did report zero consumption of CFC for aerosol production in 1998 already. During the evaluation mission, however, a third relatively large aerosol company, COPACI, was visited which reported an annual on-going CFC consumption of 37 tonnes. Three other small fillers (Simopa, Seewards, Separco) might also still use some CFC.

49. The three attractions for continued CFC aerosol productions are (1) the low cost of equipment, either still in-house or purchased at low prices, (2) the fact that CFCs have essentially no odour, unlike most available HAPs and (3) there is little concern or expense related to flammability, since the CFCs are non-flammable.

50. In many countries laws or regulations prohibit the start-up of new aerosol filling plants that produce CFC products. The degree to which these regulations are monitored and enforced varies from country to country. A number of NOUs have the ability to monitor and control the importation and thus the consumption of CFCs, since most Art. 5 countries have no domestic CFC production. While a few very small fillers might escape detection for awhile, any large use of the three CFCs used for aerosols would probably be noticed and investigated. There is always the possibility of illegal imports, however, and this is, in fact, occurring in several countries.

51. The most compelling deterrent for reversion is the higher price of the CFCs, when compared to the much lower cost of the HAP alternatives. The ratios vary from country to country, but discounting "black-market" CFC pricings, the CFCs will generally cost about 1.6 to 2.9 times the price of the HAPs on a weight basis (more CFC is needed to get a good spray or foam, compared with HAPs --- typically 1.5 to 2.2 times as much --- and the greater density of the CFCs means that more product weight must be put in the can). These conjugate factors also raise factory and retail costs. The total cost difference is so large that any CFC-based aerosols would have to be niche-marketed and sold only in the most expensive cosmetic shops. However, such establishments would not risk their image by accepting anything less than well-known brand-name products.

52. Should one of the converted fillers revert to the use of CFCs, the back-slide would soon be public knowledge within the company. It might then be reported even more widely, quite possibly also to regulatory enforcement entities. Although HAP equipment can be easily used with CFCs the concentrate composition would have to be revised, and the filling weights as well. Such changes would almost inevitably get into production records, which could be verified by auditors under fiscal laws in most countries.

IX. Equipment Destruction and Possibilities of Retrofitting

53. While there was a general understanding about equipment destruction since about 1995, it is only since 1999 that Implementing Agencies made equipment destruction regularly part of the formal and signed contracts with the beneficiary companies and also prescribed that destruction had to be certified, by the NOU, and/or the agency, or one of their consultants. The destruction is then to be duly reported in the PCR, supported by documentation. According to the 72 PCRs received, 37 of the 77 completed projects have not destroyed their old equipment. This was confirmed by the field visits which showed that almost one third of the companies had kept the CFC gassing heads in storage. Most of these projects were implemented by UNIDO. The old gassers were seen sitting on remote work-benches or in storage areas --- or at least said to be unused but still available, elsewhere in the factory. This indicated that the spirit of the agreements was being observed, if not the required destruction. Nevertheless, there is a risk that the old gassers might either be re-used with CFC or sold to other companies or more likely be used with HAP, after an incomplete and unsafe retrofit, exposing the company to great fire risks. One manager intimated that his old CFC gasser might be retrofitted and used to expand his HAP-based production facility, or serve as temporary back-up capacity should business development warrant. In the Jintong Company in China, (Fujian umbrella project CPR/ARS/24/INV/244), this actually took place.

54. In some cases, the destruction was made more complicated by the fact that the beneficiary firm had used two or more CFC gassers while receiving only one HAP gasser with large capacity. In other situations, the gasser unit was an integral part of a machine designed to fill the product concentrate, seal the aerosol valve in place, and then inject the CFC gas, backwards through the valve. While the gassing head itself could be detached and destroyed, the wiring and electronics were integrated with the other two operations and could not be extirpated, except by an expert from the supplier. A few firms took advantage of this multi-phase equipment and were able to include new combined rotary filler/crimper/gasser machines into their projects, while keeping the old ones.

55. One of the cornerstones of agency presentations to prospective beneficiary firms is that the old CFC gassing equipment is assumed to be always leaky, and thus too dangerous to be used for HAP productions. This tenet has caused the discontinuance or destruction of many CFC gassers which were replaced by single or multi-operation HAP gassers, at prices ranging from about US $20,000 to $90,000 each.

56. In actuality, these deposed gassers had only one moving part (for the gasser, per se) and that was the piston. The wear of piston-against-cylinder is normally minimal, unless the propellant is contaminated with abrasive particles and not filtered. Even if some modicum of wear occurs, the piston surface can be lightly nickel plated and readily machined back to the original or ideal diameter. The only leakage loci of any consequence would be the rubber or plastic gaskets. These are readily and inexpensively replaced when gassing with either CFCs or HAPs. Evidence of elastomer leakage is readily discovered. When liquid propellant seeps past a defective gasket and evaporates, a cooling effect results. The centering bell or other metal parts will then first accumulate a mist of moisture, as their temperature falls below the dew-point. As things progress, the mist will turn into water droplets and finally freeze, forming a layer of ice. This is quite obvious and signals the operator or maintenance person to shut the machine down and replace the worn gasket with a minimum of delay.

57. The inflexible premise that "all CFC gassers leak and must be destroyed" might profitably be re-examined --- unless the units are too old and worn out and the company has not the technical capacity to retrofit them. Assuming good maintenance and proper execution of the retrofitting, CFC gassers will work perfectly well with HAPs after re-gasketing and changing the motors to explosion-proof or air. Conversely, HAP gassers will function well with CFCs. In theory, that would allow any of the converted facilities to be used for the production of CFC aerosols. However, no evidence of this was seen, once conversion to HAPs was completed, for the reasons described in section VIII above.

X. Implementation Delays

58. Fourteen of the 29 completed projects evaluated suffered from implementation delays of more than six months, and 10 of more than one year. There have been various negative consequences, including the additional release of CFCs into the atmosphere, price increases for equipment or services, extra work for the NOU and implementing agencies and sometimes the development of frictions between the beneficiary and the other parties.

Table 7: Implementation Delays of Completed Projects Evaluated* Shown by Implementing Agency

Agency	Implementation Delays in Months					
	Early Completion	0-6	7-12	13-18	More than 18	Total
IBRD	1	3		4	1	9
UNDP		9	1		2	12
UNIDO	1	1	3	3		8
Total	**2**	**13**	**4**	**7**	**3**	**29**

*Excludes one cancelled project and 5 ongoing projects also visited.

59. The most common causes of delays were related to the certification of specific items (such as bulk storage tanks), negative results of on-site inspections, and unexpected safety requirements. Most of these were for the account of the beneficiary, and were often hotly contested. Some of the longest delays involved a national or local requirement that the filler move to a more remote location, since this required the purchase of land, plus site preparations, including construction of buildings, installation of large tanks, fencing, utility services and so forth. In such cases, the counterpart expenses became several times larger than the MLF grant.

60. In some cases, beneficiaries caused significant delays, by not being ready to install the project equipment when it arrived. Considerable planning is needed, especially if certified bulk storage is involved. Unless the beneficiary coordinates his preparatory activities with government agencies, there will often be unpleasant and time-consuming surprises.

61. The timely receipt of equipment has generally not been a problem, although it has sometimes been impounded in customs houses awaiting payment of duties or warehouse charges by the beneficiary. Occasionally some key items were missing --- either not ordered, or not included in the shipment. The beneficiary companies should carefully monitor the list of itemised equipment and accessory expenses, verify delivery, calculate any shipping costs, and compare the total against the fund allocations. In a few cases inconsistencies have been detected. Plants were also seen, operating without the benefit of such small items as crimp gauges, pressure gauges, explosimeter gas-leak detectors, fire extinguishers and so forth, even though these were in the project equipment listings. A check with the plant manager simply elicited the response that they were unavailable. There is a significant safety vector attached to the use of these items, and their absence should be a matter of concern.

62. In some cases, missions of supplier company engineers to install the various machines, monitors, power connections, piping and so forth were delayed. On some occasions, this has been caused by political instabilities, the aftermath of September 11, or the desire of suppliers to save money by sending their engineers to visit two or three filling plants on one trip, in the same region of the world. Contracts between the implementing agency and the equipment supplier, generally specify the number of visits, but can hardly be date-specific, except perhaps to say "…within one month from receipt of…", but even this cannot be precise, since there could be customs delays, or the site preparation may still be incomplete.

63. Table 8 below shows the actual duration of projects evaluated by implementing agency. 19 of the 29 projects have been completed between 19 and 36 months while 8 exceeded this duration and two were completed faster. This pattern corresponds more or less to delays and durations of all completed aerosol projects as well as to the averages observed for all completed investment projects. It shows that project completion times of 18 months or less are generally unrealistic.

Table 8: Actual Duration of Completed Projects Evaluated* Shown by Agency

Agency	Actual Duration in Months					
	0-6	7-12	13-18	19-36	36 and More	Total
IBRD			1	5	3	9
UNDP				8	4	12
UNIDO		1		6	1	8
Total		**1**	**1**	**19**	**8**	**29**

*Excludes one cancelled project and 5 ongoing projects also visited.

XI. Technology Choices and Selection of Equipment

64. Generally, CFCs have been substituted by HAPs, and in one case in PR China by DME. Thus the conversions had to focus on controlling flammability and limiting the fire risks. Non-flammable substitutes like carbon dioxide and HFC-134a were chosen in 3 projects only (see Table 9 below). In North-America and Europe a number of non or less flammable substitutes were tested and adopted. These include DME, 1,1-difluorethane (HFC-152a), HFC-134a, and the high pressure gasses, such as carbon dioxide, nitrous oxide, nitrogen and compressed air (CAIR). The HFCs are to some extent global warming agents but less than most CFC's. Others require special equipment. Trials of various beneficiary companies with non-HAP propellants were, with the few exceptions mentioned above, not satisfactory and abandoned after short periods. (See also Annex IV on the choice of various propellants).

Table 9: Technology Choices as per Inventory of Approved Projects*

Technology Choice	Total No. of Technology Choices Completed	No. of Technology Choices Evaluated	Percentage Evaluated
CFC-11 to HAP	32	17	53%
CFC-113 to HAP	1	0	0%
CFC-114 to HAP	6	4	67%
CFC-12 to Carbon dioxide	1	0	0%
CFC-12 to Dimethyl ether	1	1	100%
CFC-12 to HAP	69	30	43%
CFC-12 to HFC-134a	1	1	100%
CTC to HAP	1	0	0%
MCF to Carbon dioxide	1	0	0%
Total	**113**	**53**	**47%**

*Later unapproved technology changes are not reflected; some projects use more than one conversion technology.

65. Fillers and marketers in Art. 5 countries have very few research facilities, and those that do exist are mostly rather primitive. Therefore, formula innovations are obtained by copying formulas and packaging specifications used by European multi-national marketers who have their products filled locally. Knowing this, the Europeans have taken steps to prevent or minimise this plagiarism. For most Art. 5 countries the leading products are insecticides, followed by personal deodorants, air fresheners, mould releases, hair sprays and colognes. The remaining products, less than 5%, include polishes and shave creams.

66. The recommendations of the aerosol consultants have always played a key role in the selection of technology and equipment by agencies, subject to certain guidelines laid down by the Executive Committee. This modus operandi has generally worked well. Since the consultants live and work in North America and Europe, where over 90% of the world's aerosol equipment is produced, it is natural that they have favoured the use of such equipment. On the other hand, they are aware of some simple equipment made in India, and more complex lines of equipment manufactured in the P.R. of China and in Japan. Some of these items may be suggested in future projects, and invitations to tenders should not exclude local suppliers, either on behalf of the implementing agency or the beneficiary company.

67. There are seven international suppliers of aerosol production equipment, thus far used in projects. Two from the USA, three from England, one from Switzerland and one from Italy. Nimmo (U.K.) is on the verge of bankruptcy and this should be considered in future projects. All these suppliers make equipment ranging from manual, to semi-automatic to automatic, with production speeds from about 10 to 400 cans per minute. Most Art. 5 country requirements are in the 10 to 35 cans per minute range. Of these suppliers, six may be considered as good and comparable in quality and pricing. The seventh (Pamasol - Switzerland) is generally rated as extremely good, but prices are 20 to 30% higher than for equipment offered by their competitors.

68. For fillers in Art. 5 countries being situated far from the equipment suppliers, breakdowns can be quite devastating, in terms of lengthy business interruptions and customer dissatisfaction. Because of their more rugged construction, advanced engineering and the use of highest quality materials, Pamasol machines have earned a worldwide reputation for accuracy, and trouble-free performance. Those fillers who had Pamasol CFC-equipment were very satisfied with it, and have uniformly wished to have the project replace it with new Pamasol HAP-equipment. They have been willing to pay for the difference in cost, over that of the lowest priced competitor in the bidding process.

69. While this has been accepted practice of UNDP and the World Bank, it is unacceptable to UNIDO. In a number of instances, companies did not know what equipment supplier had been selected by UNIDO until a bill of lading was received. This has caused frictions between the companies and UNIDO and sometimes the NOU. The possibilities for a more flexible purchasing procedure might be considered by UNIDO.

70. There is a lot of confusion concerning the proper utilisation of water baths which were seen at 20°C or 40°C at many locations. They should be at about 54°C anticipating a 100% immersion time of a minute or two, for purposes of testing both the pressure resistance and leak-free condition of the filled aerosol cans.

71. In three companies, gas alarm systems were installed but inoperative. In another project, the electronic "black box" of one was resting on an office desk. Pointing to it, the owner of the company said, "This cost over US $10,000 but I have no idea how to install it!" In a few instances, the associated sensing modules were seen in open-air locations, where wind currents made them almost valueless.

72. In most Article 5 countries, due to the bad odour of LPGs available, devices called molecular sieves are required to remove at least some of the worst smelling contaminants. These were seen in cylinders of between 40 and 360 mm diameter and many different lengths and numbers (one to six consecutive cylinders). Only two plants were seen to have molecular sieves of the correct dimensions. In addition, at least two were packed with absorbents in the wrong sequence, and three others were piped incorrectly, allowing the LPG liquid to channel through the cylinders, instead of welling up slowly, in a laminar fashion, from bottom to top. Most fillers complained that, even with molecular sieving their LPG propellant emerged with much of its original offensive "rotten egg" odour. When corrective information was conveyed, fillers said that they had received nothing in the way of instructions. Finally, in several locations, relatively open bags of Zeolyte (molecular sieve material) were seen. This gave the Zeolyte an opportunity to absorb up to 29% of its weight of moisture from the air, making it useless as a decontaminant medium.

73. The bad odour of the LPG gases, often still present after purification with molecular sieves, is a serious deterrent to aerosol sales. Some firms have therefore used finger-pump sprayers in aerosol cans, in particular for perfumes, colognes and deodorants, and thus avoided the use of any propellant. Their success was mediocre at best. The spray performance is not optimal with locally available pumps and imported pumps are too expensive (for more details see Annex V on packaging systems).

74. Some fillers have had to invest in bulk-tanks, where they would not ordinarily do so. This is because virtually all HAP cylinders are used for heating and cooking, and the government requires that all of them are to be stenched with either ethylthiol or isobutylthiol (mercaptans), in order to enable users to detect leaks rapidly by the offensive smell. Aside from frequent interchanges (some cylinders only hold 11.3 kg), and the resulting increase in handling hazards, these deliberate contaminants are only partly removed by the majority of poorly engineered molecular sieves in Art. 5 countries, and this leads to HAP odours almost intolerable in certain aerosol products, such as colognes and personal deodorants.

75. If bulk-tanks for HAPs are included in the conversion process, the NOU and the implementing agency should carefully consult with government bodies having jurisdiction, on matters of construction standards, certification requirements, placement and so forth, in order to avoid serious administrative delays or rejections. This is especially true for imported bulk-tanks.

76. Two small fillers in India purchased thousands of used and emptied aerosol cans from waste dump scavengers. After culling out the unusable ones, they filled them backwards, through the valve, using a complete aerosol formulation compounded in a 1.5 m tall cylinder, which hung inverted from the ceiling, near the gasser. The cans were then paper-labelled for the new product. Products such as mould release agents, insecticides and personal deodorants were being filled in this fashion --- saving the rather high cost of the can and valve, but increasing the risks of leakages.

77. Frequently, language differences between engineers from equipment suppliers and beneficiary companies rendered communication during visits difficult. The problem was compounded by the fact that supplier texts, manuals, lay-outs, check-lists and so forth were usually in English and could not be understood by many recipients. One reason that Pamasol equipment was preferred in those parts of the Near East and Northern Africa where French is the second language (after Arabic) is that this Swiss firm sends French-speaking engineers and produces various manuals trilingually, including in French. Communication needs should be addressed by implementing agencies when they negotiate with potential equipment suppliers. Solutions might include to have a translator present during installation and trial runs.

XII. Funding Levels for Incremental Capital Costs, Incremental Operating Costs and Savings

78. At the beginning of every project preparation the potential beneficiary is advised by the Implementing Agency of funding parameters and limitations. The key factor is usually the cost-effectiveness threshold, set at US $4.40 per kg of the baseline CFC consumption which is the average annual consumption in the 3 years before project preparation or the consumption in the last year before project preparation whichever is higher). In some cases, a 60 or 80% increase of consumption was claimed for the last year before project preparation. Such figures should be more closely checked during project preparation. In one memorable case, the figure given for CFC consumption was more than twice the estimated capacity of the factory.

79. Sizeable differences were noted for equipment prices between various projects, even for items with comparable specifications, such as through-put, containment volume and so forth. The range appears to extend beyond what would be expected from inflation, transportation, possible omission of an otherwise low bidder, or accessory listings. In the case of gas detection equipment, prices have ranged from about US $ 8,000 to $ 25,000 for the standard control box and four sensing modules.

80. Project gassers have cost from about US $ 20,000 to $90,000, depending on design, through-put and supplier. In some projects, the agency has approved the purchase of a gasser, where the machine actually consists of a round-table filler, crimper and gasser. Such machines are obviously more costly than a simple gasser of equivalent speed. They provide the recipient with a filler and crimper which are not part of the HAP production process and would be disallowed if requested as separate machines.

81. Beneficiaries have been surprised to learn that, when a rotary gasser is quoted, it is standard to offer it with the capability of gassing only one aerosol can diameter. Since most fillers expect to fill 3 to 6 can diameters, the extra cost of about US $5,000 to $10,000 for change parts, not listed in the documents, is to be paid by the companies.

82. 8 projects have utilized Nimmo (U.K.) gassers and other machines. Like all production equipment, change parts and replacement parts may have to be ordered in the future. It is now common knowledge that Nimmo is virtually bankrupt and for sale. The company has made offers to other equipment houses and these have been rejected. Agencies should take such situations into account when purchasing equipment for future projects.

83. Incremental operational savings (IOS), have generally been calculated by establishing the cost difference of operating with CFCs and the cheaper HAP over four years, using a 10% discount rate. This results in the net present value for the incremental operating savings, which is then subtracted from the eligible incremental capital cost (ICC) to determine the eligible total funding (except for contract filling, following decision 17/15, para 4). This exercise would be only valid from the beneficiaries perspective if they could sell HAP aerosols at the same price as the CFC aerosols and if they would not have increases of current expenses, for example for higher fire insurance premiums, higher skilled labour and molecular sieve maintenance.

84. The practice of subtracting IOS in the aerosol sector should be reviewed for future projects on a case by case basis. Non-contract fillers, like contract fillers already now, might be exempted from deductions of incremental operating savings if such savings are not realized on company level, but by the clients only (reduced selling prices). By bringing in more realism into the calculation of IOS, the companies and Implementing Agencies might become less inclined to exaggerate the baseline CFC consumption in order to justify a project budget covering the full or at least a substantial part of the incremental capital cost.

85. These days, when a beneficiary places an HAP-based aerosol on the market, it must compete with a preponderance of other HAP-based aerosols, since CFC-based products have shrivelled to small proportions. Because HAP formulas are much lighter in density, the market has identified this with "less product per can" and has forced prices to dwindle to (typically) about 70% of the former CFC aerosol price. With less product per can, the relative cost of the dispenser and other packaging also increase, but this is not recognized by the market.

86. Virtually all HAP fillers visited have been quick to comment that their profitability has eroded sharply since converting to HAP formulas. They report about lost business, higher overhead cost and depressed selling prices. The benefit of converting to cheaper HAPs has thus been reaped rather by the consumers than by the fillers. Beneficiaries whose sole business was aerosols have suffered most acutely, with a few now facing bankruptcy or closure.

87. Finally, contingency allocations have varied from about 3 to 14%. It has been thought that the nominal figure was 10%, so this large range is a curious phenomenon. Moreover, it was found in several cases, that contingency funds were used to buy additional equipment rather than to compensate for unforeseen increases of cost.

XIII. Cost Effectiveness

88. At the 16th Meeting of the Executive Committee, it was decided that for future projects, cost-effectiveness thresholds would be applied. The record of the evaluated completed Aerosol projects with regard to the thresholds value is shown in Table 10 below.

89. The majority of the projects evaluated had no problem to meet the cost-effectiveness threshold of US $4.40/kg ODP but several came close to it. Four projects evaluated had an approved and actual cost-effectiveness between US $4.00 and $4.40/kg ODP, like another seven completed aerosol projects. Some companies with small CFC-consumption had to bear substantial parts of the eligible capital cost, after incremental operating savings had been deducted. In future projects, very small fillers (under 10 tonnes of annual CFC consumption) might have to pay their conversion largely themselves with the risk that safety measures will be neglected. In such cases, the conversion to HAP aerosols might not be a viable option, even with increased technical assistance.

Table 10 Average Actual Cost Effectiveness of Evaluated Completed Aerosol Projects

Sub-sector	Number of Projects	Average Actual Cost-Effectiveness (US $/Kg.)	Cost-Effectiveness Threshold (US $/Kg.)
Contract Filler*	11	2.83	4.40
Filling Plant	22	3.40	4.40
LPG Purification	1	N/A	N/A

*Excludes project CPR/ARS/13/INV/79 which reported phase-out of 4,067 ODP tonnes with a cost effectiveness of 0.33 US $/Kg.

90. Annex III shows that there is no clear correlation between the size of a project and its cost-effectiveness, neither in relation to the volume of funding nor the CFC consumption. It also shows a rather wide range of values for the actual cost-effectiveness. Only four projects were approved above the level of US $4.40/kg ODP, one before the 16th meeting of the Executive Committee and three for low-volume consuming countries. The three completed projects in China were excluded from the graphs because they reported ODP phase-out of 4,000 to 6,000 tonnes each, which would have altered the scale.

XIV. Environmental and Safety Risks

91. Unlike CFCs, HAPs have no effect on the earth's stratospheric ozone layer. Once emitted into the air they are slowly decomposed into carbon dioxide and water vapour, mainly through the action of naturally occurring hydroxyl free radicals. The half-life for propane is 11 to 14 days, and that for the butanes is about 5.0 to 5.5 days, depending on climatic conditions. One could argue that some carbon dioxide is produced --- a very weak global warming agent --- but the effect is negligible. In the USA, since about 1991 there has been a slowly growing panoply of state and federal regulations, particularly in California, aimed at limiting the emission of certain substances, called Volatile Organic Compounds (VOCs), which sometimes cause the generation of excessive amounts of tropospheric ozone in stagnant air over cities, provided NO_x is also present. This has now greatly affected the USA (and Canadian) aerosols industries, and will challenge them even more strenuously in the future. While there is a modest worldwide comprehension of this phenomenon, nothing has been done about outside North America, except for some taxation in Switzerland and (shortly) Holland. The issue will probably not affect Art. 5 countries for another 12 years or so.

92. The so-called "micro-environmental" issues, such as those caused by the conflagration of an aerosol facility, contamination of air and groundwater, and so forth, have been the subject of regulatory activity in the USA (U.S.EPA and U.S. OSHA), but nowhere else, nor is this expected any time soon.

93. As mentioned previously, safety risks must be very carefully considered, wherever the highly flammable HAPs are being stored or used in production. Approaches to personnel and facility safety have varied very widely from plant to plant visited, from climate to climate, and from country to country. In general, government oversight and certification only relates to bulk storage installations. The predominant responsibility and accountability rests with plant management. They receive advice from their engineers, agency consultants, and sometimes from equipment suppliers, seminars, manuals and so forth, but frequently significant deficits of understanding were observed regarding the potential fire hazards of HAPs and how to adequately cope with that continuous challenge. The writer was repeatedly asked for educational material in this area, preferably in the local language.

94. The simplest way to reduce flammability or explosivity hazards is through adequate ventilation. This may be mechanically supplied, by air blowers, or by fresh air --- or both. Other aspects, such as gas detection, dousing, equipment placement and maintenance, fire extinguishers, explosimeter surveys for leak detection, use of water baths, and so forth are also important. A common error is to become callous, and thus careless. Another is to try to be a hero, such as remaining in a potentially explosive area to fix a serious leak --- rather than turning off the HAP supply from a remotely placed valve. Gruesome pictures of freshly burned victims have been shown by some consultants to shock plant staff out of any complacency regarding the relentless hazards presented by HAPs, if they get loose in sufficient amounts.

95. In one plant a semi-automatic gasser was operating in a rather large room, with no ventilation or detectable air movement. Periodically a door was opened to an outside yard. The HAP was only partly deodorised, and the smell was immediately obvious. By kneeling and sniffing the air at floor level the odour was found to be much more intense. (HAP vapours are about twice as heavy as air, and sink when released). Despite hearing a comment that the room would probably catch fire or explode if a match was struck or a spark occurred, the owner remained nonchalant, responding that the plant had operated safely for over a year without incident. He would install ventilation "sometime soon". This ignorance illustrates the under-estimation of fire risks observed in some plants.

XV. Overall Rating of Projects Evaluated

96. The overall rating of completed projects in the old project completion report format requested a qualitative assessment by the implementing agencies. The ratings for the 26 projects of the sample for which project completion reports are available in the old format vary between highly satisfactory, more than planned (1), satisfactory as planned (15), and satisfactory, though not as planned (10). No project was declared as unacceptable. Over half of the projects were reported as satisfactory because in the end the goal of ODS aerosol phase-out was achieved. However, "less than planned" status reflects the fact that implementation of most projects was delayed and/or had budget challenges.

Table 11: Overall Assessment by Implementing Agencies of Evaluated Aerosol Projects as per old PCR

Agency	**Ratings by Implementing Agencies***					**Total**
	1	2	3	4	5	
IBRD		2	6			8
UNDP		8	1			9
UNIDO	1	5	3			9
Total	**1**	**15**	**10**	**0**	**0**	**26**

*1 - Highly satisfactory, more than planned
2 - Satisfactory, as planned
3 - Satisfactory, though not as planned
4 - Unsatisfactory, less than planned
5 - Unacceptable

97. The results of applying the new overall assessment scheme for investment projects adopted at the 32nd Meeting of the Executive Committee are shown in Tables 12 and 13 below. It is difficult to compare it with the ratings by the Implementing Agencies. The scale is different (only three categories) and it has not been applied to all projects but only to those that had been completed according to Decision 28/2 of the Executive Committee (see Section VI above). In the Consultants' assessment it emerges that a higher share of projects turned out to be highly satisfactory. Overall, the picture is more positive than in the assessment by the implementing agencies. However, one has to bear in mind that in the new rating, 14 of the projects are rated not applicable (N/A) because at least one of the conditions defined in Decision 28/2 was not fulfilled indicating various deficiencies of project implementation. In two cases, N/A is due to particular features of the project.

Table 12: Overall Assessment by the Evaluators using the new Rating Scheme

Agency	Ratings				
	Highly Satisfactory	Satisfactory	Less Satisfactory	N/A	Total
IBRD	3	4		4	**11**
UNDP	8	2		2	**12**
UNIDO	2			10	**12**
Total	**13**	**6**		**16**	**35**

98. Table 13 shows the results of additional qualitative ratings made by the consultant using the new assessment scheme. The conversion technology, the type of equipment, the supplier and the provisions made to prevent return to ODS use were rated "highly satisfactory" for most projects. Less positive are the assessments for the quality of project design, the capacity for maintaining the equipment and the product quality, and in particular for the safety and health protection. These assessments are explained in detail in the individual Project Evaluation Reports (PERs).

Table 13: Qualitative Rating of Project Performance of Evaluated Aerosol Projects

Category	Ratings*				Total
	5	3	1	N/A	
Quality of project design	15	16	2	2	35
Conversion Technology	25	9		1	35
Type of equipment	29	5		1	35
Supplier	30	3	1	1	35
Safety/health protection	10	15	8	2	35
Capacity for maintenance of equipment	11	22		2	35
Product quality maintained	8	23	1	3	35
Provisions made to prevent return to ODS use	22	4	6	3	35

* Highly Satisfactory (5)
Satisfactory (3)
Less Satisfactory (1)

XVI. Project Documents, Technical Reviews and Project Completion Reports (PCR)

99. While a number of PCRs were found to be quite concise, accurate and complete, many omitted important data or contained wrong figures contradicting other documents, in particular project documents and progress reports. In some cases, the PCRs were misleading by suppressing relevant information regarding implementation problems. Two PCRs were issued by UNIDO before the projects were actually completed. The most striking example is project ALG/ARS/20/INV/18 (Laboratoire Bendi) for which a PCR was submitted in September 1999, reporting the project being completed "satisfactory, as planned" in December 1998, followed by project cancellation at the 37th meeting of the Executive Committee after extended discussions between the company, the NOU and UNIDO. Equipment worth of US $53,700 was delivered but never unpacked and installed.

100. Most PCRs were undated and the author unidentified. This was not required in the old PCR format but is also sometimes incomplete in the new format. Reviewers need this information, since project situations are constantly changing and an old (undated) report can be misleading if it is thought to be reasonably current. In some cases, an evaluator may want to contact the author to elicit further information. Without a name and e-mail tag, this can be difficult. If reports are signed by the writer, then countersigned by that person's superior and the other parties involved, this practice will also instill a greater sense of accountability, leading to more completeness and accuracy.

101. One of the many rationales for project documents and PCRs is to serve as a guide for new projects in the same sector. For this, more specific information concerning equipment selection would be helpful. For example, rather than a generic description of the gasser, which might fit many machines, the name of the supplier, his model number, its rated speed (cans per minute) and the f.o.b. price should be included for reference purposes. This could be a negotiating advantage and a money-saving expediency for new projects.

102. The technical reviews are prepared by independent consultants or experts, who generally have not visited the project facility and must draw their conclusions based solely on the paperwork submitted for analysis. Consequently, the reviews have often appeared to be almost identical in content, to contain generic statements of limited usefulness, and function rather as a formality than evoking substantial discussions. Maybe the analysis goes deeper than that and questions are being clarified during the drafting process, as claimed by Implementing Agencies, but this is not obvious to readers of the final version. In a few instances, significant errors in the project documents have been overlooked by the reviewer.

103. The relative brevity and condensation of vital data into tables in the Project Completion Report (PCR) is commendable. The PCR should be issued only when the project is truly completed, and this is not always the case. Also, there is merit in having the NOU or a consultant visit the plant, several months after project completion, to check on safety, answer engineering questions, look for possible recidivism, and so forth. There should be some financial residue in the project budget to allow this to happen. This might be done by applying Decision 32/18(d) --- withholding some small amount of funding for the visit, and to ensure the cooperation of the beneficiary in supplying data to completely prepare the PCR, or to amend it if necessary.

Annex I
Statistical Overview and Rating of Aerosol Projects Evaluated

(See Excel document)

Annex 1: Statistical Overview of Aerosol Projects Evaluated

Country	Code	Project Title	Agency	ODP To Be Phased Out As Per Inventory	ODP Phased Out As Per PCR	ODP Phased Out As Per Evaluation	ODP Points	ODS-free Production Points	Equipment Destruction Points	Date Approved	Approved Date of Completion	Revised Completion Date As Per Progress Report	Actual Date of Completion As Per Progress Report 2001	Actual Date of Completion As per Evaluation	Delay in Implementation (months)	Delays Points
Algeria	ALG/ARS/18/INV/12	Enterprise Nationale des Detergents (ENAD)	UNIDO	150.0	150.0	150.0	20	20	0	Nov-95	May-97		Dec-97	Dec-97	7	0
Algeria	ALG/ARS/20/INV/16	Vague de Fraicheur	UNIDO	51.4	51.4	51.4	20	20	0	Oct-96	Oct-97		Dec-98	Dec-98	14	-15
Algeria	ALG/ARS/20/INV/17	Ets Wouroud	UNIDO	47.0	47.0	47.0	20	20	0	Oct-96	Oct-97		Dec-98	Dec-98	14	-15
Algeria	ALG/ARS/20/INV/18	Laboratoire Bendi	UNIDO	19.2	19.2	19.2	20	0	0	Oct-96	Oct-97		Dec-98	Cancelled*	N/A	N/A
Algeria	ALG/ARS/20/INV/19	Ets Cophyd	UNIDO	15.0	15.0	15.0	20	20	20	Oct-96	Oct-97		Jul-97	Jul-97	-3	15
Algeria	ALG/ARS/25/INV/28	Ets Djadir	UNIDO	38.4	38.4	38.4	20	20	0	Jul-98	Aug-99		Dec-00	Dec-00	16	-15
Algeria	ALG/ARS/28/INV/38	Floreal	UNIDO	18.1	18.1	Unclear	0	0	0	Jul-99	Aug-00		Jul-01	Ongoing	N/A	-15
Algeria	ALG/ARS/28/INV/41	Saco	UNIDO	19.0	19.0	Not sure	N/A	N/A	N/A	Jul-99	Aug-00		Ongoing	Ongoing	N/A	-15
China	CPR/ARS/13/INV/79	Zhongshan Fine Chemical Aerosol Filling Center	IBRD	4,067.0	4,067.0	4,067.0	20	20	20	Jul-94	Jul-96	Jun-98	May-97	May-97	-13	15
China	CPR/ARS/24/INV/244	NCLI and Fujiang Light Industry Co.	IBRD	1,224.0	Ongoing	Ongoing	N/A	N/A	N/A	Mar-98	Apr-00		Ongoing	Ongoing	N/A	-15
India	IND/ARS/22/INV/113	Stella Industries	IBRD	105.0	105.0	105.0	20	20	20	May-97	Jun-98		Sep-98	Sep-98	3	15
India	IND/ARS/22/INV/114	Accra Pack	IBRD	52.0	PCR Due	52.0	20	20	20	May-97	Jun-98	Jun-99	Apr-01	Apr-01	22	-15
India	IND/ARS/22/INV/115	Ultra Tech Specialty Chemicals Pvt. Ltd.	UNDP	30.8	30.8	30.8	20	20	20	May-97	Jun-98	Sep-99	Nov-99	Nov-99	2	15
India	IND/ARS/22/INV/117	Texas Enterprises	UNDP	31.2	31.2	31.2	20	20	20	May-97	Jun-98	Sep-99	Nov-99	Nov-99	2	15
India	IND/ARS/22/INV/118	Aerol Formulations	UNDP	31.0	31.0	31.0	20	20	20	May-97	Jun-98	Sep-99	Nov-99	Nov-99	2	15
India	IND/ARS/22/INV/135	Aerosols D'Asia Pvt. Ltd. aerosol conversion	UNDP	18.0	18.0	18.0	20	20	20	May-97	Jun-98	Sep-99	Nov-99	Nov-99	2	15
India	IND/ARS/22/INV/136	Asian Aerosols Pvt. Ltd.	UNDP	25.0	25.0	25.0	20	20	20	May-97	Jun-98	Sep-99	Nov-99	Nov-99	2	15
India	IND/ARS/22/INV/138	Aero Pack Products aerosol conversion	UNDP	20.4	20.4	20.4	20	20	20	May-97	Jun-98	Sep-99	Nov-99	Nov-99	2	15
India	IND/ARS/22/INV/139	Aero Industries	IBRD	27.6	27.6	27.6	20	20	20	May-97	Jun-98		Jun-99	Oct-99	16	-15
India	IND/ARS/22/INV/141	Aeropres Aerosol	IBRD	50.0	50.0	50.0	20	20	20	May-97	Jun-98		Jun-99	Oct-99	16	-15
India	IND/ARS/24/INV/167	Sunder Chemical	UNDP	15.0	15.0	15.0	20	20	20	Mar-98	Apr-00		Jun-00	Jun-00	2	15
India	IND/ARS/24/INV/171	Sara-Chem Pvt. Ltd.	UNDP	23.3	23.3	23.3	20	0	0	Mar-98	Apr-00		Mar-01	Mar-01	11	0
India	IND/ARS/24/INV/174	Chem-Verse Consultants	UNDP	18.0	18.0	18.0	20	20	20	Mar-98	Apr-00		Jun-00	Jun-00	2	15
Cote D'Ivoire	IVC/ARS/20/INV/07	Parfumerie Gandour D.A.F.	UNIDO	66.0	66.0	66.0	20	0	0	Oct-96	Oct-97	Dec-99	Dec-99	Ongoing	N/A	-15
Cote D'Ivoire	IVC/ARS/20/INV/08	Sicobel	UNIDO	20.8	20.8	Not sure	0	20	0	Oct-96	Oct-97	Dec-99	Dec-99	Dec-99	0	15
Jordan	JOR/ARS/07/INV/12	Jordan Refinery Company	IBRD	0.0	0.0	0.0	N/A	N/A	N/A	Jun-92	Jun-95	Jul-97	Jan-98	Jan-98	6	0
Jordan	JOR/ARS/07/INV/14	Haddad and Sons Inc.	IBRD	85.0	85.0	85.0	20	20	20	Jun-92	Jun-95	Jul-97	Dec-97	Dec-97	5	15
Jordan	JOR/ARS/20/INV/26	Jordan Industrial Petrochemical Co. Ltd. (JIPCO)	IBRD	98.0	Ongoing	Ongoing	N/A	N/A	N/A	Oct-96	Oct-97	Dec-00	Ongoing	Ongoing	N/A	N/A
Jordan	JOR/ARS/20/INV/27	Jordan Antiseptics and Detergents Ind. Co. Ltd. (JADICO	IBRD	20.0	20.0	20.0	20	0	20	Oct-96	Oct-97		Dec-98	Dec-98	14	-15
Jordan	JOR/ARS/20/INV/28	Jordan Chemical Products	IBRD	61.0	61.0	61.0	20	20	20	Oct-96	Oct-97		Dec-98	Dec-98	14	-15
Lebanon	LEB/ARS/19/INV/05	Cosmaline Industries s.a.al.	UNIDO	87.7	87.7	87.7	20	20	20	May-96	May-97		Dec-97	Dec-97	7	0
Lebanon	LEB/ARS/19/INV/06	Zeeni's Trading Agency	UNIDO	212.0	212.0	212.0	20	20	0	May-96	May-97		Dec-97	Dec-97	7	0
Vietnam	VIE/ARS/17/INV/07	Saigon Cosmetics Company	UNDP	80.0	80.0	80.0	20	20	20	Jul-95	Dec-96		Aug-98	Aug-98	20	-15
Vietnam	VIE/ARS/18/INV/10	Daso Company Ltd.	UNDP	27.0	27.0	27.0	20	20	20	Nov-95	Nov-96	Jun-99	Dec-99	Dec-99	6	0
Vietnam	VIE/ARS/18/INV/11	Cosmetics Producing and Trading Company (CP & T)	UNDP	85.0	85.0	85.0	20	20	0	Nov-95	May-97	Sep-99	Ongoing	Jun-01	21	-15

* Cancelled at the 37th Meeing

Annex 1: Statistical Overview of Aerosol Projects Evaluated

Code	Project Title	Approved Cost-Effectiveness Planned As Per Inventory (US$/kg)	Actual Cost-Effectiveness As Per PCR (US$/kg)	Cost-Effectiveness As Per Evaluation (US$/kg)****	Cost-Effectiveness Points	Funds Approved As Per Inventory	Funds Disbursed As Per Progress Report 2001	Funds Disbursed As Per PCR	Difference Inventory and Progress	Project Financially Closed	Funds Returned to the MLF	Qualitative Points	Rating by IA in Old PCRs *	Rating by IA in New PCRs **
ALG/ARS/18/INV/12	Enterprise Nationale des Detergents (ENAD)	4.10	4.09	4.09	0	614,850	614,499	610,028	-351			40	2	
ALG/ARS/20/INV/16	Vague de Fraicheur	3.20	3.06	3.20	0	164,623	164,522	157,499	-101	X	101	38	3	
ALG/ARS/20/INV/17	Ets Wouroud	3.99	3.98	3.98	0	187,772	187,055	187,055	-717	X	717	36	3	
ALG/ARS/20/INV/18	Laboratoire Bendi	2.96	2.96	N/A	N/A	56,790	53,700	56,700	-3,090			N/A	3	
ALG/ARS/20/INV/19	Ets Cophyd	3.53	Not Provided	3.44	0	53,024	51,651	52,000	-1,373	X	1,373	26	1	
ALG/ARS/25/INV/28	Ets Djadir	3.85	3.82	3.82	0	147,807	139,757	146,720	-8,050			30		3
ALG/ARS/28/INV/38	Floreal	4.26	4.23	4.25	0	77,145	76,945	76,600	-200			30		N/A
ALG/ARS/28/INV/41	Saco	3.88	3.87	3.87	0	73,691	66,580	73,500	-7,111			28		N/A
CPR/ARS/13/INV/79	Zhongshan Fine Chemical Aerosol Filling Center	0.33	0.32	0.33	0	1,351,360	1,351,041	1,310,500	-319	X	319	32	2	
CPR/ARS/24/INV/244	NCLI and Fujiang Light Industry Co.	0.45	Ongoing	Ongoing	N/A	547,675	327,530	Ongoing	-220,145			32	Ongoing	Ongoing
IND/ARS/22/INV/113	Stella Industries	2.56	2.56	2.56	0	269,175	269,175	269,175	0	X		36	2	
IND/ARS/22/INV/114	Accra Pack	2.49	PCR Due	2.34	5	129,690	121,860	PCR Due	-7,830			36	PCR Due	PCR Due
IND/ARS/22/INV/115	Ultra Tech Specialty Chemicals Pvt. Ltd.	2.27	2.11	2.27	0	70,000	70,000	65,278	0	X		30	2	
IND/ARS/22/INV/117	Texas Enterprises	2.24	2.00	2.09	5	70,000	65,097	62,572	-4,903	X	4,902	32	2	
IND/ARS/22/INV/118	Aerol Formulations	2.24	2.20	2.21	0	69,450	68,659	68,341	-791	X	791	34	2	
IND/ARS/22/INV/135	Aerosols D'Asia Pvt. Ltd. aerosol conversion	3.86	3.58	3.73	0	69,450	67,071	64,540	-2,379	X	2,379	32	2	
IND/ARS/22/INV/136	Asian Aerosols Pvt. Ltd.	3.63	3.20	3.32	5	90,890	83,123	80,082	-7,767	X	7,767	32	2	
IND/ARS/22/INV/138	Aero Pack Products aerosol conversion	3.40	2.89	3.40	0	69,450	69,450	59,037	0	X		32	2	
IND/ARS/22/INV/139	Aero Industries	4.39	4.27	4.27	0	121,735	117,832	117,832	-3,903	X	3,903	32	3	
IND/ARS/22/INV/141	Aeropres Aerosol	2.94	2.86	2.86	0	146,860	142,820	142,820	-4,040	X	4,040	34	3	
IND/ARS/24/INV/167	Sunder Chemical	3.99	3.57	3.75	5	59,892	56,275	53,559	-3,617	X	3,617	24	2	
IND/ARS/24/INV/171	Sara-Chem Pvt. Ltd.	3.83	2.55	2.55	5	89,164	59,441	59,441	-29,723		29,723	28		1
IND/ARS/24/INV/174	Chem-Verse Consultants	3.74	3.18	3.64	0	67,324	65,452	57,171	-1,872	X	1,872	32	2	
IVC/ARS/20/INV/07	Parfumerie Gandour D.A.F.	1.61	Not Provided	1.61	0	106,061	106,061	105,969	0			30	2	
IVC/ARS/20/INV/08	Sicobel	2.84	Not Provided	2.71	0	59,171	56,415	58,732	-2,756			28	2	
JOR/ARS/07/INV/12	Jordan Refinery Company	N/A	N/A	N/A	N/A	700,000	799,341	805,000	99,341	X		21	3	
JOR/ARS/07/INV/14	Haddad and Sons Inc.	5.00	2.52	2.94	5	250,000	214,200	250,000	-35,800	X		38	3	
JOR/ARS/20/INV/26	Jordan Industrial Petrochemical Co. Ltd. (JIPCO)	1.05	Ongoing	Ongoing	N/A	102,855	0	Ongoing	Ongoing			N/A	Ongoing	Ongoing
JOR/ARS/20/INV/27	Jordan Antiseptics and Detergents Ind. Co. Ltd. (JADICC	3.29	3.29	3.29	0	65,720	65,720	65,720	0	X		20	3	
JOR/ARS/20/INV/28	Jordan Chemical Products	3.33	3.33	3.33	0	203,328	203,328	199,079	0	X		32	3	
LEB/ARS/19/INV/05	Cosmaline Industries s.a.al.	2.42	Not Provided	2.42	0	212,500	212,500	209,476	0	X		40	2	
LEB/ARS/19/INV/06	Zeeni's Trading Agency	1.71	Not Provided	1.66	0	361,900	351,874	349,109	-10,026	X	10,026	30	2	
VIE/ARS/17/INV/07	Saigon Cosmetics Company	2.98	2.97	2.95	0	238,430	235,991	237,983	-2,439	X	2,439	40	3	
VIE/ARS/18/INV/10	Daso Company Ltd.	4.09	4.07	4.07	0	110,340	110,020	110,021	-320		319	36		2
VIE/ARS/18/INV/11	Cosmetics Producing and Trading Company (CP & T)	3.35	3.01	3.01	5	285,120	252,886	256,080	-32,234			28		2

* Cancelled at the 37th Meeing

* Overall assessment by Implementing Agencies as per Old PCR
1 - Highly satisfactory, more than planned
2 - Satisfactory, as planned
3 - Satisfactory, though not as planned
4 - Unsatisfactory, less than planned
5- Unacceptable

** Overall rating by Implementing Agencies as per New PCR
1 - Highly satisfactory: 100 to 120
2 - Satisfactory: 75 to 99
3 - Less satisfactory: 48 to 74
**** Cost Effectiveness As Per Evaluation = ODP Phased Out As Per Evaluation/Funds Disbursed As Per Progress Report/1000
Note: Some disbursed figures are provisional data

Annex 1: Statistical Overview of Aerosol Projects Evaluated

Code	Project Title	Total Points in PER	New Rating in PER ***	Quality of project design	Conversion Technology	Type of equipment	Supplier	Safety/health protection	Capacity for maintenance of equipment	Product quality maintained	Provisions made to prevent return to ODS use
ALG/ARS/18/INV/12	Enterprise Nationale des Detergents (ENAD)	N/A	N/A	5	5	5	5	5	5	5	5
ALG/ARS/20/INV/16	Vague de Fraicheur	N/A	N/A	5	5	5	5	5	5	5	3
ALG/ARS/20/INV/17	Ets Wouroud	N/A	N/A	5	5	5	5	3	3	5	5
ALG/ARS/20/INV/18	Laboratoire Bendi	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
ALG/ARS/20/INV/19	Ets Cophyd	101	1	1	3	5	5	3	3	3	3
ALG/ARS/25/INV/28	Ets Djadir	N/A	N/A	3	5	3	5	5	5	3	1
ALG/ARS/28/INV/38	Floreal	N/A	N/A	5	5	5	3	3	5	3	1
ALG/ARS/28/INV/41	Saco	N/A	N/A	3	5	5	3	5	3	N/A	1
CPR/ARS/13/INV/79	Zhongshan Fine Chemical Aerosol Filling Center	107	1	3	5	5	5	1	5	3	5
CPR/ARS/24/INV/244	NCLI and Fujiang Light Industry Co.	N/A	N/A	3	3	5	5	3	3	5	5
IND/ARS/22/INV/113	Stella Industries	111	1	5	5	5	5	3	5	3	5
IND/ARS/22/INV/114	Accra Pack	86	2	5	3	5	5	5	5	5	3
IND/ARS/22/INV/115	Ultra Tech Specialty Chemicals Pvt. Ltd.	105	1	3	5	5	5	3	3	1	5
IND/ARS/22/INV/117	Texas Enterprises	112	1	5	5	5	5	1	3	3	5
IND/ARS/22/INV/118	Aerol Formulations	109	1	5	5	5	5	3	3	3	5
IND/ARS/22/INV/135	Aerosols D'Asia Pvt. Ltd. aerosol conversion	107	1	3	5	5	5	3	3	3	5
IND/ARS/22/INV/136	Asian Aerosols Pvt. Ltd.	112	1	3	5	5	5	3	3	3	5
IND/ARS/22/INV/138	Aero Pack Products aerosol conversion	107	1	3	5	5	5	3	3	3	5
IND/ARS/22/INV/139	Aero Industries	77	2	3	5	5	5	3	3	3	5
IND/ARS/22/INV/141	Aeropres Aerosol	79	2	5	5	5	5	3	3	3	5
IND/ARS/24/INV/167	Sunder Chemical	104	1	3	3	5	5	1	3	3	1
IND/ARS/24/INV/171	Sara-Chem Pvt. Ltd.	N/A	N/A	3	3	5	5	1	3	3	5
IND/ARS/24/INV/174	Chem-Verse Consultants	107	1	3	5	5	5	3	3	3	5
IVC/ARS/20/INV/07	Parfumerie Gandour D.A.F.	N/A	N/A	3	5	3	5	5	3	3	3
IVC/ARS/20/INV/08	Sicobel	N/A	N/A	5	5	5	5	1	3	3	1
JOR/ARS/07/INV/12	Jordan Refinery Company	N/A	N/A	3	3	3	3	3	3	3	N/A
JOR/ARS/07/INV/14	Haddad and Sons Inc.	118	1	3	5	5	5	5	5	5	5
JOR/ARS/20/INV/26	Jordan Industrial Petrochemical Co. Ltd. (JIPCO)	N/A	N/A	N/A	3	5	5	N/A	N/A	N/A	N/A
JOR/ARS/20/INV/27	Jordan Antiseptics and Detergents Ind. Co. Ltd. (JADICO	N/A	N/A	1	3	3	1	1	3	3	5
JOR/ARS/20/INV/28	Jordan Chemical Products	77	2	5	5	5	5	1	3	3	5
LEB/ARS/19/INV/05	Cosmaline Industries s.a.al.	100	1	5	5	5	5	5	5	5	5
LEB/ARS/19/INV/06	Zeeni's Trading Agency	N/A	N/A	5	5	5	5	1	5	3	1
VIE/ARS/17/INV/07	Saigon Cosmetics Company	85	2	5	5	5	5	5	5	5	5
VIE/ARS/18/INV/10	Daso Company Ltd.	96	2	5	5	5	5	5	3	3	5
VIE/ARS/18/INV/11	Cosmetics Producing and Trading Company (CP & T)	N/A	N/A	3	3	3	5	3	3	3	5

* Cancelled at the 37th Meeing

Annex II: Conversion Process And Requirements

1. The conversion of CFC propelled aerosols to HAP types involves a major change in formulation, labelling, production, storage and (often) transportation. About the only thing these two classes of propellants have in common is that they are liquids, under low to medium pressure at ambient conditions. The differences are as follows:

CFCs	HAPs
High liquid density	Low liquid density (40% that of the CFCs)
Non-flammable	Extremely flammable
Can be varied in pressure	Generally available in only one pressure
Medium solvency	Poor solvency
Essentially odourless	Often with offensive odours
Further purification not required	Further purification generally required for Art. 5 countries
Minor leaks in production are tolerated	Leaking machines cannot be tolerated
No leak detection equipment needed	Leak detection equipment is required

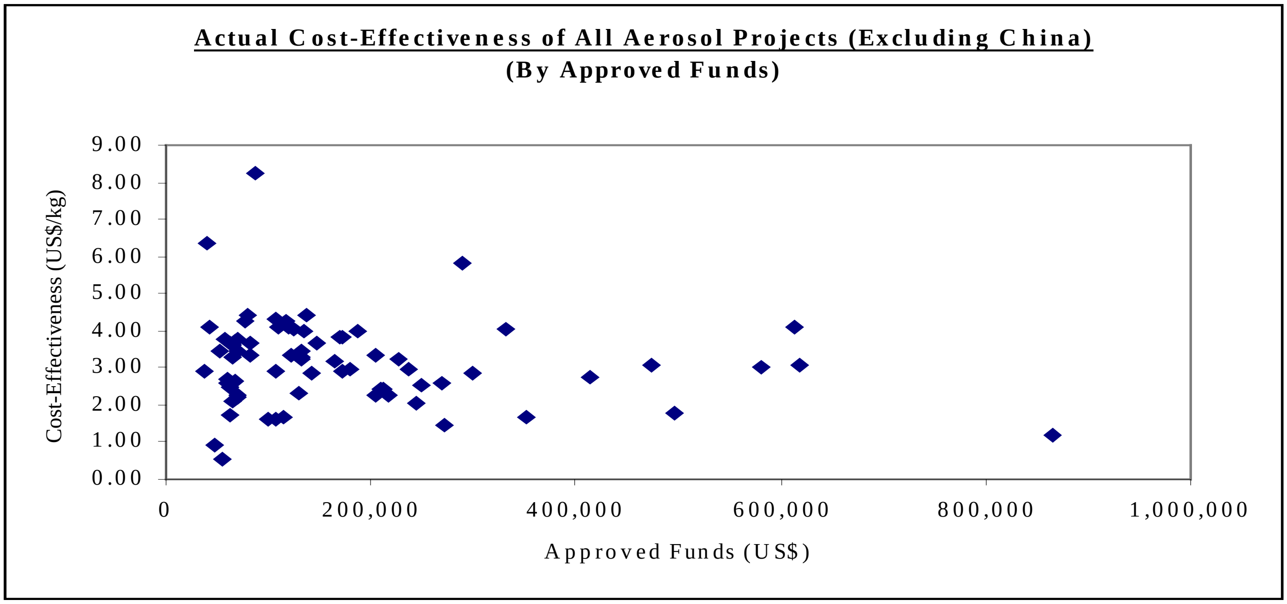
2. Because of their poor solvency, HAPs can cause the sedimentation of certain fragrance ingredients from cologne formulas, film-formers from hair sprays, resins from paint aerosols and polymers from mousses --- unless formulations are very carefully balanced and engineered. The resulting products are much lighter in liquid density than the corresponding CFC formulations. Consumer complaints about lightweight dispensers (often thought to be only partly filled), have led to increased product volumes per can or changes to larger cans and to higher levels of active ingredients (perfumes, germicides, insecticide toxicants and silicone mould release agents), so marketers can claim the same potency per can, as with the previous CFC products. Some fillers reported that the reduced acceptance of HAP products has hurt sales. Consumer resistance to "light-weighting" is greatest in India, but this complaint is slowly ebbing, worldwide, as consumers get accustomed to CFC free products.

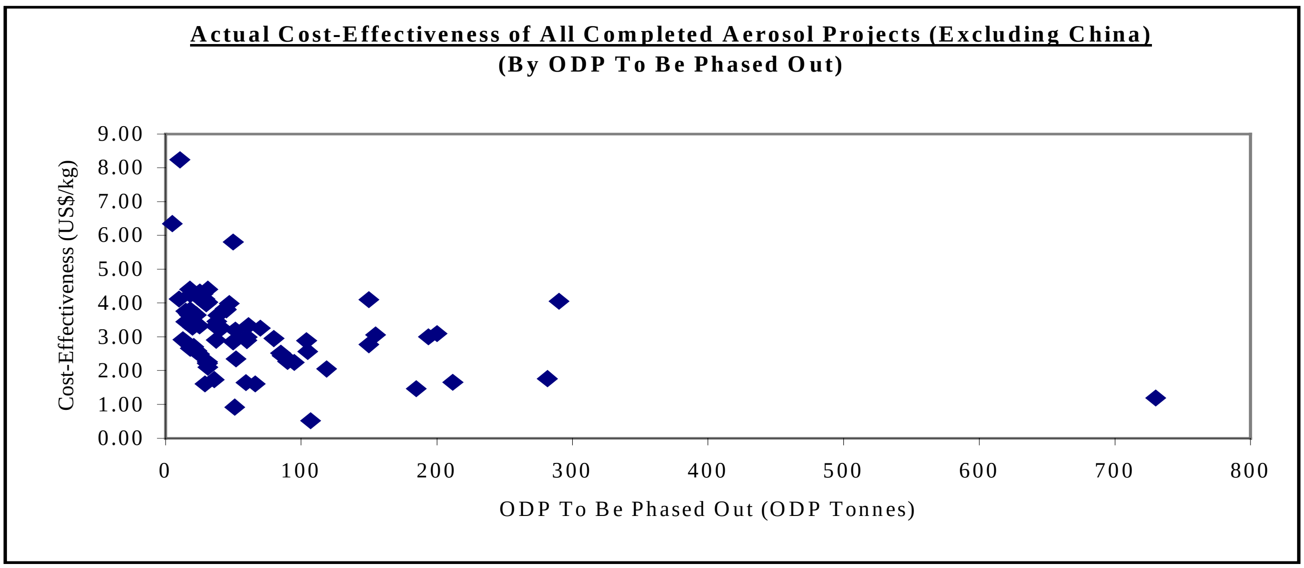
3. The most profound difference between CFCs and HAPs is the extreme flammability of the latter. For example, a mere 17 ml of liquid HAP is sufficient to explode an empty 204 liter steel drum, if vaporized and uniformly mixed with air in the drum. This feature must be dealt with in all aspects of production, storage and sale. The escape of HAP (liquid or vapours) must be absolutely minimized. When HAPs do escape, as they always do, to some extent, in the gassing operation, methods must be employed to keep the concentration of gas very dilute to stay below the lower flammability limit, which is typically 2% of the vapour in air. The most reliable and least costly way to do this is to do the gassing outside, under a suitable roof. Normal air movements in open spaces keep HAP gas concentrations sufficiently low. In over 20 years, at numerous sites around the world, there has never been a fire incident associated with open-air gassing. If climatic conditions (cold weather, sand-storms) make open-air gassing an unattractive option, one can enclose the gassing machine in a well ventilated box, or gassing room, ideally to be situated outside the main plant. Several fillers seen have located their gassers either inside the main plant or in a room adjacent to it --- separated by a wall through which conveyors pass, taking cans out to be gassed and then back inside. In three cases, gassing was done deep inside the main building, with no mechanical ventilation. This was quite distressing. Inside gassing should be made under highly protected conditions, always involving good ventilation to the

outside, gas sensing and alarm equipment, fire extinguishers and other safety measures which add complexity to the filling operation. In fact, several fillers have complained that they must now employ more qualified plant workers, at extra cost, to competently handle the new equipment. Inside and enclosed gassers also elevate the project cost to much higher levels. In Lebanon, the group purchase of five boxed gassers, gas detection systems and related equipment has cost the MLF more than US $200,000 above the cost of simple open-air gassers. It follows that the economic and safety advantages of open-air installations should be stressed, even more than now.

4. Piping and hoses for liquid HAP should be brought inside the main building only when absolutely necessary. In the USA, at least four large filling plants were destroyed when intolerable amounts of HAP leaked from pipes or hoses. Molecular sieve units, sometimes seen inside plants, should always be located outside, and in an open area. Periodically, these units must be opened, to remove saturated Zeolyte prills and replace them with fresh absorbent material. Very large amounts of liquid and gaseous HAPs can be discharged in this process, depending upon sieve design and size. In a non-project incident, this was sufficient to blow out the back end of a filling plant near Johannesburg, South Africa. Hot water-bath leak testers for filled cans are needed, and incorporated in projects unless the beneficiary already has one. These tanks are designed to detect gross leakages of cans, as a result of faulty dispenser design or sealing. There are still possibilities for slow leakage and latent (delayed) leakage, and for these reasons warehouses for filled HAP aerosols should have at least modest ventilation, to carry off flammable vapours. This was rarely encountered in the projects visited.

Annex III: Data on Cost-Effectiveness





Projects with Approved and/or Actual Cost Effectiveness greater than the threshold (US $4.40/ODP kg)

Code	Agency	Status	Project Title	ODP To Be Phased Out	ODP Phased Out	Original Approved Funds	Total Funds Approved including Adjustments	Funds Disbursed	Approved CE	Actual CE
TUN/ARS/07/INV/04	IBRD	FIN	Technical seminar and conversion to non-CFC technology in aerosol sector	50	50	239,995	289,995	289,995	1.52	5.80
SRL/ARS/18/INV/07	UNDP	COM	Conversion to CFC-free hydrocarbon aerosol propellant technology at International Cosmetic Ltd. (ICL)	5	5	38,968	31,733	31,733	7.79	6.35
CRO/ARS/22/INV/05	UNIDO	FIN	Phasing out CFCs at Pliva d.d.	10.6	10.6	89,779	87,296	87,296	8.47	8.24
MAR/ARS/27/INV/11	Germany	COM	Investment project for phasing out CFCs at Chem Tech-Stella Industries, Port Louis	16		90,400	90,400	90,230	4.92	N/A

Explanation: The project in Tunisia was approved before the 16th Meeting of the Executive Committee which established the thresholds. Sri Lanka was a low volume consuming country at the time of project approval, and Croatia and Mauritius as well.

Annex IV: Technology Choices (Propellants)

1. The LPG gas-liquids (propane, n.butane and isobutane) have been very widely recommended for CFC replacement propellants in the Art. 5 countries. Ideally these should be purified to the low-odour HAP form, by removing certain contaminants. As has been said, the primary disadvantage of these hydrocarbon propellants is their extreme flammability, which poses costs for the MLF, complexities and extra costs for the filler, and hazards to the indiscriminate consumer. If the malodorous contaminants are not removed --- or at least reduced to acceptable levels --- the aerosol business in the affected country will languish, and will tend to be restricted to such products as insecticides and industrial mould releases, where the off-odours can be better tolerated. This situation is most prevalent in India, where the status and future prospects for aerosols must be considered deplorable.

2. The HAP propellants generally consist of a relatively fixed blend, containing from 0 to 30% propane, and with the remaining portion being the naturally occurring mixture of n. butane and isobutane. Their ratio is generally about 70:30. Pure isobutane is sometimes seen in Vietnam. That used in Malaysia and Lebanon is imported from Europe. European propane is also imported by at least one firm in Lebanon. While these three gas-liquids can be used to obtain pressures from 1.1 bars to 7.5 bars at 21°C, usually Art. 5 countries must settle for the domestic blend, which has a typical pressure of 3.50 bars at 21°C. This may rise or fall in pressure, according to refinery, and the sales requirements of the refineries for alternative uses. In summary, the true potential of the HAPs is almost never available to Art. 5 countries fillers, because they are unable to obtain the blends most suitable for various aerosol products.

3. The various propellants used for aerosols in the USA can be summarized in the following chart.

Propellant name	Formula	Pressure	Art. 5 Country Where used
HAPs			
Propane	C_3H_8	7.5	Lebanon
n. Butane	C_4H_{10}	1.2	---
Isobutane	CH_3-C_3H_7	2.1	Lebanon, Malaysia., Ivory Coast
HFCs			
HFC-134a	CH_2F-CF_3	4.9	Lebanon (experimentally)
HFC-152a	CH_3-CHF_2	4.3	PR China
Dimethyl Ether (DME)	CH_3-0-CH_3	4.3	PR China
HP Gases			
Carbon Dioxide	CO_2	57.3	PR China
Nitrous Oxide	N_2O	51.4	---
Nitrogen	N_2	NA**	---
Compressed Air (CAIR)	$N_2 + O_2$	NA**	---

Pressures are in bars (gauge), at 21°C.
** Cannot be liquified (even at 50,000 bars), at 21°C.

Notes:
The CFC option is not considered.
Carbon dioxide and nitrous oxide have been used for study purposes in Algeria and Lebanon.
The PR China has two excellent HAP suppliers (near Shanghai), seven DME suppliers, (according to a recent reliable publication by Dr. You Yizhong, of Changzhou), two HFC-134a suppliers and one or two HFC-152a suppliers.
High pressure gases (HP Gases) are readily available in the PR China.

4. Dimethyl ether (DME) is the least costly and most readily available alternative to the HAPs. It can be imported from Japan, PR China, Taiwan, and (it is thought) Oman, as well as from Europe and the USA. It is relatively easy to make, by the hot, catalytic dehydration of methanol. Turn-key plants are available. It may play a part in the medium-term future of the aerosol industry of India, when it is manufactured from mid-Asian LPG, principally for use as clean-burning fuel for motorised vehicles. The cost of DME (99.9% to 99.99% purity) is about 1.6 times the cost of HAP in Europe and about 2.3 times the cost of HAP in North America. Marketing incentives apply that preclude exact price comparisons.

5. DME is a colourless liquid and gas, with a clean, ethereal odour. The odour is suppressed to almost nothing when it is diluted by various solvents. It is a very strong solvent, and is uniquely soluble in water --- up to 34.2% by weight under its own vapour pressure. (6.65% under atmospheric pressure). It finds use in hair sprays, mould release sprays, aerosol paints and lacquers, and air fresheners. In the USA it is used for underarm deodorants and (with some HAP) in aerosol antiperspirants. It cannot be used for foam products, such as shave creams or mousses, due to its solubility in water. It is not food approved.

6. European hair sprays have smaller particle sizes than those in North America, and for this, more propellant is required. Europe's hair sprays typically have 40 to 65% DME -- with the remainder being an ethanol concentrate, also containing the resin, perfume, special ingredients and sometimes a bit of water. If these levels were to be replaced with HAP the resin would fall out of the solution as a sticky mass, able to immediately clog the aerosol valve.

7. American hair sprays typically used from 20 to 28% HAP --- with a concentrate of principally ethanol, resin, etc. --- before being forced to include very large amounts of water by various regulatory bodies (CARB, EPA, and others). At this range of HAP the resins remained soluble. Fillers of hair sprays in Art. 5 countries now face the same problem: they cannot add more than about 28% HAP, due to incompatibility of the resin. Stronger solvents, such as methylene chloride (used in over 10,000,000,000 USA hair sprays until condemned as a possible rodent carcinogen) can no longer be used -- as the Art. 5 countries follow the USA example. Thus, Art. 5 countries are unable to formulate hair sprays that can duplicate the European types --- except for PR China, where DME is available.

8. The HFC propellants (which also include HFC-227ca, not shown in the table, since it cost about US $42.00 per kg, and is authorized only for pharmaceuticals in the USA), represent a fair quantity of North American aerosols. However, they are not used in Europe, except as a (still) future replacement for CFCs now used for MDIs. HFC-152a is a useful propellant, but exhibits a very minor global warming effect. It is effectively banned in Japan, the E.U. and a few other places. It is only slightly flammable. The price is currently about US $ 4.75 per kg, which makes it of no interest to fillers in Art. 5 countries. Of the liquid, low-pressure propellants there is finally HFC-134a. This is a moderately strong global warming agent and its aerosol applications are limited, in the USA, Canada and Western Europe were aerosols with HFC-134a propellant are only used for health or safety reasons (HFC-134a is non-flammable). Another limitation is the high price: about US $5.85 per kg. Only one firm visited during the evaluation was using small quantities of HFC-134a for some revised formulas, and a pharmaceutical company in Jordan is considering it for two products which are sprayed into the mouth.

9. The so-called "high-pressure" propellants, which include carbon dioxide as the most important, are used for about 8% of North American aerosols. They are all non-flammable. Their major shortcoming is that only small amounts can be dissolved into aerosol concentrates before pressures become too high for safety. Three examples can be given:

(a) Disinfectant/deodorant spray for hard surfaces (like Lysol): 5% CO_2 is dissolved in a concentrate that is mainly ethanol.

(b) Water displacement and lubricant spray (like WD-40) 3% CO_2 is dissolved in a petroleum distillate base.

(c) Cookware release agent spray (like PAM): 4.4% N_2O is dissolved in corn oil or soya bean oil base.

10. For nitrogen or compressed air, only about 0.5% can be dissolved. With so little propellant the only atomisation comes from the use of mechanical break-up actuators that produce a swirling action --- somewhat like that of a garden hose. The pressures also sink, as the products are used, and this can be serious unless at least about 40% of the can capacity is reserved for the vapour space.

11. The only known use of the high-pressure propellants (HP gases) in Article 5 countries occurs in Southern PR China, where bug killers are being produced using CO_2 cylinders in inventory. The production line produces about 45 cans per minute; i.e. 9,000,000 cans per year, using two 8 1/2 hour shifts per day.

12. All the sprays from HP gases are coarse, and are designed to produce surface coatings. If sprayed into the air, they quickly fall to the floor. It is possible to use CO_2 for hair sprays, but at least 35% of the ethanol must be replaced with a combination of methylene chloride and iso-pentane, to get a good break-up, and the use of methylene chloride is often looked upon with disfavour. Finally, due to their high pressure (typically 7 bars at 21°C), all these products spray at relatively fast rates.

13. To be complete, there is one further propellant (ethyl fluoride, or HFC-161) that is under development. It is easily made by reacting ethylene gas and hydrogen fluoride gas at about 90°C. The propellant has no known environmental detractions and has been formally approved by the U.S. EPA for aerosols, under their SNAP programme. It is flammable, and has a fairly high pressure. Propellant suppliers, such as DuPont and Honeywell, are well aware of this gas, but apparently do not wish to disturb their sales of the more costly HFC-152a by introducing it to the aerosol market.

Annex V: Packaging Systems

1. In many cases marketers can opt not to use aerosols, but an alternative packaging system --- or perhaps both. The pump-action (or finger-pump) sprayers are the most popular alternatives. Some of the more common ones are:

(a) Fragrances

(b) Hair Sprays

(c) Window Cleaners

(d) General Hard Surface Cleaners (including disinfectant types)

(e) Insecticides and Insect Repellent Sprays

2. Less common alternatives are stick and roll-on antiperspirants, ointments, in-sufflators (for powders), and products applied by brush, such as moisture barriers and paint.

3. In general, the pump-action products simply involve filling a liquid or gel into a container, and then attaching a pump-sprayer. The pump-sprayer may be sealed to the container by means of clinching, or by simply screwing it on. In the latter case it is possible to refill the spray bottle from a larger supply bottle. This allows the relatively costly pump-sprayer to be used indefinitely.

4. In the case of colognes, the pump-sprayers are made with 13 to 20 mm diameter gold anodised ferrules, valve stems and mechanical break-up buttons that look almost exactly like the corresponding aerosol valve. They are attached to the bottle or aluminium can finish in the same way, by a clinching action. A filler can produce a pump-action cologne on an aerosol line, simply by affixing the pump-action sprayer and eliminating the gassing operation. To the unpractised eye, the aerosol and pump-action colognes can be almost indistinguishable.

5. For hair sprays, marketers in North America, Japan and Europe often give the consumer a choice of the aerosol or pump-action form. Typically, the products are packaged in containers of the same size and decoration, about 250 ml in size. The aerosol will be in a tinplate or aluminium can, while the pump-action counterpart will be in an aluminium or plastic container. Unless the protective plastic cover is removed, the two products will look almost the same, and some consumers have purchased the pump-action types, thinking they were aerosols --- and vice-versa. As a rule, the pump-action valve is screwed onto the container, whereas the aerosol valve is crimped permanently onto the container.

6. The aerosol and pump-action systems can be compared in many ways. In the case of colognes, packed into glass bottles the pump-spray is generally favoured over the aerosol, for these reasons:

(a) Plain glass aerosols can break and explode if dropped on ceramic or tile floors. Flying glass may cause injuries. Released HAP with ethanol mist, can cause a fireball, if an ignition source is present; i.e. bathroom, gas fired hot water heater.

(b) Due to the above, most glass aerosols over 30 ml are plastic sheathed. This detracts from their appearance, shape and feel.

(c) Shapes of pressure-resistant glass are limited to rounded surfaces.

(d) The HAPs are poor solvents and often cause the separation of solid ingredients from the perfume oil mixture. Filtration is impractical. The precipitated matter, often light to dark brown, looks bad in the bottle, unless the glass is frosted into translucency or made opaque. In rare cases it can fly out with the spray, causing discolorations on skin or clothing.

(e) If very low odour HAP is unavailable (or too costly) the unsaturated and organo-sulfur contaminants can adversely affect the perfume odour. They may also react chemically with certain perfume ingredients, to form new chemicals of unknown odour and properties.

(f) Water can be added to perfume / ethanol mixtures, in amounts to 15 to 20%, conveying a "green, fresher" odour. These solutions can be filtered and used in pump-sprays, but if HAPs are added to produce aerosols, the water will cause two liquid phases to develop. The economics of using water are not available for aerosols.

(g) The filling and packaging of glass aerosols can cause flammability and glass explosivity hazards not encountered with pump-spray colognes.

(h) Some consumers feel that the aerosol is harder to control, as to dosage and directionality, compared to pump-action sprayers.

(i) Since the pump-action sprays more slowly (a little at a time) it tends to last longer than aerosols of the same size.

(j) Empty aerosol bottles are generally pressure tested to about 10 bars at the factory, or by the filler. This step adds cost and hazard.

7. On the other hand, the aerosol has certain advantages over the pump-action spray colognes. Some of these follow:

(a) The aerosol is a hermetically sealed system --- no air can get inside to oxidise or otherwise adversely affect fragrance ingredients. With pump sprayers, air is injected with each spraying.

(b) The density of HAP colognes is about 0.7 g/ml, while that of pump sprayers runs about 0.8 g/ml. This saves about 13% on the cost of the ethanol and propellant.

(c) In many countries the ethanol is taxed, due to its ability to be used in certain beverages. By replacing some of the ethanol with HAP, the taxation is reduced.

(d) The aerosol spray valve costs about US $0.053 in large quantities, in North America, and slightly more in Europe. The pump-action valve costs about US $0.89; same basis. Both valves will rise in cost if special features, like gold-metallized actuators and ferrules, are used for additional elegance.

(e) In the developed countries, most perfume oil suppliers know what ingredients should be avoided, for aerosol colognes --- so that separations will be eliminated or minimized. (This may not be the case for perfume oils blended in Art. 5 countries)

(f) By adjusting the percentage of the HAP propellant, the particle size of the spray can be modified. It is easy to produce aerosol particles that average 5 to 20% as heavy as the average pump-spray particle, and these spread more evenly, give a more uniform pattern, and provide a better "bloom" of fragance, when applied. (In contrast, the pump sprays are normally denser near the bottom of the spray cone).

(g) The aerosol colognes need no priming. (Pump-sprays do).

(h) The aerosol valve can be adjusted, using orifices as small as 0.25 mm in diameter, to give very soft, relatively slow and controllable spray patterns. The pump-sprays do not have this ability, since it would make the spray period too long per stroke.

(i) A detraction for this type of aerosol valve is that the tiny metering orifice takes rather long to gas, during production. This is less important for small fills and slow, manual type gassers.

8. The hazards of packaging aerosols in glass can be eliminated if aluminium tubes are used instead. However, consumers like to get a heavy (high mass) product, when they spend a lot of money for a good cologne. Consequently, many think that the relatively lightweight aluminium aerosol colognes are cheap imitations of good fragrance products. The aluminium can be nicely decorated by offset printing, but it is still a simple cylinder, which does not compete well with the more stylishly shaped glass containers often used for pump-action colognes.

9. A major reason for the popularity of the aerosol cologne in some Art. 5 countries is that they can be packaged in plain glass bottles (clear or frosted) in sizes up to about 75 ml, without the contract filler and/or marketer becoming exposed to very large financial losses if a consumer should become injured by flying glass shards or by a possible fire. The fears of legal actions in civil courts has decimated the initial glass aerosol business in the USA, which used to be about 80,000,000 units per year in 1978. It is now estimated at 2,500,000 units per year.

10. The hair spray business in the USA is now about 35% pump-action and 65% aerosols, but the volume has been dropping steadily as consumers use increasing amounts of aerosol mousse products to both set and condition their hair. In the Art. 5 countries the pump-action is well known, but the popularity is much less.

11. The pump-action air spray suffers from these disadvantages:

(a) Many individual pumpings must be done to set and finish the hair.

(b) Some, around the back of the head, must be done at awkward angles, putting a strain on older people, especially in the case of larger economy size containers.

(c) The spray is composed of larger particles, and feels "wetter" on the hair.

(d) The spray stays "wet" on the hair for a longer time, before becoming tacky and then dry. (The aerosol film dries faster, since some of the HAP remains dissolved in the ethanol, helping it to evaporate).

(e) The pump-action spray valve is about twice as costly as the aerosol valve, but consumers refuse to pay any extra money for the pump type hair spray. Thus, the marketer makes a reduced profit.

(f) In most countries the price of ethanol (the hair spray solvent) is much higher than the cost of HAP. This means that the pump-action products have a higher chemicals cost by weight. This is even higher by volume, due to the very low density of HAP. The disparity also reduces marketer profits.

(g) While supply bottles of the hair spray liquid are available (large size, and screw-capped) consumers often avoid buying them, due to the inconvenience of transferring flammable liquids, and having to store two containers instead of just one. Thus, they unknowingly purchase the more expensive pump-action valve for each can they use.

12. The aerosol also has its usual problems, such as potential for explosivity and flammability, if used inappropriately. Also, the addition of more than small amounts of HAP will cause the fall-out of hair spray resins. Many hair spray aerosols use dimethyl ether (DME) propellant --- or HAP / DME blends --- to resolve this compatibility problem. In fact, nearly all European hair sprays now use only DME, since this allows quicker-drying sprays, and the inclusion of small amounts of water, for economics, better odours and reduced flammability potential.

13. The quality of pump-sprayers produced in Art. 5 countries is considered to be much inferior to those made by such firms as Seaquist/Perfect (USA), Precision (USA), Emsar (USA), Valois (France), Coster (Italy), et al. in developed countries. The construction of these pump-action valves is both complex and exacting, with a few critical dimensions specified to the nearest 0.0025 mm. Poorly sized or assembled pump-action valves will leak, drain, have inconsistent spray patters or exhibit other problems. The sprays seen for domestic productions in Art. 5 countries were considered unusually heavy in mean particle size and quite non-uniform in spray pattern. The fillers recognized this situation, but responded that the higher quality (American and European) pump-sprayers were too costly for them to import.

14. At such time as better pump-sprayers become available, and when the much greater flammability potential of the aerosol colognes and hair sprays becomes more fully recognized, there may be a greater swing toward pump-action products in the Art. 5 countries.
